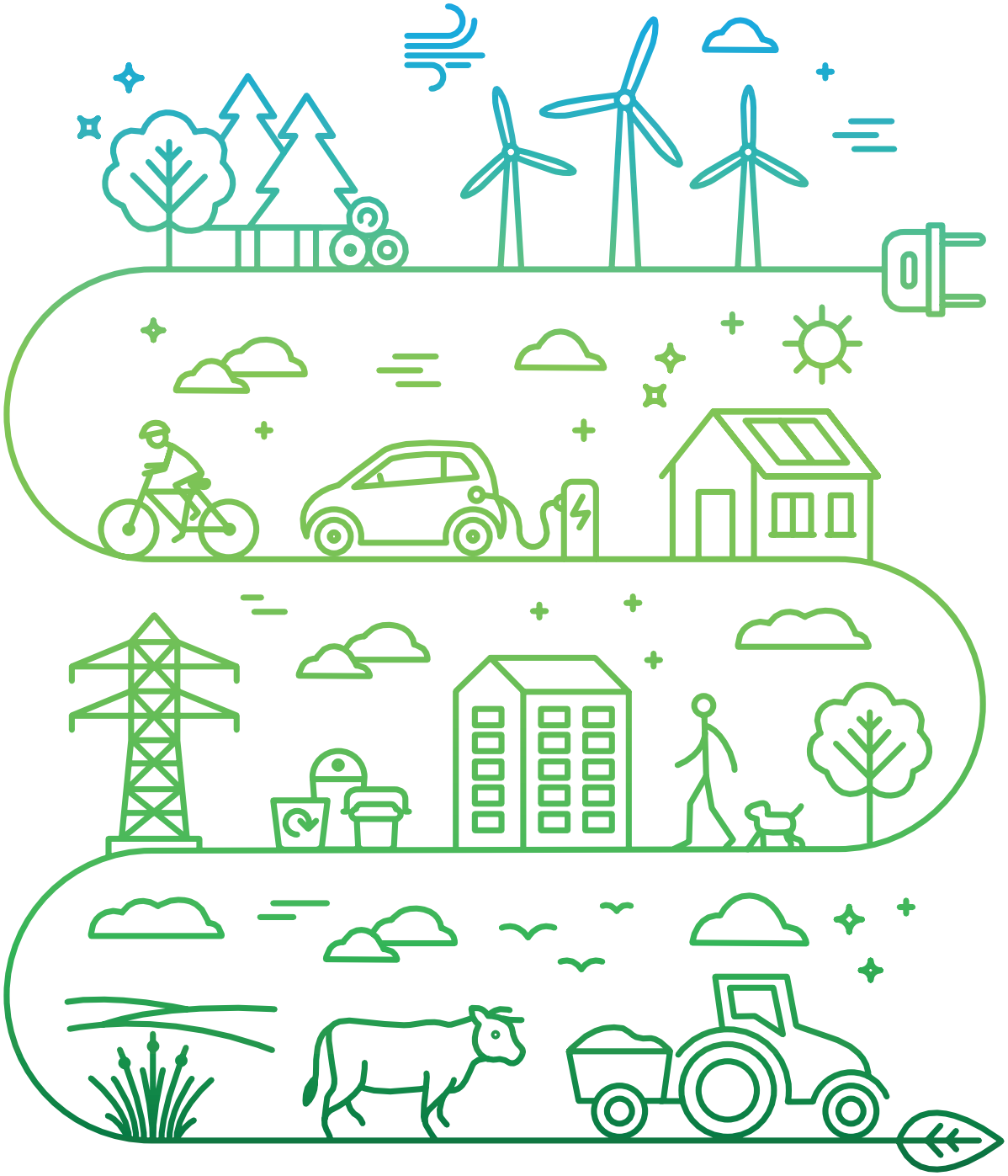
DRAFT CLIMATE CHANGE PLAN

The draft third report on policies and proposals 2017-2032

January 2017



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Ministerial foreword

In 2009, the Scottish Parliament passed unanimously the most ambitious climate change legislation anywhere in the world. Seven years on, we are now developing our Third Report on Policies and Proposals, the Climate Change Plan (CCP), which will take us to 2032. In those seven years, much has changed and we are in a fundamentally different political, economic, social and technological landscape to that of 2009.

In the international context, the UN Paris Agreement, the first global legally binding agreement to limit greenhouse gas emissions, came into force on 4 November 2016, significantly earlier than was anticipated by the international community. We are now seeing extraordinary momentum towards a low carbon future which, although it will not be linear or smooth, appears unstoppable. The COP 22 Marrakech Action Proclamation celebrates this momentum by governments, states, regions, cities and businesses. I had the privilege of attending the 22nd Conference of the Parties (COP 22) in Marrakech and was proud that Patricia Espinosa, the Executive Secretary of the United Nations, recognised the 'great achievement' of Scotland exceeding its 2020 emissions reduction target six years early. Closer to home, Lord Deben, the Chair of the Committee on Climate Change, has also stated that 'there is no doubt that Scotland is certainly doing better than any other part of the United Kingdom'.

While the UN climate change processes provide us with much-needed confidence at the global level, many people have expressed fears about the potential impact of the UK's damaging Brexit vote on the climate change agenda. One major concern is a potential hampering of climate ambition. It is a concern we share, but we will not be deterred. In this document, the Scottish Government continues its ambitious plans to lower emissions while supporting others to lower theirs.

We need an emissions reduction plan which takes explicit account of such uncertainties, while maximising the opportunities for Scotland and protecting our domestic economy. In charting the course for this draft CCP, we have been helped by a robust evidence base and modelling framework. For the first time since the 2009 legislation, we have made use of an international standard for modelling of greenhouse gas emission reductions and energy issues ('TIMES') which has been calibrated with Scottish data and sector intelligence. This model confirms that the targets are achievable, though they are demanding. The model has helped us decide how best to reduce emissions across the whole economy, using a pathway broken down into carbon envelopes, or budgets, for each major sector. Each sector's carbon needs are now interlinked in the modelling. If one sector over or under-performs against our expectations, we can now model the knock-on impact on emissions savings required from the other sectors of the economy in the future.

There are different emission reduction pathways that could be followed, but my Cabinet colleagues and I have selected the path that we believe is the most beneficial to the people of Scotland. In making this choice, we have considered emerging technologies, issues of delivery, costs and disruption. We have considered the steps required to prevent industries moving away from Scotland if our carbon constraints are perceived to be too tight versus competing economies, leading to 'carbon leakage'. We have also considered the economic opportunities that should emerge from being at the forefront of innovative business practice.

We have also benefited from the parallel development of the Scottish Government's first Energy Strategy, a companion to the CCP. The Energy Strategy explores questions that are key to successful decarbonisation – the supply of safe, clean, reliable and affordable energy that will both underpin the Scottish economy and contribute to the wellbeing of our society. Both the Energy Strategy and the CCP are rooted in the ambition and vision of Scotland's Economic Strategy. The actions in these documents are designed to boost productivity and secure competitive advantage, protect and preserve our environment and deliver inclusive growth.

The draft CCP contains transformational outcomes in transport, heat, electricity generation, and energy efficiency along with increased natural carbon sinks and more efficient and profitable agricultural practices.

In the 2030s we expect to see dramatic reductions in emissions from buildings – both residential and non-domestic – through energy efficiency measures and the decarbonisation of heat. In electricity generation we expect to have almost entirely decarbonised by 2025 through a mix of energy generation technologies, with negative emissions (achieved via the use of carbon capture and storage and gas from plant material and biomass waste) from the late 2020s onwards. We will increasingly rely on electricity to heat our homes and power our vehicles.

For the industrial sector, our plans are broadly consistent with existing EU and UK regulatory frameworks for industrial emissions with a fall of around 19% by 2032 due to a combination of fuel diversification, cost saving energy efficiency and heat recovery, and emissions trading.

Transport emissions will have reduced by around a third by 2032, through the wide-scale uptake of low carbon vehicles, enhanced freight logistics and measures such as low emission zones.

Reducing greenhouse gas emissions from waste continues to be a good news story for Scotland and the landfilling of biodegradable municipal waste will be phased out, ahead of the statutory ban that applies from 2021. By 2030 we expect to be in tandem with the UN Sustainable Development Goals to reduce food waste by 50% and, in the longer term, we aim to be delivering emissions reductions through a circular economy approach in our business and industry sectors by 2050.

Our ambition for agriculture is for Scotland to be among the lowest carbon and most efficient food producers in the world. Our agricultural emissions will decline over time through efficiency measures and a focus on low carbon produce. We will also drive up peatland restoration and woodland planting rates to increase our natural carbon sinks.

To achieve these transformations, we have developed policies and proposals in the context of the Scottish Government's wider objectives to create a dynamic, sustainable and inclusive economy. This is a huge opportunity – setting a course that will modernise and transform the economy over the next 15 years while setting us up for almost complete decarbonisation by 2050. This long-term approach enables investors, businesses, communities and households to plan changes well in advance, while realising other important benefits – including improved air quality as a result of the widespread use of low carbon vehicles and enhanced biodiversity generated by peatland restoration.

Importantly, the transition away from fossil fuels in transport, heating and electricity generation, coupled with our promotion of the circular economy, provides Scottish businesses and the research community with extensive opportunities to innovate, and with the support of our enterprise agencies, to export those innovations more widely.

While we acknowledge that such transformation will inevitably involve some difficult choices, we are committed to working with business leaders and others to co-design policies and proposals which maximise commercial, export and job opportunities. Our Scottish Energy Efficiency Programme, for example, will support thousands of jobs across Scotland, creating a substantial Scottish market and supply chain for energy efficiency and renewable heat services and technologies and related expertise which is transferable to international markets. Millions of pounds should be saved in fuel bills, money which could be recycled into local economies thus regenerating our communities and the public spaces at their heart.

Most importantly, the outcomes and associated actions in the CCP must be supported and owned by the people of Scotland. We know that the majority of people don't discuss climate change on a regular basis although many are actively involved in climate friendly behaviours at home, work or in their communities. However, in implementing this Plan, we will touch on the lives of everyone in Scotland: on the way we travel and move our goods around; the way we heat our homes and buildings; the way we manage our land and produce food; the jobs and training opportunities to which we will have access; the new energy infrastructure we will need; and the way this all builds Scotland's economic capacity and competitiveness.

We have been encouraging communities in Scotland to talk about these issues in a number of different ways – through the Climate Challenge Fund and the Climate Conversations to name just two. I am determined that these conversations continue, and that everyone in Scotland will have a role in shaping our low carbon future.

This draft Climate Change Plan is being laid in the Scottish Parliament for a scrutiny period of 60 days. My Ministerial colleagues and I look forward to the forthcoming analysis by the Parliament, and receiving the resultant committee reports in due course. We will give those reports full consideration when publishing the final Climate Change Plan.

Roseanna Cunningham
Cabinet Secretary for Environment, Climate Change and Land Reform

Part one

1. The draft Climate Change Plan explained

1.1 How to use this document

1.1.1 This document is a draft of the Scottish Government's Third Report on Policies and Proposals, the Climate Change Plan, for meeting its greenhouse gas emission reduction targets from 2017-2032. This draft Plan contains a set of introductory chapters, a set of sector specific chapters, and a set of annexes.

1.1.2 This chapter provides background information on the policy history of Scotland's emissions reductions activity from 2009 to the present, a summary of the Committee on Climate Change's fifth report on Scotland's progress towards meeting emission reduction targets, and an explanation of this draft Plan's companion document – the draft Energy Strategy.

1.1.3 Chapter 2 summarises our emissions reductions pathway to 2032 by sector, outlines our approach to adaptation, explains our response to the Paris Agreement, including our proposed new Climate Change Bill, and references our approach to Brexit.

1.1.4 Chapter 3 focuses on the roles of the main players: Scottish Government, local government, the wider public sector, the private sector, the third sector and communities. All have critical roles to play in both policy design and implementation. The role of individuals is addressed in Chapter 5 in the section on behaviours. Further information relating to behaviour change is provided in the annexes on the ISM tool and Climate Conversations.

1.1.5 Chapter 4 provides details of our statutory duties including the emissions reduction targets themselves out to 2032, how we compensate for excess emissions, how we account for traded and non-traded emissions, and an explanation of consumption emissions. It also provides a summary of our new system-wide energy model – TIMES – and how we have used that to allocate emissions reductions effort across the economy. This chapter also explains the difference in approach from previous reports on proposals and policies and this draft Climate Change Plan.

1.1.6 Chapter 4 also contains information on costs, how we take account of co-benefits and potential adverse side effects, and the Strategic Environmental Assessment.

1.1.7 Chapter 5 focuses on two of the major enabling elements of transformational change: understanding and influencing behaviours and the role of Scotland's planning system in decarbonisation.

1.1.8 Chapter 6 provides detail of our new monitoring and evaluation framework. Based on a set of principles, and using a set of indicators, the framework will enable Ministers to monitor progress to ensure quality improvement in policy action. It will also enable the Scottish Parliament and stakeholders to scrutinise implementation.

1.1.9 Chapters 7 to 14 are sector specific: electricity, residential, transport, services, industry, waste, land use, and agriculture. Each of these sectors is set out in the same way. They contain information on: historical emissions; ambition and milestones for 2020, 2030 and 2050; policy outcomes, policies, policy development milestones and proposals; progress since the Second Report on Policies and Proposals; and wider impacts including co-benefits and possible adverse side effects.

1.1.10 Each sector chapter is organised according to specific policy outcomes. These statements of change are developed from the TIMES energy model employed to develop the Climate Change Plan and provide the foundations of a low carbon Scotland. The TIMES model analysis is powerful in helping to understand the possible pace of change of future technologies and fuel types, allowing sectors to provide a robust set of policy outcomes. These tangible, real life, descriptions of change provide a descriptive window into the future low carbon economy.

Text box 1-1: Definitions and explanations

Definitions and explanations

For the purpose of this draft Plan:

A **policy outcome** is a measure of change on the ground, resulting from a policy or combination of related policies. An example policy outcome from land use would be the commitment to support an increase in the annual rate of peatland restoration from 10,000 hectares to 20,000 hectares per year.

A **policy** is a committed course of action which has been wholly decided upon, and to which a policy outcome can be attributed to with a reasonable level of confidence. The land use policies of providing sufficient finance to fund at least 20,000 hectares of peatland restoration per year from 2018/19, and to provide training in peatland restoration, both contribute to the realisation of the policy outcome of 20,000 hectares of peatland restoration per annum.

A **policy development milestone** is a government action which is needed to progress or develop a final policy that will reduce emissions in a particular sector. For example, a commitment to consult on the introduction of emission reducing regulations would be considered a policy development milestone. It is not possible to confidently attribute any contribution to policy outcomes from a policy development milestone, although it is a committed course of action indicating a clear intention.

A **proposal** is a suggested course of action or exploratory action, the details of which might change as this course of action is explored further. It is not possible to confidently attribute the realisation of a policy outcome to a proposal until it is converted to a policy.

1.1.11 This draft Climate Change Plan was laid in the Scottish Parliament on 19 January 2017, and is subject to a 60-day period for Parliamentary consideration. Before finalising the Climate Change Plan, Ministers must have regard to any representations on the draft Plan, any resolution on the draft passed by the Scottish Parliament, and any report on the draft published by any Committees of the Parliament.

1.2 How we got here

1.2.1 The table below summarises the milestones from the Scottish Government's Climate Change Delivery Plan publication in June 2009, through to the publication of this draft Climate Change Plan.

Table 1: How we got here

Date	Milestone
June 2009	Scottish Government's Climate Change Delivery Plan published.
June 2009	Climate Change (Scotland) Act 2009 passed unanimously by the Scottish Parliament.
February 2010	Committee on Climate Change (CCC) advice to the Scottish Government on the 2020 interim target and annual emissions targets 2010-2022.
May 2010	The Climate Change (Limit on Carbon Units) (Scotland) Order 2010, setting carbon unit limits 2010-2012.
October 2010	The Climate Change Annual Targets (Scotland) Order 2010, setting annual emissions reduction targets 2010-2022.
November 2010	Scottish Government's draft First Report on Policies and Proposals (RPP1) laid in the Scottish Parliament, followed in March by publication of the final RPP1.
July 2011	CCC advice to Scottish Ministers on the second batch of annual targets 2023-2027 received.
August 2011	CCC advice to Scottish Ministers on setting carbon unit limits 2013-2017 received.
October 2011	Scottish Government's Climate Change Annual Targets (Scotland) Order 2011 setting the annual emissions targets 2023-2027.
December 2011	The Climate Change (Limit on Carbon Units) (Scotland) Order 2011, setting carbon unit limits 2013-2017.
January 2012	CCC's first annual progress report, Reducing emissions in Scotland, published.
October 2012	Scottish Government's First Annual Report, The Scottish Greenhouse Gas Emissions Annual Target 2010, published.
January 2013	Scottish Government's draft Second Report on Policies and Proposals (RPP2) laid in the Scottish Parliament, followed in June by publication of the final RPP2.
March 2016	CCC advice to Scottish Ministers on the third batch of annual targets 2028-2032 received.
July 2016	CCC updated advice to Scottish Ministers on the third batch of annual targets.
October 2016	The Climate Change (Annual Targets) (Scotland) Order 2016.
October 2016	The Climate Change (Limit on Use of Carbon Units) (Scotland) Order 2016.
January 2017	Draft Climate Change Plan – the draft Third Report on Policies and Proposals (RPP3) laid in the Scottish Parliament.

Text box 1-2: Committee on Climate Change Progress Report

Committee on Climate Change assessment of Scotland's progress

The Committee on Climate Change publishes an annual report on progress towards meeting Scottish climate change targets. The Committee published its fifth report in September 2016[1] and advised that Scotland is leading the UK in greenhouse gas emissions reductions, but more needs to be done to ensure future targets are met. Lord Deben, Chairman of the Committee on Climate Change said: "Scotland continues to lead the UK both in performance and ambition when it comes to tackling climate change. Emissions are reducing and the latest targets have been hit. Scotland has set out its intention to meet the challenges of climate change and its contribution to the ambition agreed at the Paris climate conference last December. New policies are now required for Scotland to continue its commendable path to decarbonising its economy."

The report highlights that emissions have fallen by an average of 3.3% per year since 2009, mostly due to progress in the power sector with reduced coal and expanded renewable generation. However, there has been little progress in reducing emissions from transport and agriculture and land use, and there is much further to go for renewable heat uptake. To meet high ambition and tighter targets beyond 2020 there is a need for stronger policies in the Climate Change Plan.

1.3 The Climate Change Plan and the Energy Strategy

1.3.1 The Scottish Government's draft Energy Strategy should be regarded as a free-standing companion document to this draft Plan. In developing the draft Energy Strategy, the Scottish Government has set out, for the first time, a full statement of its ambitious long-term vision of energy supply and use in Scotland, aligned with our greenhouse gas emissions reduction targets. The draft Energy Strategy is being published in January 2017 for public consultation.

1.3.2 The draft Energy Strategy explores the choices Scotland faces in relation to the future energy system, acknowledging that while the Climate Change Plan is required by law to present a clear route to meeting emissions reduction targets to 2032, we cannot predict with accuracy the exact future mix of energy in Scotland out to 2050.

1.3.3 The draft Energy Strategy, therefore, takes a more exploratory approach, particularly important for the medium to longer term – providing opportunities to demonstrate and consider alternative sources of low carbon energy supply that are not yet certain enough to include in the Plan. It commits to undertaking further work to establish where, with the right support and leadership from government, these emerging fuel sources and technologies can be credible alternatives in the future.

1.3.4 Some of these alternative energy sources may, for example, have the potential to reduce both the cost and the delivery barriers of policies or proposals in the current draft Plan, such as the replacement of natural gas by 100% pure hydrogen for space heating in some areas of the gas network.

1.3.5 The draft Energy Strategy consultation also provides an opportunity to seek views on the targets that will set the ambition of the Scottish Government and guide the transition towards the modern, integrated, clean energy system we wish to see in Scotland. A number of stakeholders have proposed a 50% 'all energy' renewables target for 2030. The draft Energy Strategy will make an appraisal of this target – meeting the pledge in the 2016 SNP Manifesto to give it careful consideration.

1 www.theccc.org.uk/publication/reducing-emissions-in-scotland-2016-progress-report/

2. Scotland – climate friendly, climate ready, climate just

2.1 Low carbon Scotland is a better Scotland

2.1.1 Since 2007, this Government's central purpose has been to create a more successful country, with opportunities for all of Scotland to flourish, through increasing sustainable economic growth. Scotland's Economic Strategy (2015) sets out an overarching framework for how we aim to achieve a more productive, cohesive and fairer Scotland. It forms the strategic plan for existing and all future Scottish Government policy. It prioritises boosting investment and innovation, supporting inclusive growth and maintaining our focus on increasing internationalisation. This ambition underpins our approach and commitments in the draft Climate Change Plan.

2.1.2 A low carbon Scotland will capitalise on both our natural resources and the talents and skills of our people. It will make better use of our precious natural resources and provide us with greater resilience to volatile international energy and commodity prices. It will stimulate innovation and enterprise in new technologies and industries that ensure Scotland is well placed in the global shift to a low carbon global economy. Simply put, a low carbon Scotland is a better Scotland. We regard it as an essential investment, for the benefit of future generations, in our economy as well as our environment.

