Ibec
For Irish Business

Better Lives,
Better Business
An Ibec campaign

Building a low carbon economy

A roadmap for a sustainable Ireland in 2050

Better Lives,
Better Business
An Ibec campaign

A four-part Ibec campaign to make Ireland a better place to live and work.

01 Housing
02 Infrastructure
03 Planning
04 Sustainability

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Contents

Foreword

Danny McCoy, Ibec CEO

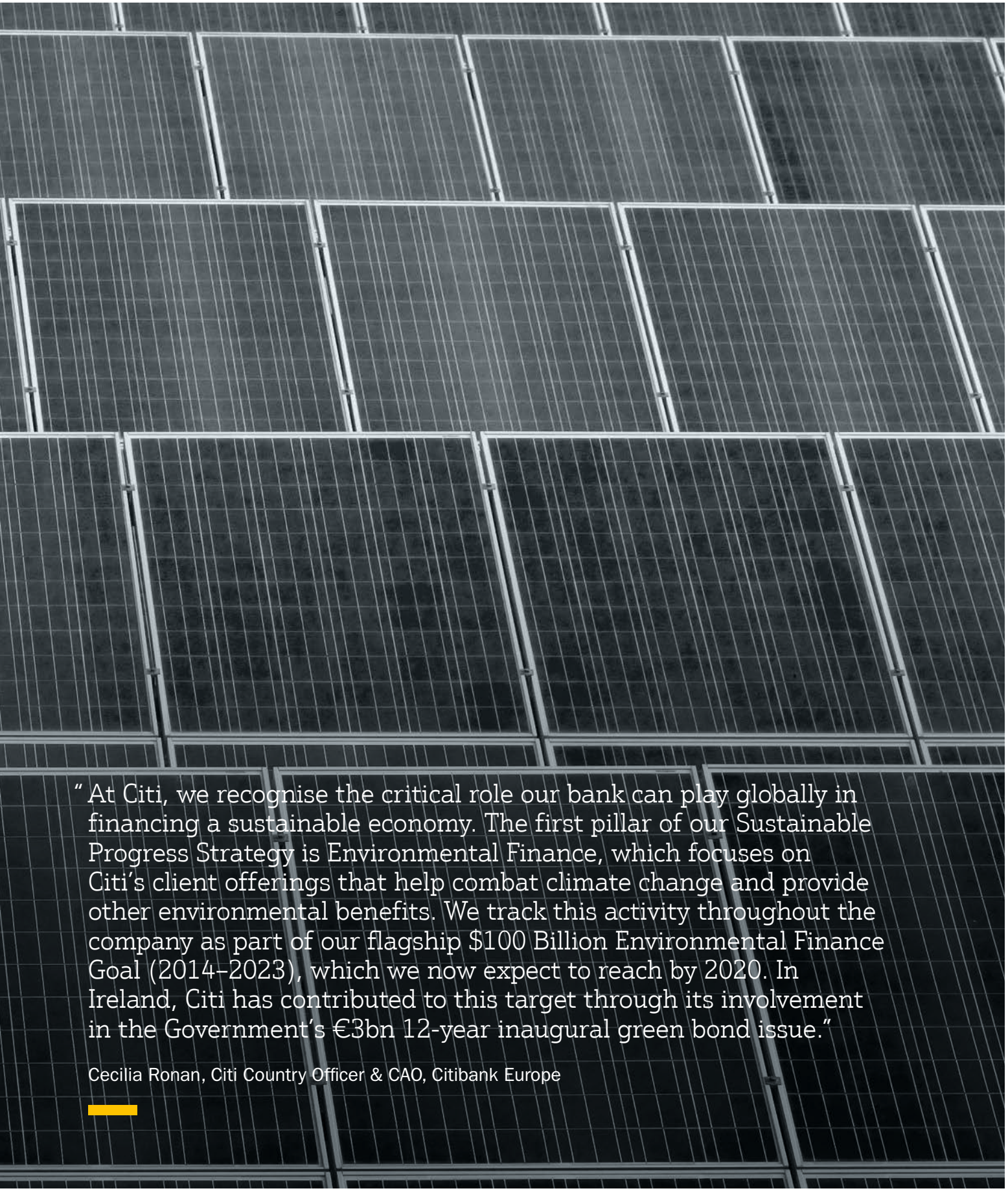
The recovery in the Irish economy in the last few years has been remarkable. Economic growth is now boosting households and businesses right across the country as the labour market moves towards full employment. This recovery, however, has come at an environmental cost. Greenhouse gas emissions have increased by 5% since 2013 and we are now significantly off track in meeting Ireland's international climate obligations. Ireland must take decisive action to decouple emissions and economic growth and build the foundations of a sustainable, competitive low carbon economy.

The scale of this challenge can be daunting. It will require substantial public and private investment, the deployment of new technologies and big changes in everyday human behaviour. More fundamentally, it demands a complete rethink in how we grow our economy and plan future development. System-wide changes are now required for the low carbon era.

There will be risks along with opportunities. However, our proposals constitute "no regrets" measures and make sense in any scenario. Poor decisions could significantly increase energy costs; harm energy security; and erode Ireland's international competitiveness. Policy design that is suboptimal could see efficient and sustainable Irish businesses lose market share to international competitors with inferior environmental credentials and higher carbon footprints. By focusing on cost-effective solutions and evidence-based policies, these trade-offs can be avoided.

Irish business fully supports the transition to a low carbon economy. This report is part of a wider Ibec campaign called *Better Lives, Better Business* which aims to make Ireland a better place to live and work. It sets out an Ibec vision for what a low carbon economy could look like in the year 2050 and a roadmap for Ireland to pursue this ambition that also safeguards our energy security and competitiveness.

Ibec calls on Government to follow through on the recommendations in this report, support private investment and make 2019 a breakthrough year for climate-smart economic development.



" At Citi, we recognise the critical role our bank can play globally in financing a sustainable economy. The first pillar of our Sustainable Progress Strategy is Environmental Finance, which focuses on Citi's client offerings that help combat climate change and provide other environmental benefits. We track this activity throughout the company as part of our flagship $100 Billion Environmental Finance Goal (2014–2023), which we now expect to reach by 2020. In Ireland, Citi has contributed to this target through its involvement in the Government's €3bn 12-year inaugural green bond issue."

Cecilia Ronan, Citi Country Officer & CAO, Citibank Europe

Executive summary

Climate change is the single greatest challenge humankind faces today. The scientific evidence is unequivocal. Global temperatures are increasing, our environment is changing, and man-made greenhouse gas (GHG) emissions are the main driver. The level of CO_2 emissions into the Earth's atmosphere reached record levels in 2018 and our planet is now on track for three degrees of warming by the end of this century. The point of no return is fast approaching.

Ireland is part of the international effort to address climate change and has made a commitment to reduce GHG emissions and transition to a low carbon economy by the year 2050. But Ireland's migration efforts are falling short. Emissions have increased by 5% since 2013, and Ireland is now significantly off-track to meeting its obligations.

Irish business fully supports the Government's long-term climate ambition. We believe that with smart evidence-based policies, the transition could be extremely good for Ireland. It presents a unique opportunity to build greater energy resilience, boost competitiveness, improve quality of life, and create thousands of sustainable jobs across the country.

But the transition will not be easy. It will require enormous private and public investment, the deployment of new and innovative technologies, and a complete transformation in how we use energy, run our factories, fuel transport, build towns and cities and interact with our environment. It will also mean hard choices, job losses and challenging times for business. There are also big risks as poor decisions could lead to higher energy costs, a weakening of national energy security, and reduced competitiveness. Therefore, to realise the full benefits of the transition, we must prioritise cost effective evidence-based policies.

This report sets out an Ibec vision for a competitive low carbon economy in the year 2050 and a roadmap for Ireland to achieve this ambition that safeguards our energy security and competitiveness. The report has been developed in consultation with Ibec member companies and with guidance from the SFI MaREI Centre's Energy Policy and Modelling team at UCC. Ibec has also considered the findings and recommendations of the 2019 International Energy Agency's (IEA) review of Irish energy policy and the Joint Oireachtas Committee on Climate Action's 2019 report *"Climate Change: A Cross-Party Consensus for Action"*.

The report is part of a wider Ibec campaign called *Better Lives, Better Business* which aims to make Ireland a better place to live and work.

Key findings and conclusions

- With smart policies, the low carbon transition presents an opportunity to strengthen competitiveness, enhance energy security, improve quality of life and create thousands of sustainable jobs
- Ireland can make up for lost ground and become a leader in climate action, but the longer we delay the more disruptive and costlier the transition will be on everybody
- Effective climate action has been hindered by the lack of a strong national consensus on climate change, poor spatial planning and inadequate market signals and supports for investment in energy efficiency and low carbon technologies
- Ireland must find ways to decouple emissions growth from population and economic growth and ensure future development is emissions-free where practical
- Poorly considered polices could lead to carbon leakage where manufacturing and jobs move to another country with no fall in global emissions
- There is no single solution. Addressing climate change will require a suite of new technologies, the adoption of more sustainable business practices and society-wide behavioural change
- Without new policies, Irish emissions will continue to increase, and Ireland will not meet its targets
- The transition will cause considerable disruption to the labour market, especially in Ireland's Midlands region. Action is needed to ensure state services are fully equipped to support displaced workers

Our 2050 scenario

- Ireland in 2050 will have a smart low carbon economy, known for its sustainable enterprise-base, industrial competitiveness, energy resilience, skilled workforce and high quality of life
- Energy demand will drop significantly despite a growing population and increased economic activity
- Energy supply will be built on renewables like wind, solar, renewable gas, biofuels and waste to energy, with natural gas providing crucial stability and security to the power sector
- Peat and coal will be completely removed from the energy mix and what oil remains in the system will be used in aviation, heavy vehicles and sectors with no alternatives
- Electricity will play a vital role due to its inherent efficiency, rapidly reducing carbon footprint and end-use versatility in heat and transport
- Natural gas is a key transitionary fuel and will play a vital role in providing flexibility and stability to Ireland's future electricity system when equipped with carbon capture technology
- Diesel will remain the primary fuel used in transport out to 2030. However, from 2020 there will be a continuous fall in demand due to an increased use of biofuels, vehicle efficiency gains, the steady electrification of private transport and the use of gas and renewable fuels in heavier vehicles
- Ireland will be a cleaner, healthier and greener place to live and work. Citizens will play a greater role in managing scarce resources. Buildings will be smarter, warmer and more comfortable. Communities will be connected by a reliable low carbon public transport network. Cars will be electrified with public transport, walking and cycling the norm for short journeys in urban areas
- The expansion of forestry and woodland, coupled with greater on farm efficiency, better land management and land use change, will see Ireland build on its efficient grass-based production system and become a world leader in sustainable agriculture, land-use and carbon sequestration
- Ireland’s economy will be competitive, productive and innovative, benefiting from an entrepreneurial and innovative culture and access to secure low carbon energy. Ireland’s green reputation will drive export growth and attract talent and investment while a dynamic renewable and bioeconomy will provide country-wide sustainable employment.

Key figures

To achieve a low carbon economy by the year 2050:

Ireland's electricity system will need to reduce emissions by

84-92%

by 2050 relative to 1990

Ireland's transport system will need to reduce emissions by

72-92%

by 2050 relative to 1990

Ireland's buildings and factories will need to reduce emissions by

75-99%

by 2050 relative to 1990

Forest cover will need to increase by

at least 64%

by 2050

Key actions

1. **Introduce short term carbon budgets**
   Ibec recommends the introduction of continually reducing carbon budgets for sectors outside the Emissions Trading System (ETS). These budgets would restrict the amount of GHG emissions Ireland could emit over a specified period of years. This would bring greater visibility to Ireland's emissions targets and obligations. It would also give more certainty to investors and promote greater policy discipline across government departments. Any shortfalls would require remedial action.

2. **Redesign the carbon tax**
   Ibec supports the introduction of an upward carbon tax. Small, gradual, predictable increases will give greater investment certainty. But the revenue must be ringfenced to support investment in emissions reduction, energy efficiency and low to zero carbon technologies. In this way the tax should follow the model of the National Training Levy. A portion of the revenue should also be used to support fuel poor households and vulnerable business sectors with no practical alternatives to fossil fuels. The tax should be set at €30 per tonne in 2020 and increase by €5 per tonne annually until it reaches €80 in 2030. A review of outcomes and impact should be held in 2025.

3. **Establish a social dialogue on climate action**
   Ibec recommends the formation of a multi-stakeholder social dialogue on climate action bringing together industry, trade unions, environmental groups, local representative groups and political parties. It could build on the cross-party work conducted by the Joint Oireachtas Committee on Climate Action in 2019. Achieving a broad national consensus on climate action is vital to ensuring effective delivery and outcomes. A dedicated Just Transition taskforce should also be formed to ensure state services are fully equipped to support displaced workers and the labour market can take full advantage of new low carbon employment opportunities.

4. **Promote climate smart planning and development**
   Climate action should be fully integrated into the planning system as set out in the National Planning Framework. The planning system must enable a low carbon transition by better supporting the roll-out of strategic energy infrastructure, the development of public transport, afforestation and carbon sequestration. The planning system must also ensure future development is compact and promotes walking, cycling and public transport use.

5. **Undertake a review of security of supply to 2035**
   Government must undertake a comprehensive study into security of supply out to 2035. Secure access to energy underpins all economic development. The transition to a low carbon economy should in time boost Ireland's energy resilience as we take advantage of indigenous renewable resources and energy efficiency improvements reduce total demand. However, poor policy decisions could undermine energy security. Decarbonisation should happen in phases to ensure a smooth transition and continued access to affordable energy, even during a supply crisis.

6. **Support private investment**
   The transition will require in excess of €40 billion of new capital investment by 2050.[1] The transition will be largely funded by households and businesses. Mobilising low carbon investment has proven extremely challenging. Targeted supports and incentives will be required to help businesses and households overcome the high capital costs and long payback periods. Strong government signals are also needed to drive investor certainty and gradually replace state subvention with market-led decarbonisation.

1. https://www.sustainablenation.ie/wp-content/uploads/2017/05/SNI_Green_Finance_Ireland-FINAL-for-web.pdf

"Helping customers to change their behaviour is a critical part of tackling the challenge of climate change. The recommendations in this report aim to enable people to make the millions of individual decisions needed to secure sustainability. We need significant investment in infrastructure and technology to support this goal, but we also need to find ways to make it affordable for households and businesses to be part of shaping a low carbon future."

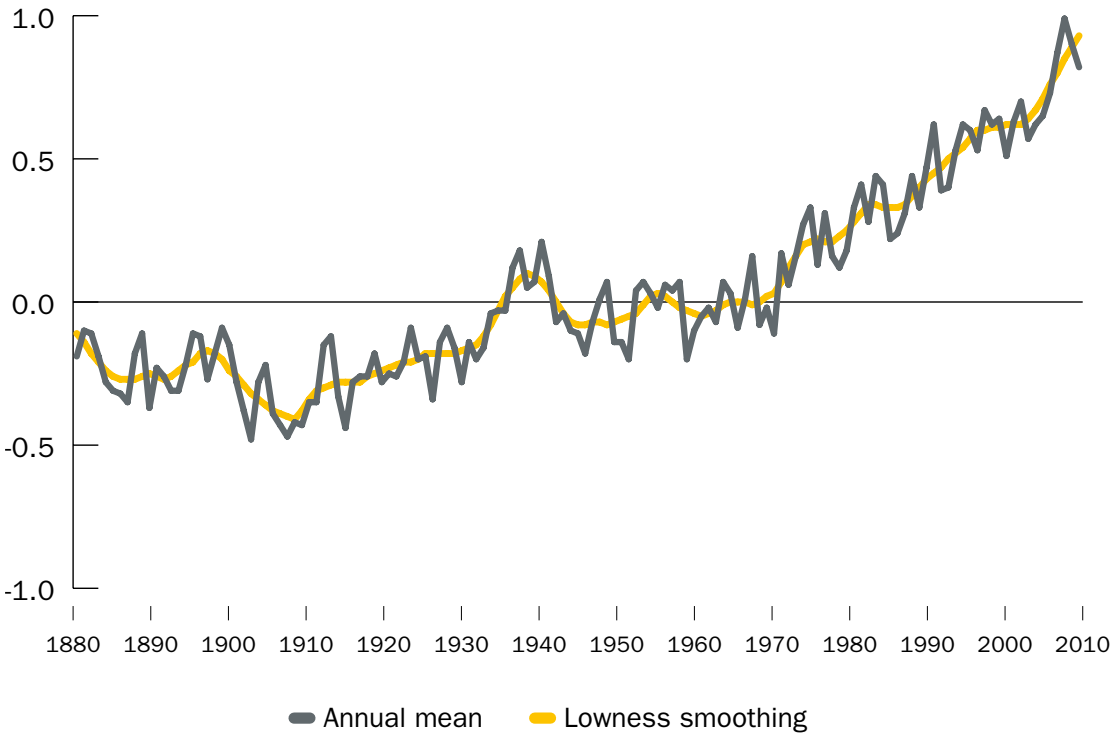
Catherine O'Kelly, Managing Director, Bord Gáis Energy

1. Context: the scale of the challenge

The threat of climate change

Climate change represents the single biggest challenge facing mankind today. The scientific evidence is unequivocal. Global average temperatures have already increased by almost 1˚C since pre-industrial times – with 18 of the warmest years on record happening in the last 19 years. This past summer, temperatures above the Arctic Circle were 5ºC higher than usual. The atmosphere and oceans have warmed, snow and ice cover has diminished, and sea levels are rising. The frequency and intensity of extreme weather events are increasing. Thousands of animal species face extinction and communities in water poor regions and low-lying countries are already at great risk.