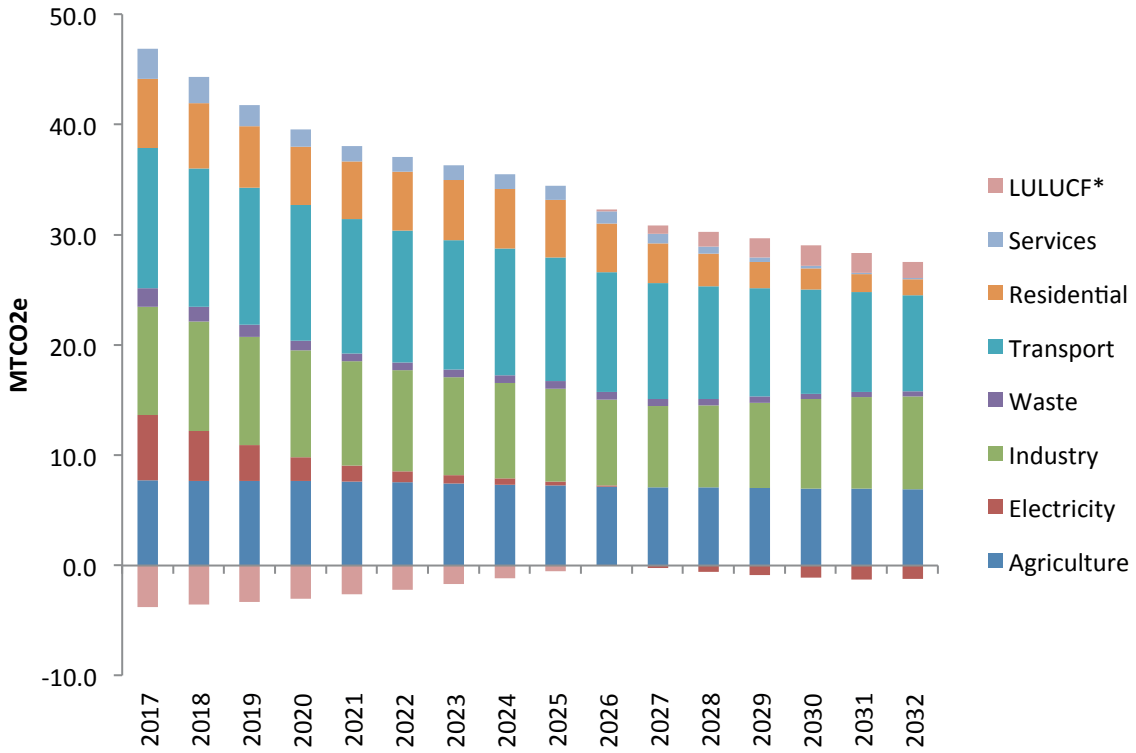
2.2 Our pathway to 2032

2.2.1 The section below summarises our decarbonisation pathway out to 2032 as suggested by TIMES, set out by sector. Details can be found in the sector chapters later in this document.

2.2.2 The analysis from the TIMES model is powerful in helping understand future technologies and fuel types, which allows future scenarios to be built up to inform climate change planning. In particular, the analysis from TIMES demonstrates the nature and scale of changes that need to happen on the ground – across our economy – in order to meet our emissions targets. This includes both the use of low carbon fuels and technologies as well as other emission reduction action, including land use and reducing demand from our energy system – for example through improving the fabric of our buildings.

2.2.3 On the ground changes are described as policy outcomes in this draft Plan. By providing a real-life set of changes that must happen, they are the bedrock of our approach, and all the policies and proposals outlined in this draft Plan (in the sector chapters) are intended to realise those policy outcomes.

Figure 1: Pathway to 2032



*Land Use, Land Use Change and Forestry (including Peatland)

2.2.4 By 2030 Scotland's **electricity system** will be wholly decarbonised and supply a growing share of Scotland's energy needs. Electricity will be increasingly important as a power source for heat and transport. As a result, the total volume of electricity supplied within Scotland will increase to 2032. System security will be ensured through diverse generation technologies, increased storage, smart grid technologies and improved interconnection. From the late 2020s, Carbon Capture and Storage (CCS), along with gas from plant material and biomass waste, has the potential to remove CO_2 from the atmosphere (i.e. negative emissions). CCS will be critical in heat, industry and power sectors.

2.2.5 In **services** (non-domestic buildings), we will need to achieve near zero carbon emissions by 2032. We will focus our efforts up to 2025 largely on energy efficiency improvements. After 2025 we will prioritise low carbon heat with virtually all natural gas boilers being replaced by low carbon heat technologies by 2032.

2.2.6 In the **residential** sector, the approach is similar to the services sector although the rate of emissions reduction is slower particularly until 2025 when the focus is on energy efficiency. By taking action across our services and residential sectors our building stock will be largely decarbonised by 2032.

2.2.7 We envisage significant decarbonisation of **transport** by 2032, with emissions reducing by 32% compared to 2014. Low emission cars and vans will be widespread and becoming the norm; low emission HGVs will be more common; a third of the ferries owned by the Scottish Government will be low carbon; aircraft fleets will be on the cusp of radical new designs; freight infrastructure will feature more efficient HGVs operating from out-of-town consolidation centres; and low emission vehicles will also play a role in energy storage within the wider energy system.

2.2.8 For the **industrial** sector, our plans are broadly consistent with existing EU and UK regulatory frameworks for industrial emissions with a fall of around 19% by 2032 through a combination of fuel diversification, cost saving energy efficiency and heat recovery, and participation in the EU Emissions Trading System (EU ETS). Technologies critical to further emissions reduction will be demonstrated at commercial scale by 2030. These measures will enhance industrial productivity, improve competitiveness and realise new manufacturing opportunities in the global market.

2.2.9 In the **waste** sector we should see emissions continuing to fall as we make progress towards our ambitious waste targets. By 2020, the landfilling of biodegradable municipal waste will be phased out, ahead of the statutory ban that applies from 2021. By 2030 we expect to be in tandem with the UN Sustainable Development Goals to reduce food waste by 50%. In the longer term, we aim to be delivering emissions reductions through a circular economy approach in our business and industry sectors by 2050.

2.2.10 On **agriculture** our ambition is for Scotland to be among the lowest carbon and most efficient food producers in the world. By 2020, we will work with farmers so that they know the pH of the soil on a third of their improved land to help increase the efficient use of nitrogen fertiliser. We will encourage farmers producing a substantial proportion of Scotland's agricultural output to complete a carbon audit, and by 2030 most farmers will know the nutrient value of their improved soil and will be implementing best practice in nutrient management and application.

2.2.11 In terms of the **Land Use, Land Use Change and Forestry** (LULUCF) sector the draft Plan sets out the Scottish Government's ambitions specifically on forestry and peatland. For **peatland**, by 2020, 50,000 hectares of degraded peatland will have been restored, from a 1990 baseline, and by 2030 we will have increased this to 250,000 hectares – an improvement of valuable soils in around 20% of Scotland's landmass. By 2050, Scotland's expanded peatlands will be thriving habitats, sustaining a diverse ecosystem and sequestering more carbon than ever before.

2.2.12 By 2032, Scotland's **woodland** cover will increase from around 18% to 21% of the Scottish land area. To achieve this we will increase our planting rates over time up to 15,000 hectares per year in 2024/25. We will also promote greater use of Scottish timber in UK construction to around 3 million cubic metres by 2031/32 from 2.2 million cubic metres today. By 2050, Scotland's woodlands will be delivering a greater level of ecosystem services, such as natural flood management and biodiversity enhancement.

Table 2-1: Pathway to 2032 (envelopes in $MtCO_2e$)

	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Agriculture	7.8	7.7	7.7	7.7	7.6	7.5	7.4	7.3	7.2	7.2	7.1	7.1	7.0	7.0	7.0	6.9
Electricity	5.9	4.5	3.2	2.2	1.4	1.0	0.7	0.6	0.4	0.1	-0.2	-0.5	-0.9	-1.1	-1.3	-1.2
Industry	9.8	9.9	9.8	9.7	9.5	9.2	8.9	8.7	8.5	7.8	7.3	7.5	7.7	8.1	8.3	8.4
Waste	1.7	1.4	1.1	0.9	0.7	0.7	0.7	0.7	0.7	0.7	0.6	0.6	0.5	0.5	0.5	0.5
Transport	12.7	12.6	12.5	12.3	12.2	12.0	11.8	11.5	11.2	10.9	10.5	10.2	9.8	9.4	9.1	8.7
Residential	6.3	5.9	5.6	5.3	5.3	5.3	5.4	5.4	5.2	4.4	3.6	3.0	2.4	1.9	1.6	1.5
Services	2.7	2.4	1.9	1.6	1.4	1.3	1.3	1.4	1.3	1.1	0.9	0.6	0.4	0.3	0.1	0.1
LULUCF*	-3.8	-3.5	-3.3	-3.0	-2.6	-2.2	-1.7	-1.1	-0.5	0.1	0.8	1.3	1.7	1.9	1.8	1.5

*Land Use, Land Use Change and Forestry (including Peatland)

2.3 Scotland's climate is changing

2.3.1 This draft Climate Change Plan refers only to emissions reduction. It is not a plan for adapting to a changing climate. However, it is important to understand that climate change is already affecting Scotland. In Scotland the average temperature in the 2000s was 0.90°C warmer than the 1961-1990 average and warmer than any other decade since records began in 1910[2], and annual rainfall has increased by around 11% over the past century[3]. As demonstrated during winter 2015-2016, extreme weather and flooding are immediate and major climate risks; in the longer term, sea level rise is also likely to be an important risk for Scotland.

2.3.2 An independent assessment[4] in 2016 by the Adaptation Sub-Committee of the UK Committee on Climate Change of Scotland's Adaptation Programme[5] (SCCAP) highlighted that Scotland's unique geography creates both resilience and vulnerabilities to the impacts of extreme weather and climate change. Scotland's iconic industries, including forestry, fisheries and whisky, rely on climate-sensitive natural resources. Changes in weather patterns and sea level rise will test our transport, communication, fuel, and energy networks and challenge the delivery of health and social care services.

2.3.3 Supported by the Scottish Government funded Adaptation Scotland programme, climate change adaptation is already well integrated within many key policy areas in Scotland. Recent developments which are strengthening our adaptation response include: the establishment of Scotland's National Centre for Resilience[6], new Flood Risk Management Plans[7], mapping of flood disadvantage[8], new public body reporting duties which include adaptation[9], new indicators developed by ClimateXChange to show how well Scotland is performing across sectors[10], and important locally-based initiatives such as Edinburgh Adapts, Climate Ready Clyde and Aberdeen Adapts.

2.3.4 We will continue to strengthen our adaptation to climate change in the years and decades ahead and the Scottish Government and Adaptation Scotland will work with stakeholders across sectors on the priorities for the next update of the adaptation programme. In doing so, Scotland will also retain a strong focus on climate justice recognising that climate change impacts tend to impact most severely on poorer people and vulnerable communities.

2.3.5 Adapting to the impacts of climate change is a global challenge faced by all countries. The Paris Agreement on climate change links mitigation and adaptation and sets a global goal of reducing vulnerability to climate change. All countries must plan for and take action on adaptation. We will continue to share learning with our counterparts internationally at events such as the third European Climate Change Adaptation Conference to be held in Glasgow in June 2017.

2 http://www.gov.scot/Topics/Statistics/Browse/Environment/TrendTemperature

3 http://www.environment.scotland.gov.uk/climate_trends_handbook/Chapter02/2_01.html

4 https://www.theccc.org.uk/publication/scottish-climate-change-adaptation-programme-an-independent-assessment-for-the-scottish-parliament/

5 http://www.gov.scot/Publications/2014/05/4669

6 http://www.readyscotland.org/ready-government/ncr/

7 http://www.gov.scot/Topics/Environment/Water/Flooding/whatsnew

8 http://www.gov.scot/Publications/2015/12/9621

9 http://www.keepscotlandbeautiful.org/sustainability-climate-change/sustainable-scotland-network/climate-change-reporting/

10 http://www.climatexchange.org.uk/adapting-to-climate-change/indicators-and-trends/

2.4 Scotland – our role as a global citizen

The Paris Agreement

2.4.1 The historic Paris Agreement[11] is the first truly global plan to tackle the urgent threat of climate change. Binding in international law, the treaty has been signed by almost 200 countries – including USA, China, EU and UK – and came into force four years early: on 4 November 2016. The agreed international aim is to limit global temperature rise to well below 2°C and pursue efforts to limit it to 1.5°C, with rapid reductions in emissions to net zero in the second half of this century.

2.4.2 The Paris Agreement followed calls from the G7 leaders of industrialised countries for urgent and concrete action, deep cuts in greenhouse gas emissions, and a decarbonisation of the global economy this century, as well as strong calls for action from world faith leaders. Current pledges by countries under the Paris Agreement might be enough to limit global temperature rise to around 3°C (although a wide range of outcomes is possible) so more will need to be done.

2.4.3 Other countries must now step up to match Scotland's ambition and actions – we cut our adjusted emissions[12] by 45.8% between 1990 and 2014 exceeding our 2020 target of a 42% cut six years early, and we did so while growing our economy. We were second only to Sweden among Western European countries in cutting emissions over this period, with only a very narrow gap now between Scotland's per capita emissions and the EU generally.

2.4.4 The EU, which currently pledges at least 40% emissions cuts by 2030, has committed to play a full part in the mechanisms under the Paris Agreement designed to raise global ambition over time: the Intergovernmental Panel on Climate Change (IPCC) review in 2018 of the 1.5°C goal; the facilitative dialogue in 2018; mid-century low emissions strategies due by 2020; first global stocktake in 2023; and five-yearly updates to pledges.

Climate justice

2.4.5 Scotland champions climate justice and we hope the Paris Agreement will drive global action to avoid the worst impacts of climate change falling on the poorest and most vulnerable people across the world. £6 million from Scotland's innovative Climate Justice Fund has already supported 11 projects in some of Africa's most vulnerable communities. The First Minister has pledged a further £12 million over five years to support developing countries with an initial £2 million announced for clean water for vulnerable communities in Malawi and £1 million to help developing countries engage with the Paris Agreement.

11 http://unfccc.int/paris_agreement/items/9485.php

12 Adjusted emissions account for Scotland's participation in EU-wide emissions trading. All sectoral charts in this Plan relate to unadjusted emissions, which amounted to 46.7 $MtCO_2e$ in 2014.

Text box 2-1: the Climate Change Bill

The forthcoming Climate Change Bill

The Scottish Government has committed to playing its part in delivering the Paris Agreement and will be outlining proposals for a new Climate Change Bill later this year.

As stated above, Scotland exceeded the level of the interim 2020 target under the 2009 Act, of a 42% emissions reduction, six years early. The Bill will set a new and more testing 2020 target. It will also increase transparency in how we assess progress to targets, by measuring this on the basis of actual Scottish emissions. Our approach to new emissions reductions targets is based on the best available evidence and we have written to the Climate Change Committee seeking advice on the form, mechanisms and levels of emissions reduction targets in the Bill. The Committee published its public call for evidence in December 2016 and this will close on 1 February 2017. This draft Climate Change Plan sets out proposals and policies to meet existing targets out to 2032 and is a requirement under the 2009 Act.

Brexit

2.4.6 Energy and climate policy has domestic, regional and global implications and connections. The EU's legislative reach, market influence and climate diplomacy are extensive. The EU has led international efforts to secure a global, legally-binding agreement to address climate change, and was instrumental in two decades' worth of complex negotiations with other major economies such as the US, China and India, to deliver the landmark Paris Agreement in 2015. Through the UK's membership, Scotland has benefited from being a direct part of the EU's considerable diplomatic clout in the climate negotiations, projecting our domestic climate leadership internationally, through collective effort with our EU partners.

2.4.7 The Scottish Government has been clear that the referendum result on EU membership does not affect our desire or ability to maintain, enhance and protect our environment. The body of EU legislation that impacts on climate, environmental and energy related issues is complex and wide ranging. The forthcoming negotiations to determine the UK and Scotland's future relationship with Europe will therefore need to consider this important area of policy in detail with a view to safeguarding Scotland's key interests and maintaining our place as a progressive leader on climate action.

2.4.8 In December 2016 the Scottish Government published Scotland's Place in Europe[13], a set of proposals designed to mitigate the risks for Scotland of being taken out of the EU. We believe it is in the interests of both Scotland and the UK that the UK as a whole should remain within the European Single Market, through membership of the European Economic Area and active cooperation in other areas. However, if the UK Government opts to leave against the advice of Scottish Ministers and the clearly expressed wishes of 62% of Scotland's voters in the June 2016 referendum, then the proposals set out a differentiated approach which would allow Scotland to retain single market membership as part of the UK, even if the remainder of the UK is taken out of the single market.

13 http://www.gov.scot/Publications/2016/12/9234

3. A collaborative approach

3.1 Cross-government approach

3.1.1 Passed unanimously by the Scottish Parliament in 2009, Scotland's climate change legislation anticipated that reducing greenhouse gas emissions would be required across all major sectors of the economy and society. Specifically, it requires us to set out policies and proposals for energy efficiency, energy generation, land use and transport. We have interpreted this in a holistic way – and this draft Climate Change Plan provides details for reductions in electricity generation, residential, transport, services, industry, waste, land use, agriculture.

3.1.2 In recognition of this cross-government responsibility, the Cabinet Sub-Committee on Climate Change, chaired by the Cabinet Secretary for the Environment, Climate Change and Land Reform, has overseen the development and production of this draft Plan. Scottish Ministers have worked collaboratively to develop policies and proposals for emissions reductions across sectors in ways that maximise opportunities and minimise costs.

3.1.3 However, the Scottish Government cannot, and should not, attempt to meet the ambitious emissions reductions targets on its own. Local government, other public bodies, the private sector, the third sector, and communities and households all have important roles to play. Throughout this draft Plan there are examples of how and where other actors are, or will be, taking action to reduce greenhouse gas emissions and reaping the wide range of other social and economic benefits that such actions bring.

The role of local government

3.1.4 Scottish local government is fully committed to combatting climate change. In 2007, Scottish local authorities demonstrated clear leadership by voluntarily creating and signing the Scottish Climate Change Declaration. This document set out local authorities' intent to work across all areas in order to drive the behaviour and technological changes necessary to reduce carbon emission levels to those required to meet national targets. Since then, emissions directly attributable to council actions and estates have fallen substantially, demonstrating both the commitment of Scottish local authorities and the power of public statements of intent.

3.1.5 As major players under the Climate Change (Scotland) 2009 Act, local authorities also play a critical role in the delivery of the Public Bodies Climate Change Duties. However, it is not only with regards to directly attributable emissions that councils have played their part. The work of local authorities affects all sectors of Scottish society, and influences individuals and communities across the country.

3.1.6 Over the course of this Plan and beyond, the Scottish Government will continue to work with local government to empower councils to meet local challenges so that they can continue to make a valued contribution to Scottish targets, policies and proposals.

Text box 3-1: Mandatory reporting

The wider public sector – mandatory reporting

The Climate Change (Scotland) Act 2009 places duties on public bodies relating to climate change. Further to the Act, in 2015 the Scottish Government introduced an Order[14] requiring all 150 Public Bodies who appear on the Major[15] Player list to report annually to Scottish Ministers on their compliance with the climate change duties. The first mandatory reports were submitted on 30 November 2016. Annual reporting supports compliance with the public bodies duties and consolidates climate change information from the public sector.

This Public Bodies Climate Change Duties Reporting mechanism provides a solid basis for tracking public sector action on climate change and driving continuous improvement. The reporting platform introduces standard methodology to improve data consistency. Reports and analysis are publicly available, increasing accountability and transparency, and making it easier for the public and other parties to understand an organisation's climate performance. This in turn is helping improve leadership and engagement, while raising awareness of the impact of climate change with senior management, ensuring climate change objectives are integrated in corporate business plans and action embedded across all departments.

The reporting framework also assists better decision making and strategic planning and helps identify opportunities for financial efficiencies and cost savings. We will establish a baseline from the 2016 reporting data to identify future trends in performance.

The Scottish Government funds the Sustainable Scotland Network (SSN) to provide operational support for this reporting process. SSN acts as a single point of contact for all public bodies on reporting, providing training and support to bodies completing their reports, coordinating returns and analysing the data. Scottish Government also works with public sector leadership networks, including the Scottish Leaders Forum, Chief Executives' Forum and the Scottish Government Delivery Bodies Group, to promote action on climate change.

3.2 Community action – the Climate Challenge Fund

3.2.1 The Climate Challenge Fund, fully funded by the Scottish Government, supports communities across Scotland to run locally-led projects that reduce local carbon emissions, improve their local communities and help adapt to the impacts of a changing climate. Since its launch in 2008, the Scottish Government has awarded £75.7 million to 588 communities.

3.2.2 The Climate Challenge Fund focuses on supporting projects which deliver the greatest reduction in carbon emissions and support Scotland's most deprived communities. Continued Scottish Government investment in the Fund helps ensure that communities are empowered, well-equipped and supported to deliver solutions to local issues on their own terms.

14 http://www.legislation.gov.uk/ssi/2015/347/contents/made

15 http://www.keepscotlandbeautiful.org/media/1556802/major-players-290816.pdf

Table 3-1: Climate Challenge Fund

Climate Challenge Fund project types	Organisations
The Fund supports a range of activity and has helped communities to reduce, reuse and recycle their waste, increase the energy efficiency of homes and community buildings, encourage active travel and the use of low carbon transport, and produce local food.	The Fund supports a wide range of community-led action by, for example, arts groups, sports clubs, community councils, faith groups, student unions, residents associations, local charities, food groups, community-led housing associations and development trusts.

3.2.3 Although the Climate Challenge Fund's core aims are climate change related, as with so many other climate change policies, the positive benefits have been found to be wide reaching. These include social and health benefits, the creation of employment and training opportunities, and financial savings for individuals and reductions on fuel poverty through home energy efficiency measures.

3.3 The role of the private sector

3.3.1 Sustainable and inclusive business growth is the core of Scotland's Economic Strategy. Successful implementation of this draft Plan depends crucially on promoting and empowering changes over time in every home and business across Scotland. Building on the work of the 2020 Climate Group, and the many individual businesses that have been developing low carbon products and services, we will widen our work with business organisations and companies to develop a shared understanding of how best to reduce carbon emissions in line with this Plan and continue to boost productivity and economic success.

3.3.2 We have already started to talk to business and sectoral organisations, and we will listen to individual businesses around Scotland. This will facilitate their own strategic thinking and inform our decisions on business support, now and in the longer term. And it will ensure that the business voice shapes the implementation of the final Plan. The challenges are clear – as are the opportunities to innovate and to enhance competitiveness by being at the forefront of agreed international steps to deliver a low carbon global economy.

3.4 The role of the third sector

3.4.1 The third sector has a central role to play in securing the implementation of the draft Climate Change Plan. Third sector organisations can weave environmental issues into their overall purpose, promoting action in response to climate change to a wide audience. Examples of this activity include Eco-Congregation Scotland, who offer a programme to enthuse and equip churches to address climate change through their estates and congregations, and Development Trusts Association Scotland, whose 2016 conference focused on climate change, localism and social justice. Implementation of the Plan will be strengthened by working with the community sector across Scotland engaging on the Plan and its delivery.

3.4.2 Non-government organisations are also very important in reflecting public support and highlighting best practice. Coalitions such as Stop Climate Chaos Scotland (SCCS) engage with tens of thousands of people from across Scotland on climate change and play an important role in policy development, scrutiny and the promotion of Scotland's climate change story to international audiences.

4. Statutory duties and methodologies

4.1 Setting the targets

4.1.1 The Climate Change (Scotland) Act 2009[16] ('the Act') sets targets to reduce Scotland's emissions of the basket of six Kyoto Protocol greenhouse gases[17] by at least 42% by 2020 and 80% by 2050, compared to the 1990/1995 baseline. The Act also requires that the Scottish Ministers set, by Order, annual emissions reduction targets for each year in the period 2010-2050, consistent with achieving the long-term targets. These annual targets are set in batches at least 12 years in advance.

4.1.2 Before setting a batch of annual targets, Scottish Ministers must request advice from the Committee on Climate Change (CCC). The CCC is an independent expert body established by the UK Climate Change Act 2008 to provide climate change advice to the UK Government and devolved administrations.

4.1.3 Following advice from the CCC in March 2016[18] and then again in July 2016[19], the Scottish Parliament passed legislation setting the third batch of annual targets in October 2016, for the years 2028 to 2032[20]. The targets set an emission reduction pathway to 2032 and in doing so establish a 2032 target that represents a 66% reduction below 1990 levels.

16 http://www.legislation.gov.uk/asp/2009/12/contents

17 The basket of Kyoto Protocol greenhouse gases comprises carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O), for which the baseline is 1990; and hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6), for which the baseline is 1995.

18 http://www.gov.scot/Topics/Environment/climatechange/scottish-emissions-targets-2028-2032

19 http://www.gov.scot/Topics/Environment/climatechange/legislation/CCC-updated-advice

20 http://www.legislation.gov.uk/ssi/2016/328/contents/made

Table 4-1: Annual targets 2017-2032[21]

	Annual target (tCO_2e)	% reduction year-on-year	% reduction from baseline*
2010	53,652,000		-31%
2011	53,404,000	-0.46%	-31%
2012	53,226,000	-0.33%	-31%
2013**	47,976,000	-9.86%	-38%
2014	46,958,000	-2.12%	-39%
2015	45,928,000	-2.19%	-41%
2016	44,933,000	-2.17%	-42%
2017	43,946,000	-2.20%	-43%
2018	42,966,000	-2.23%	-44%
2019	41,976,000	-2.30%	-46%
2020	40,717,000	-3.00%	-47%
2021	39,495,000	-3.00%	-49%
2022	38,310,000	-3.00%	-50%
2023	37,161,000	-3.00%	-52%
2024	35,787,000	-3.70%	-54%
2025	34,117,000	-4.70%	-56%
2026	32,446,000	-4.90%	-58%
2027	30,777,000	-5.10%	-60%
2028	29,854,000	-3.00%	-61%
2029	28,958,000	-3.00%	-63%
2030	28,089,000	-3.00%	-64%
2031	27,247,000	-3.00%	-65%
2032	26,429,000	-3.00%	-66%

* The percentage reductions against baseline levels are rounded to the nearest percentage point and shown on the basis of the most recent (2014) Scottish greenhouse gas inventory. Revisions to the inventory (which have occurred every year for which Official Statistics are available) have the effect of changing the percentage reduction from baseline figures, as the annual targets remain fixed but the baseline level of emissions is revised.

** The large drop in 2013 reflects Phase III of the EU ETS coming into effect.

4.1.4 The Act requires that, as soon as reasonably practicable after setting a batch of annual targets, Ministers publish a report setting out policies and proposals for meeting those targets. This draft Climate Change Plan is the third report on policies and proposals and lays out how Scotland can deliver annual targets for reductions in emissions from 2017-2032.

21 In order to meet these annual targets, targets in TIMES had additional effort built-in per annum to account for excess emissions of over 3Mt to be met out to 2032.

Compensating for excess emissions

4.1.5 Based on the 2014 emission statistics[22], there is a cumulative emissions excess of 3.319 megatonnes of carbon dioxide equivalent ($MtCO_2e$) across the annual targets for 2010-2014. In accordance with Section 36 of the Act, this draft Climate Change Plan includes proposals and policies to compensate, in future years, for these excess emissions. The TIMES model pathway includes an additional 3.319 $MtCO_2e$ of abatement, over and above what is required to meet the statutory annual targets out to 2032.

4.2 Accounting for emissions

4.2.1 All the emissions reduction targets set out in the Act are based on the Net Scottish Emissions Account (NSEA). The NSEA is defined in the Act as the amount of net Scottish emissions of greenhouse gases, reduced or increased by the amount of carbon units credited to or debited from it. The policies and proposals laid out in this draft Climate Change Plan are designed to reduce the level of the NSEA.

4.2.2 Net Scottish emissions cover all emissions from sources within Scotland plus domestic and international aviation and shipping, reduced by any greenhouse gases removed from the atmosphere by Scottish sinks, such as woodland.

4.2.3 Carbon units can be credited to or debited from the NSEA through the operation of the EU Emissions Trading System (EU ETS), or credited to it by the purchase of international carbon units by Scottish Ministers.

How we account for the traded sector (the EU ETS)

4.2.4 The EU ETS is a 'cap and trade' system, aimed at mitigating climate change by limiting greenhouse gas emissions from industry sectors and aviation. Participants include more than 11,000 heavy energy-using installations in power generation, the manufacturing industry and airlines across 31 countries in the European Economic Area (EEA)[23]. Participating organisations trade emissions allowances within a decreasing overall cap. This provides an incentive for participants to find the most cost-effective way to reduce emissions. By 2020, the volume of emissions permitted within the system at EU level, will be 21% lower than in 2005.

4.2.5 For accounting purposes under the Act, emissions are split into 'traded sector' emissions covered by the EU ETS and 'non-traded sector' emissions that do not fall under the EU ETS. The approach to accounting for traded sector emissions is defined under the Act's Carbon Accounting Regulations[24], and explained in the Scottish Greenhouse Gas Emissions 2014 publication[25].

Future emissions reduction in the traded sector

4.2.6 The EU ETS continues to be the primary driver of emissions reductions in the traded sector in Scotland. We rely on it to drive emissions reduction from around 95 installations in Scotland (accounting for around 40% of our territorial emissions), by promoting decarbonisation in the power sector, creating price signals for long-term investment, ensuring a level playing field for industry through access to an EU-wide carbon market, and it providing protection for industry against competitors outside the EU who don't bear carbon costs (carbon leakage) through free allocation.

22 http://www.gov.scot/Publications/2016/06/2307

23 http://www.gov.scot/Publications/2016/06/2307/329344

24 http://www.legislation.gov.uk/ssi/2016/46/contents/made

25 http://www.gov.scot/Publications/2016/06/2307/329344

4.2.7 Negotiations on reforms for Phase IV (2021-2032) are currently underway, with the overarching principle of delivering a 43% reduction on 2005 EU emission levels by 2030.

Text box 4-1: How TIMES deals with the EU ETS

How TIMES deals with the EU ETS

In the years to 2020 an ETS cap is imposed on the traded sector in Scotland that has been calculated using the same methodology that is employed in the Scottish Government's Greenhouse Gas Statistics. Our whole systems energy model TIMES searches for the least cost way in which this cap can be met by the sector. In the years after 2020 our modelling includes actual emissions from the traded sector as Scotland's notional share of the EU ETS phase IV cap is yet to be determined. The EU ETS is, however, expected to continue to contribute to Scotland's emission reductions post-2020. This approach is consistent with that taken in RPP2.[26]

The domestic effort target

4.2.8 The Act places a duty on Scottish Ministers to ensure that reductions in net Scottish emissions of greenhouse gases account for at least 80% of the reduction in the NSEA in any target year. Carbon units surrendered by participants in the EU ETS are counted as part of domestic effort for the purpose of this target, in line with international practice.

4.2.9 The Climate Change (Limit on Use of Carbon Units) (Scotland) Order 2016[27] means that international carbon units purchased by Scottish Ministers cannot be used to help meet targets over the period 2018-2022. In line with previous commitments, we also have no proposals or policies to purchase such carbon units across the remainder of the period of this draft Climate Change Plan, although this does remain an option for consideration. Our focus is on measures that seek to reduce our emissions at source and for the long term. We intend, therefore, that the policies and proposals will be consistent with meeting the domestic effort target in each target year.

Revisions to the baseline

4.2.10 The Scottish Greenhouse Gas Inventory provides the source of data from which the Official Statistics on Scottish emissions are compiled. The inventory is the key tool for understanding the origin and magnitudes of emissions. The inventory is compiled in line with international guidance on national inventory reporting from the Intergovernmental Panel on Climate Change (IPCC).

4.2.11 The Inventory is updated every year to reflect technical improvements in the underpinning science, data and modelling. These updates result in successive revisions to the entire time-series of Scottish emissions for all years back to 1990 and the baseline period.

4.2.12 At the time the Act was passed, the most up-to-date inventory covered the years from 1990-2008. This is the inventory upon which the long-term targets in the Act and the first two batches of fixed annual targets covering 2010-2027 were set. Subsequent revisions to this inventory, resulting from improved science and international reporting requirements, have shown that Scotland has historically been emitting greater amounts of greenhouse gas than was understood to be the case at the time. These revisions have had a substantial effect on the level of emissions reduction required to meet the fixed annual targets.

26 The impact of the UK's exit from the European Union on the role of emissions trading is not factored into the draft Plan, since the UK Government has not yet commenced negotiations with the EU, and has not yet taken a position on the UK's future relationship with the EU Emissions Trading System. The EU ETS remains a fundamental part of UK and Scottish climate change legislation. Powers exist under the Climate Change Act 2008, to create emissions trading schemes in the UK.

27 http://www.legislation.gov.uk/ssi/2016/330/contents/made

Consumption emissions

4.2.13 Consumption-based emissions are all emissions attributable to the goods and services we consume in Scotland (as opposed to the domestic emissions on which our targets are based). The Act requires that Scottish Ministers report, in so far as is reasonably practicable, the emissions of greenhouse gases (whether in Scotland or elsewhere) which are produced by, or otherwise associated with, the consumption of goods and services in Scotland. These reports on consumption emissions must be laid before the Scottish Parliament in respect of each year in the period 2010-2050, and can be accessed on the Scottish Government's website[28].

4.3 The TIMES model

4.3.1 TIMES is a Whole System Energy Model (WSEM). These models aim to capture the main characteristics of an energy system and are particularly useful for understanding the strategic choices that are required to decarbonise an economy. The Scottish TIMES model is a high-level strategic model, covering the entire Scottish energy system and containing many thousands of variables covering existing and future technologies and processes.

4.3.2 The model combines two different, and complementary, approaches to modelling energy: a technical engineering approach and an economic approach. The model uses this information to identify the effectiveness of carbon reduction measures in order to provide a consistent comparison of the costs of action across all sectors. The aim of the model is to capture the main characteristics which affect the deployment of technologies, their costs and associated greenhouse gas emissions for Scotland as a whole given a range of policy and other constraints. This allows consideration of the strategic choices which Scotland faces as it seeks to decarbonise its energy system.

How TIMES has been used

4.3.3 The development of the draft Climate Change Plan draws significantly on the Scottish TIMES model. By constraining TIMES with the annual emissions reductions targets, the model helps us understand least-cost ways of achieving emission reductions by assessing how effort is best shared across the economy, taking account of both individual sectors and how those sectors interact. This approach allows us to develop an optimal pathway for meeting Scotland's statutory climate change targets. The pathway contains a carbon envelope, or budget, for each sector along with suggested policy outcomes needed to live within the carbon envelope. Examples of policy outcomes include the introduction of new energy technologies or the penetration of electric vehicles. Policies and proposals are then developed to realise the outcomes.

4.3.4 Because the model interacts with non-energy sectors such as land use and waste, TIMES is able to provide a system-wide view of how we can most effectively deliver our targets.

A new approach from previous reports on policies and proposals

4.3.5 Previous reports on proposals and policies (RPP1 and RPP2) were produced using a bottom-up approach that identified abatement for individual policies and proposals from sector specific emissions projections. We have taken a different approach from this by using TIMES.

4.3.6 The consequence of employing TIMES is that it does not present annual emissions abatement for individual policies and proposals as was the case in the two previous reports on proposals and policies. In order to calculate emissions abatement, we would have to deduct emissions from a projected business as usual path. TIMES does not work on the basis of sector projected business as usual paths, so there is no counterfactual from which to describe abatement.

28 http://www.gov.scot/Topics/Statistics/Browse/Environment/Publications/carbonfootprint9812

4.3.7 In addition to the absence of sector business as usual projections, attributing abatement to any one sector is problematic when considering the whole energy system. For instance, does a reduction in electricity demand in one sector equate to abatement for that sector or for the electricity generation sector? Similarly does an increase in electric vehicles result in emissions abatement from transport, an increase in demand from the generation sector or a reduction in emissions from refineries? TIMES addresses this challenge by taking a system-wide view.

4.3.8 In accordance with the Act, this draft Plan presents the proposals and policies for meeting the annual targets. However, for the reasons described above, the link between policy action and meeting the annual targets is different to that of the previous RPPs. In the absence of abatement numbers, the verification of the projected emissions consequences of a particular policy or proposal will be provided by the results of the monitoring framework and the greenhouse gas inventory. The monitoring framework will thus describe if the policy outcome has occurred (from the policy package) as projected and the inventory has to show if overall emissions have reduced for the relevant sector as anticipated. This approach is stronger, and more transparent, than the previous one:

- The system-wide approach allows a whole system perspective on cost enabling us to identify the least cost emissions pathway for the Scottish economy.
- The system-wide approach of apportioning emissions envelopes, or budgets, to each sector avoids the additional uncertainty inherent in projecting future sectoral greenhouse gas emissions.
- When combined with sector evidence and models, the approach provides a clear picture of the policy outcomes that need to be delivered across sectors over the 15-year period, in order to meet the statutory targets.
- Specifying the policy outcomes that need to be delivered supports the design, costing and delivery of polices.
- Providing a concrete set of policy outcomes (such as penetration rates of low emissions vehicles or carbon intensity of energy generated at fixed time points) provides a direct link to Scottish Government action. This means it will be possible to take informed and timely corrective action to ensure the Climate Change Plan stays on track following publication.
- The presentation of measurable policy outcomes improves transparency and accountability as well as enabling the public to have a better understanding of what we will achieve 'on the ground'.

4.4 Our approach to addressing costs, benefits and wider impacts

4.4.1 This draft Climate Change Plan presents policies and proposals to meet Scotland's annual targets out to 2032. Based on the most recent Scottish greenhouse gas inventory (2014), these annual targets represent an emissions reduction of 66% compared to baseline levels by 2032. This level of transformational change presents Scotland with significant challenges and opportunities, and we have explored these through the development of the draft Plan.

Global economic impacts of a changing climate

4.4.2 The Intergovernmental Panel on Climate Change's (IPCC) Fifth Assessment Report[29] makes clear that 'business as usual' is not an option: either significant action is taken on a global scale to limit climate change, or economic activity will have to adjust to the costs imposed by a changing climate.

29 http://unfccc.int/science/workstreams/cooperation_with_the_ipcc/items/8732.php

4.4.3 Such costs could be significant. The Stern Review on the economics of climate change[30] estimated that, if policies are not put in place to reduce emissions, the impacts would be equivalent to losing 'at least 5% of global GDP, now and forever'. This rises to as much as 20% when wider impacts, such as flooding or impacts on wellbeing, are included. On the other hand, the Review found that strong and early action to tackle climate change would outweigh the costs, pricing the cost of mitigation in the range of -1% to 3.5% of global GDP by 2050.

Wider impacts in Scotland

4.4.4 There is increasing recognition and acceptance that policies designed to reduce greenhouse gas emissions not only mitigate the risks of climate change but also impact on other societal objectives such as improved air quality and health outcomes. Developing a more detailed understanding of such potential wider impacts has been an important part of the development of this draft Plan.

4.4.5 The Scottish Government commissioned three evidence reviews of the potential wider impacts of climate change mitigation options, focusing on: agriculture, forestry, waste and related land use; the built environment; and transport. The reviews highlighted the potential for positive social, economic and environmental impacts to result from the draft Plan. A summary of the findings from the reviews is provided in Annex E, and the full documents are published alongside this draft Plan.

4.4.6 We have used these evidence reviews to assess the potential wider impacts of policies within this draft Plan. These assessments inform the development and implementation of policies in order to maximise potential positive impacts and mitigate any potential negative impacts. For example, in the residential sector, there is evidence that improving the energy efficiency of people's homes can improve their health, both physical and mental, particularly among households affected by fuel poverty. As such, Scottish Government energy efficiency grants will continue to target low-income and fuel-poor households, whose occupants have the greatest potential to benefit. In the transport sector there is evidence that increasing the uptake of electric vehicles will improve air quality in towns and cities, resulting in reduced levels of illness caused by pollution.

4.4.7 As proposals within the final Climate Change Plan are developed into policies, they will be informed by assessment of their wider impacts.

Scotland's economy

4.4.8 Meeting our climate change targets will change the Scottish economy by moving the economy's competitive advantage to low carbon sectors. It is essential that this transition be managed to minimise any adverse impacts and maximise the benefits of decarbonisation.

4.4.9 Our Review of Enterprise and Skills recognises we need to do things differently and take a simpler, more flexible and cost-effective approach if we are to reach our goals for productivity and inclusive growth,

4.4.10 We are already seeing the benefits of Scotland's ongoing transition, with around 43,500 people directly or indirectly employed in the low carbon and renewable energy economy in Scotland. In sectors such as low carbon heating the combination of ambitious targets and high consumption in Scotland, coupled with the supportive policy environment, has allowed Scottish-based companies to compete globally. Such opportunities are likely to increase in future years, with low carbon innovation benefiting sectors across the economy, and resulting in the development of key expertise in Scotland, which could potentially be exported to the rest of the word.

30 http://webarchive.nationalarchives.gov.uk/20080910140413/http://www.hm-treasury.gov.uk/independent_reviews/stern_review_economics_climate_change/sternreview_index.cfm

4.4.11 Driven by the same ambition, the publication of this draft Plan and the draft Energy Strategy reinforce our position in the vanguard of international momentum towards a low carbon future.

4.4.12 They will shape action to deliver:

- a modern, integrated, clean energy system, delivering reliable energy supplies at an affordable price, in a market that treats all consumers fairly; and
- a strong, low carbon economy – sharing the benefits across our communities, reducing social inequalities and creating a vibrant climate for innovation, investment and high value jobs.

4.4.13 The approach set out in these documents contains transformational outcomes in transport, heat, electricity generation, and energy efficiency along with increased natural carbon sinks and more efficient agricultural practices.

4.4.14 As described in section 2.2 on the pathway, in the 2030s we expect to see dramatic reductions in emissions from all buildings through energy efficiency measures, the decarbonisation of heat and technology and business process innovations that we can shape together. In electricity we expect to have almost decarbonised by 2025 through the use of renewables and other low carbon technologies. And for the industrial sector, our plans are broadly consistent with existing regulatory frameworks for industrial emissions with reductions delivered through a combination of fuel diversification, cost saving energy efficiency and heat recovery.

4.4.15 Taking this action now will position our economy at the forefront of the low carbon future that the world economy needs to move towards, and the solutions our businesses develop to address these challenges in Scotland will have export potential. Scotland's Energy Efficiency Programme, for example, will support thousands of jobs, creating a substantial domestic market and supply chain for energy efficiency and renewable heat services and technologies and related expertise which can transfer to international markets. Millions of pounds should be saved in fuel bills.