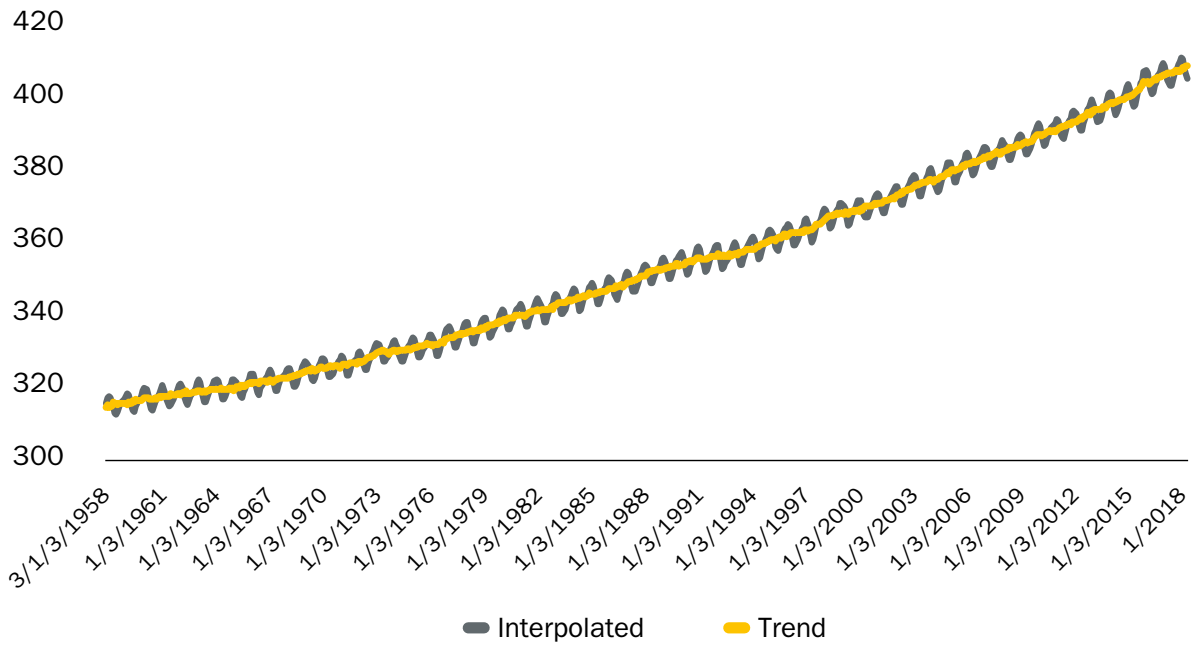
Figure 1: Global temperature anomaly – 1880-Present



This graph illustrates the change in global surface temperature relative to 1951-1980 average temperatures. Eighteen of the 19 warmest years all have occurred since 2001, with the exception of 1998. The year 2016 ranks as the warmest on record. (Source: NASA/GISS). This research is broadly consistent with similar constructions prepared by the UK's Climate Research Unite and the US National Oceanic and Atmospheric Administration.

The main driver of climate change is increasing man-made greenhouse gas emissions, notably carbon dioxide (CO_2) and methane (CH_4). These gases act like a blanket, trapping infrared radiation emitted from the surface and preventing it from escaping into outer space. The end result is a progressive warming of the Earth's atmosphere and surface. This effect becomes ever stronger as the atmospheric concentration of GHGs increases. A tipping point is fast approaching. The tonnage of CO_2 emissions into the Earth's atmosphere reached record levels in 2018 and the UN's Intergovernmental Panel on Climate Change (IPCC) has warned that the Earth is now on track for three degrees of warming by the end of this century. According to their analysis, we only have 12 years to keep global warming below 1.5˚C – the higher ambition in the 2015 landmark Paris Agreement.

Figure 2: Atmospheric carbon dioxide at Mauna Loa Observatory, 1958–present



Source: National Oceanic and Atmospheric Administration[2]

Ireland's response

Ireland has joined the global effort to address climate change. Through the EU, we are a signatory to the 2015 Paris Agreement which aims to hold global warming to well below 2 °C above pre-industrial levels and pursue efforts to keep it below 1.5 °C. The EU response includes a commitment to reduce EU-wide emissions by 20% by 2020 and 40% by 2030. And we also have our own national long-term commitment, namely, to deliver a low carbon economy by the year 2050. Government defines a low carbon economy as an 80% reduction in energy related emissions and an approach to carbon neutrality in the agriculture and land-use sector. Ireland therefore has distinct short-term, medium-term and long-term targets for emissions reduction. On top of this Ireland has also made a host of other accompanying commitments for renewable energy, energy efficiency, energy security, the reduction of air pollutants and waste.

2. https://www.esrl.noaa.gov/gmd/ccgg/trends/full.html

Table 1: Ireland's GHG emissions reduction targets

Timeframe	Target	Set by	Sectors covered	Base year
Short term	20% reduction by 2020	The EU	· Heat · Transport · Agriculture & land use	2005
Medium term	30% reduction by 2030	The EU	· Heat · Transport · Agriculture & land use	2005
Long term	80% reduction by 2050	Ireland	· Electricity generation · Heat · Transport	1990
	An approach to carbon neutrality by 2050		· Agriculture, land-use and forestry	N/A

Source: Department of Communications, Climate Action and Environment (DCCAE)

EU targets and the European Emissions Trading System (ETS) explained

The EU has an ambition to reduce GHG emissions by 80-95% by 2050 compared to 1990. It aims to meet this target through an EU-wide Emissions Trading System (ETS) and binding Member State targets

The ETS covers GHG emissions from heavy industry and power generation through a cap and trade model. Participating installations must surrender tradeable permits known as Allowances for every tonne of emissions they produce each year. The total number of new Allowances made available for purchase reduces each year. The resulting scarcity puts a transparent price on carbon and gives a signal for investment in decarbonisation. There are approximately 100 ETS sites in Ireland, accounting for about 80% of industrial emissions and all power generation emissions. GHG emissions from these sites are excluded from Ireland's 2020 and 2030 national obligations but not from the Government's own 2050 target.

To address emissions in the remaining sectors (transport, heat, waste and agriculture), the EU sets binding national GHG emission reduction targets for all Member States. Ireland's 2020 non-ETS target was set in 2007 and Ireland's 2030 non-ETS target was agreed in 2018. As a percentage of total national emissions, Ireland's non-ETS sector (70%) is somewhat larger than that the EU average (57%). In 2019 Ireland must submit to the EU a 10-year National Energy and Climate Plan (NECP) outlining the measures it will adopt to reach its 2030 target.

How are we doing?

Ireland's progress on climate action has been very mixed. We continue to make considerable progress in removing fossil fuels from our electricity system and Ireland is set to achieve 40% renewable electricity penetration by 2020. But power generation only accounts for one-fifth of total national emissions. Our transport and heat sectors are still heavily reliant on fossil fuels. Furthermore, GHG emissions from Irish agriculture have increased in the last few years. Total Irish emissions dropped by only 0.9% in 2017 (the latest data available at time of publication). We appear to be deviating ever further from the trajectory needed to meet our emissions reduction targets. The Environmental Protection Agency (EPA) projects that we will only achieve a 1% reduction in the Effort Sharing sector by 2020 compared to a binding target of 20%. The State can bridge the compliance shortfall by purchasing credits from other Member States, but it will need to acquire far more than previously envisaged.

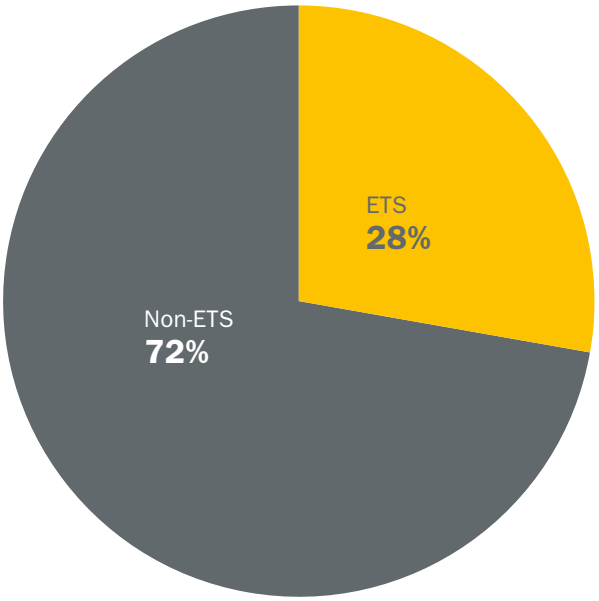
The European Commission has tacitly accepted that Ireland's 2020 target was somewhat unrealistic in its ambition[3]. However, to miss it by such a wide margin will place us at a significant disadvantage for reaching our 2030 and 2050 targets. Corrective action will be needed if the State is to have any chance of avoiding costly penalties. The longer we delay, the more disruptive and costlier the transition will be for businesses and citizens.

Business related GHG emissions represented approximately 18% of total Irish GHG emissions in 2017. Including agriculture, the share increases to 52%. Ireland's ETS sector which comprises heavy industry and power generation experienced a 24% fall in emissions since 2005. Agricultural emissions increased by 2% and non-ETS industry and commercial emissions fell by 18% in the same period.

3. https://ec.europa.eu/clima/sites/clima/files/strategies/2020/docs/swd_2012_5_en.pdf

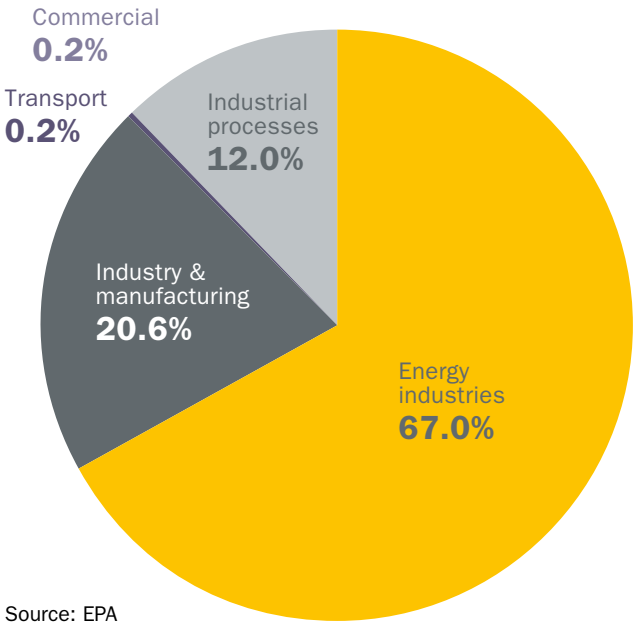
Figure 3: Ireland's GHG emissions in 2017 & sector shares

GHG emissions in 2017



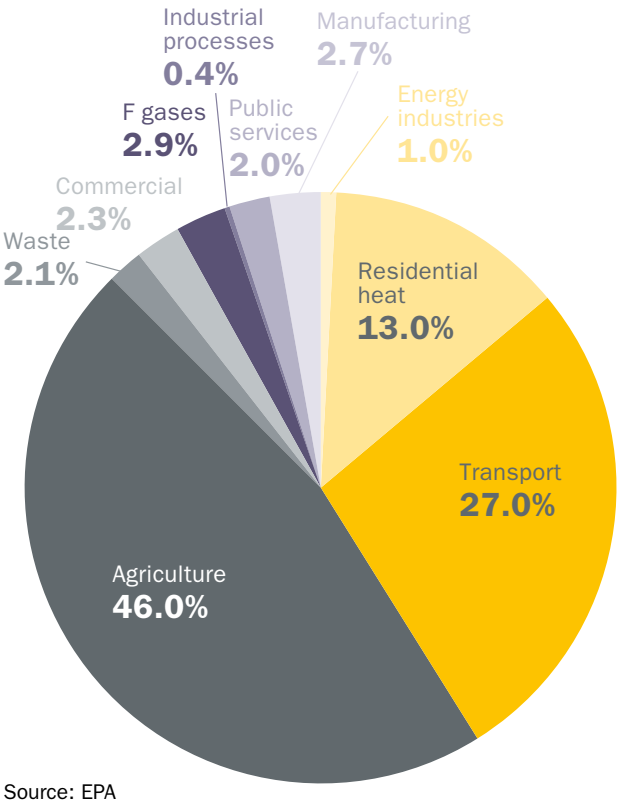
Source: EPA

ETS Emissions in 2017 & sector shares



Source: EPA

Non-ETS Emissions in 2017 & sector shares



Source: EPA

" Microsoft has made and met a series of commitments to reduce our carbon footprint, including reducing emissions by 75% by 2030. We have an internal "tax" to hold business divisions financially responsible for carbon reduction. In 2017, we signed an agreement with GE to purchase all electricity from the Tullahennel wind farm in Kerry. We also invest in schemes to protect native woodland. Our high efficiency data centres will run on 60% renewable energy by year end."

Cathriona Hallahan, Managing Director, Microsoft Ireland

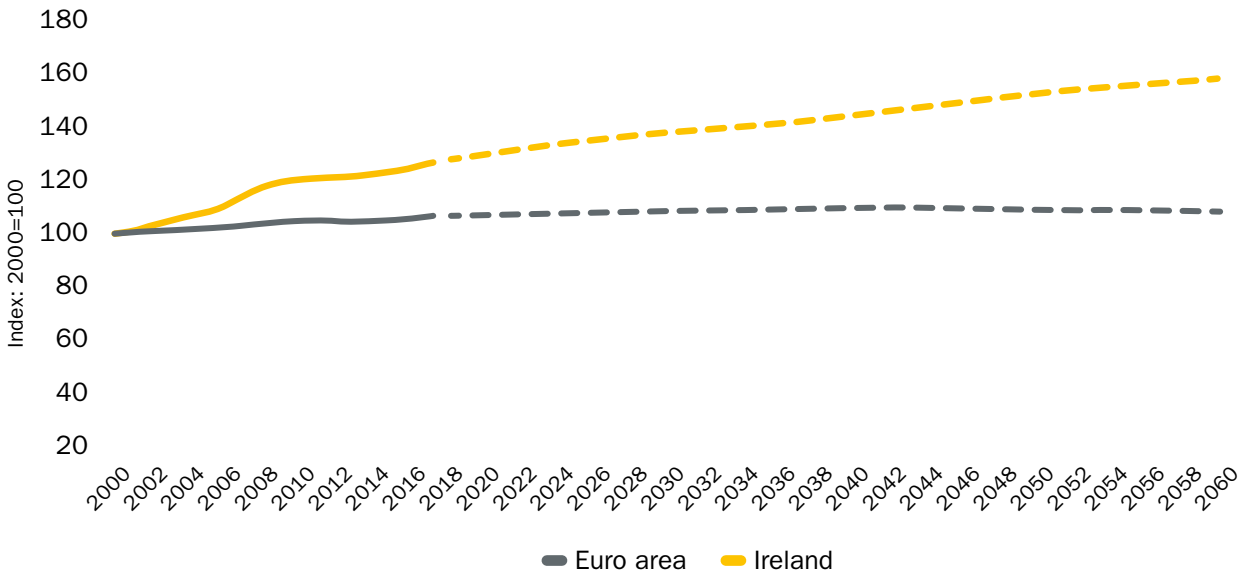
2. Barriers to emissions reduction

In our analysis, the following barriers have prevented effective climate action in Ireland. Unless we address these barriers, we are unlikely to meet our climate obligations.

1. High economic and population growth

Like many countries, Ireland's economic fortunes are closely tied to energy demand and emissions growth[4]. Increased economic activity and a rising population mean more cars and trucks on the road, more industrial production and a greater demand for heating in buildings. Ireland today has one of the fastest growing economies in Europe and population growth rates are five times the EU average. This explains why our emissions have grown by 5% since the start of the economic turnaround in 2013. Given current forecasts for both population and economic growth, it is imperative we find ways to decouple emissions from population growth and economic output and ensure that all future development is emissions free where practical.