4.4.16 We will work with business to deliver this transformation over time. This is a huge opportunity and will set a course to modernise and transform the economy over the next 15 years while setting us up for almost complete decarbonisation by 2050. This long-term approach enables investors, businesses, communities and households to plan changes well in advance. The Climate Change Plan must be supported by and owned by the people of Scotland: it will touch on all our lives and build Scotland's future economic capacity and competitiveness.

4.4.17 The draft Climate Change Plan and draft Energy Strategy set out very challenging but achievable goals which will boost Scotland's productivity, and foster a vibrant climate for innovation, investment and high value jobs. We are committed to working even more closely with business to finalise and implement these plans and secure sustainable economic growth driven by investment, innovation, exports and inclusion.

System costs

4.4.18 The net present system cost of meeting the Scottish Government climate change targets can be estimated using TIMES. This is done by calculating the net present cost of delivering the system described in the draft Plan relative to the cost of delivering a reference scenario with no climate change constraints. The system cost represents the capital and operating costs for Scotland as a whole of running the energy system described by TIMES.

4.4.19 According to Scottish TIMES, the cumulative discounted system resource cost to 2050 has been estimated to be equivalent to around 2% of the cumulative Scottish GDP.

4.4.20 These are broadly in line with other estimates. For example, as stated previously, the Stern Review found the annual cost of climate change mitigation to the global economy to be in the region of -1% to 3.5% of annual global GDP by 2050.

4.4.21 Tackling climate change also has significant potential benefits that are not considered in TIMES. These would include the potential co-benefits of taking action to reduce greenhouse gases, such as improvements in life expectancy as a result of cleaner air.

4.4.22 Finally, TIMES does not take into account the potential costs avoided by taking action to tackle climate change. The Stern Review estimated that business as usual emissions (in the absence of climate change policies) and the resulting impact of climate change, taking into account the risk of catastrophic events on a populations welfare, would be equivalent to permanently losing 5% of global GDP, with an upper estimate of as much as 20% of global GDP.

4.4.23 It is not possible to disaggregate the system cost into individual sector costs given the interdependence between sectors.

The Strategic Environmental Assessment

4.4.24 The Environmental Assessment (Scotland) Act 2005 sets out statutory requirements for the preparation and publication of Strategic Environmental Assessments (SEA). SEA is a process of identifying significant environmental effects that may arise from the implementation of plans, programmes or strategies and documenting these in an open and transparent way at a number of distinct stages.

4.4.25 Screening and scoping are two initial preparation stages of the assessment process. Consultation on the joint screening and scoping report commenced in September 2016. The screening and scoping report set out information such as the likelihood of significant environmental effects arising from the policies and proposals within the draft Climate Change Plan and draft Energy Strategy, the proposed assessment methodology and the evidence base to be considered in the assessment process. Due to a number of common elements within the development of these two documents, a combined approach to the assessment has been undertaken. This provides an opportunity to consider key issues relevant to both within a single Environmental Report.

4.4.26 The findings of this assessment process have been set out in the Environmental Report. This includes the identification of the likely significant environmental effects that are likely to arise from the implementation of the policies and proposals in the draft Climate Change Plan and draft Energy Strategy. The identification of any mitigation measures to reduce or prevent significant adverse effects and/or enhance positive ones has also been included, in addition to the consideration of any reasonable alternatives to these.

4.4.27 The Environmental Report will be published imminently for consultation.

- Comments on the Environmental Report in relation to the draft Climate Change Plan should be submitted within the 60-day parliamentary process so that they can be taken into account.
- The draft Energy Strategy will be subject to a 12-week consultation. Comments on the Environmental Report in relation to it should be submitted within that time period.

5. Achieving transformational change

5.1 The role of behaviours in achieving transformational change

5.1.1 The transition to low carbon Scotland will require all of us to take action: changing the ways we get around; the ways we insulate and heat our homes; and the ways we purchase products and services to support the circular economy. Delivering these changes in our behaviours will require cultural shifts and major infrastructural and technological advances over the coming years.

5.1.2 Infrastructural and technological measures are crucial in moving us towards a low carbon Scotland, and the effectiveness of many of them depends heavily on the extent to which people adopt and use them. Understanding how and why people behave the way they do is key if we are to design interventions that encourage the uptake of low carbon initiatives. Understanding what influences behaviours is thus critical to delivering the outcomes in this draft Plan, and ultimately achieving our climate change ambitions.

Influencing behaviours: The ISM approach

5.1.3 People's choices and behaviours are influenced in various ways – within the values and attitudes that we hold, the habits we have learned, the people around us, and the tools and infrastructure available to us in our day-to-day lives. To influence the way we all behave, a package of interventions, that takes account of the wider aspects of our daily lives, will generally be more successful.

5.1.4 The ISM approach was developed to help understand all of the contexts that shape people's behaviours – the *Individual*, the *Social* and the *Material*. By understanding the different contexts and the multiple factors within them that influence the way we act every day, more effective policies and interventions can be developed.

5.1.5 The *Individual* level includes an individual's values, attitudes and skills, the *Social* context includes factors that influence us through networks, relationships and social norms, and the *Material* context covers factors like infrastructure, technologies and regulations.

5.1.6 Experience of using the ISM approach, across a range of policy areas including housing, energy, transport and forestry, has highlighted key benefits including:

- providing greater understanding of the wide range of factors that will impact on successful delivery of policies
- giving clarity on the areas to be targeted and prioritised
- highlighting the relative importance of different factors in effecting change and using these as levers to change, in particular, the importance of considering the social context in delivering and developing policies

5.1.7 The Scottish Government has used the ISM approach in various ways to support policy development, including:

- Running smaller internal workshops to initially explore behaviours, current behaviours landscapes (drilling down into the behaviours and looking at the evidence we have and how this fits within the ISM framework), and identifying key stakeholders. This insight helps frame the ISM workshop with key stakeholders.
- Delivering ISM workshops with broad groups of stakeholders. The aim of the workshop is to gather wider views on the behavioural challenge, investigating the current landscape and identifying potential barriers and gaps.
- Following up the ISM workshops with a small working group approach focused on action planning and delivery, using insight (potential barriers and gaps) from initial workshops.
- Using the ISM framework to support literature reviews of the behavioural challenge.

5.1.8 We will test the ISM approach later in 2017 as a potential way to engage the public on policies and policy development. Building on the initial housing workshops (which brought together a range of key stakeholders) we are developing an ISM style workshop to engage the public on the same behaviour. The aim is to bring together a small group of members of the public to supplement the initial ISM workshop findings with a public point of view.

5.1.9 Using the ISM approach across low carbon policy areas will also support the implementation of policies and proposals in the final Climate Change Plan, and delivery of policy outcomes.

Engaging with people on climate change

5.1.10 With half the Scottish population stating that climate change is an immediate and urgent problem, an increase of five percentage points on the previous year, we are seeing progress in engaging people about the urgency of climate change. Public understanding, engagement and action are critical to the social and economic transformations required to achieve a low carbon society.

5.1.11 As part of the ongoing engagement with the public, the Scottish Government initiated a series of Climate Conversations, held across Scotland, to encourage a public discussion about climate change. By participating in Climate Conversations, people who do not generally talk about climate change are able to engage in the issues in a way that matters to them. The outcomes from these conversations are feeding into the development and communication of climate change policies.

5.1.12 These conversations have 'taken the temperature' of public views on climate change and the actions that might be needed to tackle it, by engaging people in meaningful conversation about the wider impacts of climate change and the measures that might be needed to mitigate its causes and effects. These group discussions enable participants to share their views on climate change, on potential policies to tackle climate change, and on potential changes to people's everyday lives. The key findings from the conversations to date are:

Knowledge of climate change

- People are generally aware of climate change as both an issue and a problem and were aware that action is necessary to tackle it. There was some confusion between concepts and some factual inaccuracy in the conversations. However, many of the participants appeared reasonably well informed.
- Participants want to act on climate change but want more information on climate change, the impacts of climate change and the actions they can take.
- Participants felt they were already taking some action on climate change.

Themes

- The most prevalent themes concern the impact of a changing climate in relation to transport disruption, wildlife and ecosystems, changing weather patterns, rising sea levels, food supply and land use, and changes to energy generation.
- Local energy and public transport were consistently popular themes in the conversations, with strong support for improvements to the public transport network, and participants favoured increased energy generation through renewables.
- Across the groups there were strong views that improving energy efficiency of homes and sourcing power from renewable energy would both reduce emissions and create significant added benefits to local people's health, wealth and wellbeing.

Going forward

- People want to engage but need help to go from interest to action. The low carbon choice needs to be the easy choice and the fair choice.
- Some groups highlighted an appetite for an ambitious and holistic vision of the future.
- People want a transparent and consistent approach to climate change across government.

5.1.13 The Climate Conversations format enabled participants to enjoy their conversation. The conversations are continuing through local groups across Scotland, with the outcomes of these discussions building on the knowledge we have compiled so far and feeding into policy developments.

Engaging on low carbon behaviours

5.1.14 People across Scotland need to understand fully the changes we need to make, and how to incorporate these changes into everyday lives, to ensure everyone is both willing and able to take the actions required for low carbon living. This will be challenging, but low carbon initiatives being taken forward aim to make the transition as seamless and straightforward as possible as well as providing a host of other benefits (referenced in other parts of this draft Plan).

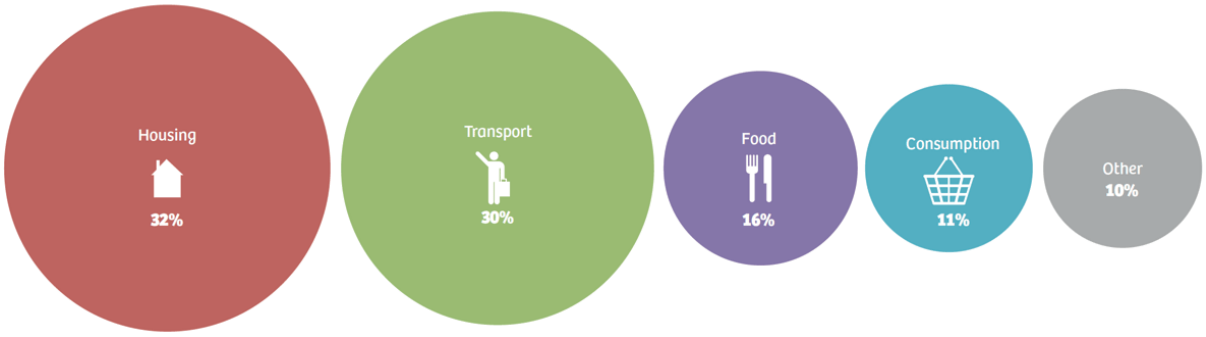
5.1.15 Alongside this we need to engage with the public on the impacts of climate change, the actions we can take to support the move to a low carbon Scotland and why these actions are important.

5.1.16 Through the Greener Together[31] campaign, which engages and motivates the public on a range of actions that can be taken to tackle climate change, we found that three-quarters of those surveyed acknowledged that their behaviour could help tackle climate change and over 50% of the general public reported having a conversation on climate change in the past month.

5.1.17 A recent survey by Young Scot, found that nearly half (42%) of young people consider that they themselves have some responsibility to tackle climate change, but only a third are aware of the practical actions they could take.

5.1.18 Individuals and households account for over three-quarters of Scotland's consumption emissions (all the emissions we are responsible for as consumers of goods and services, including those we import into Scotland), and have a significant role to play, alongside the public sector and businesses, in reducing Scotland's emissions.

Consumption emissions associated with individuals and households by theme



5.1.19 The four consumption emissions themes have been broken down further into 10 Key Behaviour Areas (KBAs), showing specific behaviours where changes by individuals and households can contribute to reducing Scotland's carbon footprint.

31 http://www.greenerscotland.org/

Figure 2: 10 Key Behaviour Areas

5.1.20 There is progress across most of these areas, but some behaviours are showing little or no progress. Attitudes are changing and people are engaging with climate change issues, but to increase the pace of change we need to clearly set out the changes that lie ahead and why they are important, along with associated infrastructure and services, as part of the support we are offering to communities and households across Scotland. We plan to deepen this work following the publication of the final Climate Change Plan.

5.2 The planning system

5.2.1 Ensuring the planning system supports decarbonisation is another essential element of the Scottish Government's approach to meeting the statutory climate change targets. Because development allowed today will be around for decades or maybe hundreds of years the most important decision the planning system makes is where that development should be built.

5.2.2 The planning system is there to make the places where we live, work, and play, better. Working with communities and organisations, Planners make a plan for the area. The plan is known as a development plan. It sets out what kind of development, which could be a building or piece of infrastructure like a cycleway or road, should go where. It also says how green spaces and rivers, or other water features like lochs, could be changed or protected. Councils will make decisions on applications for planning permission based on the development plan.

5.2.3 We have national policies to help councils across Scotland make development plans for their areas. Our key national policies are:

- Scotland's National Planning Framework[32]
- Scottish Planning Policy[33]
- Creating Places[34]

5.2.4 The National Planning Framework is required by law to have the objective of contributing to sustainable development, which includes reducing greenhouse gas emissions. All development plans must take account of the National Planning Framework when they are being made.

5.2.5 Our key national policies help to reduce the greenhouse gas emissions from development by setting the following principles:

- a presumption in favour of development that contributes to sustainable development
- support for the transition to a low carbon economy
- that we build high quality places that are resource efficient
- that we build in town centres and on previously used land first
- there should be a mix of development in town centres so people can live, shop, work and play there
- travel opportunities should prioritise walking and cycling before public transport and cars
- the development of a wide range of electricity generation from renewable sources is supported, with a plan in place for where wind farms could go
- support for the development of heat networks in as many locations as possible
- that there is no need to make a planning application for a range of small scale renewable energy technologies like solar panels and heat pumps, so they can be installed quickly

5.2.6 The Scottish Government has published a consultation on the future of the Scottish Planning System. Responses are invited to the proposals by 4 April 2017[35].

32 http://www.gov.scot/Publications/2014/06/3539
33 http://www.gov.scot/Publications/2014/06/5823
34 http://www.gov.scot/Publications/2013/06/9811
35 http://www.gov.scot/Publications/2017/01/3486

6. Monitoring and evaluation

6.1.1 Monitoring the implementation of the Climate Change Plan is necessary to ensure effective implementation and communication of progress under the Climate Change (Scotland) Act 2009. Our proposed monitoring framework builds on approaches to assess the previous reports on policies and proposals and on the method applied by the Committee on Climate Change to monitor progress against the UK carbon budgets. This monitoring framework marks a new approach to understanding the implementation of the Climate Change Plan. We will continue to develop the approach over the course of its application.

We have used the following principles to design and develop the framework:

PRINCIPLE 1: The monitoring framework will focus on both policy implementation and policy outputs. This is necessary to describe progress and also to support learning and continuous improvement in policy delivery.

PRINCIPLE 2: Development of proposals will also be monitored to ensure the plan is on track for its longer-term goals.

PRINCIPLE 3: Over time we will develop policies that are SMART (Specific, Measurable, Attainable, Realistic and Time limited) to allow them to be monitored.

PRINCIPLE 4: The monitoring framework will be maintained online and a summary report published annually from 2018 onwards.

PRINCIPLE 5: While the monitoring framework will ensure a consistent approach across the plan it will be proportional in its data and indicator demands to reflect the range of different policies within the Climate Change Plan.

PRINCIPLE 6: Improvement and learning underpins the framework. Policy design and implementation will evolve and respond to the learning from monitoring to support improvement in delivery.

6.1.2 The monitoring framework will provide the information required to allow for ongoing policy development and improvement in implementation. Policy implementation will, therefore, be dynamic and responsive to the learning from monitoring data. The indicators within the monitoring framework provide the direction of travel that is expected to occur as a result of a particular policy. The collection of data ensures evidence-based decisions can be taken to amend the policy approach in response if required.

6.1.3 The monitoring framework applies a suite of indicators to present an accurate description of progress and a full explanation of policy implementation. Indicators apply the SMART criteria. This means that they must be Specific, Measurable, Attainable, Repeatable and Time relevant. Importantly the data behind each indicator will be of sufficient quality to allow confident interpretation of its meaning. We are developing the suite of indicators in the monitoring framework to answer the following questions:

- *Is implementation of the policies and proposals in the Climate Change Plan on track?* This will provide a description of progress against the Climate Change Plan timelines.
- *How is the policy implementation process progressing?* This will allow for learning and improvement in policy delivery.

6.1.4 We are using the following indicators to monitor the implementation of the Plan:

- **Annual greenhouse gas emissions statistics.** These present the highest level outcome indicator. The presentation of sector greenhouse gas emissions provides the raw data that, when combined with the indicators below, allows for the verification of sector projections and policy development.
- **Policy outcomes.** Policy outcomes are the measurable consequence of a particular package of policies and proposals. For example a suite of policies and proposals are intended to help increase the sale of electric vehicles. Progress against each of the policy outcomes will be monitored on an annual basis.
- **Policy implementation indicators.** These indicators will address the question: *How is the policy implementation process progressing?* In order to capture the learning needed to allow for quality improvement in policy delivery, and to offer an explanation of outputs, we will identify and apply implementation indicators for a selection of policies. For each indicator a projected trend will be described using quantitative measures, this is necessary to understand the implementation process.
- **Policy output indicators.** These indicators will address the question: *Is implementation of the Climate Change Plan on track?* We will use policy output indicators to determine if implementation of the Climate Change Plan is on track and will flag any policy area that needs particular attention. In some cases it will be possible to measure the policy output on an annual basis, in others it will be necessary to use an indicator to describe progress. For each indicator a projected trend will be described using quantitative measures. This is necessary to understand the implementation process.
- **External drivers.** Policy outputs will be achieved as a result of policies working in combination with external drivers. It is important to track the key drivers as they are likely to provide a significant explanation for progress. External drivers will include contextual factors (such as demographics, oil price etc) and drivers that we expect to see a positive trend in as a result of collective efforts to build a low carbon future (e.g. reductions in technology costs).
- **Long-term trend indicators.** In certain sectors there may be policies that are responsible for contributing to long-term trends. Where these are significant we will identify and monitor them. Examples of long-term indicators might include attitudinal surveys, uptake of vocational courses or graduation from particular degree courses.

6.1.5 The draft Climate Change Plan describes proposals as making a significant contribution in future years when their development allows them to be converted to policies. To ensure the implementation of the Climate Change Plan remains on track, the monitoring framework will track the development of proposals. We will ask the following questions of each proposal:

- *What action has been taken to develop the proposal?*
- *What are the next steps to progress the proposal to policy?*
- *Will the proposal still deliver the projected outcome on time?*
- *Is the proposal still relevant in the context of changing circumstances?*
- *What are the risks to developing the proposal further and how will these be addressed?*

6.1.6 We will set up a governance body to oversee and respond to the monitoring and implementation of the Climate Change Plan. It will have an important role in ensuring the Scottish Government and its partners are able to respond to the results of the monitoring framework, applying the learning from the suite of indicators to ensure quality improvement in policy action and rigorous scrutiny of implementation. This body will provide advice to the Scottish Cabinet on a regular basis.

6.1.7 We will continue to develop the monitoring framework and intend to publish an update alongside the final Climate Change Plan later in 2017. The final version will be published in 2018, from when we plan to publish annual summary monitoring reports.

Monitoring reserved climate policies

6.1.8 Implementation of the Climate Change Plan is reliant on a combination of EU, UK and Scottish policy. The monitoring framework has been designed to understand and improve the delivery of Scottish Government climate policy. However, it must also capture the progress made under UK and EU policy direction. To this end the required policy outputs from UK Government and EU policy will be assessed at regular intervals to see if they are consistent with the assumptions made in the Plan.

6.1.9 The following tables present examples of how the monitoring framework will be applied to policies from different sectors.