Figure 4: Population growth forecasts – Ireland and Euro area



Source: Eurostat

4. https://webstore.iea.org/download/direct/2537?fileName=Energy_Policies_of_IEA_Countries_Ireland_2019_Review.pdf

2. A low carbon price

The price of carbon (in Ireland and elsewhere) is currently too low to drive behaviour change and market-led investment in energy efficiency and low carbon technologies. For heavy industry and the power generation sector this is set to change. Recent reforms to the EU ETS are beginning to show results and the price of EU Allowances has been steadily rising. For sectors outside the ETS, a change is needed to the Irish carbon tax, which has stood unchanged at €20 per tonne of emitted CO_2 since 2014. However, the rate of increase must be gradual and predictable. Sharp, unexpected increases would have negative economic and social impacts.

3. The lack of a strong national consensus

Effective climate action has been frustrated by the absence of a strong national consensus. Until recently climate change was not widely considered a political priority. Consequently, difficult decisions were shelved for short term expediency and vital areas and programmes starved of the necessary resources. The development of the JOC 2019 report "Climate Change: A Cross-Party Consensus for Action" and the launch of the National Dialogue on Climate Action were important first steps in addressing this problem. A strong national consensus is required to empower Government to take the necessary steps and make difficult decisions without recrimination. In 2019 the politics needs to be taken out of climate change.

4. Financial hurdles

Sustainable Nation Ireland estimate that Ireland's transition will require in excess of €40 billion of new capital investment by 2030[5].This is a conservative estimate. Retrofitting Ireland's building stock alone is likely to cost in excess of €25 billion. This will largely be funded by households and businesses. Mobilising this investment has proven extremely challenging. Payback periods for some energy efficiency upgrades can be in excess of a decade, even with generous capital grants. Targeted supports, incentives and innovative financial products will be required to help businesses and households overcome high capital costs and long payback periods. Strong government signals are also needed to replace state subvention with market-led decarbonisation.

5. Overlapping policies

Ireland's response to climate change has suffered because it has been built around three sometimes conflicting 2020 targets: emissions reduction, renewable energy and energy efficiency. There is also a risk that the pressure to meet short term targets could undermine the cost-effective achievement of a longer-term GHG emissions reduction trajectory. The development of an integrated National Energy and Climate Plan in 2019 is therefore a positive step. A fully integrated plan should empower Government to prioritise emissions reduction, with renewables and energy efficiency as means to that end.

5. https://www.sustainablenation.ie/wp-content/uploads/2017/05/SNI_Green_Finance_Ireland-FINAL-for-web.pdf

6. Poor planning and development

Poor spatial planning and development have hindered effective climate action, particularly in the transport sector. Too often, major infrastructure projects and developments are progressed without considering access to sustainable transport and services, including urban delivery logistics, energy requirements and opportunities for mitigation. This is worrying because decisions being made today affect our emissions profile in 2030 and beyond. And decisions today could lock entire communities into a future dependence on fossil fuels. On the other hand, we have experienced growing resistance and delays to strategically vital infrastructure including renewables, grid expansion and public transport projects. Project 2040 and the new National Planning Framework identify climate action as a key consideration for all future development. This is a positive step and must be implemented in full at national and local levels.

7. Limited joined-up thinking

Climate change must become a whole of government issue. Today the responsibility for climate action rests almost exclusively with the Minister and the Department of Communications, Climate Action and Environment (DCCAE). Administratively this makes sense. But the Department has limited influence over other departments and local authorities. This means policy does not always take heed of our climate obligations. Leadership is needed at the very top and climate action must become a cross departmental priority. Ibec welcomes the new initiative to develop an all-government plan for climate action based on the Action Plan for Jobs model which could help resolve this issue and increase cross department accountability. The new Climate Action Regional Offices (CAROs) should enable greater top-down policy alignment.

8. A lack of focus on heat and transport

Over the last decade decarbonisation has focused almost exclusively on our power sector. And yet electricity only accounts for one-fifth of our emissions. Our transport and heat sectors remain heavily reliant on imported fossil fuels. The scale of this problem is daunting and addressing it will require mass behavioural change, new consumer practices and private investment. But there remains significant scope to reduce emissions in these sectors through targeted supports, innovative incentives, better regulation, investment in public transport and smarter spatial planning. Failure to act could see transport emissions increase by 12% and heat emissions increase 6% by 2030 compared to 2017[6].

6. EPA 2018 Greenhouse Gas Emissions Projections 2017-2035 http://www.epa.ie/pubs/reports/air/airemissions/ghgprojections2017-2035/#d.en.64043

9. An emerging skills gap

Decarbonisation requires the installation of new technologies, a change in how we design buildings and a dynamic retrofit and renovation market. However, currently the advice from different technology suppliers and installers can be contradictory and confusing. The construction and trades sector have spent decades mastering the installation and optimisation of fossil fuel technologies. Inadequate understanding of the new technologies could lead to costly installation mistakes (damaging consumer confidence) or to low carbon and renewable technologies being overlooked altogether. A systematic upskilling programme is needed to develop nationwide expertise and know-how in new low carbon technologies, energy efficiency design, building services and retrofitting.

10.Carbon leakage

Irish climate action policy must always be mindful of carbon leakage. This occurs when business costs driven by local climate policies induce businesses to relocate production or a planned capital investment to another jurisdiction. It also occurs when local businesses lose market share to a competitor in another jurisdiction without these climate policy related costs. We are already experiencing carbon leakage. Europe's progress in reducing emissions in the last three decades has in part been because it was deindustrialising in a period in which other countries were expanding their carbon-intensive industries. As carbon prices rise, there is a consequent risk of business closure, lost investment and job losses in Ireland without a net reduction in global emissions. In some cases, it could even lead to a net increase. The risk of carbon leakage is highest for energy-intensive industries.

3. Ibec's vision for 2050

Ireland in 2050 will have a smart low carbon economy – known for its sustainable enterprise-base, industrial competitiveness, energy resilience, skilled workforce and high quality of life

Key components

A low carbon energy system
Ireland's energy system will be secure, sustainable and competitive. Supply will be built on renewables like wind, solar, renewable gas and biofuels with natural gas and carbon capture technology providing stability and security. Peat and coal will be removed from the energy mix. What oil remains will be used for sectors with no alternatives. Energy efficiency improvements, the use of indigenous resources and new links with Europe will boost energy resilience.

A low carbon economy
Ireland's economy will be competitive, productive and innovative. It will benefit from an entrepreneurial culture and a secure supply of low carbon energy. Ireland's green reputation will drive export growth and attract talent and investment. A dynamic renewable industry and indigenous bioeconomy will provide sustainable employment across the country.

A low carbon society
Ireland will be a cleaner, healthier and greener place to live and work. Citizens and businesses will play a greater role in managing scarce resources. Buildings will be smarter, warmer, and more comfortable. Cars will be electrified and a low carbon public transport system and cycling network will connect communities, reduce commute times and improve air quality. More green space and woodland will provide new recreational areas and boost biodiversity.

4. Our roadmap to 2050

In 2015 the Irish Government made a commitment to transform Ireland into a Low Carbon Economy by the year 2050.

The Government quantified this as:

- an aggregate reduction in 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.

For Ibec, this presents an opportunity to build a smarter more competitive economy, create jobs and improve living standards and quality of life *(see opposite)*. How we realise this ambition is not straightforward. There are many possible pathways Ireland can take. Given the immense costs and risks involved, it is imperative we identify and pursue the most cost-effective pathway available and prioritise evidence-based polices.

In this section Ibec sets out a cost-effective roadmap for Ireland to achieve its 2050 ambition and secure the full benefits of transition. We present a viable 2050 scenario for Ireland's energy sector (electricity, transport and heat) and give insights into when major changes will happen along the way. We also note the opportunities arising from an approach to carbon neutrality in the agriculture, land-use and forestry sectors and the implications of the transition on labour markets.

Our methodology

To construct this roadmap, we consulted widely with industry and reviewed a range of already published roadmaps. We also sought independent expert advice and assessed the costs, risks and benefits of a wide range of technologies and potential solutions to our climate challenge. Ibec ran a series of eight consultation workshops in Autumn 2018 to gather member views. These sessions were facilitated by independent experts and covered all the key areas; electricity, transport, heat, energy efficiency, agriculture and land-use, carbon pricing and the just transition.

Our roadmap is heavily influenced by the CO_2-80 scenario from the SFI MaREI Centre's 2013 'Low Carbon Energy Roadmap[7]', developed at University College Cork using the Irish TIMES energy systems model. The Irish TIMES model uses scenario analysis to provide a range of energy system configurations for Ireland that each delivers projected

7. Deane J.P, Curtis J., Chiodi A, Gargiulo M., Rogan F., Dineen D., Glynn J., Fitz Gerald J. and Ó Gallachóir 2013 *Low Carbon Energy Roadmap for Ireland*. Report submitted to Department of Environment, Community and Local Government.

energy service demand requirements optimised to least cost and subject to a range of policy constraints for the period out to 2050.

Ibec used this roadmap as a starting point for the energy sector because of its whole-system approach, strong international reputation and focus on cost-effective solutions. However, Ibec has departed from MaREI's CO_2-80 scenario in some key areas to incorporate business related issues that fall outside the scope of the TIMES model and to take account of developments since 2013 including falling technology costs, new policy constraints and increased demand projections.

A note on uncertainty
Identifying the right pathway to 2050 is challenging. It is difficult to predict with accuracy how our economy will evolve over the next 30 years and what technological breakthroughs are on the horizon. Equally, there are technologies that might fail to deliver as promised for a wide variety of reasons. In Annex II we include a short sensitivity analysis and highlight how different circumstances could alter our 2050 scenario and the technology mix presented in this chapter. Our policy recommendations in this document account for these risks and eventualities and can be considered "no regrets" policy options or pathways.

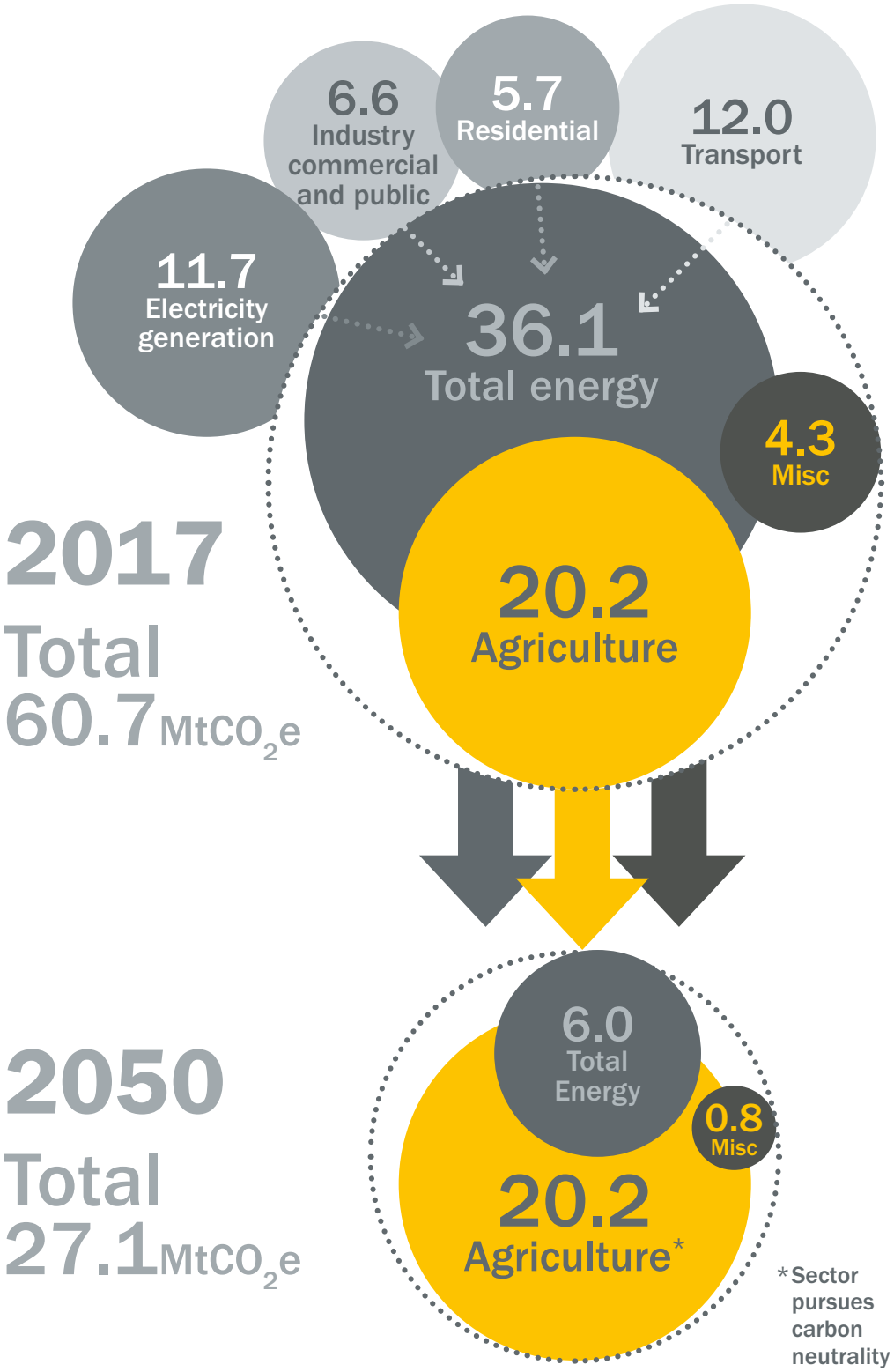
4.1 A low carbon energy system in 2050

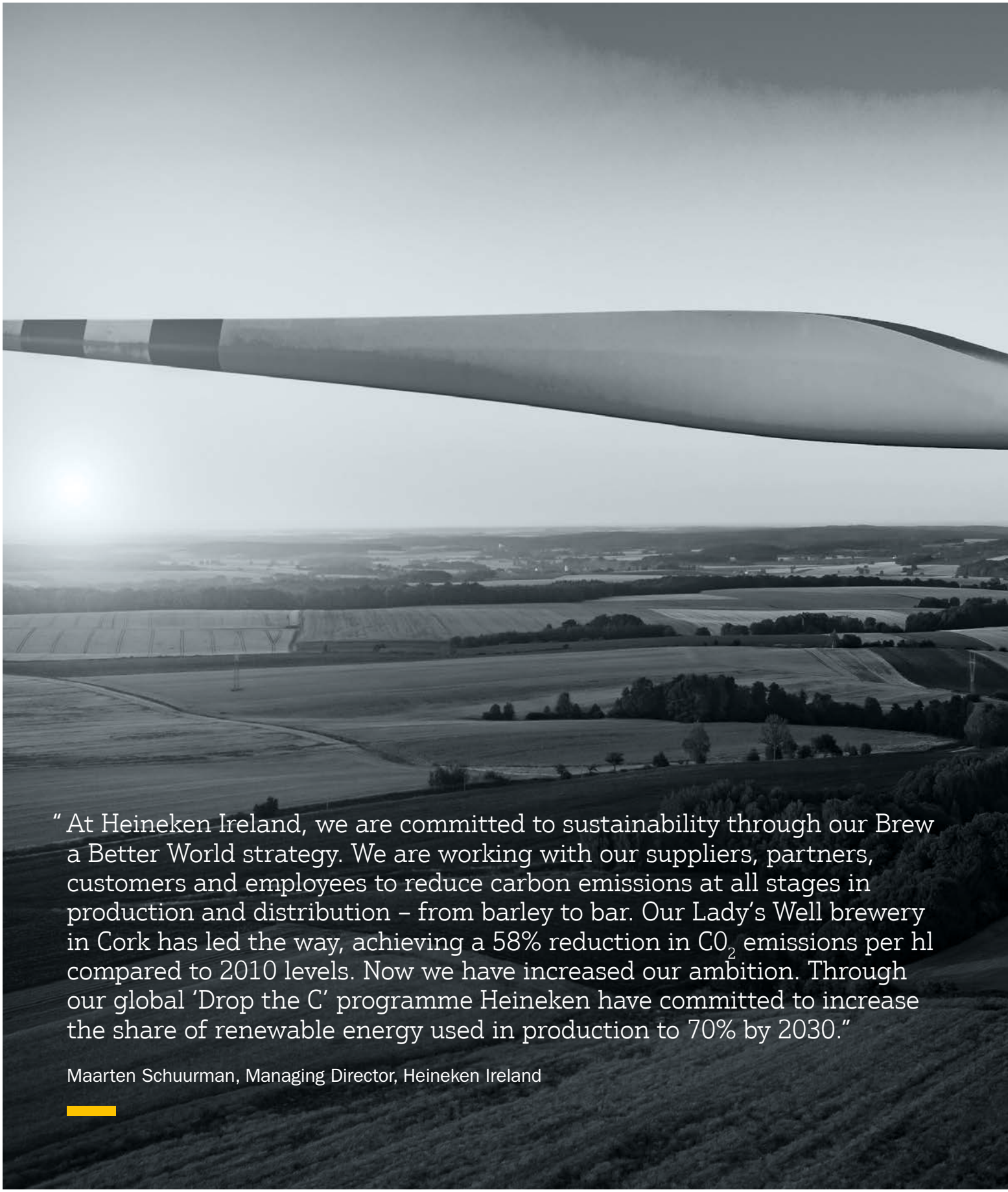
Our energy system in 2050 will be radically different from what we have today. In our scenario analysis, the Government's target to reduce energy-derived GHG emissions by 80% by 2050 is realised in the most cost-effective way through:

- an 84-94% reduction in electricity generation emissions on 1990 levels
- a 72-92% reduction in transport emissions (excluding air and marine) on 1990 levels
- a 75-99% reduction in heat emissions (space and industrial processes) on 1990 levels

Achieving emission reductions at this scale will require a large-scale deployment of renewable energy, a major reduction in energy use despite increased economic activity and a transformation in how we design buildings and move around our towns and cities. Critically, businesses and households will also need to play a more active role in managing their energy needs. The walls that today separate energy users from energy suppliers will become less defined as consumers become "prosumers". Smart buildings, internet-based applications, connected appliances, energy storage technologies, micro-generation and smart metering will empower Irish citizens and put the consumer at the centre of Ireland's future energy system. In this section we set out what these reductions will mean for our energy sectors.

Figure 5: GHG emissions today and in 2050





" At Heineken Ireland, we are committed to sustainability through our Brew a Better World strategy. We are working with our suppliers, partners, customers and employees to reduce carbon emissions at all stages in production and distribution – from barley to bar. Our Lady's Well brewery in Cork has led the way, achieving a 58% reduction in CO_2 emissions per hl compared to 2010 levels. Now we have increased our ambition. Through our global 'Drop the C' programme Heineken have committed to increase the share of renewable energy used in production to 70% by 2030."

Maarten Schuurman, Managing Director, Heineken Ireland

Table 2: Emission levels by sector ($MtCO_2e$) 1990-2050

Sector	1990	2005	2017	2050
Energy	11.3	15.9	11.7	
Residential	7.5	7.3	5.7	
ICP	6.2	8.3	6.6	
Transport	5.1	13.1	12.0	
Total energy	**30.2**	**44.6**	**36.1**	**6.0**
Industrial processes	3.3	2.8	2.2	
F Gases	0.03	1.0	1.2	
Waste	1.5	1.3	0.9	
Agriculture	20.3	19.8	20.2	
Total	**55.4**	**70**	**60.7**	**27.1**

Notes: The 2050 total energy figure represents an 80% reduction in emissions on 1990 levels as set out in the Climate Action and Low Carbon Development Act (2015). Total emissions in 2050 is based on no further reduction of agriculture emissions beyond 2017 levels and an 80% reduction in industrial processes, waste and F-gas emissions on 2017 levels.

Source: EPA, Ibec interviews and analysis

A low carbon electricity system

84-94%
emissions reduction

The challenge

Electricity will be at the heart of Ireland's future energy system because of its inherent efficiency, rapidly reducing carbon footprint and end-use versatility. Electricity consumption will rise even as efficiency improvements bring down overall energy use across the economy. This is because of a growing population, increased economic activity and the partial electrification of our heat and transport sectors. Ireland's electricity system has transformed dramatically in the last twenty years and Ireland will achieve or be close to achieving the Government's target to reach 40% renewable electricity output by 2020. Our power system will need to continue this strong decarbonisation trajectory and achieve emissions reductions of 84-94% by 2050 to help meet our overall 80% reduction target.

Our 2050 scenario

In our scenario, solid fossil fuels like peat and coal are largely removed from the generation mix by 2025 and completely removed by 2030. In the same period the rate of cost-effective renewable deployment increases, and renewables emerge as the main source of electricity production. By 2050 the system is built on renewables with wind generation being the single largest contributor. In the short-term onshore wind will continue to dominate supply. However, as costs fall and available land for onshore projects diminishes– offshore will become an increasingly important contributor.

Other generation technologies will play a smaller but vital role. The ability of solar photovoltaic (PV) to complement wind power will give it an important role in Ireland's 2050 electricity system. In the near-term the contribution will be modest – between 390 MW and 1160 MW for 2030. However, as technology costs drop, and efficiency improves, we envisage the roll out of some large-scale solar farms and increased co-location with wind farms. The co-firing of biomass with peat is already helping to reduce the carbon intensity of Ireland's power sector and this trend is set to continue as the share of biomass grows. Some plants will convert to dedicated biomass-only facilities. But EU restrictions and uncertainty about future supply costs will limit newly built biomass-only generation to a few small 250MW units.

Ireland is a global leader in its ability to support high levels of intermittent renewables like wind on the electricity system at any given time. The most recent record of 65% was set in April 2018 and there is now expectation that 75% will be achieved in due course. But there are technical limits and some form of dispatchable or "on demand" power generation will still be required in 2050 for grid stability and during times when wind is low. As an island nation with no nuclear generation our options are limited. In our assessment, gas generation equipped with carbon capture and storage technology presents the most viable solution. This involves the capture of CO_2 from a plant's flue gases and its transportation to a geologically stable underground or undersea storage facility. The depleted Kinsale Head Gas Field is an obvious location for a carbon storage project. A secure supply of gas is required to meet this demand.

Power-to-Gas (P2G) conversion will likely be present in the system in some form. Excess power generated from intermittent renewables at times of low demand can be used to produce hydrogen by electrolysis. Because hydrogen is not a greenhouse gas and does not emit CO_2 when burnt or converted to energy it could be used to fuel transport and micro CHP units (via fuel cells), provide inter-seasonal storage before generating electricity again or combined with the CO_2 produced by AD units and industry to deliver additional biomethane.

Our scenario envisages closer cooperation and integration with our neighbors through the EU's Energy Union programme and a reinforcement of the all-island electricity network. We assume the North South Interconnector is built out as planned, helping to reduce costs, increase grid efficiency and safeguard security of supply for the island out to 2030. We also envisage an additional 1GW of electricity interconnection built out before 2030 and a further 1GW added before 2050. Interconnection together with a strengthening of the all-island network will play an important role in supporting grid efficiency and wind penetration. However, all interconnector projects must undergo a whole energy system cost-benefit analysis to ensure benefits always outweigh costs to Irish consumers.

Electricity markets are also set to fundamentally change as more zero and low-cost renewable generation enters the market. We expect that future electricity retail prices will be driven more by system charges and ancillary services and less by direct input costs. In this way future electricity markets will imitate the economics of telecommunications and broadband. The market design will need to adapt to accommodate these changes.

Key features of a low carbon electricity system in 2050

Increased electricity demand
Electricity consumption will rise by at least 40% out to 2050 due to a growing population, increased economic activity and the partial electrification of the heating and transport sectors.

A phasing out of peat and coal
The EU's Large Combustion Plant Directive, together with a rising price of carbon in the ETS, will see peat and coal largely removed from the generation mix by 2025 and completely eliminated by 2030.

A system built on wind power
Wind power will be the dominant source of electricity generation in 2050 due to its relative cost effectiveness and plentiful supply.

Solar photovoltaic (PV)
As technology costs drop, and efficiency improves, we envisage the roll out of large-scale solar farms and increased co-location with wind farms. In the near-term the contribution will be modest, between 390 MW and 1160 MW for 2030.

Biomass power generation
Some plants will convert to dedicated biomass-only facilities. But EU restrictions and uncertainty about future supply costs will limit newly built biomass-only generation to a few small 250MW units.

Natural gas with carbon capture
Natural gas generation will provide stability to the grid in 2050 and be supported by carbon capture and storage (CCS) technology.

Energy storage
Storage technologies will play an important role in managing grid efficiency and renewable penetration over short time scales.

Small scale gas generation
Ireland may need some small unabated open cycle gas turbines for use as peaking plant when variable renewable generation is low, and demand is unusually high.

Increased interconnection
We envisage an additional 1GW of electricity interconnection in place before 2030 and a further 1GW added before 2050.

Waste to energy
EU waste targets will require the operation of dedicated thermal recovery capacity for the treatment of waste that cannot be reused or recycled. This will be in the range of 120MW to 140MW and constitute existing facilities and projects in development.

Power-to-Gas
Power-to-Gas (P2G) conversion will likely be present in the system in some form. Excess power generated from intermittent renewables at times of low demand can be used to produce hydrogen by electrolysis for storage or as an alternative fuel.

A low carbon transport system

72-92%
emissions reduction

The challenge
The battle to decarbonise our energy system will be won or lost in transport. Transport is the largest energy consuming sector and is responsible for over a quarter of Ireland's non-ETS emissions. As a country we remain heavily dependent on petrol and diesel vehicles and since 2013, emissions in the transport sector have risen by 13%, in line with economic growth.

Our reliance on private cars and road freight is especially problematic with these sectors responsible for 52% and 26% of all transport emissions respectively. Public transport accounts for only 5.5% of journeys nationally, with most of these journeys taking place in Dublin[8]. Even then, participation in Dublin is a modest 13.1% compared to other capital cities like Paris (69%) and Lisbon (45%).[9] Rail freight meanwhile only accounts for 0.4% of total freight tonnage in Ireland – compared to 8.4% in the UK, 14.5% in Portugal and 18.8% in Germany[10].

Our transport sector (excluding air and marine) will need to achieve emissions reductions of 72-92% by 2050 to help meet our national 80% reduction target. This will entail a large-scale uptake of low and zero emissions vehicles, smart compact growth and a countrywide modal shift towards public transport and active modes like walking and cycling. Failure to act will lead to a 12% increase in transport emissions by 2030, a deterioration in air quality and more congestion on Irish roads.

Our 2050 scenario
In our 2050 scenario, diesel remains the primary fuel used in transport out to the year 2030. However, from 2020 there is a continuous reduction in demand. By 2030, falling battery costs, a rising carbon tax and greater consumer choice will see approximately 50% of the car fleet electrified through a combination of fully-electric and hybrid-electric vehicles. By 2050 all cars and light vehicles are fully electrified, supported by timely investment in electricity infrastructure. Because electric motors are more efficient than petrol and diesel engines, this also leads to significant energy efficiency savings.

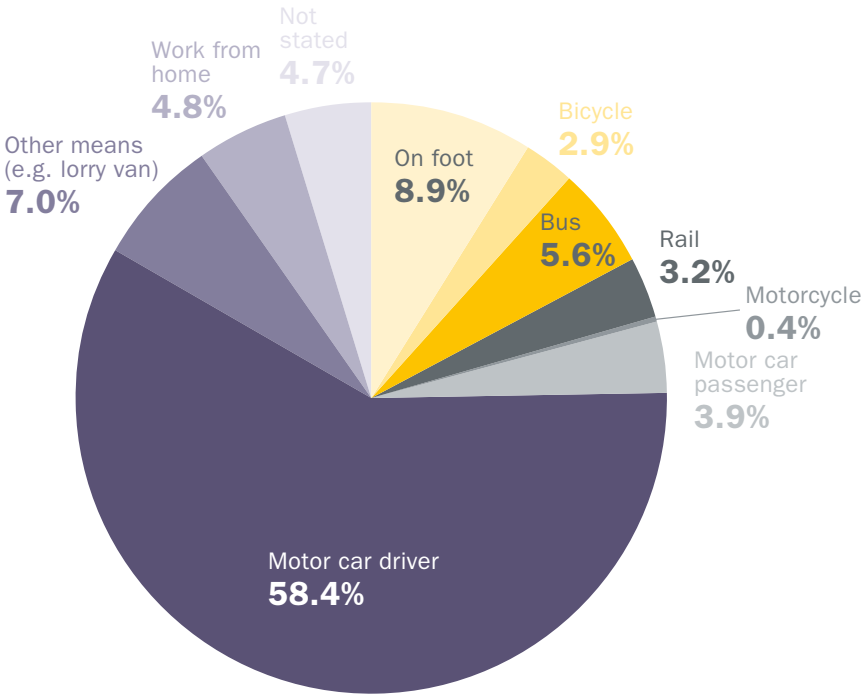
In the same period Ireland's reliance on the car diminishes with the development of a reliable and widely accessible low carbon public transport network. The completion of key public transport infrastructure projects like Metrolink and Dart expansion, combined with network redesigns like BusConnects in all Irish cities and smarter spatial planning will ensure wider access to public transport. Nationally, the development of high-speed electric rail links will better connect Dublin to Cork and Belfast, delivering emission reductions and more balanced regional development. The public transport network will run on electricity, liquid biofuels and Compressed Natural Gas (CNG) with growing levels of bio-CNG. Within urban areas, air quality requirements will determine the fuel used. In areas with poor access to public transport, ride sharing will help reduce single occupant journeys. Safer and more accessible streets will ensure active modes like walking and cycling become the norm for short journeys in urban areas.

8. http://www.dttas.ie/sites/default/files/publications/corporate/english/transport-trends/transport-trends-2017.pdf
9. Urban Europe- Statistics on Cities, Towns and Suburbs -2016 edition https://ec.europa.eu/eurostat/documents/3217494/7596823/KS-01-16-691-EN-N.pdf
10. https://ec.europa.eu/eurostat/statistics-explained/pdfscache/1142.pdf

Road freight will remain the dominant mode for transporting goods with Heavy Goods Vehicles (HGVs) gradually switching over to low and zero carbon vehicles/fuels. In 2050, road freight will predominantly be fuelled by biofuels like biodiesel, bioethanol, bio DME and bio methane-CNG *(see page 39)*. The roll-out of a national CNG refuelling network coupled with business supports will drive CNG vehicle uptake. As Ireland's biogas industry expands these CNG vehicles will have access to growing levels of bio-CNG. Liquid biofuel penetration will continue to grow, aided by the Biofuel Obligation Scheme. However, as the car fleet is electrified, liquid biofuel volumes are re-directed to serve large vehicles exclusively. Some small levels of gasoline will still be required. By 2050 the freight sector in Ireland is around 10% gasoline and 90% biofuels.

Ibec also anticipates that the current trend towards remote working and more flexible working arrangements will reduce congestion on Irish roads. We also envisage greater use of Ireland's heavy rail freight network and the introduction of innovative urban delivery solutions to reduce emissions and congestion like the use of cargo bikes and electric vans for final mile deliveries.

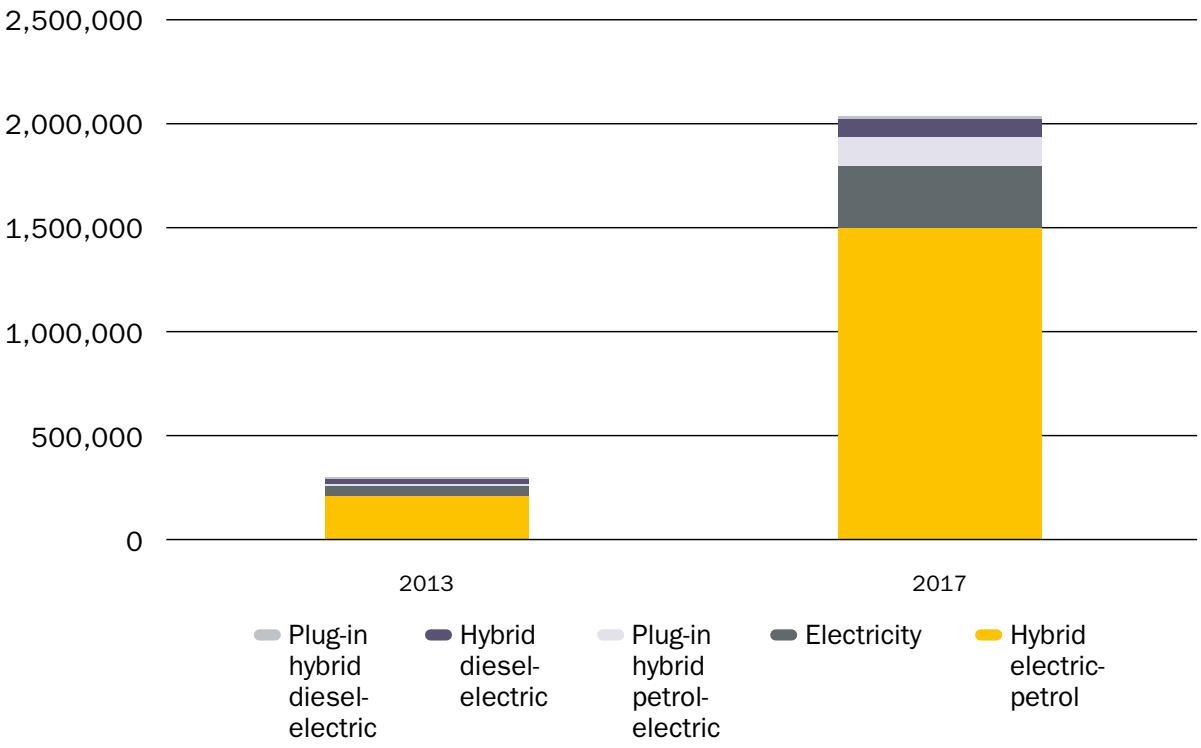
Figure 6: Commuting journeys by mode Ireland -2016



Note: Commuting journeys to place for work or education for the population aged 15 years and over. Includes not at work, college or school.