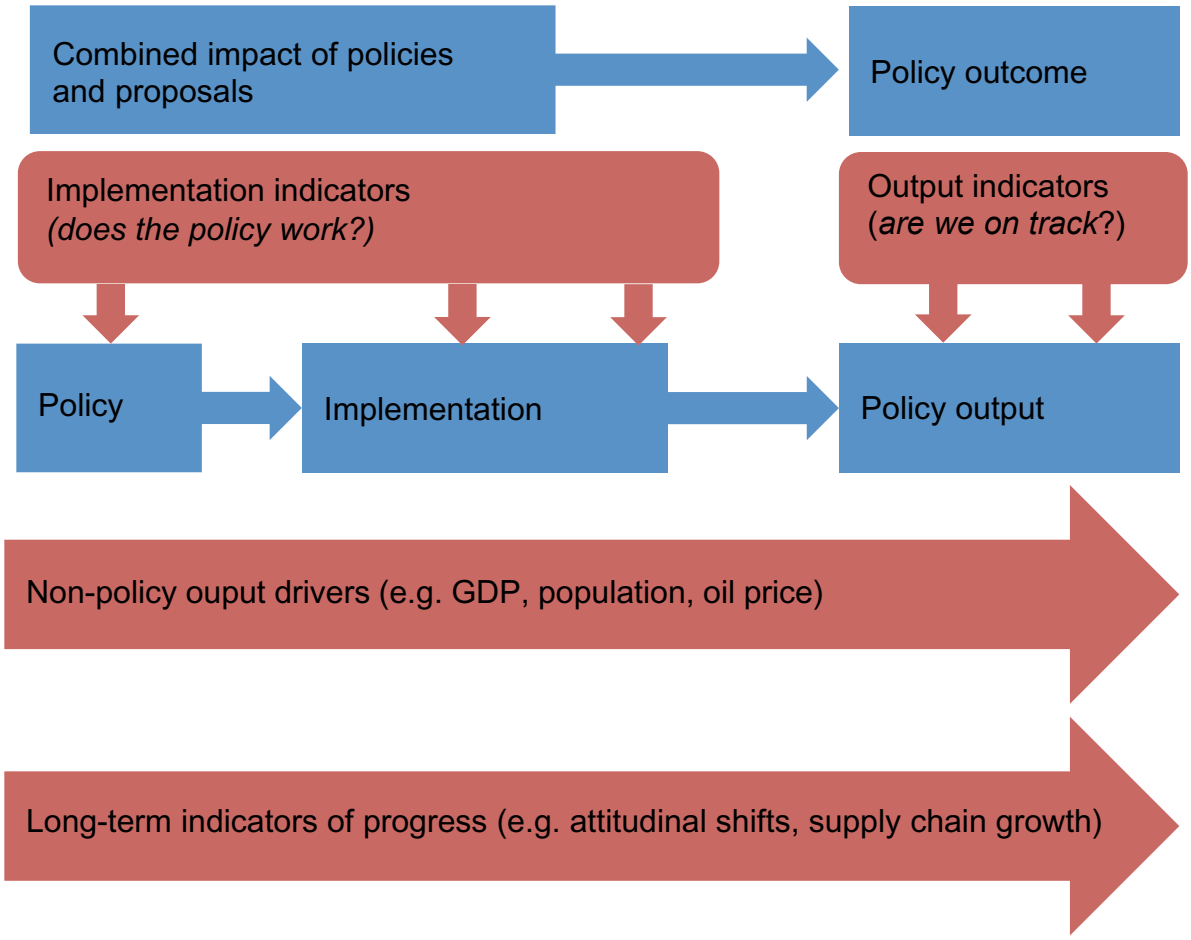
Table 6-1: Peatland monitoring example

Sector	**Peatland**									
Policy outcome	Deliver 10,000 hectares of peatland restoration in financial year 2016/2017									
Policy	Provide financial and other support, to deliver 250,000 hectares of peatland restoration from 1990 baseline									
Implementation indicators	No. of grant applications	2017	2018	2019	2020	2021	2022	2023	2024	2025
		80	100	120	130	140	150	150	150	150
	No. of successful applications	2017	2018	2019	2020	2021	2022	2023	2024	2025
		70	90	110	115	120	125	130	130	130
	Rationale for selection of indicators: The number of applications the grant scheme attracts is a reflection of the reach and engagement with a wide range of stakeholders including communities. This is very important for wider public engagement. A few large remote projects could produce the annual hectares target (policy outcome), but may not have the same impact as wider engagement that involves local communities. Over time we would expect the proportion of successful applications to increase as applicant's knowledge and understanding improves.									
Output indicator (and milestones)	Indicator: no. of hectares of restored peatland per year									
	Date	2017	2018	2019	2020	2021	2022			
	Output	10,000 ha	10,000 ha	20,000 ha	20,000 ha	20,000 ha	20,000 ha			

Table 6-2: Forestry monitoring example

Sector	Forestry				
Policy outcome	To enhance the contribution that trees make in reducing emissions, through sequestering carbon, we will introduce a stepped increase in the annual woodland creation rates from 2020-21.				
Policy	We will provide funding each year, via the Forestry Grant Scheme, to support eligible land owners establish appropriate woodlands.				
Implementation indicators	Year (report in December each year)	2017-18	2018-19	2019-20	2020-2021
	Indicator 1: proposed new woodland area based on approved applications	10,000 ha	10,000 ha	10,000 ha	12,000 ha
	Year (report each financial year)	2017-18	2018-19	2019-20	2020-21
	Indicator 2: improving customer satisfaction rating	Baseline to be determined	Measure to be added once baseline established	Measure to be added once baseline established	Measure to be added once baseline established
	Rational for selection of indicators: Indicator 1: the volume of grant applications being processed provides key management information to track progress towards delivering the annual target. Once an application is approved the area of woodland to be created is confirmed and the year it will be created identified. However, applicants may vary the year the woodland is created depending on individual circumstances. This data will be published in December each year and will provide an indicator as to progress against the annual target – see output indicator. Indicator 2: there is a current forum called the Customer Representatives Group, which has membership from the main forestry management companies and NGOs that interact with the Forestry Grant Scheme. This group, or equivalent, will be surveyed annually using a qualitative questionnaire to record feedback on the management of the Forestry Grant Scheme.				
Output indicator (and milestones)	Indicator: total area of woodland created each financial year (Official Statistics published in June (provisional data) and September (final data) each year for the previous financial year				
	Date	2017-18	2018-19	2019-20	2020-21
	Output	10,000 ha	10,000 ha	10,000 ha	12,000 ha

Figure 3: The monitoring framework



Part two

The following eight chapters set out how each sector will meet their respective carbon envelopes through the implementation of policies and proposals. Each chapter follows the same structure and includes all the information relating to that sector. The chapters contain the following information:

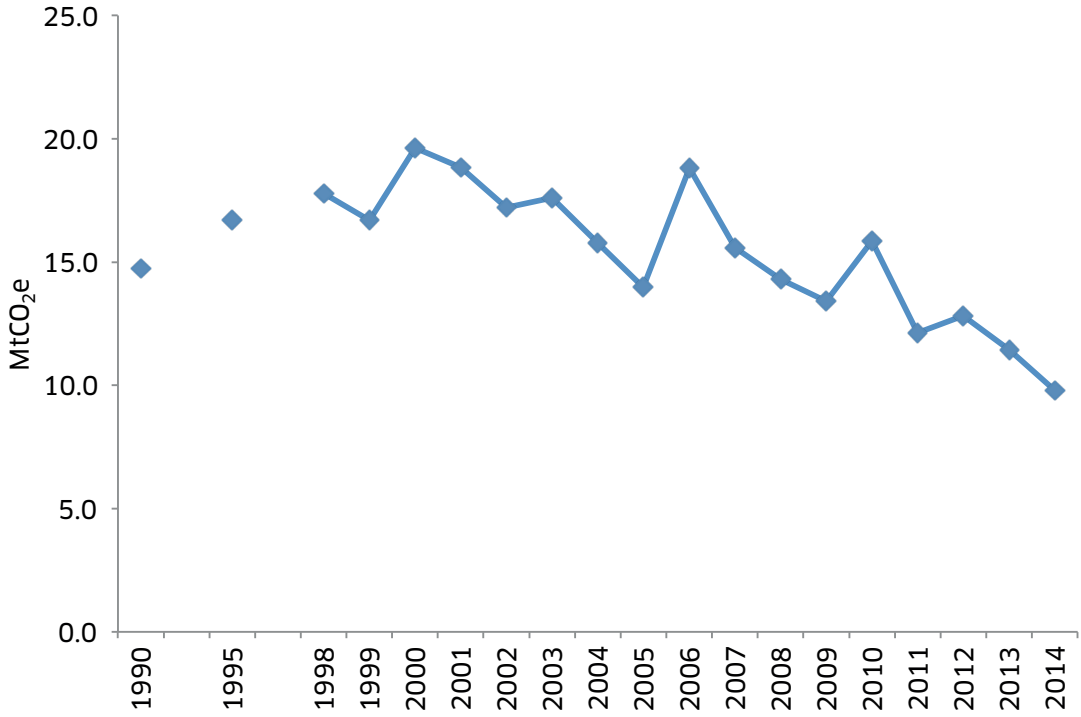
- Context: describes the historical emissions for the sector and the key characteristics of the sector.
- Ambition: describes the long-term change required of each sector and includes milestones for both 2020 and 2030 and a description of 2050.
- Policies and proposals: sets out how the package of policies and proposals will deliver the policy outcomes required to remain within the emissions envelope. Relevant definitions are given in text box 1.1 in Part one of this document.
- Progress since RPP2: describes progress towards implementing proposals and policies set out in earlier reports.
- Wider impacts: outlines the significant co-benefits and possible adverse side effects of the polices and proposals.

7. Electricity

The electricity sector covers the generation and wider electricity system for Scotland.

7.1 Where we are now

Figure 4: Electricity generation historical source emissions



7.1.1 Scotland's electricity generation mix has changed significantly since 1990 – emissions have fallen 33.6% by 2014, to 9.8 $MtCO_2e$.

7.1.2 The volume of Scottish electricity arising from renewable sources has increased fourfold since 2002, accounting for 42% of Scottish electricity generation in 2015.

7.1.3 Renewables generated the equivalent of 59.4% of Scotland's electricity requirements in 2015, from just over 12% in 2002 – which means we have met the interim target to deliver the equivalent 50% of Scotland's electricity needs from renewables by 2015.

7.1.4 Generation located in Scotland has successfully contributed toward Scottish and UK renewable energy targets, and a large pipeline of projects remains that could continue to provide cost-effective, carbon-free generation to the GB network.

7.1.5 Just over a third of Scotland's electricity supply came from nuclear energy in 2015. This represents an increase from 2007, when nuclear energy represented 25.7% of Scotland's electricity supply.

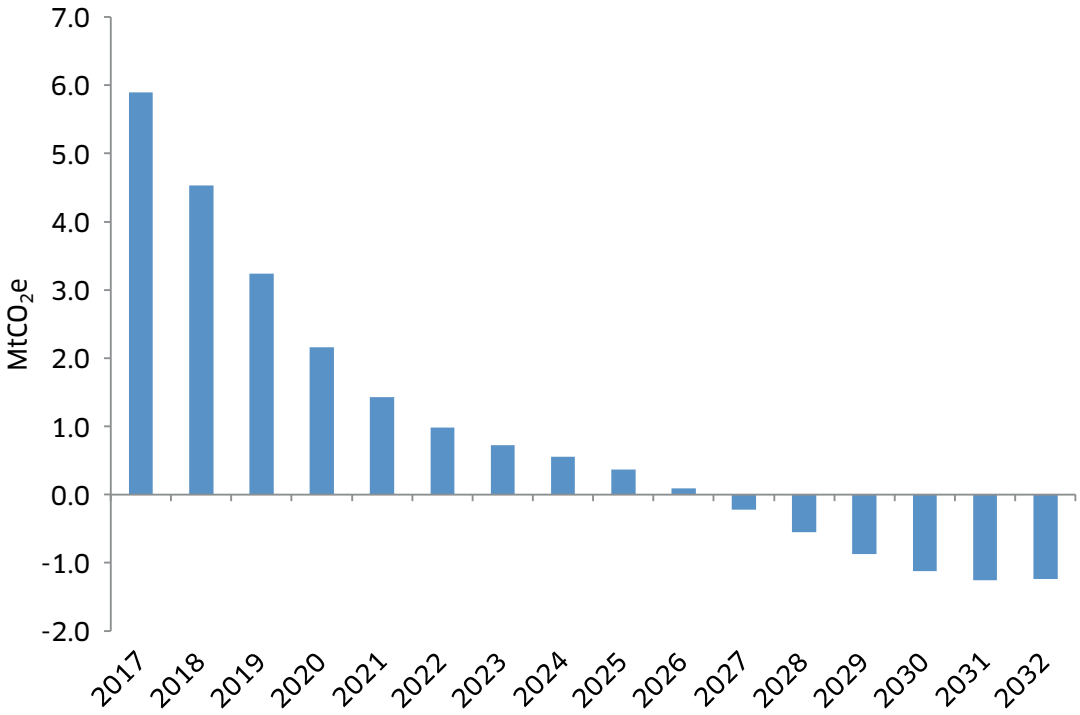
7.1.6 Fossil fuel powered electricity generation as a whole has decreased from 31.9% in 2013 to 22.0% in 2015. This reflects, in part, the closure of Cockenzie coal-fired power station in 2013. The closure of Longannet coal-fired power station in March 2016 is not captured in the latest emissions inventory or electricity generation statistics.

7.1.7 Scotland has also consistently been a net exporter of electricity over the past decade, exporting 29% of the electricity generated in 2015 to the rest of the UK – up from 24% in 2014.

7.1.8 Emissions from the electricity sector are entirely covered by EU ETS.

7.2 Our ambition

Figure 5: Electricity generation carbon envelopes



7.2.1 In 2030, Scotland's electricity system will be wholly decarbonised and supply a growing share of Scotland's energy needs. Alongside lighting our buildings and powering household appliances, electricity will be increasingly important as a power source for keeping our homes warm and our vehicles on the move.

7.2.2 As a result, the total volume of electricity supplied within Scotland will increase to 2032. System security is ensured through a diversity of generation technologies, enhanced system flexibility through increased storage, smart grid technology and appliances and improved interconnection.

7.2.3 Carbon Capture Storage (CCS) is critical to the delivery of a cost-effective emissions reduction trajectories under the Plan; CCS will also act as a technology capable of playing a central role across the decarbonisation strategies of key sectors such as heat, industry and power.

7.2.4 The United Nations Inter-Governmental Panel on Climate Change (IPCC), the International Energy Agency (IEA) and the Committee on Climate Change have all identified Carbon Capture Storage as an essential lowest cost climate mitigation technology. The IPCC fifth assessment report states that it would cost 138% more to achieve a 2°C scenario without CCS.

7.2.5 The successful deployment of this technology, alongside the development of gas from plant material and biomass waste, has the potential to deliver an overall emissions envelope for electricity which removes carbon dioxide from the atmosphere. While technically feasible, additional analysis and testing will be required before such a technology becomes commercially viable.

7.3 Policy outcomes, policies, development milestones and proposals

Policy outcome 1: Scotland's electricity grid intensity is below 50g CO_2 per kilowatt hour, aided by enhanced flexibility mechanisms and powered by a high penetration of renewables, using a range of technologies including onshore wind, offshore wind, hydro, solar, marine and bioenergy.

There are two policies, four policy development milestones and one proposal which will contribute to the delivery of policy outcome 1.

Policies which contribute to the delivery of policy outcome 1

1) Support the future development of a wide range of renewable technologies through addressing current and future challenges, including market and wider policy barriers.
2) Promoting greater flexibility in the electricity sector, including efficient network management, demand side response and electricity storage.

Policy development milestones which contribute to the delivery of policy outcome 1

1) UK Government delivers a viable route to market for wide range of renewable technologies, including onshore wind in Scotland, and long term funding under the Levy Control Framework.
2) By 2020, at least 1 GW of renewable energy will be in local or community ownership.
3) Successful delivery of Renewable Energy Investment Fund, Community and Renewable Energy Scheme, and Low Carbon Infrastructure Transition Programme.
4) Development of UK Routemap for Flexibility and Smart energy systems.

Proposals which contribute to the delivery of policy outcome 1

1) The Scottish Energy Strategy consultation will explore proposals that increase the level of renewable electricity generation, including new targets, additional measures to support onshore wind, and exploring the role for a government-owned energy company and Scottish renewable energy bond.

Policy outcome 2: By 2030, emissions from electricity generation are negative, providing a net reduction in energy system emissions.

There is one policy, one policy development milestone and one proposal which will contribute to the delivery of policy outcome 2.

Policy which contributes to the delivery of policy outcome 2

1) Encouraging the demonstration and commercialisation of Carbon Capture and Storage (CCS) in Scotland.

Policy development milestone which contributes to the delivery of policy outcome 2

1) UK Government announcement of CCS Strategy aligned with Scottish energy priorities.

Proposals which contribute to the delivery of policy outcome 2

1) The Scottish Energy Strategy consultation will explore proposals that increase the level of low and zero carbon electricity generation and facilitate increased flexibility in the electricity system, including the assessment of the potential for small scale CCS demonstration across a range of sources including the application of CCS within industrial processes; and the scope to combine bioenergy production and CCS – with a view to maximising the benefits for the energy system as a whole including the potential for negative emissions.

7.3.1 Full details of policies, policy development milestones and proposals are set out in the tables below. The delivery of these will be tracked through the monitoring framework (see section 6).

7.4 Wider impacts

7.4.1 There are wider benefits for consumers and businesses that arise from a smarter, more flexible energy system. The National Infrastructure Commission estimates that a 'smart' system could provide gross benefits to consumers of between £3 billion and £8 billion a year to 2030, consistent with the outcomes of other research in this area. Scottish companies and academic institutions have been active early in the smart sector, and there is the potential to secure economic benefits if the pace of change is maintained.

7.4.2 Demonstration at commercial scale of Carbon Capture and Storage could protect Scottish business against future carbon price rises and could secure economic benefit in the supply chain for knowledge transfer of technology expertise to other businesses in international markets.

7.4.3 Investment to enhance the competitiveness and productivity of Scotland's low carbon electricity generation and network sector will contribute to the Scottish Government's wider objectives of sustainable economic growth and this will ensure that highly skilled employment opportunities continue to be located in Scotland, benefiting all people across Scotland, in both urban and rural areas.

7.4. 4 Today, we are a knowledge hub for energy exploration and production, for power system engineering and a host of modern, renewable energy technologies and systems – placing Scotland at the forefront of the challenge to decarbonise the global economy. We wish to combine the mutual strengths, capacities, skills and ideas of communities, industry, and other stakeholders in shaping and delivering Scotland's future energy system.

7.4.5 The Scottish Government will maximise these co-benefits through working with our public sector partners and industrial trade associations to support the investment necessary for these improvements in the deployment of low carbon electricity supply and storage, and continue to work with the UK Government and Ofgem to promote a flexible, smart energy system that will facilitate the transition to a low carbon economy.

7.4.6 As with any industry requiring significant capital investment, there may be the potential for impacts to arise from the construction, operation and decommissioning of new renewable or low carbon developments (e.g. risks of impacts to air, soil, water, biodiversity and visual impacts to cultural heritage and landscape, displacement of other land or marine users, amongst others). These impacts are considered as part of the planning process.

7.4.7 The Scottish Government will continue to ensure that adverse impacts are considered as part of the planning process, and that developments are permitted in the appropriate locations.

7.5 Summary of policies, development milestones and proposals

Policy outcome 1: Scotland's electricity grid intensity is below 50g CO_2 per kilowatt hour, aided by enhanced flexibility mechanisms and powered by a high penetration of renewables, using a range of technologies including onshore wind, offshore wind, hydro, solar, marine and bioenergy.

Table 7-1: Policies which contribute to the delivery of policy outcome 1

Policy	EU, UK or Scottish policy	Public sector partners	Delivery route
Support the future development of a wide range of renewable technologies through addressing current and future challenges, including market and wider policy barriers	UK Scottish EU	Local Energy Scotland Ofgem Highlands and Islands Enterprise Scottish Enterprise Local Authorities	The feed-in-tariff, the Renewable Obligation and Contracts for Difference are UK-wide subsidy schemes that provide a route to market for renewable electricity projects. To complement UK subsidies, the Scottish Government gives project funding for developing and piloting new technologies, including community models. Scotland is leading the way across the UK in how it supports community and locally owned energy, providing comprehensive support, available under our Community and Renewable Energy Scheme (CARES). The main components of CARES are local energy ownership and shared ownership both of which are facilitated through a range of interventions from start-up grants to pre and post planning loans and by bespoke advice and support free at the point of use. Over the past four years, Renewable Energy Investment Fund (REIF) has given vital support to most of the major projects deployed in the community energy sector in Scotland. This has entailed Scottish Enterprise working in strong partnership with the CARES contractor Local Energy Scotland, and with other partners, including Social Investment Scotland and commercial lenders, to facilitate deals and streamline diligence costs. REIF has also been vital to the development of the marine energy sector in Scotland, and has been recognised in Europe in this regard as a template for investment. To date, £59 million has been invested through REIF to support over 30 projects, levering in more than twice this amount in private investment. Under section 36 of the Electricity Act 1989 the Scottish Government determines renewable electricity applications for projects with an installed capacity of over 50 Megawatts. Below this decisions are made by the relevant local authorities under the provision of the Town and Country Planning Act 1990. The Scottish Government has taken a number of steps through planning policy and the Consenting process to ensure renewable technologies are sited in the correct place, minimising the impacts on environmental and residential amenities.

Policy	EU, UK or Scottish policy	Public sector partners	Delivery route
			As offshore wind moves into deeper waters, the introduction of an enhanced level of support under the Renewable Obligation (Scotland) will assist the test and development of this technology both in the short and longer term with the deployment of floating offshore wind. The Scottish Government's financial contribution to the Offshore Wind Accelerator (OWA) has assisted the programme to continue to reduce the cost of offshore wind as the sector moves to its target of £100/MWh by 2020. Wave Energy Scotland (WES) was established at the end of 2014. WES is fully funded by Scottish Government and delivered by Highlands and Islands Enterprise (HIE). It provides up to 100% funding for the development of innovative technologies to produce low cost, efficient and reliable components and subsystems. There are limitations to the Scottish Government's ability to influence the future energy mix as many of the policy levers are reserved to the UK Government. As a whole, the renewable energy sector faces a challenging future. Current uncertainties over the support for renewables under UK subsidy schemes – including Remote Island Wind, offshore wind (both floating and fixed installation) and wave and tidal under the Contracts for Difference scheme – are now jeopardising the future deployment of renewable electricity technologies in Scotland. Moreover, the current transmission network charging arrangements (reserved to the UK Government) do not account for the reality that many of the best renewable-energy sources are far from centres of demand.
Promoting greater flexibility in the electricity sector, including efficient network management, demand side response and electricity storage	UK Scottish	Local Energy Scotland Ofgem Highlands and Islands Enterprise Scottish Enterprise Strathclyde University	The UK Government and Ofgem currently allows for some demonstrator flexibility projects to be funded through energy bills via the Low Carbon Network Innovation Fund, including projects in Scotland. The Scottish Government Local Energy Challenge Fund (LECF) supports large-scale low carbon demonstrator projects which show a local energy economy approach linking energy generation to energy use. This includes projects looking to develop innovative energy distribution and storage solutions that have an overall aim of creating more local value and benefit.

Policy	EU, UK or Scottish policy	Public sector partners	Delivery route
			The second round of LECF is being developed in partnership with the Low Carbon Infrastructure Transition Programme[36] (LCITP). The LCITP focuses on supporting the acceleration of projects to develop investment grade business cases allowing them to secure existing streams of public and private capital finance. The LCITP is a working partnership between the Scottish Government, Scottish Enterprise, Highlands and Islands Enterprise, Scottish Futures Trust and sector specialists. This partnership is supported by the new 2014 – 2020 European Regional Development Fund[37] (ERDF) programme. Pumped hydro storage (PHS) is a mature and highly flexible technology, and, as one of the few large scale means of storing energy, could play an even greater role in our future energy system. Pumped hydro storage provides 24 GigaWatt hours of storage capacity in Scotland with a further 1GW of consented PHS capacity. The recently formed PHS Working Group has published a report into PHS that provides a clear account of the range of benefits that PHS can offer as well as a supportive policy and market framework similar to the "cap and floor" regime for interconnector. The Scottish Government will work with the UK Government and key stakeholders to realise the opportunities and overcome the barriers to deploying new pumped hydro storage capacity in Scotland. The Scottish Government continues to support the The Power Networks Demonstration Centre (PNDC) – a unique world-class facility designed to accelerate the adoption of new, 'smart' technologies within advanced power grids, supporting the increased accommodation of renewable energy, electric vehicles and demand side management. The Scottish Government is working with industry to help them identify and develop viable business models to realise storage solutions, and to identify barriers for storage. The work will aim to develop solutions aimed at promoting a market environment in which storage can compete on an equal playing field, look to identify technology innovation requirements and standards to build confidence in storage solutions and identify and promote the development of a Scottish supply chain.

36 http://www.gov.scot/Topics/Business-Industry/Energy/Action/lowcarbon/LCITP

37 http://www.gov.scot/Topics/Business-Industry/support/17404

Table 7-2: Policy development milestones which contriubte to the delivery of policy outcome 1

Policy development milestone	Delivery route
UK Government delivers route to market for wide range of renewable technologies, including onshore wind in Scotland, and long term funding under the Levy Control Framework	The Scottish Government will continue to make the case to the UK Government for a stable, supportive regulatory regime, appropriate support for investment in renewable energy (including remote island wind) and to extend Levy Control Framework beyond 2020/21 to provide greater certainty to investors.
By 2020, at least 1 GW of renewable energy will be in local or community ownership	Community and Renewable Energy Scheme will support Local and Community Owned Energy projects, including through a focus on opportunities for community stakes in commercial schemes.
Successful delivery of Renewable Energy Investment Fund, Community and Renewable Energy Scheme, and Low Carbon Infrastructure Transition Programme	REIF and CARES will continue to build on their success to date and to be ready to adapt to meet emerging priorities and market changes. By 2018, the LCITP will have supported a large number of projects to demonstrate technologies that will deliver low carbon energy solutions.
Development of UK Routemap for Flexibility and Smart energy systems	During the course of 2017, UK Government and Ofgem will develop a Routemap to a smart, flexible energy system. Scottish Government will contribute to the process and work to secure the right regulatory framework to incentivise flexibility and storage projects in Scotland.

Table 7-3: Proposals which contribute to the delivery of policy outcome 1

Proposal	Delivery route
Energy Strategy will explore the role for further ambitious proposals that will support electricity policy outcomes	The draft Scottish Energy Strategy consultation considers additional proposals to complement existing policies that support policy outcomes for the electricity sector (as well as other sectors in the Climate Change Plan). In particular these are: • targets for increased renewable energy generation • additional measures to support onshore wind, working with industry to meet the challenge of delivering onshore wind in a subsidy-free market. • the development of a whole-system Bioenergy action plan • the role of a government owned energy company to support low carbon and community energy • the potential for Green Energy Bonds to support ongoing renewables and low carbon development.

Policy outcome 2: By 2030, emissions from electricity generation are negative, providing a net reduction in energy system emissions.

Table 7-4: Policies which contribute to the delivery of policy outcome 2

Policy	EU, UK or Scottish policy	Public sector partners	Delivery route
Encouraging the demonstration and commercialisation of Carbon Capture and Storage (CCS) in Scotland	Scottish UK	Scottish Enterprise Oil and Gas Authority	The near-term demonstration of small scale projects leading to the medium and large-scale deployment of Carbon Capture Storage (CCS) will be critical for cost-effective decarbonisation of heat, power and industry. However, efforts to realise the commercialisation of Carbon Capture and Storage (CCS) in Scotland have suffered a set-back as a result of the UK Government's decision to remove £1 billion worth of funding to a ground breaking project. There is now an urgent need for strong inter-governmental collaboration and the Scottish Government will continue to press the UK Government to offer a renewed CCS strategy to mobilise CCS activity and secure a demonstrator project in Scotland. Scotland has the existing pipeline infrastructure and CO_2 storage capacity to support the development and deployment of commercial scale CCS. If managed and planned effectively, Scotland could have strategically located CCS decarbonisation systems across the country. This could be achieved by for example: • ensuring Scotland's competitive advantage in CCS is maintained by protecting our legacy oil and gas infrastructure and the extensive CO_2 storage potential in our depleted oil and gas fields for repurposing for use in a future CCS system • supporting the transition efforts of Scottish oil and gas firms and domestic supply chain companies to deploy their expertise and skills to develop future CCS industrial opportunities • building on Scotland's world-renowned academic and research reputation, including the links between the Scottish Government and European projects proposed in the North Sea Basin in Norway and the Netherlands, and applying the learning from the collaborative CCS research work being developed in Guangdong Provence in China

Table 7-5: Policy development milestones which contriubte to the delivery of policy outcome 2

Policy development milestone	Delivery route
UK Government announcement of CCS Strategy aligned with Scottish energy priorities	The Scottish Government will seek to influence the UK Government's CCS strategy so that it is aligned with Scottish energy priorities; including securing a CCS demonstrator project, building on the conclusions of the Scottish and UK Government funded research into CCS the retention of existing critical infrastructure, including key oil and gas pipelines suitable for use with CCS.

Table 7-6: Proposals which contribute to the delivery of policy outcome 2

Proposal	Delivery route
Energy Strategy will explore the role for further ambitious proposals that will support electricity policy outcomes	The forthcoming draft Scottish Energy Strategy consultation considers additional proposals to complement existing policies that support policy outcomes for the electricity sector (as well as other sectors in the Climate Change Plan). In particular these are: • assess opportunities for small scale CCS demonstration and CO_2 utilisation projects in Scotland across a range of sources including the application of CCS within industrial processes • explore the scope to combine bioenergy production and CCS – with a view to maximising the benefits for the energy system as a whole

Table 7-7: Policy outcomes 1 and 2 over time

Policy outcomes 1 and 2	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Electricity Sector carbon Intensity falls to less than 50 grams of CO_2 per kilowatt hour, and then becomes negative from 2030 onwards.				Less than 50 grams of CO_2 per kilowatt hour										Carbon intensity of Scottish electricity generation becomes negative, providing a net emissions reduction to the Scottish energy system.		

7.6 Progress since RPP2

Table 7-8: Progress since RPP2

Summary of progress
RPP2 set out the ambition to have a largely decarbonised electricity system with a grid-intensity of 50g CO_2 per kilowatt hour of generation by 2030. The carbon intensity of Scottish electricity generation has reduced from 318 grams of carbon dioxide per kilowatt hour in 2010, to 196 grams of carbon dioxide per kilowatt hour in 2014. The closure of Longannet coal fired power station in 2016 will reduce this figure considerably, to close to the RPP2 target level.

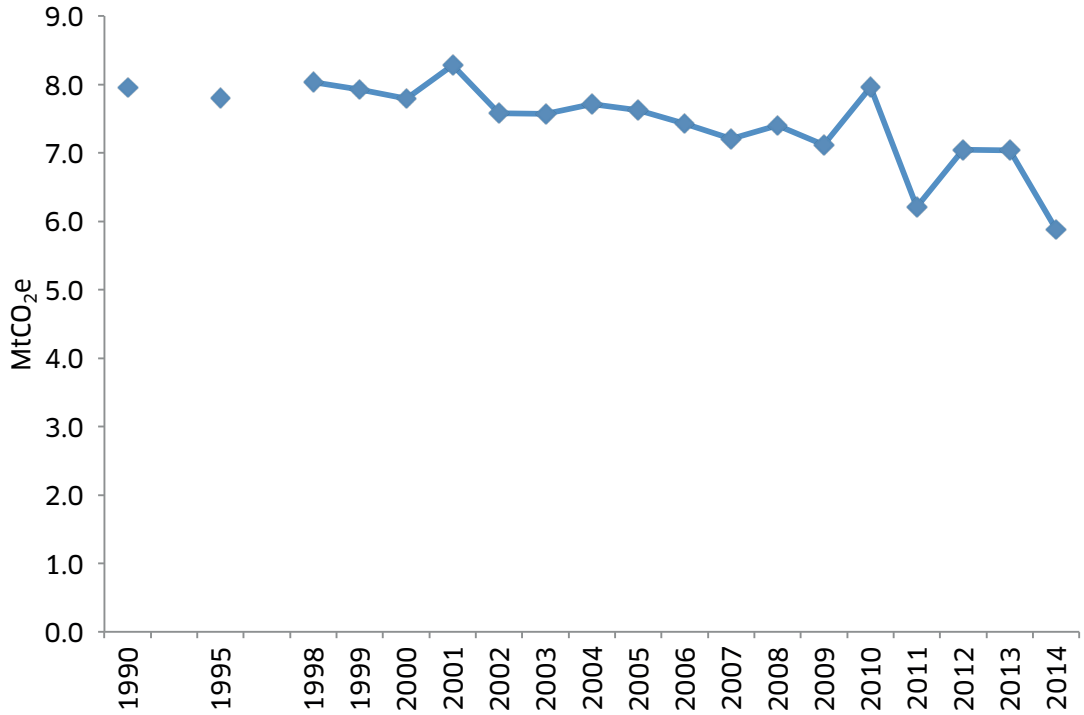
8. Residential

The Residential sector covers all of Scotland's housing, including owner occupied, private and socially rented housing. The majority of the emissions in this sector are related to how much energy we use and how we heat our homes.

8.1 Where we are now

8.1.1 Total emissions in 2014 were 5.9 $MtCO_2e$. This is just under 13% of Scotland's total direct emissions. Residential emissions have fallen 26% between 1990 and 2014, although they vary annually, driven by fluctuating external temperatures, as was seen in 2010. Since the Climate Change (Scotland) Act 2009 was passed emissions have fallen by 17%.

Figure 6: Residential historical emissions

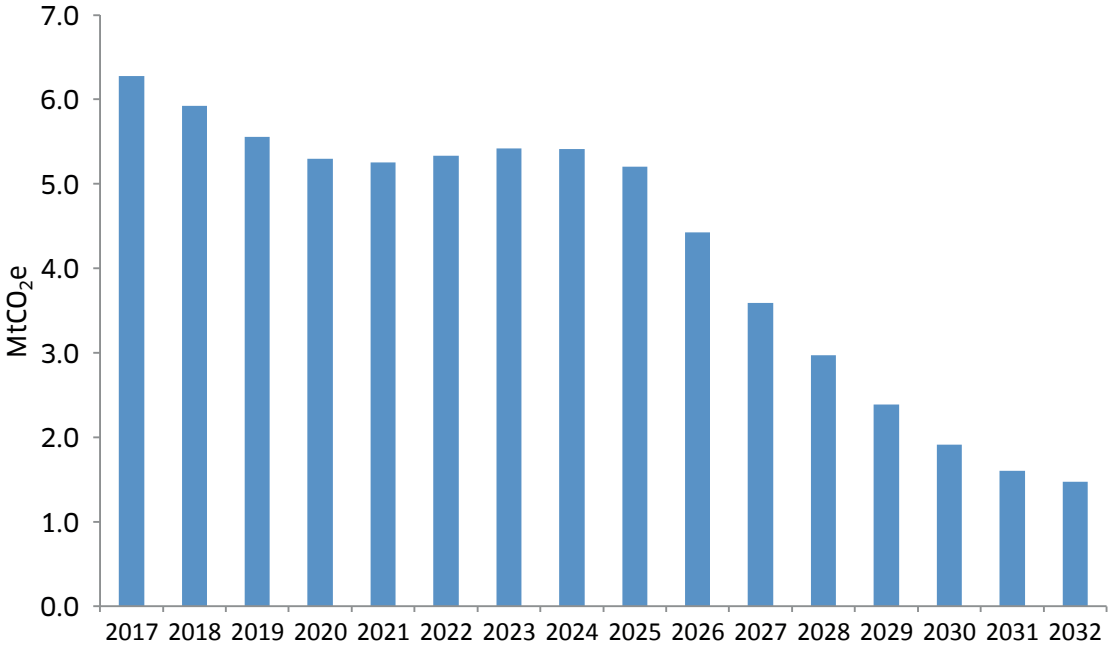


8.1.2 In 2015 there were 2.56 million households in Scotland. The residential sector is very diverse varying in tenure, age, primary heat source and level of energy efficiency. As regards tenure, 23% of Scotland's homes are socially rented, 14% privately rented and 61% owner occupier. It is likely that over 80% of the housing in use today will still be in use in 2050. Three-quarters of our homes were built before 1982 and a fifth were built before 1919. Space heating and the provision of hot water account for over three-quarters of the energy we use in our homes. At present 79% of households use mains (natural) gas as their heating fuel, 12% of households use electric heating, 7% oil and the remainder use other fuels.

8.1.3 The energy efficiency of Scotland's homes has improved in recent years. In 2015, around two-fifths of homes achieved an EPC rating of Band C or above. Scotland now has proportionately 40% more homes with the top three EPC ratings (A-C) than in England. The Scottish House Condition Survey (SHCS) estimates that in 2015 92% of lofts had 100mm of insulation, while the proportion of insulated cavity walls recorded by the SHCS increased from 62% in 2010 to 71% in 2015. The proportion of solid wall dwellings with insulation was 11%.

8.2 Our ambition

Figure 7: Residential carbon envelopes



8.2.1 The Scottish Government has designated energy efficiency as a National Infrastructure Priority, the cornerstone of which will be Scotland's Energy Efficiency Programme (SEEP). By 2032, through SEEP, Scotland's housing stock will be significantly transformed so that, where technically feasible, all homes will have lofts and walls insulated to the maximum recommended level, and the heating systems will be highly efficient, making our homes warmer and easier to heat. From the mid-2020s we will have stepped up the deployment of low carbon and renewable heating systems, meaning that by 2032 the majority of homes will be connected to low carbon heating systems. This means that in the future an increasing proportion of homes will be connected to renewable and low carbon heating, including district heating and heat pumps, rather than using natural gas.

8.2.2 Over their lifetime, our programmes and policies will have supported thousands of jobs across Scotland and created a substantial Scottish market and supply chain for energy efficiency and renewable heat services and technologies. Furthermore, by improving the energy efficiency of homes across Scotland households will save hundreds of millions of pounds on their fuel bills over the lifetime of the plan helping to maximise disposable incomes – money which could be recycled into local economies – and will also have helped to regenerate communities by improving the appearance of the built environment, as well as contributing to improving health and early years outcomes through people living in warmer homes.

8.2.3 To help guide us towards our ambition and meeting our climate change targets we set the following milestones out to 2050:

- Where technically feasible by 2020 60% of walls will be insulated and 70% of lofts will have at least 200mm of insulation.
- By 2032, 80% of domestic buildings' heat[38] is supplied using low carbon technologies[39], where technically feasible, and will be insulated to the maximum appropriate level.
- By 2050, all buildings across Scotland will be near zero carbon – homes will be highly efficient and the heat supply will be largely decarbonised.

38 Relates to space heating

39 This includes the electrification of heat. Currently, around 12% of domestic buildings' heat is supplied using electricity which, over time, will see an increase in the low carbon feedstock.

8.2.4 This compares to a 2015 starting position of 57% of walls insulated, 64% of lofts having 200mm of insulation, around 2% of homes heated by low carbon technologies and fuel and almost negligible zero carbon homes.

8.3 Policy outcomes, policies, development milestones and proposals

Policy outcome 1: Improvements to the fabric of Scotland's domestic buildings results in a 6% reduction in their heat demand by 2032.[40]

There are five policies, five policy development milestones and one proposal which will contribute to the delivery of policy outcome 1.

Policies which contribute to the delivery of policy outcome 1

1) Energy Company Obligation – UK Government scheme which delivers energy efficiency measures across households in Great Britain. From 2017 the scheme will be worth £640 million per annum across Great Britain and is committed out to March 2022. Limited powers over the design and delivery of ECO have been devolved to Scottish Ministers under the Scotland Act 2016 with consideration of how best to use these new powers to be taken forward as part of SEEP.
2) Home Energy Efficiency Programmes for Scotland (HEEPS) – Scottish Government has allocated £114 million in the draft budget for 2017/18 to support delivery of over 14,000 energy efficiency measures by March 2018. Our funding will continue to help bring together a range of funding streams (including our area-based schemes, Warm Homes Scotland and HEEPs loans) and help to lever maximum investment under the Energy Company Obligation in Scotland.
3) Scotland's Energy Efficiency Programme Pilots – Scottish Government awarded £9 million funding in 2016/17 and will make available further funding to support pilots in 2017/18 to test innovative delivery mechanisms for energy efficiency and low carbon heat.
4) Social landlords will meet the Energy Efficiency Standard for Social Housing in 2020.
5) Smart Meter roll out – the UK Government is committed to ensuring that every home and business in the country is offered a smart meter by 2020, providing the opportunity for a greater understanding of final energy consumption we are keen to ensure an effective rollout of smart meters and that it occurs in such a way as to maximise benefits to consumers – particularly those who are vulnerable or in fuel poverty.

Policy development milestones which contribute to the delivery of policy outcome 1

8.3.1 Energy Efficiency was designated as a national infrastructure priority in June 2015. In that context, the Programme for Government commits the Scottish Government to significant policy development on heat and energy efficiency improvements in buildings across Scotland. Scotland's Energy Efficiency Programme (SEEP) is a long-term programme to improve the energy efficiency and reduce the environmental impact of Scotland's domestic and non-domestic buildings. It will build on our existing successful delivery programmes and include the development of a package of actions, across the following themes that will contribute to the delivery of the policy outcome:

1) Regulation and Standards
2) Financial Incentives
3) Advice and Information
4) Delivery Programmes
5) Evidence and Evaluation

40 Fabric improvements relate to the installation of insulation.

8.3.2 In the Programme for Government, Scottish Ministers committed to £0.5 billion for SEEP over four years from 2017/18. The Scottish Government will undertake initial consultation on the design of delivery programmes within SEEP in early 2017, alongside consultation on the Energy Strategy, and will publish a SEEP Routemap in 2018 alongside the launch of the programme. The Programme for Government also committed to bring forward a consultation on minimum energy efficiency standards in the private rented sector in early 2017.

Proposal which contributes to the delivery of policy outcome 1

1) Regulation: Review of energy standards within building regulations – to investigate topics that offer the potential for abatement from new homes and where work is undertaken on existing homes.

Policy outcome 2: By 2032 80% of domestic buildings' heat[41] is supplied using low carbon heat technologies[42].

There are five policies, five policy development milestones and one proposal which will contribute to the delivery of policy outcome 2.

Policies which contribute to the delivery of policy outcome 2

1) Renewable Heat Incentive – delivers renewable heat technologies until 2020/21, with uptake supported by advice and loan schemes such as the Home Energy Scotland Renewables Loan.
2) District Heating Loan Fund and Heat Network Partnership Policy.

Policy development milestones which contribute to the delivery of policy outcome 2

8.3.3 Energy Efficiency was designated as a national infrastructure priority in June 2015. In that context, the Programme for Government commits the Scottish Government to significant policy development on heat and energy efficiency improvements in buildings across Scotland. Scotland's Energy Efficiency Programme (SEEP) is a long term programme to improve the energy efficiency and reduce the environmental impact of Scotland's domestic and non-domestic buildings. It will build on our existing successful delivery programmes and include the development of a package of policies, across the following themes that will contribute to the delivery of the policy outcome:

1) Regulation and Standards
2) Financial Incentives
3) Advice and Information
4) Delivery Programmes
5) Evidence and Evaluation

8.3.4 In the Programme for Government, Scottish Ministers committed to making available £500 million for SEEP over the next four years. The Scottish Government will undertake initial consultation on the design of delivery programmes within SEEP in early 2017, alongside consultation on the Energy Strategy. As part of this consultation, we will consult specifically on regulation of district heating. The Scottish Government will publish a SEEP Routemap in 2018.