Source: CSO

Figure 7: Number of electric and hybrid electric cars registered in the EU, 2013-2017



In 2017 there were 262 million cars registered in the European Union (EU) Member States. Around 2 million (0.8 %) of these were classified as either electric cars or hybrid electric cars that can be driven in combination with a petrol or diesel engine.

Notes: 2013: For the United Kingdom, data are for 2012. 2017: For Italy data are for 2016, for Romania data are for 2015

Source: Eurostat[11]

11. https://ec.europa.eu/eurostat/documents/4187653/9753784/Number+of+electric+cars+2013+and+2017

Key features of a low carbon transport system in 2050

A reduction in energy demand
Energy use in transport will drop significantly out to 2050 despite a growing population and increased economic activity. These energy savings will be the result of more efficient vehicles like electric cars and modal shift.

Smart planning and street design
All future development will be planned and designed in a way that encourages walking and cycling and ensures access to an integrated public transport network.

Low carbon public transport
In 2050 rural and urban communities will be better connected by a reliable low carbon public transport network running on electricity, gas, biofuels and potentially hydrogen.

The electrification of cars, light vehicles and rail
The car fleet will be fully electrified by 2050. Approximately 50% of the fleet will be electrified through a combination of fully-electric and hybrid-electric vehicles by 2030. Small buses, light vehicles and many rail routes will also be electrified.

A steady expansion of biofuels
The volume of biofuels in the Irish transport system will increase significantly- primarily serving road freight. By 2050 the freight sector in Ireland is around 10% gasoline and 90% biofuels.

Modal shift in freight
Ireland's heavy rail network will help displace road freight volumes and be used to transport ISO tanks, containers and bulk freight materials.

" At the SEAI we have worked with thousands of businesses across the country for over 15 years to transform our approach to energy. Alongside our other business advisory programmes, EXEED (Excellence in Energy Efficient Design) helps businesses achieve optimum energy efficiency and carbon reduction through best practice design, construction and management of their buildings and processes. Although still at an early stage, we have engaged over 100 businesses on the programme to date. A Pilot phase of EXEED delivered high returns on investment and annual CO_2 savings of 17,000 tonnes. "

Jim Gannon, CEO, Sustainable Energy Authority of Ireland

Cutting emissions through rail freight

Ireland's heavy rail network offers an opportunity to reduce road freight emissions and road congestion. A 2016 study by the UK's Department of Transport found that "each tonne of freight transported by rail reduces carbon emissions by 76% compared to road and each freight train removes 43 to 76 lorries from the roads. Ireland's heavy rail network is underutilised. Rail freight only accounts for 0.4% of total freight tonnage in Ireland, compared to an EU 28 average of 17.4%[12]. Ireland's heavy rail network is ideally suited to transporting ISO tanks, containers, bulk freight materials like mineral ores, biomass and timber. The lines between Ballina and Dublin Port and Waterford Port give a direct connection with maritime traffic.

The gasification of transport

Natural gas is an established alternative transport fuel and can help reduce emissions and improve air quality. Natural gas vehicles run on either Compressed Natural Gas (CNG) or Liquefied Natural Gas (LNG). Space considerations make these vehicles better suited for large vehicles. Gas Networks Ireland (GNI), in cooperation with National University of Ireland Galway, are developing a national CNG refuelling network. When complete, the network will comprise 70 refuelling stations servicing trucks, vans and buses on Irish motorways. The first of these stations will be open in 2019 at Dublin Port with a further 13 built out by 2020. As Ireland's biogas industry expands *(see page 46)* these CNG vehicles will have access to growing levels of renewable gas (biomethane). By 2050 much of the available biomethane supply will be directed to help service these large vehicles.

12. https://ec.europa.eu/eurostat/statistics-explained/pdfscache/1142.pdf

A low carbon heat system

75-99%
emissions reduction

The challenge
When it comes to heating our buildings and running our factories, Ireland is still heavily dependent on imported fossil fuels. Heat accounts for approximately one fifth of total GHG emissions – and the proportion is rising. Ireland is highly oil-dependent, making us an outlier in Europe. Oil is used in 37% of Irish homes and 69% of rural homes. The dispersed nature of Irish housing makes this extremely challenging to resolve. Irish buildings are also on average extremely inefficient. The average Irish house is D rated on the BER scale and there are big energy savings to be made in the commercial and industrial sectors. In our analysis, Ireland's heat sector will need to achieve emissions reductions of 75-99% by 2050 to meet our overall 80% reduction target. This will entail significant improvements to the thermal performance of buildings, further efficiency savings in industry and large scale switching to low carbon heat technologies.

Our 2050 scenario
In our scenario, residential buildings require far less heat than they do today. Evolving building standards will mean that a third of houses in 2050 are A-rated or achieve passive status. With clever design, appropriate orientation and maximising passive solar gain, these buildings use 10% of the energy that our existing building stock requires. Meanwhile a national retrofitting programme moves the existing housing stock towards B1 BER status. The industrial and the commercial sectors improve their thermal and process efficiency at a faster rate, driven by their need to reduce business costs and their greater access to capital and state supports like EXEED. Co-benefits include warmer more comfortable homes and workplaces, reduced energy costs, better air quality and improved quality of life.

Oil is absent from the residential heating system by 2050. Domestic oil boilers are converted to a low carbon alternative at a rate of 5% per year so that by 2040 there are none in operation. Approximately half of these oil boilers switch to heat pump technology with others switching to network gas containing progressively higher proportions of bio-methane. By 2050 at least one third of households use electric heat pumps or equivalent electric based solutions. Because heat pumps are significantly easier and cheaper to install during construction, they become a default option for new builds. Electricity continues to be the primary heating fuel for key commercial sectors like offices, warehouses, public houses, restaurants and retail units. However large complexes and businesses will likely rely on combined heat and power (CHP) units, biomass and natural gas with progressively higher proportions of bio-methane to meet their requirements.

Industrial demand for high grade heat is met by a combination of biomass, renewable gas, waste-to-energy, CHP and natural gas with carbon capture. The appropriate fuel depends on the location and production requirements. Certain energy intensive industries will rely on natural gas, possibly with CCS.

Ibec also anticipates the roll out of efficient community heating networks in densely populated areas. These networks are commonplace in Nordic cities and can serve the needs of households, apartment complexes, hotels and commercial units. These heat networks could make efficient use of waste heat from thermal power stations, data centres and industry or heat from high efficiency CHP units.

Key features of a low carbon heat system in 2050

More efficient buildings
In 2050 buildings will require far less heat than they do today. The move to B1 and A BER ratings will lead to an overall reduction in heat demand despite increased population and economic growth.

Excellence in industrial efficiency
In 2050 Irish industry will be known for its world leading energy efficient plant design and thermal process efficiency.

A phasing out of oil, peat and coal
A rising price of carbon and state supports for alternative heating systems will ensure oil and solid fossil fuels are absent from our heating system in 2050.

A combination of fuels for industry
Demand for high temperature heat will be met by a combination of biomass, biogas, biomethane, waste-to-energy and natural gas with carbon capture. The appropriate fuel will depend on location and production needs.

Electrification of heat
By 2050 at least one third of households will use electric heat pumps or equivalent electric based solutions. This figure might rise if technology and retrofitting costs drop further than projected. Electricity will remain the primary heating fuel for most commercial sectors.

Natural Gas
Households near the gas grid will benefit from a gas supply with progressively higher proportions of bio-methane. Certain intensive industries will require natural gas, possibly with CCS.

Combined Heat and Power & district heat networks
District heating is present in some built up areas using waste heat from nearby industry, data centres, CHP and Waste-to-Energy plants if available. Efficient standalone CHP will also be present.

4.2 A sustainable agriculture and land-use sector

The challenge

Agriculture accounts for about 33% of Irish emissions. This is unique in Europe and reflects the significance of Ireland's strong agri-food economy. Methane (CH_4), predominantly caused by the natural process in the digestive system of ruminant animals (in Ireland mainly cattle and sheep), accounts for 64.5% of total agricultural emissions. Nitrous oxide (N_2O) meanwhile contributes about 35% of agricultural emissions arising mainly from the use of nitrogen-based fertiliser and animal slurries. The remaining emissions are caused by the storage and management of animal manures, lime and urea application, and on farm energy use for tractors and other machinery. The EPA projects that without intervention, agricultural emissions will increase by 9% by 2030 (relative to 2005). This increase will be driven by increased production responding to a growing global demand for food.

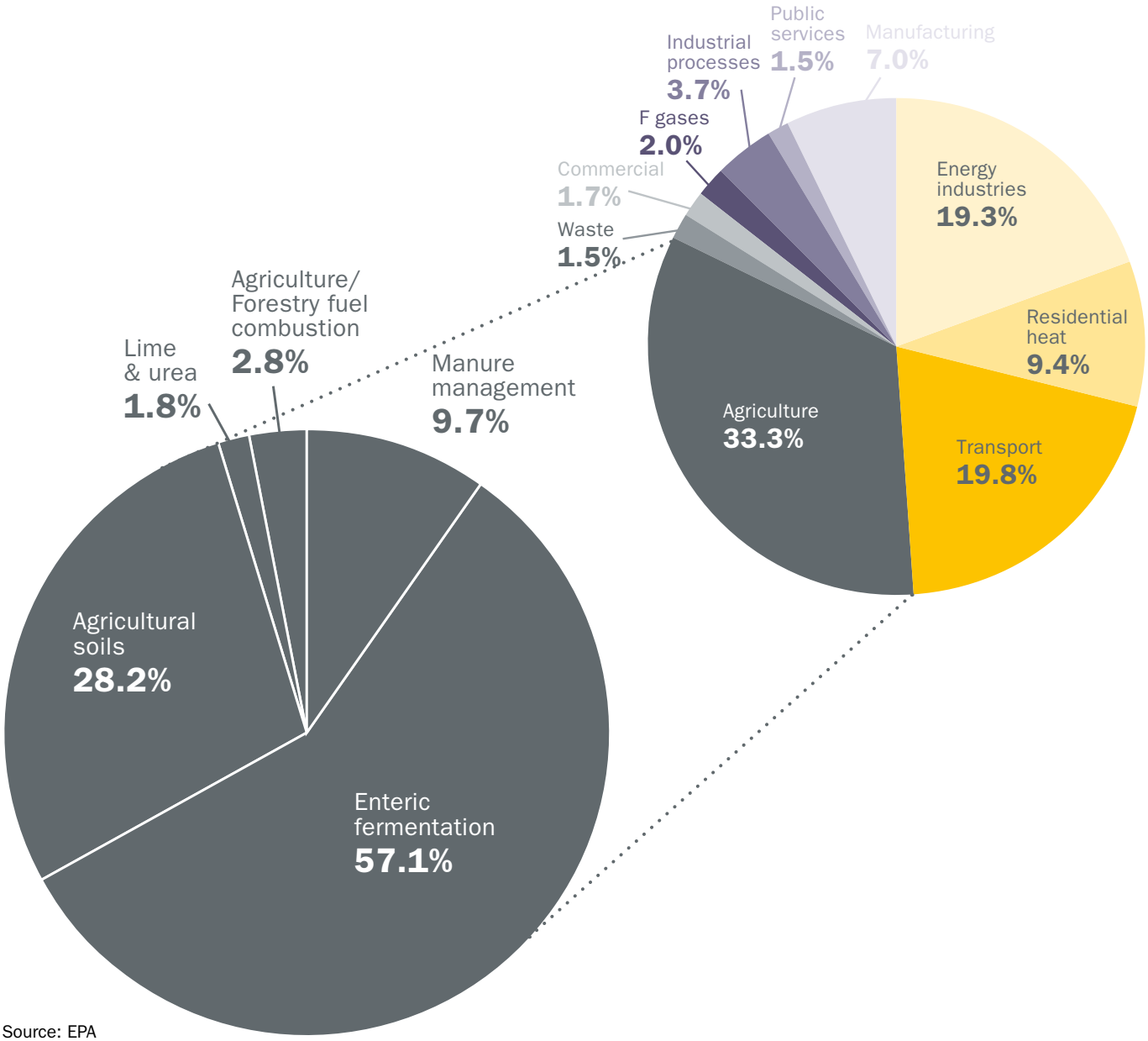
Ireland's long-term vision for the agriculture and land use sector is based on an approach to carbon neutrality for the sector. Effectively this means that agricultural emissions need to be balanced by the removal or sequestration of carbon from the atmosphere through afforestation, land use change and better crop and grassland management.

Meeting this ambition will be extremely challenging. While there is significant potential for additional carbon sequestration, EU accounting rules put a limit on the overall contribution it can make to achieving our 2030 emission reduction targets. On-farm mitigation meanwhile is extremely difficult as there is limited scope to alter the natural digestive process of ruminant animals. While a reduction in the national herd would cut emissions in Ireland, it would likely have no impact on global emissions given growing global demand for food. It is also possible that global emissions would increase if, as a consequence, production moves to overseas locations with a higher on-farm emissions intensity.

A complicating factor is the way in which GHG emissions are counted. GHG emissions reporting standards are today set by the United Nations Framework Convention on Climate Change (UNFCCC). However, recent academic research suggests that this framework overstates the long-term damage caused by short-life GHGs like methane.[14] Unlike CO_2 which remains in the climate system for a very long time, methane breaks down in the atmosphere over 12-14 years, but is very damaging in that short period. This new research is not a reason to delay mitigation or reduce the ambition of the sector to pursue carbon neutrality. However, it is important to note that any future change to the UNFCCC emissions accounting rules or amendment to the global warming impact of methane, would have significant implications for Ireland's emission profile.

14. Allen, M.R., Shine, K.P., Fuglestvedt, J.S., Millar, R.J., Cain, M. and Frame, D.J. (2018) A solution to the misrepresentations of CO_2-equivalent emissions of short-lived climate pollutants under ambitious mitigation. *Climate and Atmospheric Science*

Figure 8: A breakdown of agriculture emissions in 2017



Source: EPA

The opportunity

The EU Joint Research Centre ranks Ireland as the most carbon efficient dairy producer and 5th most carbon efficient beef producer in Europe. There is however room for improvement. With the right supports, a focus on carbon sequestration and cost effective on-farm measures, Ireland could build on its efficient grass-based production system and become a world leader in sustainable agriculture, land-use and forestry.

Three opportunities for emission abatement in the sector

1. **Carbon sequestration**
   Ireland has significant potential for additional carbon sequestration. Ireland's forests, bogs, shrublands, hedgerows and grasslands already play a valuable role in removing carbon from the atmosphere. And yet only 11% of Ireland is under forest cover (2017 figures). This is well below the EU average of 40%. The State currently has a target to increase forest cover to 18% by 2050.This would not only create income opportunities for land owners, but also provide a steady supply of indigenous wood products and biomass which could help fuel the decarbonisation of industrial heat and drive employment and growth in a vibrant bioeconomy. With the right policies carbon sequestration could reduce agricultural emissions on an annual basis while also supporting flood management, sustainable employment and biodiversity.

2. **Greater on-farm efficiency**
   On-farm efficiency can be a win-win for the farmer and the environment. Increased participation in the Beef Genomics Scheme & Beef Data Programme and use of the Economic Breeding Index (EBI) would help improve the genetic merit of the national beef and dairy herds, improving fertility and animal health, increasing milk yields and weight gain and reducing calving intervals and replacement rates. These measures can help improve farm profitability and reduce emission intensity at the same time. However, emissions reductions would be offset if the resulting increase in farm income leads to a total increase in production leading to higher total emissions.

3. **Renewable gas production**
   For Irish farmers there will be commercial and emissions mitigation opportunities in Ireland's emerging renewable gas industry. This will involve a network of anaerobic digestion (AD) plants using feedstock from their surrounding area. The raw biogas can be used to fuel local combined heat and power units or upgraded to biomethane and brought to a dedicated regional grid injection facility. These AD plants will primarily use grass from nearby farms but will also use food and animal waste when available. The nutrient-rich digestate produced during the AD process will be returned to local farms as a replacement to fossil/chemical-based fertilisers. The first injection facility will be built in 2019 and GNI is targeting 11TWh of renewable gas in the gas grid by 2030. This equates to 20% of the current gas demand. It will be crucial to direct this biomethane resource to sectors where it is needed most.