41 Relates to space heating

42 This includes the electrification of heat. Currently, around 12% of domestic buildings' heat is supplied using electricity which, over time, will see an increase in the low carbon feedstock.

Proposal which contributes to the delivery of policy outcome 2

1) Develop and identify best approach to the long-term decarbonisation of the heat supply, to commence after 2025. We intend to include a proposal on how we may realise this potential, in a future Climate Change Plan, taking into account decisions that the UK Government will take on the future of the gas network and the outcomes of the consultation on the draft Energy Strategy.

8.3.5 Full details of policies, policy development milestones and proposals are set out in the tables below. The delivery of these will be tracked through the monitoring framework (see section 6).

8.4 Wider impacts

8.4.1 The following co-benefits and adverse side effects have been identified for the residential sector:

Co-benefits to be realised

8.4.2 Support through SEEP for investment to improve the energy efficiency of domestic buildings will help to make the homes of people across Scotland easier to heat, enabling households to reduce fuel bills and tackle fuel poverty. There is also evidence to suggest that improving the energy efficiency of homes will improve health outcomes – both physical and mental – particularly among households affected by fuel poverty. Through SEEP we will continue to provide support to tenants living in rented accommodation, who are not always in a position to take action themselves to improve the energy efficiency of their homes. This will build on the successes of our Home Energy Efficiency Programmes for Scotland and the Energy Efficiency Standard for Social Housing. We will consult specifically on minimum energy efficiency standards for privately rented homes in early 2017.

8.4.3 Improving the energy efficiency of homes will also help households collectively to save hundreds of millions of pounds on their fuel bills over the lifetime of this Climate Change Plan, money which is then available to be recycled into local economies. Some of the measures needed to improve a building's energy efficiency, e.g. external wall insulation, lead to changes to its outward appearance, which contribute to community regeneration objectives.

8.4.4 SEEP will help to support jobs and businesses within the local and national economy. Scottish Government analysis suggests that for every £100 million spent on energy efficiency improvements in 2017, approximately 1,000 full-time equivalent jobs are supported across the Scottish economy. SEEP will help to realise economies of scale, thereby helping to drive down the cost of energy efficiency measures. There will be opportunities for SMEs and third sector organisations to deliver and/or support the delivery of energy efficiency measures.

8.4.5 These proposals will affect the majority of households, however they will most positively affect those households living in poverty, both in rural and urban areas, who struggle to pay their bills, and who spend more time at home or where they require higher indoor temperatures, including:

- retired households
- households where one or more members is living in poor health or with a disability
- households with young children not of school age who are cared for at home

8.4.6 The energy bills savings will most positively affect those households living in poverty, both in rural and urban areas, who struggle to pay their bills.

8.4.7 SEEP's delivery programmes will be designed to emphasise cost-effective energy efficiency and heat decarbonisation measures that reduce energy bills and enhance competitiveness. Scottish Government grants will continue to target low income and fuel poor households as has been the focus through our Home Energy Efficiency Programmes for Scotland to date. SEEP will also develop a range of support and incentives, including loans for households able to make a contribution.

Adverse side effects to be managed

8.4.8 If the capital costs of improving the energy performance of domestic buildings and of installing low carbon heat technologies, and the operating costs of running them, are higher than current systems, then households could find energy bills are less affordable, which could have adverse effects on fuel poverty. Current energy prices mean that gas is the cheapest heating fuel for many households. Running costs for heating homes in the future will depend greatly on energy prices at that time which cannot be predicted with certainty in the long term.

8.4.9 Any increase in running costs is mostly likely to have adverse effects on households already living in poverty, particularly those households that spend on average more time at home, including households where members are retired, living with a disability or have young children cared for at home as well as households living in the least energy efficient homes.

8.4.10 Scottish Government grants will therefore continue to target low income and fuel poor households, as has been the focus through our Home Energy Efficiency Programmes for Scotland to date. SEEP will also develop a range of support and incentives, including loans for households able to make a contribution.

8.4.11 The Scottish Government will work with end users and delivery partners to ensure that SEEP's delivery programmes will be designed to emphasise cost-effective energy efficiency and heat decarbonisation measures that reduce energy bills and enhance competitiveness. We will work with households on how to ensure SEEP supports these cost-effective measures, including on evidence and evaluation where needed.

8.5 Summary of policies, development milestones and proposals

Policy outcome 1: Improvements to the fabric of Scotland's domestic buildings results in a 6% reduction in their heat demand by 2032[43]

Table 8-1: Policies which contribute to the delivery of policy outcome 1

Policy	EU, UK or Scottish policy	Public sector partners	Delivery route
Energy Company Obligation – from April 2017 worth £640 million per annum across Great Britain – delivers energy efficiency measures to homes across Scotland until March 2022	UK		ECO requires obligated energy supply companies to deliver energy efficiency measures to homes – mainly insulation based measures and boiler replacements. It is funded via a levy on energy bills and from April 2017 will be worth £640 million per annum across Great Britain and is a market-based mechanism allowing for delivery where it is most cost effective. Historically, 11.5% of measures have been delivered in Scotland, exceeding our population share. Limited powers over the design and delivery of ECO have been devolved to Scottish Ministers under the recent Scotland Act.
We have allocated £114 million in the 2017/18 draft budget to our Home Energy Efficiency Programmes for Scotland (HEEPS) to support delivery of over 14,000 energy efficiency measures by March 2018	Scottish	Local Authorities; Registered Social Landlords	The Home Energy Efficiency Programmes for Scotland (HEEPS) include: • Area-based Schemes – designed and delivered by Local Authorities in areas at risk of fuel poverty. The schemes install a range of energy efficiency measures, predominantly solid wall insulation, and are targeted toward areas vulnerable to fuel poverty. • Loans – offered at zero interest and available to both Registered Social Landlords, to enable them to improve the energy efficiency of their properties and assist some of our most vulnerable households, and all private sector households to help spread the upfront cost of investing in energy efficiency improvements. • Warmer Homes Scotland – our national fuel poverty programme – worth up to £224 million over seven years, which helps vulnerable households make their homes warmer and more comfortable by installing energy efficiency and heating measures. It is available to households no matter where they live and is accessed via Home Energy Scotland (the Scottish Government programme that provides a network of local advice centres covering all of Scotland offering free impartial advice on energy savings).

43 Fabric improvements relate to the installation of insulation.

Policy	EU, UK or Scottish policy	Public sector partners	Delivery route
Provide £9 million funding to support SEEP Pilots in 2016/17 and make available further funding to support pilots in 2017/18 to test innovative delivery mechanisms for energy efficiency and low carbon heat	Scottish	Local Authorities	Pilot projects funded to test innovative approaches to integrated, area-based energy efficiency and heat decarbonisation programmes across domestic and non-domestic sectors from 2016-20. Will be evaluated and contribute evidence to support the design of SEEP.
Energy Efficiency Standard for Social Housing (EESSH)	Scottish	Local Authorities and Registered Social Landlords	Introduced in 2014 social landlords must ensure their properties meet the first milestone for minimum energy efficiency standards by 2020. Standards are based on Energy Performance Certificate (EPC) Energy Efficiency Rating and vary by property type. EESSH will be reviewed in 2017 and the review will consider progress towards both the 2020 milestone and further milestone(s) towards 2050.
All homes to be offered a smart meter by 2020	UK		The UK Government is committed to ensuring that every home and business in the country is offered a smart meter by 2020, and to delivering this as cost effectively as possible. Smart meters provide the opportunity for a greater understanding of final energy consumption; an accurate metering and billing system which eradicates estimated bills; the potential for positive behavioural change and a reduction in energy costs; as well as creating opportunities for innovation. The smart meter rollout is a supplier-led obligation.

Table 8-2: Policy development milestones which contriubte to the delivery of policy outcome 1

Policy development milestone	Delivery route
SEEP – Regulation and Standards	The Programme for Government commits the Scottish Government to consult on regulation and standards for energy efficiency and for heat. This includes a commitment to consult on the phased regulation of existing buildings, and to look at financial incentives. The Scottish Government will undertake initial consultation on the wider role of regulation and standards within SEEP in early 2017, alongside consultation on the Energy Strategy, and this will then inform future programme development. We will consult specifically on regulation of district heating and will also consult on minimum energy efficiency standards for privately rented homes in early 2017.
SEEP – Financial Incentives	The Programme for Government delivers the Infrastructure Investment Plan 2015 commitment to long-term multi-year financing for SEEP, and includes a commitment to £0.5 billion for SEEP over the first four years of the programme. Availability of loan finance, grants and appropriate incentives introduced at the right times will be necessary to stimulate the market for investment or to help building owners and tenants to meet energy efficiency or heat standards set by regulation. The Scottish Government will undertake initial consultation on the role of financial incentives within SEEP in January 2017, alongside consultation on the Energy Strategy, and this will then inform future programme development. Limited powers over the design and delivery of ECO have been devolved to Scottish Ministers under the recent Scotland Act. Consideration of how best to use these new powers will be taken forward as part of SEEP.
SEEP – Advice and Information	Our existing advice and support services for residential (Home Energy Scotland), business and public sectors (Resource Efficient Scotland) will continue to deliver during the design phase of SEEP. As SEEP develops over the longer term, we will consider the future provision of advice and information to homes, businesses, and the public sector, to support them in improving the energy efficiency and decarbonising the heat supply of their buildings. The Scottish Government will undertake initial consultation on the role of advice and information within SEEP in January 2017, alongside consultation on the Energy Strategy, and this will then inform future programme development.
SEEP – Delivery Programmes	SEEP will build on our existing successful delivery programmes for domestic and non-domestic buildings by developing new, integrated programmes to offer advice, information, financial incentives, and access to managed, trusted installers, to building owners and tenants. The eventual delivery programmes will build on the evidence and lessons learned from existing programmes and from pilot projects, such as the £9.1 million announced in September 2016. The Scottish Government will undertake initial consultation on the design of delivery programmes within SEEP in January 2017, alongside consultation on the Energy Strategy, and this will then inform future programme development.
SEEP – Route Map	The Scottish Government will publish a SEEP Route Map in 2018 setting out the steps we will take to deliver our commitments on energy efficiency and low carbon heat.

Table 8-3: Proposals which contribute to the delivery of policy outcome 1

Proposal	Delivery route
Regulation – Review of energy standards within building regulations	Staged improvements to energy standards within building regulations have resulted in emissions from new homes built to current standards being, on aggregate, around 75% lower than those built to standards in force in 1990. A further review of energy standards will commence in 2017 and will investigate a number of topics that offer the potential for further abatement from new homes and where work is undertaken in existing homes.

Table 8-4: Policy outcome 1 over time

Policy outcome 1	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Number of insulation measures installed as a consequence of policies listed above to reduce heat demand	45,000	32,000	32,000	32,000	32,000	32,000	0	0	0	0	0	0	0	0	0	0
Number of insulation measures installed as a consequence of proposals listed above (once policies) to reduce heat demand	0	58,000	58,000	58,000	58,000	58,000	90,000	90,000	90,000	90,000	90,000	90,000	90,000	90,000	90,000	90,000
Total change in policy outcome as a result of policies and proposals	45,000	90,000	90,000	90,000	90,000	90,000	90,000	90,000	90,000	90,000	90,000	90,000	90,000	90,000	90,000	90,000

Policy outcome 2: By 2032 80% of domestic buildings' heat[44] is supplied using low carbon heat technologies[45].

Table 8-5: Policies which contribute to the delivery of policy outcome 2

Policy	EU, UK or Scottish policy	Public sector partners	Delivery route
Renewable Heat Incentive delivers renewable heat technologies until 2020/21, with uptake supported by: Advice and loan schemes such as the Home Energy Scotland Renewables Loan scheme, which help households to identify renewable heat technologies and provide the capital they require to access the regular payments available from the RHI once the renewable heat technology has been installed	UK Scottish		The Renewable Heat Incentive is a UK-wide scheme created by the UK Government (with the agreement of the Scottish Government). The domestic RHI was launched in April 2014 and provides financial support to the owner of the renewable heating system for seven years. The non-domestic RHI provides finance to the owner of the renewable heat technology for 20 years, including where this is supplied to householders through district heating schemes. The scheme covers England, Wales and Scotland and is targeted at – but not limited to – off-gas heat use. There is no commitment to funding the RHI beyond 2020/21 and during the development of SEEP we will consider what sort of funding mechanisms are needed into the 2020s and 2030s to enable continued take-up of these technologies. Uptake is supported by Scottish Government programmes providing advice, such as Home Energy Scotland Specialist Advisors providing in-house visits, and loan finance including the Home Energy Scotland Renewables Loan (HESRL) scheme.
District Heating Loan Fund	Scottish	Local Authorities, Scottish Enterprise, Scottish Futures Trust, and agencies delivering SG programmes	The District Heating Loan Fund helps address the financial and technical barriers to district heating projects by offering low interest loans. The scheme is open to local authorities, registered social landlords, small and medium sized enterprises and energy services companies with fewer than 250 employees. During the development of SEEP, we will consider what sort of funding mechanisms are needed to continue to support the expansion of district heating networks. As noted above these programmes will be reviewed as part of the SEEP development work which initially focusses on delivering existing programmes more effectively, trailing new innovative approaches and designing new policies to support delivery.
Heat Network Partnership			The Heat Network Partnership is a collaboration of agencies focused on the promotion and support of district heating schemes in Scotland. Through its support to local authorities and practitioners, it is building capacity and project development capability to support heat planning and programme delivery work that will be developed by local authorities, the Scottish Government and its partners, as part of the wider SEEP programme in future.

44 Includes both space heating

45 This includes the electrification of heat. Currently, around 12% of domestic buildings' heat is supplied using electricity which, over time, will see an increase in the low carbon feedstock.

Table 8-6: Policy development milestones which contribute to the delivery of policy outcome 2

Policy development milestone	Delivery route
SEEP – Regulation and Standards	The Programme for Government commits the Scottish Government to consult on regulation and standards for energy efficiency and for heat. This includes a commitment to consult on the phased regulation of existing buildings, and to look at financial incentives. The Scottish Government will undertake initial consultation on the wider role of regulation and standards within SEEP in January 2017, alongside consultation on the Energy Strategy, and this will then inform future programme development. As part of this consultation, we will consult specifically on regulation of district heating.
SEEP – Financial Incentives	The Programme for Government builds on the Infrastructure Investment Plan 2015 commitment to long-term multi-year financing for SEEP, and includes a commitment to £0.5 billion for SEEP over the next four years. Availability of loan finance, grants and appropriate incentives introduced at the right times will be necessary to stimulate the market for investment or to help building owners and tenants to meet energy efficiency or heat standards set by regulation. The Scottish Government will undertake initial consultation on the role of financial incentives within SEEP in January 2017, alongside consultation on the Energy Strategy, and this will then inform future programme development. Through this programme we will also consider impacts of UK Government's GB subsidy regime beyond the potential end of the RHI in 2020/21, particularly on off gas grid and vulnerable households; including how any changes can be mitigated to maintain uptake of low carbon heat technologies.
SEEP – Advice and Information	Our existing advice and support services for residential (Home Energy Scotland), business and public sectors (Resource Efficient Scotland) will continue to deliver during the design phase of SEEP. As SEEP develops over the longer term, we will consider the future provision of advice and information to homes, businesses, and the public sector, to support them in improving the energy efficiency and decarbonising the heat supply of their buildings. The Scottish Government will undertake initial consultation on the role of advice and information within SEEP in January 2017, alongside consultation on the Energy Strategy, and this will then inform future programme development.
SEEP – Delivery Programmes	SEEP will build on our existing successful delivery programmes for domestic and non-domestic buildings by developing new, integrated programmes to offer advice, information, financial incentives, and access to managed, trusted installers, to building owners and tenants. The eventual delivery programmes will build on the evidence and lessons learned from existing programmes and from pilot projects, such as the £9.1 million announced in September 2016. The Scottish Government will undertake initial consultation on the design of delivery programmes within SEEP in January 2017, alongside consultation on the Energy Strategy, and this will then inform future programme development.

Policy development milestone	Delivery route
SEEP – Route Map	The Scottish Government will publish a SEEP Route Map in 2018 setting out the steps we will take to deliver our commitments on energy efficiency and low carbon heat.

Table 8-7: Proposals which contribute to the delivery of policy outcome 2

Proposal	Delivery route
Develop and identify best approach to the long-term decarbonisation of the heat supply, to commence after 2025	We will work with our partners, including the UK Government, Local Authorities and utility providers to determine the best approach to heat decarbonisation for buildings currently heated by natural gas which are not in areas of sufficient heat demand where district heating is a low regrets option. This will include consideration of technological solutions, including district heating, electric heat pumps, repurposing of the gas network for use of biogas and/or hydrogen, etc. We will look to put forward a more detailed proposal on how we will realise this potential in subsequent Climate Change Plans as our understanding of the best approach develops. The Gas Network is reserved to the UK Government (whatever gas is transported through those pipes): The UK Government is developing work considering long term heat decarbonisation – post 2030. This will over the coming years gather evidence and analysis and try to fill key gaps relating to options such as future of the gas grid, electrification of heat and district heating and the significant impacts on infrastructure requirements that picking one or a mix of these options would have. Policy decisions are not expected to be made by the UK Government until the next parliament. i.e. from 2020.

Table 8-8: Policy outcome 2 over time

Policy outcome 2	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
By 2032 80% of domestic buildings' heat[46] is supplied using low carbon heat technologies[47], and are near zero carbon				18%					18%							80%

46 Includes both space heating

47 This includes the electrification of heat. Currently, around 12% of domestic buildings' heat is supplied using electricity which, over time, will see an increase in the low carbon feedstock.

8.6 Progress since RPP2

Table 8-9: Progress on RPP2 policies

RPP2 Policies	Summary of progress
Smart Meters	The UK Government is committed to ensuring that every home and business in the country is offered a smart meter by 2020, and to delivering this as cost effectively as possible. Smart meters provide the opportunity for a greater understanding of final energy consumption; an accurate metering and billing system which eradicates estimated bills; the potential for positive behavioural change and a reduction in energy costs; as well as creating opportunities for innovation. The rollout has commenced and 4.2 million meter installations have taken place across GB. However some meters being rolled out do not meet the highest specification due to delays by the Data and Communications Company, who provide the communications platform for the technology. The Scottish Government supports the aims of the smart meter roll-out, however, we continue to press the UK Government to ensure that the programme is delivered to the greatest number of Scottish consumers, at the lowest possible cost, whilst enhancing the benefits to the most vulnerable in our society and those at risk of fuel poverty.
Domestic Building Energy Standards (2010) New Build Properties	Policy was implemented on 1 October 2010 and results in lower emissions from new buildings. Standards set under this policy were further strengthened by a subsequent review which introduced further improvements to energy standards in October 2015 (see RPP2 proposals). Improved energy standards encourage both innovation and the deployment of low carbon solutions in construction.
Renewable Heat Incentive (Domestic)	The Renewable Heat Incentive (RHI) is a UK Government scheme established to encourage uptake of renewable heat technologies amongst householders, communities and businesses through financial incentives. The non-domestic RHI scheme was launched in November 2011 and the domestic scheme was launched in April 2014. Through its various programmes, the Scottish Government fully endorses and actively promotes the GB-wide RHI scheme to the benefit of householders and businesses across Scotland. Scotland currently accounts for 19% and 21% of all GB non-domestic and domestic accreditations respectively; well above pro-rata. In March 2016, the UK Government published a consultation to seek feedback on proposed reforms to both schemes. The UK Government is currently assessing the response and are expected to implement their chosen reforms in spring 2016.
Energy Company Obligation and Green Deal	The Energy Company Obligation and the Green Deal are UK Government schemes introduced in 2013 to improve the energy efficiency of homes in Great Britain. ECO is currently worth around £820 million per annum across GB, reducing to around £640 million pa from April 2017. UK Government changes have reduced its value by over 50% since it was introduced. Scotland has received more than its proportionate share of ECO measures, with latest statistics showing that as of June 2016 it has received just over 220,000 measures, representing 11.5% of all measures installed compared to a household population share of 9.2%. The UK Government ceased funding for the Green Deal Finance Company in July 2015, effectively bringing end to the Green Deal which significantly underperformed against all expected predictions.
Home Energy Efficiency Programmes for Scotland	Our Home Energy Efficiency Programmes for Scotland (HEEPS) has made available almost £400 million since 2013 (including the budget for 2017/18) in tackling fuel poverty and improving the energy efficiency of Scotland's housing stock. It has also leveraged additional funding from the Energy Company Obligation and the public sector of well over £300 million to date. Including 2016-17 activity, over 100,000 households in Scotland will have received an energy efficiency install through HEEPS contributing to a reduction in domestic CO_2 emissions and helping to save millions of pounds from fuel bills.

RPP2 Policies	Summary of progress
Warm Homes Fund	The Warm Homes Fund operated from the end of 2012 to March 2015, and during that time supported five renewable energy projects (including district heating) with loan funding of £2.36 million, and gave 48 development grants totalling £626,000. Take up of the loans was lower than expected. Loans for district heating remain available through the District Heating Loan Scheme.
District Heating Loan Fund	Since 2011, the District Heating Loan Fund has offered capital loans to support the development of district heating networks in Scotland. The scheme is available to provide loans for both low carbon and renewable technologies in order to overcome a range of technical and cost barriers. To date, we have offered over £10 million in loans to over 40 projects. These include our first £1 million loan to Aberdeen Heat and Power, announced in February 2015. In March 2016 the then Minister for Business, Energy and Tourism, Mr Fergus Ewing MSP, announced a further £7 million for investment in district heating for the 2016/17 financial year, which brings the total Scottish Government investment in district heating to over £17 million.