In June 2018, Teagasc's Greenhouse Gas Working group published a report examining the associated costs and benefits of a wide range of mitigation, land-use change and carbon sequestration measures. The report[15] shows considerable scope for cost-effective action than can put the sector on a pathway to carbon neutrality without forgoing agricultural output or undermining the sector's international competitiveness. Specifically, it shows that cost effective on-farm mitigation of methane and nitrous oxide together with carbon sequestration could deliver reductions of 6.39 Mt in the year 2030. The sector could achieve further emissions reduction of 1.31 Mt through fossil fuel displacement and the cultivation of biofuels and biogas. However, EU emissions accounting rules would mean these emissions savings would not all be counted within the agriculture emission envelope. In sum, the Teagasc report demonstrates that cost-effective mitigation, carbon sequestration and fossil fuel displacement could deliver between 5.57Mt and 7.70 Mt in the year 2030.

Given, that without mitigation action, our agricultural emissions in 2030 are projected to be between 19.45 Mt to 21.75 Mt under various growth scenarios, this level of emissions reduction still leaves a large gap in our longer-term aspiration of carbon neutrality. However, in Ibec's assessment, the Teagasc proposals are the best place to begin the journey to carbon neutrality. Deeper reductions would require changes to emission accounting rules, investment in research to develop breakthrough mitigation options and more fundamental changes to Irish agriculture.

15. An Analysis of Abatement Potential of Greenhouse Gas Emissions in Irish Agriculture 2021-2030 available at ???

4.3 A just transition

The challenge

The low carbon transition will cause significant disruption to labour markets around the World. Industries focused on the exploration, production and supply of fossil fuels will face big commercial challenges if confronted with higher carbon prices, more restrictive environmental standards and in some scenarios - the removal of state supports. The projected reduction in demand for fossil fuel products and corresponding increase in costs will likely demand business diversification, streamlining of operations, restructuring and job losses. Carbon intensive industries with limited or zero abatement potential will face similar challenges.

While several studies have concluded that the transition will lead to positive overall net employment gains, the impact will be spread unevenly across countries, regions and types of workers[16]. The United Nations Environment Programme estimates that 20.4 million jobs will be created in renewable energy industries related to wind, solar and bio fuels. There will also be significant job creation in the energy efficiency and building retrofit sectors.

It is difficult to measure the impact the transition will have on Irish labour markets. In 2018 the Department of Finance commissioned the Economic and Social Research Institute (ESRI) to develop a new model to examine the impact the transition will have on individual sectors of the economy. In 2019 Government will also carry out a study assessing the regional economic and employment impacts of the low carbon transition. Until this research is published, we must make do with the limited information that is available.

It is possible that Ireland's economy is less exposed to these disruptions than other countries, with 75% of total employment in the commercial sector. Energy intensive sectors like alumina production and cement manufacturing are active in the EU and therefore have a degree of protection through the carbon leakage protection framework. They are also making significant investments in energy efficiency and fossil fuel substitution. The aviation sector which employs approximately 30,000 people in Ireland is unlikely to see demand reduction in the foreseeable future, despite its emissions profile.

Most jobs in Ireland's indigenous fossil fuel sector relate to the peat industry and the supply and distribution of oil and gas products. Companies operating in these sectors are already diversifying their business activities and investing in low carbon and renewable technologies. And while overall employment in the sector is limited, the regional concentration of potential job losses is significant. For many companies in these sectors, even if displaced employees have marketable and transferable skills there may not be employment opportunities locally.

16. https://www.oecd-ilibrary.org/environment-and-sustainable-development/greener-skills-and-jobs-for-a-low-carbon-future_5k3v1dtzlxzq-en;jsessionid=6NtA4h2JVJX4IlGHQ6KDaKym.ip-10-240-5-132

" At Dairygold we are determined to play our part in reducing emissions. In 2017 we achieved over 3,100 tonnes of carbon savings in our processing sites through enhanced energy efficiency and the use of renewable biogas. As Ireland's leading farmer-owned co-operative, we are uniquely placed to promote more sustainable farming practices and on farm carbon sequestration."

Jim Woulfe, CEO, Dairygold

For Ireland the greatest challenge may be addressing displacement in the agriculture sector. Government has made a commitment to deliver an approach to carbon neutrality in the agriculture and land-use sector by the year 2050. What this means for the sector and the workforce remains unclear. In Brussels discussions are ongoing regarding the future of the Common Agriculture Policy post 2022. A tightening of environmental legislation or CAP requirements could put pressure on some farms. Teagasc's 2017 National Farm Survey indicates that already 40% of cattle rearing farms and 40% of sheep farms are 'economically vulnerable'

Opportunities for sustainable employment

On the other hand, the transition has the potential to create thousands of jobs across a host of established and new industries. The Ibec roadmap projects a significant increase in public and private investment in the coming years to support large scale deployment of renewable energy technologies, building retrofits, public transport, energy efficiency, smarter land-use management, carbon sequestration and afforestation. The pending investment in these areas will create career pathways and job opportunities for people at all skill levels. Crucially, Ireland's emerging bioeconomy should create meaningful work and quality lasting jobs to support local communities and workers in the regions that are most strongly impacted by decarbonisation.

In many ways the impact of the low carbon transition on labour markets is comparable to the dislocation caused by globalisation and the ICT revolution. The only difference is that few predicted the mass upheaval that technology and globalisation would bring. As a society we have made a commitment to deliver a fully functioning low carbon economy by 2050 and the necessary changes to our economy. In this case the changes on the horizon are relatively well understood and we have time to make adequate preparations for the changes to come.

5. New policies: Ibec recommendations

New policies are needed to support the decarbonisation of our economy. The following recommendations if implemented, will help support private investment, enable key technologies, spur necessary societal change and ensure we progress our climate ambition in a way that protects our competitiveness and leaves nobody behind. In developing these recommendations Ibec has considered the policy proposals in the 2019 IEA review of Irish energy policy and the Joint Oireachtas Committee on Climate Action's 2019 report *"Climate Change: A Cross-Party Consensus for Action"*.

To support economy-wide decarbonisation

1. Introduce short term carbon budgets

Ibec recommends the introduction of continually reducing carbon budgets for sectors outside the ETS. These budgets would restrict the amount of GHG emissions Ireland could emit over a specified period of years (no more than 5). The budgets would be set and reviewed annually by an independent expert body like the Climate Change Advisory Council. In practice this would bring greater accountability and visibility to Ireland's short, medium- and long-term emissions targets. It would also give more certainty to investors and promote cross-governmental discipline in the development of national policy. Any shortfalls would require remedial action. These budgets would need to incorporate the flexibilities provided by the EU's Effort Sharing Regulation.

2. Redesign the carbon tax

Ibec recommends a redesign of the carbon tax. The tax should follow the model of the National Training Levy where revenue is ringfenced to support investment in emissions reduction, energy efficiency and the deployment of renewable and low carbon technologies. The tax should be set at €30 per tonne in 2020 with a commitment to increase the tax annually by €5 per tonne until it reaches €80 in 2030. A full review of outcomes and impact should be held in 2025. Gradual, predictable increases in the tax will give greater investment certainty. A portion of the revenue should be used to support fuel poor households and vulnerable business sectors with no practical alternatives to fossil fuels. This includes businesses at high risk of carbon leakage, where production might move to another country where no such tax exists, causing job losses without reducing global emissions. *(See Appendix II for more information)*.

3. Establish a social dialogue on climate action

Ibec recommends the formation of a multi-stakeholder social dialogue on climate action bringing together industry, trade unions, environmental groups, local representative groups and political parties. It could build on the cross-party work conducted by the Joint Oireachtas Committee on Climate Action in 2019. Achieving a broad national consensus on climate action is vital to ensuring effective delivery and outcomes. A dedicated Just Transition taskforce should also be formed to ensure state services are fully equipped to support displaced workers and our labour market can take full advantage of new low carbon employment opportunities.

4. Promote climate smart planning and development

Climate action should be fully integrated into the planning system as set out in the National Planning Framework. The planning system must enable a low carbon transition by better supporting the roll-out of strategic energy infrastructure, the development of public transport, afforestation and carbon sequestration. This will demand reform at all levels of the planning system. The planning system must also prevent the long-term lock-in of emissions and ensure future development is compact and promotes walking, cycling and public transport use. In January 2019 Ibec launched a report setting out policy measures to help tackle the inherent problems in our planning system[17].

5. Undertake a review of security of supply to 2035

Government must undertake a comprehensive study into security of supply out to 2035[18]. Secure access to energy underpins all economic development. The transition to a low carbon economy should in time boost Ireland's energy resilience as we take advantage of indigenous renewable resources and energy efficiency improvements. However, poor policy decisions could undermine energy security. Decarbonisation should happen in phases to ensure a smooth transition and continued access to affordable energy, even during an energy security crisis.

6. Support private investment

The transition will require in excess of €40 billion of new capital investment by 2030[19]. The transition will largely be funded by households and businesses. Mobilising low carbon investment has proven extremely challenging. Targeted supports and incentives will be required to help businesses and households overcome the high capital costs and long payback periods. Strong government signals are also needed to drive investor certainty and gradually replace state subvention with market-led decarbonisation.

17. https://www.ibec.ie/IBEC/Press/PressPublicationsdoclib3.nsf/vPages/Newsroom~major-planning-report-launched-by-ibec-15-01-2019?OpenDocument
18. Note: This would be longer-term than the CRU's biennial report on electricity supply security, which has a 10-year horizon. It would also cover a wider range of energy sources.
19. https://www.sustainablenation.ie/wp-content/uploads/2017/05/SNI_Green_Finance_Ireland-FINAL-for-web.pdf

7. Close cooperation with EU Member States

Ibec recommends continued cooperation with EU partners on climate action. Climate change is a global issue and requires a global response. The EU's Energy Union and Climate and Energy Framework is built on the principles of fairness, cost-effectiveness and environmental integrity. The flexibilities provided by the EU framework have the potential to empower Member States to share the cost burden equitably while achieving emissions reductions where they are the cheapest. Ireland's 2030 target is ambitious but achievable and gives Ireland the flexibility to meet this target in a cost effective but environmentally sound way.

To support electricity decarbonisation

The large-scale deployment of renewables will need to be financed in a way that is cost effective and protects competitiveness. Up until now the decarbonisation of our power sector has been primarily financed by a PSO levy on consumers' electricity bills. Maturing technologies have the potential to become viable in the coming years without subvention. Recent reforms to the EU's ETS have led to a steady increase in the price of Allowances. This trend, along with a fall in technology costs, should create positive conditions for a market driven decarbonisation of our electricity system. However, if the ETS fails to deliver the appropriate market signals in the years ahead, additional state supports will be needed. Government must ensure any such support schemes or other policy interventions are carefully designed to protect the consumer.

New policies and regulatory changes are also needed to support the roll-out of vital energy infrastructure. Critical to the continued development of onshore wind are the revised Wind Energy Guidelines, due to be published for consultation shortly. With the development of the industry, including new national targets, it is sensible that the 2006 guidance be revised and updated. A clear permitting regime is also required to support off-shore wind, the repowering of older onshore installations and the colocation of wind, solar PV and storage projects. Finally, while carbon capture and storage (CCS) is a proven technology, it has yet to be rolled out at commercial scale. A national taskforce should be established to evaluate the costs, risks, regulatory changes required and funding arrangements for CCS deployment in Ireland.

Support the cost-effective deployment of renewable generation

- Support the EU ETS as the main instrument for electricity decarbonisation
- Ensure the Renewable Electricity Support Scheme protects consumers against unnecessary costs through competitive auctions and proportionate community support schemes
- Establish and resource the 'one stop shop' to deliver the necessary project consents as proposed by the recast Renewable Energy Directive
- Establish new rules to enable hybrid grid connections, the co-location of energy projects and wind turbine repowering
- Facilitate offshore wind development by providing a clear permitting and regulatory regime for Ireland's maritime area and enacting and implementing the Maritime Area and Foreshore (Amendment) Bill

- Investigate the supply and demand for Corporate Power Purchase Agreements and establish an appropriate enabling framework if required
- Identify opportunities to use EU funding to support peat and coal power stations to co-fire biomass and convert to biomass only stations

Mobilise greater public support for decarbonation

- Encourage energy user participation through the roll out of smart meters, new incentives for demand side response and the introduction of a new cost-effective exchequer support scheme for microgeneration
- Ensure revised wind energy development guidelines strike a balance between community concerns and our decarbonisation objectives

Develop critical energy infrastructure to enable renewable deployment and reinforce security of supply

- Secure carbon capture storage sites and establish a taskforce to investigate the costs and barriers to deployment and potential funding opportunities
- Progress the construction of the North South Interconnector to boost grid efficiency, reduce electricity costs and ensure security of supply for the island

Secure access to efficient sources of natural gas

- Assess future demand, potential supply risks and new efficient sources as part of a comprehensive study into security of supply out to 2035

To support transport decarbonisation

Until now road fuel suppliers have been the main driver of transport decarbonisation through the Biofuels Obligation Scheme (BOS). The success of the scheme can be seen in 2017 when around 225 million litres of biofuels made from wastes and residues were mixed into our petrol and diesel supply - largely unnoticed by the consumer. But the industry is approaching technical limits as the blending obligation increases. We cannot rely solely on the scheme to deliver emission reductions for the sector. New and innovative policies will be required.

The move towards car fleet electrification will largely be determined outside Ireland as battery costs fall and the global supply of electric vehicles increases. A recent report by Deloitte projects the pace of global EV adoption to increase from two million vehicles in 2018, to four million in 2020, 12 million in 2025, before rising to 21 million in 2030[20]. Ireland could become a leader in EV uptake by maintaining existing grants, rolling out a national charging network and time-limited incentives.

20. https://www2.deloitte.com/uk/en/pages/manufacturing/articles/battery-electric-vehicles.html

For freight, heavy goods and large buses - expanded state supports are needed to incentivise the uptake of CNG vehicles, grow a dynamic indigenous renewable gas industry and support the introduction of new biofuels like E10 (ethanol blend) and hydrotreated renewable diesel (HDRD).

Our 2050 scenario assumes a secure supply of affordable biofuels. However indigenous resources are limited, and Ireland will likely rely on biofuel imports to meet this growing demand. This creates a strong security of supply incentive to support local production and Ireland has an opportunity to produce HDRD using indigenous waste feedstocks like used cooking oil and tallow. This should be further investigated and supported where appropriate. It is also sensible to keep a watching brief on new and emerging technologies for the freight sector like hydrogen and inductive charging on motorways.

Our reliance on cars is largely due to poor spatial planning and low-density sprawl. Too many people live outside the reach of public transport and neighbourhoods are not built for walking and cycling. All future development will need to be planned and designed in a way that encourages walking, cycling and the use of public transport. This will mean prioritising compact growth, the development of infill and brownfield sites, changing urban height restrictions, completing key sustainable transport projects and creating safe and attractive street environments for pedestrians and cyclists. This will mean limiting vehicular access in some urban areas, wider footpaths, new street furniture and shared space for cyclists.

The experience from cycle and pedestrian friendly cities like Copenhagen and Utrecht shows that three overriding issues influence cycling and walking uptake: comfort, travel time and safety[21]. Many small cost-effective measures to address these concerns can have a significant impact in encouraging uptake.

Ensure all future development take place in areas with access to sustainable transport

- Prioritise compact growth in urban and rural areas as set out in the National Planning Framework
- Make full use of under-utilised land and buildings including ‘infill’, ‘brownfield’, vacant and under-occupied buildings
- Amend height restrictions to allow taller buildings at appropriate locations in urban/suburban areas

Target nationwide access to a reliable low carbon public transport network

- Develop an integrated long-term low carbon national public transport strategy as set out in the JOC Climate Action report
- Deliver key sustainable transport projects including Metrolink, Dart expansion, Bus Connects, rail expansion and electrification programs and the Greater Dublin Metropolitan Cycle Network

21. http://www.eltis.org/sites/default/files/case-studies/documents/copenhagens_cycling_strategy.pdf

- Develop electric rail links connecting Dublin to Cork and Belfast
- Assess the viability of high-speed electric rail connecting Dublin to regional cities
- Reform public procurement rules so lifetime costs are considered when buying state vehicles
- Transition to low or zero emission buses for the urban public bus fleet and examine the potential of converting long-distance diesel buses over to biomethane and renewable diesel
- Develop a user-friendly pilot carpooling scheme with associated incentives

Make Ireland a global leader in EV adoption

- Maintain existing EV grant supports and ensure they are not withdrawn too early
- Introduce temporary incentives for EVs including the use of bus lanes
- Introduce an electric vehicle charger pre-wiring requirement for all new buildings
- Extend the 0% Benefit in Kind rate for electric vehicles out to 2025
- Mandate no future taxi licenses to petrol and diesel vehicles after 2025
- Lead by example by mandating EV use in all government car fleets
- Support the roll-out of an accessible and interoperable public charging network
- Amend existing VRT rates to drive greater uptake in low and zero emissions private cars

Support the decarbonisation of freight and large vehicles

- Introduce carbon tax funded grants to promote CNG vehicles
- Investigate the potential to expand rail freight as set out in the NPF
- Research ways to reduce hydrogen production costs
- Support the manufacture of biofuels like E10 (ethanol blend) and HDRD
- Support innovative urban delivery solutions to reduce emissions and congestion like the use of cargo bikes and electric vans for final mile deliveries

Encourage modal shift by making streets more accessible and safer for pedestrians and cyclists

- Introduce dedicated budgets for local authorities to develop segregated cycle routes and greenways
- Reduce travel time for cyclists in urban areas by developing contraflow cycle lanes and cycle-only shortcuts
- Pilot the use of continuous footpaths and cycle lanes where cars give way to cyclists and pedestrians
- Introduce measures to discourage dangerous parking in cycle lanes
- Remove redundant street furniture and consolidate signage to create more space for pedestrians

To support heat decarbonisation

Evolving building standards should ensure that in 2050 approximately one third of Ireland's housing stock will be "A rated" and built to near carbon neutral standards. With clever design, and by maximising passive solar gain, these buildings use 10% of the energy conventional buildings require. However, there can be issues with compliance and many of these new builds are still installing fossil fuel systems. Greater awareness and enforcement will be required to fully future proof new buildings

New policies will also be needed to help bring Ireland's existing building stock up to at least B1 level. This will be extremely challenging given the high capital cost and long payback periods. Innovative financial products like green mortgages and state supports will be required to drive private investment. An opportune time to carry out these works is at the point of purchase. Therefore, the state could target supports to help buyers at this critical moment. And with approximately 32% of residential units occupied by tenants, new policies are needed to incentivise tenant-landlord investment in energy efficiency.

Every business recognises the value of smart energy management and companies across the country are already making large investments in energy efficiency to reduce costs and enhance their sustainability. For large users the business case for energy efficiency investment is robust even for some large capital projects. However, there are challenges. Many small and medium enterprises lack in-house expertise. They often receive conflicting information and do not know where to begin. Payback also remains a problem - especially for businesses with a short-medium term property lease. And in some sectors energy efficiency investment struggles to compete with other business priorities like investment, staff retention and commercial activity. The SEAI business support services and grants play a vital role in helping businesses overcome these challenges and uncloak their energy efficiency potential. These services need to be expanded in the coming years.

A rising price of carbon should help drive renewable heat technology adoption– especially in new buildings. However, supports are still required. In 2018 Government launched a Support Scheme for Renewable Heat (SSRH) which provides capital support for electric heat pump systems. The next phase of the scheme will provide an operational support for industry wishing to install biomass boilers. This is now long overdue. The scheme could be extremely effective in supporting the deployment of renewable heat in Ireland. However, additional funding will be required in the coming years. The scheme will also need to be expanded to include ETS sites and support biomethane grid injection.

Develop a National Deep Retrofit Programme

- Establish a multi-stakeholder taskforce to examine barriers, costs and solutions to bringing existing buildings up to B1 and A standards


" Since 2006, we've reduced our total carbon footprint by 45% and are working to reduce it by a further 25% by 2025 through our focus on energy efficiency and increased use of renewables."
Chris Martin, CEO, Musgraves Group

Introduce measures to leverage private investment in energy efficiency and alternative heat technologies

- Introduce an incentive programme to support tenant-landlord joint action
- Reduce the VAT for renewable technologies and energy efficiency equipment and materials to 4.8%
- Champion a review of the EU VAT Directive to allow zero rates for renewable technologies and efficiency equipment and materials
- Develop a pilot 'green mortgage' scheme in 2019

Strengthen existing supports to improve effectiveness and uptake

- Increase funding to the SSRH and allow ETS installations to participate
- Enhance the flexibility of the SEAI EXEED programme to help businesses boost energy performance
- Reform the Energy Efficiency Obligation Scheme to drive cost-effective energy savings

Support electric heat pump adoption and the development of district heat networks

- Reduce the Primary Energy Factor for electricity from 2.5 to 2 as permitted in the revised Renewable Energy Directive
- Use the Irish District Energy Association's 'Heat Atlas for Ireland' to identify viable locations for district heating schemes

Progress the development of a dynamic renewable gas market

- Roll out a national renewable gas certification scheme for Ireland to ensure the traceability and sustainability of the biogas supply
- Expand the Support Scheme for Renewable Heat (SSRH) to cover biomethane grid injection and use
- Roll out the supporting infrastructure
- Amend the Gas Regulations to allow for the potential injection of hydrogen into the gas network

To build a more sustainable agriculture and land-use sector

Cost effective emission mitigation at farm level will be driven largely by greater production efficiency. There are already several policies in place to support on farm efficiency. Increased participation in the Beef Genomics Scheme & Beef Data Programme and use of the Economic Breeding Index (EBI) should help improve the genetic merit of the national beef and dairy herds – improving fertility and animal health, increasing milk yields and weight gain and reducing calving intervals and replacement rates.

The above measures should boost farm profitability while reducing emissions intensity and therefore should come at no extra cost to the farmer. However, measures are needed to ensure resulting increases in farm incomes do not lead to re-investment in carbon intensive activities leading to a total increase in emissions. Other mitigation measures will require an investment and would increase farm operating costs e.g. changes and supplements to animal diets, slurry pit treatment and the adoption of low emission fertilisers. The Teagasc report identifies fertiliser replacement as the single biggest emissions abatement measure for the sector. This would involve farmers switching from calcium ammonium nitrate fertilisers to nitrogen fertilisers with lower emissions like protected urea. Because there is no direct monetary gain for making these changes, some form of intervention or incentive is required.

There is also significant potential to expand participation in both the Bord Bia Sustainable Beef and Lamb Assurance Scheme and Sustainable Dairy Assurance Scheme. Consideration should be given as to how existing farm payments can be structured to encourage farmers to join these schemes.

New measures are also needed to promote carbon sequestration, expand Ireland's forestry industry and help farmers on unprofitable land to maximise their income potential through land-use change. It is also worth examining the scope for incentives to encourage farmers and landowners to diversify their land use practices in a way that improves long term food supply security.

Develop a fully integrated carbon and land-use policy as proposed by the Joint Oireachtas Committee on Climate Action

Introduce measures to support cost-effective on-farm emissions mitigation

- Expand programmes that support farm efficiency like dairy EBI and beef genomics
- Incentivise greater nitrogen efficiency through appropriate soil nutrient management, slurry management and the use of grass legume mixtures and more efficient fertilisers

- Increase the availability of farm advisory services to promote on farm efficiency
- Set out a medium-term trajectory to merge the “Additional Sustainability Criteria’ into the mandatory ‘Quality Assurance Criteria’ in Bord Bia quality assurance schemes

Enable Ireland to reach its full carbon sequestration potential

- Lead efforts at EU level to remove the cap on carbon sequestration post-2030
- Include 'managed wetlands' within the scope of Irish land use, land-use change, and forestry (LULUCF) accounting.
- Examine the potential for sequestration through water table management
- Support research investigating emissions fluctuations in drained peatland and rewetted areas
- Develop an accounting and assessment system to support hedgerow carbon sequestration
- Identify areas of grassland erroneously categorised as drained peat lands
- Ensure agriculture schemes developed under the next CAP incentivise carbon sequestration

Support land-use change and the expansion of Ireland's bioeconomy

- Embed the cascade use principle for wood resource management and planning in national policy
- Address barriers to timber mobilisation and constraints on the productive capacity of forest estates
- Establish a well-resourced forest bio economy centre of excellence in Ireland
- Promote a better understanding of the economic, social and environmental benefits of the forest sector through a sustained communications campaign

Strengthen the National Forestry Programme 2021-2027

- Simplify the application process to speed up approval times
- Increase premiums to generate more interest from landowners
- Increase road grants by 20% and linear meters to 40LM to the hectare
- Ensure alignment of the forestry programme with environment schemes under a revised CAP
- Reduce percentage of payment held for maintenance grant
- Simplify and speed up felling licensing system

To support a just transition

Ibec welcomes the inclusion of the low carbon transition as a priority area in Government's new Future Jobs Ireland 2019 strategy. In the low carbon transition new jobs will be created while other jobs will disappear or be transformed. A just transition will require a well-functioning labour market and employment activation service that allows workers and firms take advantage of new opportunities and helps displaced workers find new employment.

A critical first step is to properly understand current and emerging skills needs of the low carbon economy. A comprehensive and systematic skills mapping exercise is needed to allow education and training institutions respond promptly to emerging skill requirements. This exercise will need substantial input from prospective employers to avoid instances where training programmes get ahead of the demand for products and services, and hence have trouble placing candidates into appropriate jobs.

Additional funding will also be needed to help reinforce and resource Ireland's labour market activation services so they can respond promptly, and help displaced workers in the sector find alternative employment. Timing is crucial. Fast re-integration into the labour market is hugely important to prevent the psychologically scarring effects that can come with prolonged unemployment. This is important given the expected age profile and level of education of the displaced worker. Research shows that low-skilled and older workers face above-average displacement costs — due to both longer durations of unemployment and greater wage losses once re-employed.

Since 2012, the Pathways to Work Strategy (PtW) has completely reformed the State's services to help unemployed jobseekers return to work and enhanced the capacity of the state to address individual needs. The most notable reforms include the introduction of client profiling services, the JobsPlus employment incentive scheme, labour market activation programmes like Springboard, JobPath and Momentum and the rollout of the Intreo service as a single point of contact for all employment and income supports. These will all play a vital role in enabling a just transition.

Establish a Just Transition Taskforce as proposed by the Joint Oireachtas Committee on Climate Action to assess labour market impacts and ensure state services are equipped to deal with affected workers

- Undertake a comprehensive study on the economic and employment implications of the transition in consultation with industry and trade unions.
- Investigate the future employment opportunities and skills needs arising from the low carbon transition as part of the Future Jobs Ireland programme
- Establish a multi-agency task force to manage displaced peat workers in the Midland counties
- Apply for European funds to support the retraining and reskilling of displaced workers;
- Ensure Intreo offices and labour market activation services are fully equipped to support displaced workers

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About Ibec

Ibec is Ireland's largest lobby group, representing Irish business both domestically and internationally. Our members span all sectors of the economy, collectively employing over 70% of the private sector workforce. Our policy work seeks to improve business conditions and thereby promote sustainable economic growth.

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" At Kingspan our vision is to be a global leader in sustainable business. In 2012 our Group Headquarters in Kingscourt achieved Net Zero Energy through an extensive retrofit of the existing building - incorporating our high performance building envelope, rooftop solar PV and LED lighting system. We are now on course to make our entire estate net zero energy by 2020."

Gene Murtagh, CEO, Kingspan

Appendix I
Sensitivity analysis

Identifying the right pathway to 2050 is challenging. Ibec's 2050 scenario based on key assumptions e.g. economic growth, population growth, increased energy demand, a rising price of carbon in the ETS and a fall in global technology costs. But it is difficult to predict with accuracy how our economy will evolve over the next 30 years and what technological breakthroughs are on the horizon. Equally, there are technologies that might fail to deliver as promised for a wide variety of reasons. There is also a prospect that the EU/Ireland could increase its climate ambition. This would further constrain Ireland's carbon budget out to 2050 and demand bigger changes to our economy and energy system. Below we offer some commentary on two potential eventualities that have been much discussed in recent months;

- what happens if Ireland is unable to deploy CCS as expected?
- what happens if the EU decides to increase its long-term climate ambition?

1. Failure to deploy Carbon Capture and Storage (CCS) in Ireland

Overview

Carbon capture and storage (CCS) technology is widely seen as an important decarbonisation option for energy intensive industries and power systems in future low carbon scenarios. Conventional CCS involves the capture CO_2 from a plant's flue gases and its transportation to a geologically stable underground or sub-seabed facility for permanent storage. The current generation of conventional CCS technology can capture and store around 90% of the CO_2 at the point of generation. While new approaches to CCS are emerging - like CCS with oxy-fuel combustion- more research and development is needed to bring them to the market.

Conventional CCS features prominently in Ibec's 2050 low carbon scenario. In our analysis it is the most cost-effective viable solution to meeting the needs of our future energy system. It could support efficient gas fired generation and provide valuable grid stability and reliability in a power system dominated by intermittent renewable generation. It could also help certain energy intensive sectors like cement and chemical production reduce emissions without negatively affecting production. CCS will also be required if CO_2 emissions from biomass-based energy and industrial plants are to be captured and stored to create negative emissions in a carbon neutral scenario or for the production of carbon free hydrogen. Ireland has the capability to adopt conventional CCS technology through the utilisation of the now depleted Kinsale Head Gas Field as a store of CO_2.

22. https://www.cru.ie/wp-content/uploads/2018/12/CRU18269a-GNI-Network-Development-Plan-2018.pdf

Likelihood/Risks
While conventional CCS is a proven technology- it is still in the early phases of implementation. There are only a few large-scale projects in operation and just one power generation facility (the Boundary Dam project in Canada). There are several reasons why CCS might not be deployed in Ireland.

1. **Storage availability:** The Kinsale Head Gas Field has been identified as potential location for future carbon storage. The field's gas reserves will be exhausted in 2020-2021 and it is estimated that it could store more than 2 million tonnes of CO_2 every year.[22] During decommissioning, the site will need to be maintained - and well heads plugged- a manner which can accommodate future CO_2 geological storage. Failure to secure the site now will render CCS inoperable at this location.

   Costs: CCS is not commercial at present without subvention. There are significant up-front capital costs as new infrastructure is required at the point of generation, transportation and storage. There are also high running costs with the efficiency of operating a gas CCS facility reduced relative to operating in unabated mode. Insurance costs are also prohibitive as CCS facilities need to guarantee investors that there will be no CO_2 leak – as any leakage will be priced at the future price of carbon. A rising ETS price and a reduction in technology costs will make CCS more commercially viable. But some form of national/EU subvention and a cost/risk sharing mechanism will be required to support investment.

2. **Regulation:** Deployment will require the creation of a low risk legal and regulatory regime. Irish law will need to be amended as the storage of CO_2 is currently illegal in Ireland. Rule changes may also be needed in wholesale electricity markets to reassure potential investors that CCS plant will be able to secure sufficient hours of operation and thereby earn them a return on investment. They are less flexible than conventional CCGT and will need a secure supply of natural gas to ensure continued operation.

3. **Planning approval:** CCS facilities and enabling infrastructure will require planning permission. CCS is new technology and could be met with some public resistance if the technology, its strategic importance and environmental integrity are poorly explained.

The impact
Failure to deploy CCS would significantly undermine Ireland's ability to meet its 2050 emission reduction targets while also maintaining security of energy supply and industrial competitiveness. To meet the power sector's needs, Ireland would need to develop alternative sources of low carbon dispatchable generation and our options are very limited.

1. **Hydro:** Ireland has limited hydro resources compared to other countries. Ireland has four dam-based hydro stations which combined meet about 2% of electricity demand. There is limited scope for future expansion and the SEAI expect that future projects will be small scale (1MW to 10MW).

2. **Nuclear:** The 1999 Electricity Regulation currently prohibits the construction of nuclear fission power stations in Ireland. This is unlikely to change in the near future as it would require a significant shift in public acceptance. The minimum size of nuclear power plant available is over 1,000MW which would be too large for our energy system. If Small Module Reactors (SMRs) become viable in the future they could become an option for Ireland. But there are significant costs associated with nuclear power – as has been demonstrated in the development of the €20.3 billion Hinkley Point C Power Station in the UK. There are also long-term costs associated with managing the resulting nuclear waste.

3. **Biomass:** Biomass already features strongly in Ibec's low carbon 2050 scenario – helping to meet the heating requirements of industry, run some district heating schemes and fuel some small scale 250MW biomass-only generation units. EU restrictions, uncertainty about future supply costs, supply reliability and biomass sustainability considerations will likely limit biomass use beyond this level.

4. **Interconnection:** Interconnection already features in Ibec's 2050 scenario and it will play an important role in helping accommodate increased penetration of renewable generation. However, it alone cannot be relied upon for security of supply during periods of high network stress and substitute for flexible domestic gas fired generation with CCS.

    - **Storage:** Energy storage technologies will help boost grid efficiency, facilitate renewable penetration and provide power during times of high demand. But current technologies like batteries, pumped storage and compressed air systems are only really effective over short time scales would not provide the scale needed to substitute for flexible domestic gas fired generation with CCS.

    Inability to use CCS will place particular pressure on energy intensive industries where electricity and biomass are not viable alternatives to fossil fuel use. Biomethane could play an important role but this would mean redirecting the scarce resource from the road freight sector. Alternatively, a trade-off would be needed – with other sectors being asked to achieve deeper emission reductions. Failure to resolve this issue could force these energy intensive sectors to move operations to locations with CCS and/or alternative fuel options.

2. An increased climate ambition (95-100% emission reduction)

Explanation
Ibec's 2050 roadmap and scenario is based on the Government's National Policy Position on Climate Action

This 2050 scenario is broadly in line with the EU Council's 2009 commitment to achieve an 80-95% reduction in emissions on 1990 levels by 2050. Ireland's EU targets for 2020 and 2030 are also set with this long-term objective in mind. The Irish 2050 target is also broadly in line with the lower ambition in the 2015 Paris Agreement which aims to hold global warming to well below 2 °C above pre-industrial levels and pursue efforts to keep it below 1.5 °C.

An increase in the EU's ambition could have a knock-on effect in Ireland and lead to an increase in our climate ambition. A deeper decarbonisation target would further constrain Ireland's carbon budget out to 2050 and demand bigger changes to our economy and energy system. It would also mean some notable alterations to Ibec's 2050 low carbon scenario.

Likelihood
In 2018, the UN's expert Intergovernmental Panel on Climate Change (IPCC) published a special report illustrating the environmental and social consequences of limiting global warming to 2°C as opposed to 1.5 °C. This has helped mobilise support for higher EU ambition.

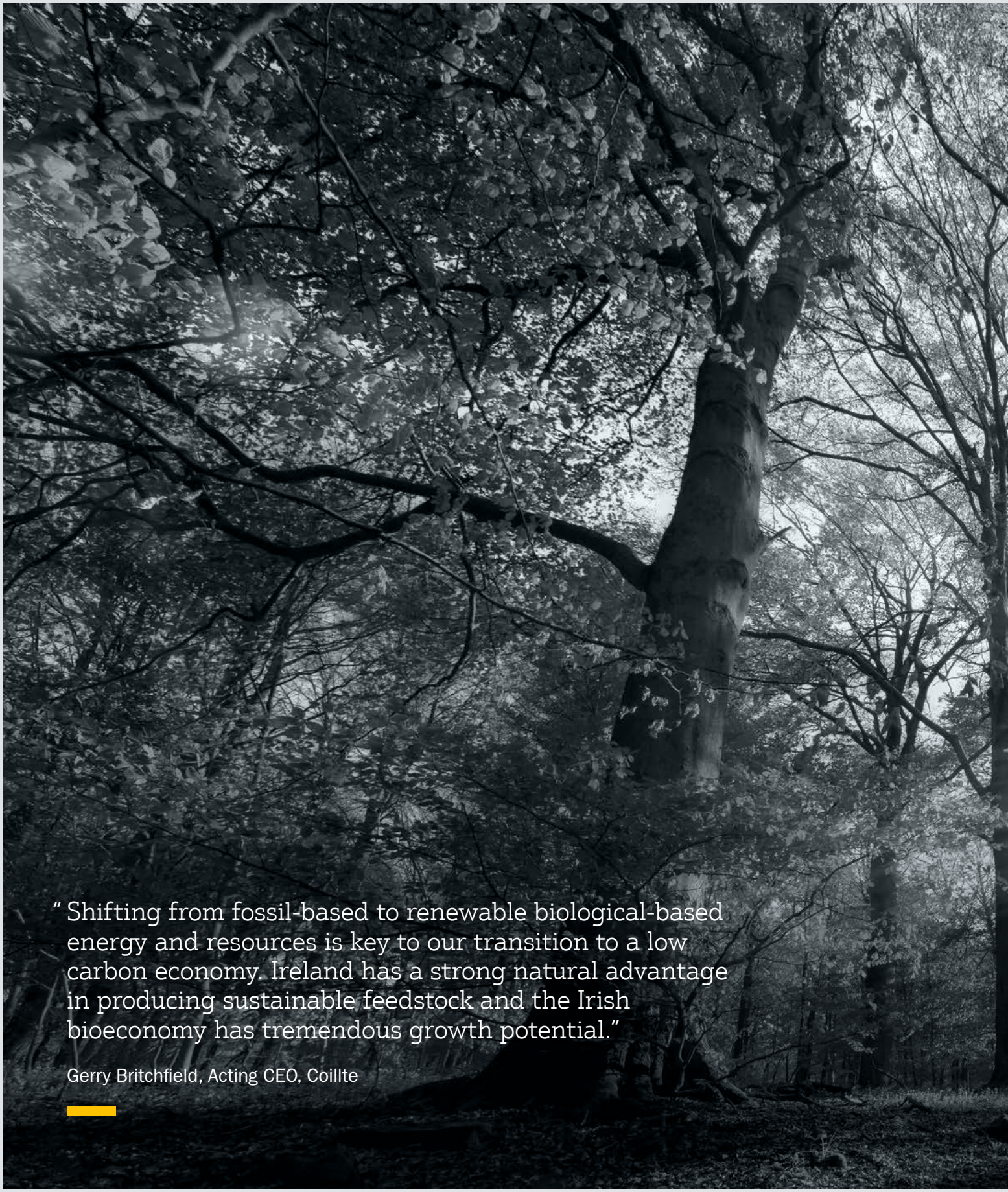
In 2019 the EU published a strategic long-term vision for decarbonisation in the EU which included eight possible 2050 pathways- two of which lead to climate neutrality. If adopted - either climate neutral scenario would represent a significant increase in the EU's long-term ambition. In March 2019 - the European Parliament voted through a resolution endorsing only the two carbon neutral pathways. Attention will now turn to the European Council and the matter will be debated throughout 2019. A decision to formally adopt climate neutrality as a long-term goal will be made after the 2019 European elections and a new College of European Commissioners is established.

Impact
At this stage it Is difficult to know how exactly an increase in EU ambition would affect Ireland. EU Climate and Energy Policy is based on a mixture of EU-wide and Member State targets. The latter are apportioned based on the principles of fairness and cost effectiveness. A lengthy negotiation process would take place in Brussels to decide how this increased ambition would be apportioned across the ETS and individual Member States.

However, if Ireland increased its 2050 ambition to reduce emissions by 95% below 1990% levels, Ibec's 2050 scenario would change as follows

1. **A greater reduction in energy demand**
2. **Increased demand for electricity**
3. **A reduced role for Natural Gas**
4. **A need for innovation and new technologies**
5. **Greater pressure on Ireland's agriculture sector to reduce emissions**
6. **Greater uncertainty for industries with no alternatives to fossil fuels**
7. **Increased carbon sequestration-**
8. **Increased costs as Ireland targets more expensive mitigation measures**

Ireland's ability to achieve "net zero" or even a 95% reduction in GHG emissions will be completely dependent on the success of emerging technologies and new innovations. This would create considerable uncertainty for sectors with no alternatives to fossil fuels and have achieved their maximum abatement potential through investment in energy efficiency. In Ibec's analysis Ireland should focus on meeting existing targets. The Ibec recommendations in this report are valid whether Ireland pursues an 80% and a 95% emission reduction scenario and therefore can be considered no-regrets policy options.



" Shifting from fossil-based to renewable biological-based energy and resources is key to our transition to a low carbon economy. Ireland has a strong natural advantage in producing sustainable feedstock and the Irish bioeconomy has tremendous growth potential."

Gerry Britchfield, Acting CEO, Coillte

Appendix II
Carbon tax analysis

Who pays the carbon tax?

There has been no previous attempt to apportion carbon tax revenues to different sectors in Ireland. This is important for this policy debate, given a significant amount of the carbon tax is paid by business and other organisations rather than households. In this section we use SEAI data on shares of energy use across both sectors and fuel types to provide an estimate of the carbon tax paid by the household and non-household sectors respectively.

Our methodology involved three steps. Firstly, we use SEAI data to apportion fuel use into a number of different categories. These categories are non-ETS business, residential buildings, commercial and public buildings, private-car or residential transport, business freight and public transport. This is split across three broad fuel groups to which the carbon tax applies – namely coal and peat, oil, and gas. These results are contained in Table 3.

Table 3: A breakdown of carbon tax related emissions - Kt CO_2e

Sector	Coal & Peat	Oil	Natural Gas
Non-ETS Business	48	994	867
Residential	1,335	2,853	1,321
Commercial and public	–	758	1,152
Transport (Business & public)	–	4,593	48
Transport (Residential)	–	6,791	–

Note: 1. Transport excludes aviation, navigation, and renewables. 2. Natural Gas is an estimate for that excluding major CHP plants 3. Unspecified transport is apportioned 50/50 4. Sectors where data is negligible are represented by a dash.

Source: SEAI & Ibec calculations

We then apportion these estimates to residential (Resi and Resi Transport) and non-residential (all others). These emissions estimates are then converted to carbon tax estimates using a €20 multiplier. Versus actual receipts in the year of our data (2017) our total receipts estimate vary by less than 1% from the actual receipts within that year – although there is greater within fuel type variance between oil and coal. These should have little, if any, impact on our overall results.

Table 4: Estimated net receipts 2017, by sector and fuel

	Total (all fuels)
Actual net receipts 2017	€419.6 million
Total (Non-residential)	€169.2 million
Total (Residential)	€246 million
Estimated receipts using our model	**€415.2 million**

Source: Ibec estimates based on SEAI and Revenue data

We believe these estimates are robust and suggest that while residential users pay around 59% of the carbon tax, non-residential users which are mostly represented by our membership pay around 41% of the total tax take from the carbon tax. While the final incidence of the tax (i.e. who pays the impact of the tax once equilibrium effects are taken into account) is difficult to ascertain, going into the future, existing research in Ireland (see Conefrey et al, 2012) suggests around 77% of the tax ends up being paid by companies once the impact of the tax on wages, costs and other equilibrium effects are taken into account.

Carbon tax revenue forecasts

In this section we set out two things:

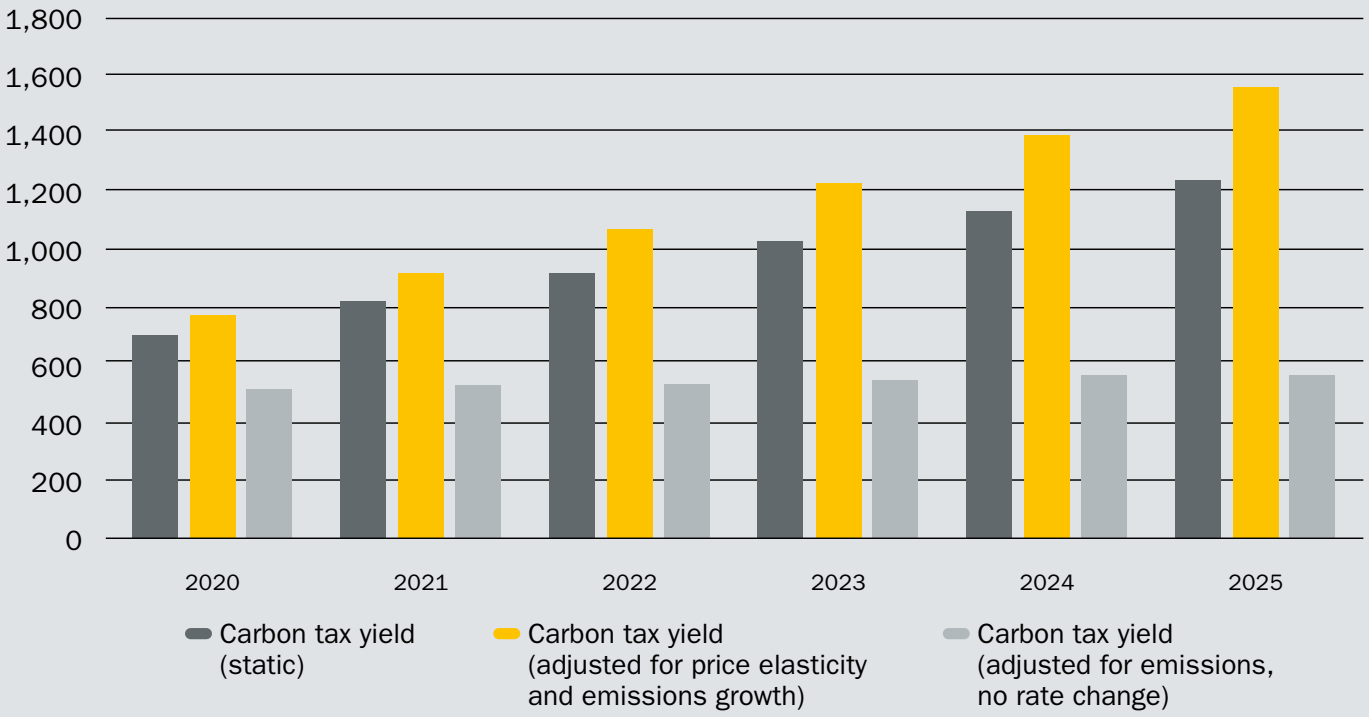
1. Firstly, our central estimate of revenue increases from our carbon tax policy out to 2025
2. Secondly, we outline how these resources should be used into the future

In this scenario we assume that the carbon tax is increased to €30 per tonne in 2020 and is then increased each year by €5 per tonne until it reaches €55 per tonne in 2025[23].

The carbon tax delivered about €491 million in the exchequer in 2018. Government estimates show that in a static environment a €5 increase in the carbon tax would bring in around €106 million in additional revenue. In response to a recent Parliamentary Question [49950/18] the Department of Finance estimated that an increase in the carbon tax from €20 per tonne to €60 per tonne over a five-year period (to 2025) in a straight-line fashion would increase that yield by an additional €3.2 billion over carbon tax revenue available in a scenario where it remains at €20 per tonne. Using the same methodology would mean that by 2025 our carbon tax proposal would raise an additional €2.6 billion cumulatively over that period. It is worth noting this includes both carbon tax and additional VAT revenues because of the carbon tax increase.

23. While Ibec recommends that the tax should increase annually until it reaches €80 per tonne by 2030, our analysis only runs to 2025. After 2025 it becomes too uncertain to estimate outcomes and revenue potential.

Figure 9: Carbon tax yield estimates



However, the Department of Finance methodology assumes a static level of emissions across the period and that increases in the carbon tax have no impact on the consumption of fuels covered by the carbon tax. Current national emissions projections assume that with some additional measures, the emissions from the heating and transport sectors covered by the carbon tax will grow by around 1.5% per year until 2025 (versus just under 2% in a no-policy change scenario). On the other hand, since the tax was expanded to include solid fuels total emissions under the carbon tax have been increasing by around 3%.

We take 2% growth in emissions as our no-policy change scenario. It is important to note; this does not account for the measures advocated for in this paper. These measures, funded by carbon tax revenue, have the potential to reduce emissions even further in the medium-term. This reduction will mean less carbon tax revenue collected,but in this case it means policy is working and fewer resources will be needed. The measures remain in the gift of policymakers.

An added complication is that the increases in the carbon tax themselves will have an impact on both household and business consumption of fuels which see increases in the tax. The effectiveness of a carbon tax increase in shifting consumption depends on the responsiveness of both households and non-ETS business to price changes. In the academic research, it is commonly held that demand responsiveness of fuel to price is quite inelastic (less than -0.52). However, there is a growing literature that shows higher demand elasticities when the price change is introduced on the back of a publicised tax increase[24]. Here the elasticities can be a multiple of market induced price changes.

24. http://www.lse.ac.uk/GranthamInstitute/wp-content/uploads/2017/03/Working-paper-212-Andersson_update_March2017.pdf

This ‘tax saliency’ effect suggests that elasticities for the carbon tax may indeed be higher than our central estimate of a -0.5 elasticity (that is a 1% increase in the price of fuel will result in a 0.5% fall in demand). In addition, the lower price and greater of availability of alternative energy sources will increase this elasticity into the future.

Recent research in Ireland suggests that every €5 increase in the carbon tax would increase the purchaser price of carbon commodities by around 0.85%. We incorporate these elasticities into our estimates of carbon tax returns, but much greater research is clearly needed into the equilibrium effects of carbon tax increases on tax yield. Our findings suggest that accounting for these factors the increase we have outlined for carbon tax will deliver an additional €3.7 billion for the exchequer between 2020 and 2025 versus a continued €20 per tonne price.

The gradual increases in the tax will give certainty to business and avoid a sudden large increase to the tax in the future. Crucially, a portion of the revenue would need to be ringfenced to compensate communities and sectors disproportionally affected by the carbon tax and sectors that have no practical alternatives. This would include businesses at risk of carbon leakage, where production could move to another country where no such tax exists, leading to job losses without reducing global emissions.

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