Table 8-10: Progress on RPP2 proposals

RPP2 Proposals	Summary of progress
Domestic Buildings Energy Standards (2014) New Build Properties	Proposal is now a policy, implemented in October 2015 and delivering intended outcomes. Emissions from new homes are now in the region of 75% lower than for buildings constructed to the standards applicable in 1990. Standards continue to encourage both innovation and the deployment of low carbon solutions in construction but show poorer cost/benefit as performance sought is more challenging.
Regulation of Private and Social Housing	The Energy Efficiency Standard for Social Housing was introduced in 2013, setting minimum energy efficiency standards for landlords to meet in 2020. A review of the Energy Efficiency Standard for Social Housing is scheduled for 2017/18. Due to UK Government changes to the UK Government funding landscape for energy efficiency in 2015, Scottish Ministers took the decision to postpone a consultation on minimum energy efficiency standards for private housing. The Programme for Government commits Scottish Government to consulting on minimum energy efficiency standards for privately rented sector homes in early 2017.
Continuation of Home Energy Efficiency Programmes for Scotland	Ministers designated energy efficiency as a National Infrastructure Priority in June 2015. This commitment was confirmed in the Infrastructure Investment Plan 2015 and the recent Programme for Government. Scotland's Energy Efficiency Programme will be the cornerstone of the infrastructure priority and will transform our approach to energy demand reduction and decarbonisation of the heat supply across the domestic and non-domestic sectors. These proposals have been superseded by Scotland's Energy Efficiency Programme, which is in development.
Low Carbon Heat (Domestic)	
Additional Technical Potential through improvements to carbon efficiency of housing stock	

9. Transport

The Transport sector covers all transport modes in Scotland, including public transport, freight, aviation, shipping, private motoring, active travel and the regulations, policies and infrastructure designed to support all of these.

9.1 Where we are now

Figure 8: Transport historical emissions

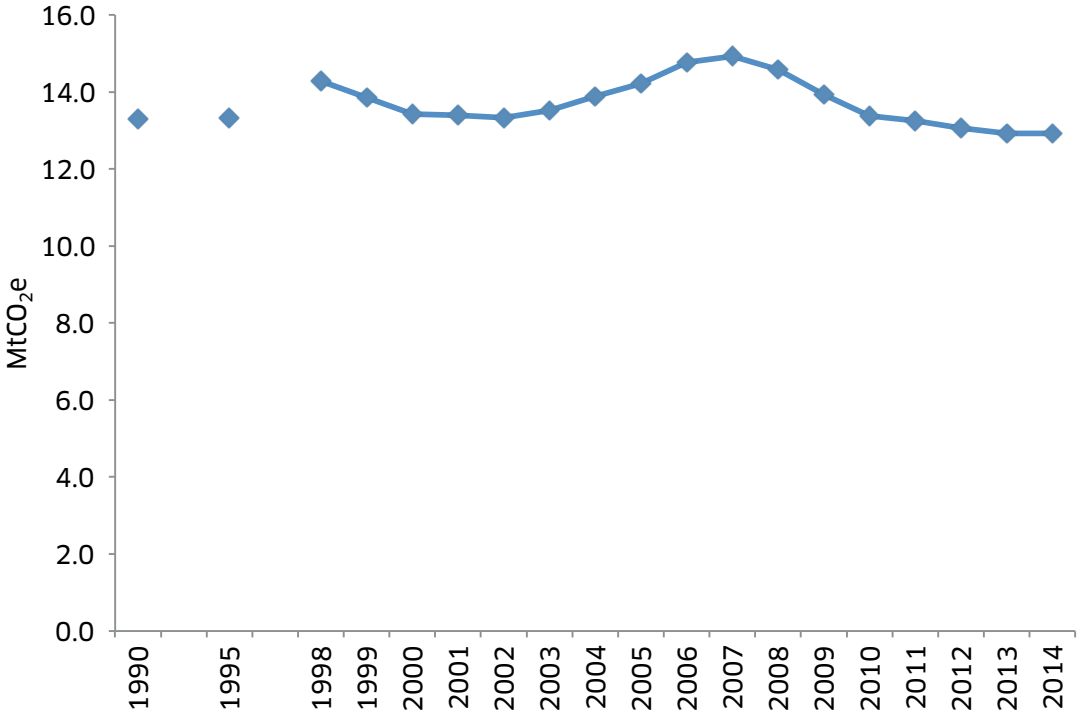
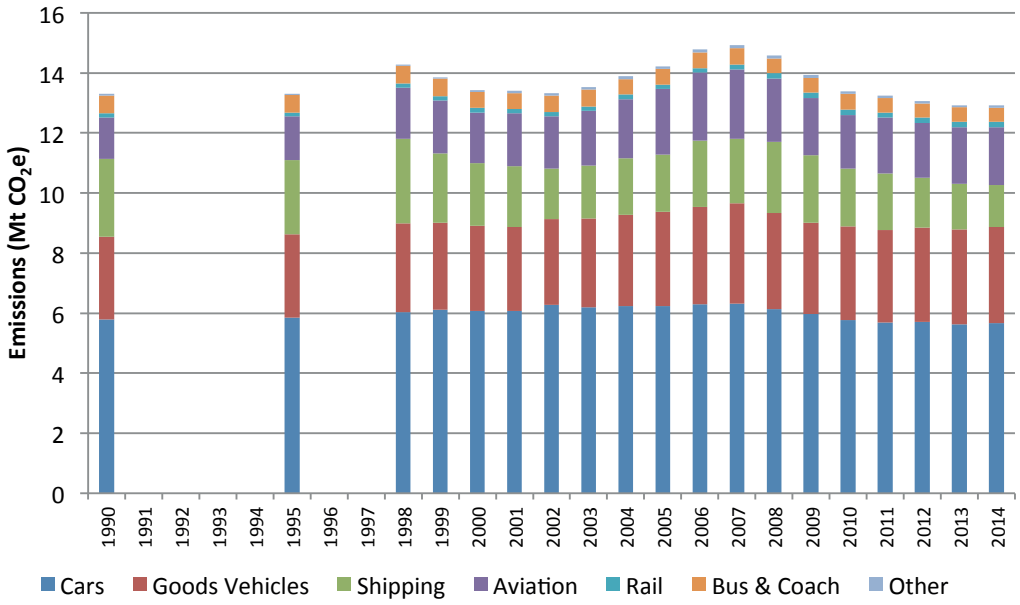


Figure 9: Scottish transport emissions by mode, 1990 – 2014



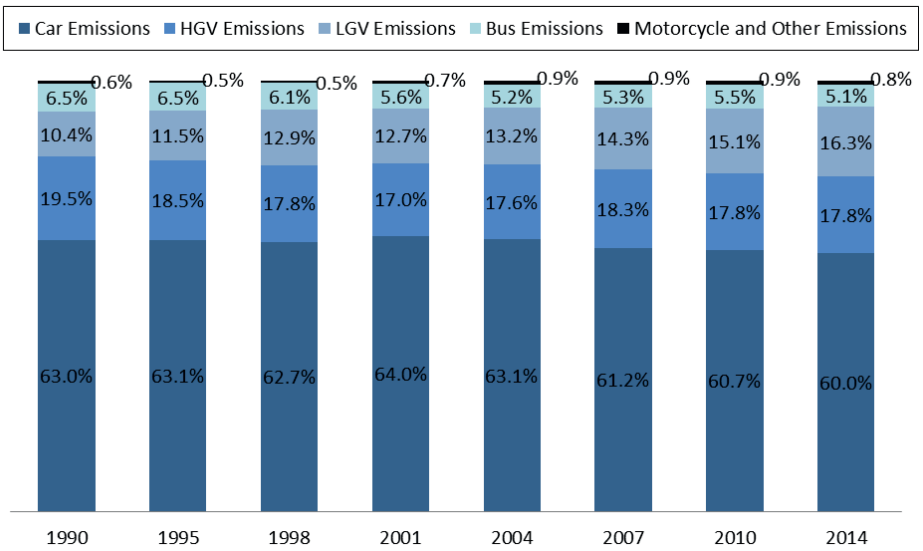
9.1.1 In 2014, transport emissions (including those from international aviation and shipping) amounted to 12.9 $MtCO_2e$, marginally below the 1990 baseline figure of 13.3 $MtCO_2e$. Currently, transport accounts for 28% of total Scottish emissions[48]. Within that long-term profile, we have seen significant reductions more recently: since transport emissions peaked at 14.9 $MtCO_2e$ in 2007, they have fallen year on year by a total of 2.0 $MtCO_2e$. This is a 13% reduction in seven years.

9.1.2 The composition of the numbers has changed significantly. For example, in 2014 demand for all road transport stood at 44.8 billion kilometres, as compared to 36.5 billion kilometres in 1995. This 22% increase in demand has been offset by significant improvements in vehicle efficiencies, combining to produce the broadly static but now reducing emissions figures.

Road transport emissions

9.1.3 The largest contributor to transport emissions is the road sector. In combination, cars, lorries, vans, buses and motor cycles accounted for 9.4 $MtCO_2e$ in 2014 (73% of total transport emissions). This compares with 9.2 $MtCO_2e$ in 1990.

Figure 10: Road transport emissions, 1990 – 2014



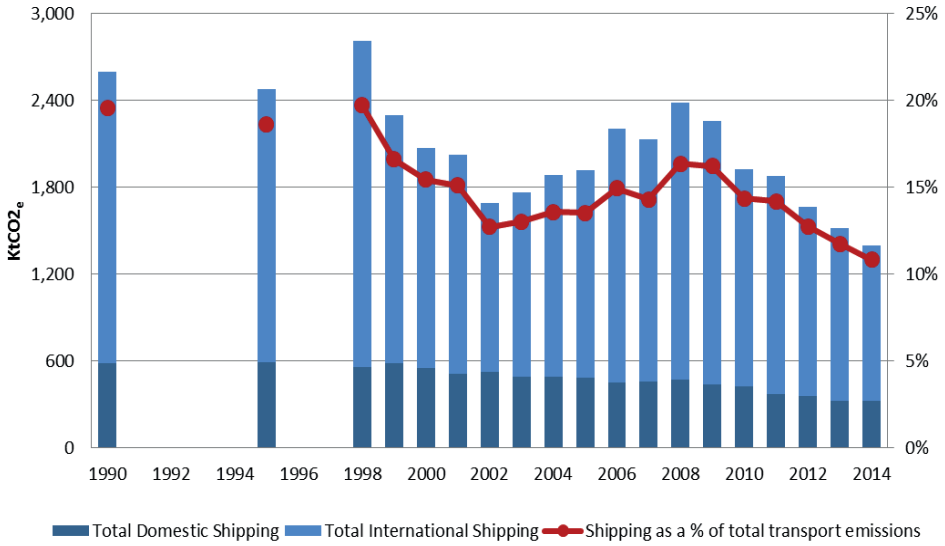
Maritime emissions

9.1.4 Emissions from maritime transport[49] in 2014 are estimated to be 1.4 $MtCO_2e$, or 11% of total transport emissions. This compares to 2.6 $MtCO_2e$ in 1990. Within that profile, emissions from international shipping have been volatile, while emissions from domestic shipping have decreased steadily since 1990.

48 Excluding adjustments for the EU Emissions Trading System

49 Includes national navigation and international shipping

Figure 11: Shipping emissions, 1990 – 2014

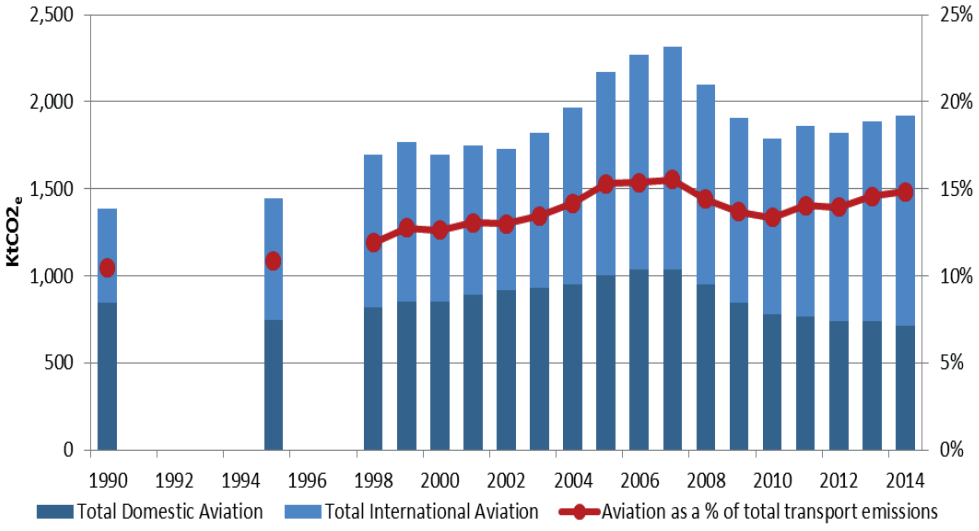


Aviation emissions

9.1.5 In 2014, aviation emissions stood at 1.9 $MtCO_2e$, or 15% of total transport emissions. This compares with 1.4 $MtCO_2e$ in 1990. Passenger numbers in that period increased from just over 10 million to 24 million. The growth in demand of 134% was thus associated with a significantly lower growth in emissions of 38%, reflecting effective efficiency improvements, including increased load factors.

9.1.6 In 2014, international aviation emissions account for 63% of total Scottish aviation emissions, almost the reverse of the proportion in 1990, when it was domestic aviation that accounted for 61% of aviation's emissions total.

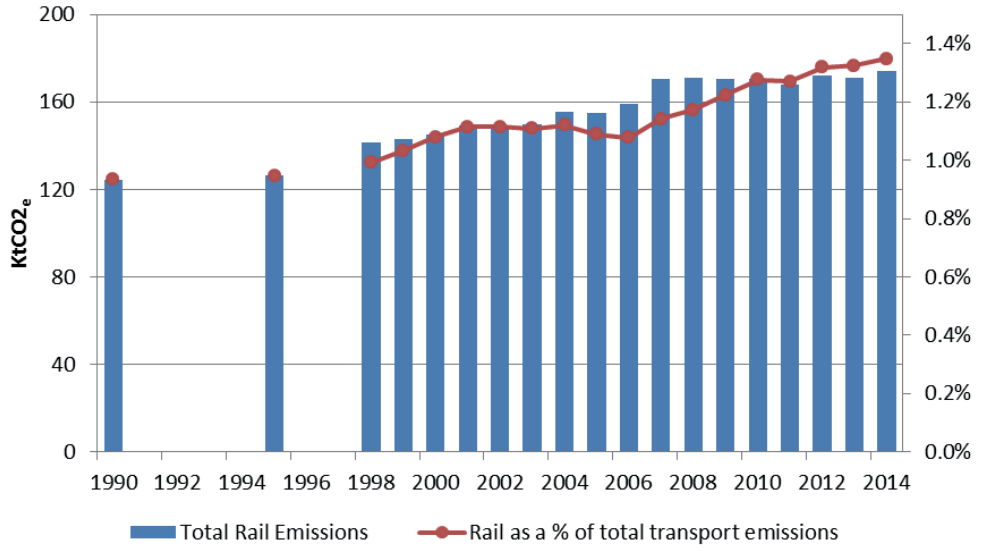
Figure 12: Aviation emissions, 1990 – 2014



Rail emissions

9.1.7 At 0.2 $MtCO_2e$ in 2014, rail accounts for only 1.3% of transport emissions. The 2014 figure is 44% above the equivalent 1990 figure of 0.1 $MtCO_2e$. and rail emissions have followed a generally rising trend over the period 1990 to 2014.

Figure 13: Rail emissions, 1990 – 2014



Active travel

9.1.8 In 2015, 1% of journeys had cycling as the main mode of transport and the average (mean) journey length was 4.7 km. For walking, the equivalent proportion cited in the Scottish Household Survey travel diary was 22%, with 14% of adults usually walking to work and 49% of children usually walking to school as their main mode of transport[50].

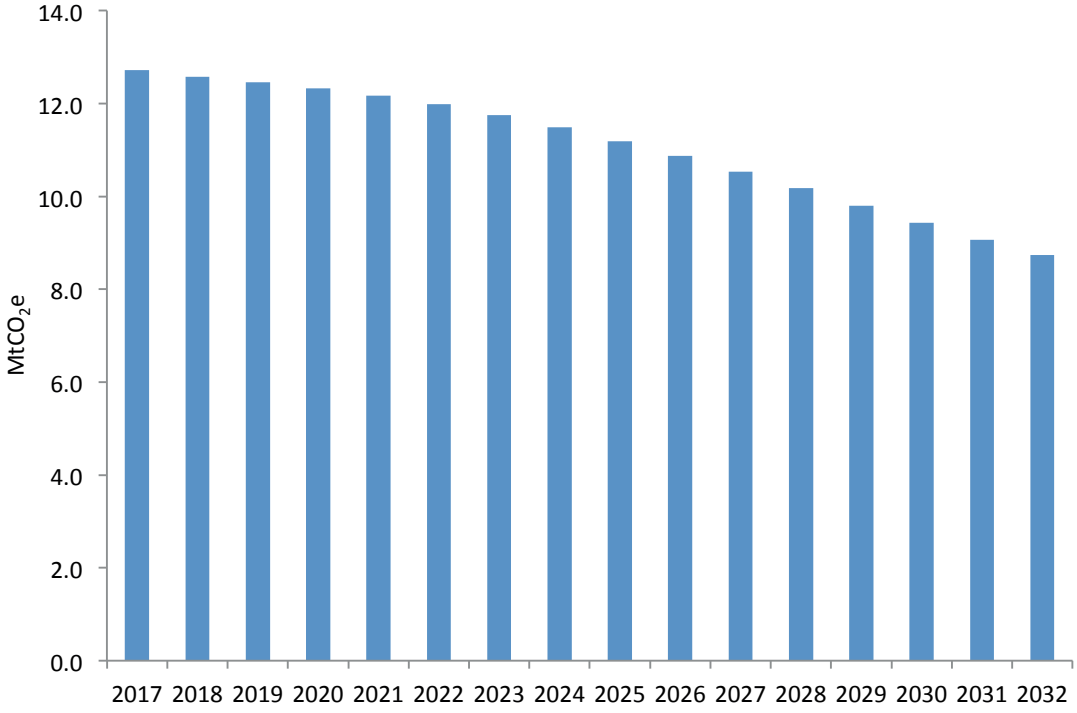
9.2 Our ambition

9.2.1 Our aim is to reduce emissions from transport in ways that promote sustainable environmental and socio-economic wellbeing. As historically, so in future we expect economic and population growth to increase the demand for the movement of goods, services and people. However, we also expect the pace of technological change to accelerate. Together with behaviour changes, that will allow for economic growth, while also reducing emissions significantly.

9.2.2 Future abatement will vary significantly across the individual transport modes. The availability of new technology; the cost of implementing technological, logistical and behaviour change; and the return on such investment will all have a bearing on which particular interventions we prioritise.

50 Transport and Travel in Scotland 2015

Figure 14: Transport carbon envelopes



The role of technology

9.2.3 We have commissioned and will be publishing research from Element Energy: Greenhouse Gas Emissions Reduction Potential in the Scottish Transport Sector from Recent Advances in Transport Fuels and Fuel Technologies.

9.2.4 On the basis of this and other work, we have identified key technological, economic and commercial trends which will form the baseline against which to measure future policy interventions, whether in relation to technology or behaviour change. We will continue to collect and interpret such baseline data. For example, air passenger numbers will be one data source that will allow us to evaluate the impact of changes to Air Passenger Duty (currently thought to be marginal in emissions terms and easily offset by other policy interventions).

9.2.5 A key observation is that, based on market-led technological change alone, we estimate an annual abatement of around 2.5 $MtCO_2e$ by 2035, even allowing for the effects of population and associated economic growth.

Cars

9.2.6 With the conventional car, we expect fuel efficiency improvements of 30% – 40% by 2035; and with hybrids and electric vehicles we expect battery costs to halve and their performance to double incrementally over the period to 2035, with a step-change in market penetration from 2020 onwards.

Road freight

9.2.7 With conventional HGVs, we expect fuel efficiencies around 25% by 2035, based on improved aerodynamics, transmissions and operations. Low carbon HGVs (such as diesel electric and gas powered LNG) will become more common from the mid-2020s.

Shipping

9.2.8 We might expect a 35% improvement in the efficiency of new, larger shipping by 2035, based on hybrid and gas-powered engines, battery-electric engines, and the potential use of assistive technology, such as sails, kite, rotors and aerofoil hulls. Gradual uptake and stock differences mean that this may equate to 10% at the fleet level.

Aviation

9.2.9 We might expect to see a 15% improvement in the efficiency of new aircraft by 2035, based on fleet modernisation, operational improvements, and improved aerodynamics and fabrication techniques (such as the use of composites). Step changes may occur in the 2030s and beyond, based on new engine technology (such as open rotors) and new aircraft designs (such as blended wing technology).

Policy implications

9.2.10 The detailed analysis underpinning these brief summaries suggests that technological change will be transformational, significantly reducing emissions, despite economic and population growth. Supporting such change remains a key priority.

9.2.11 Our research indicates that road transport can contribute most additional abatement, essentially because its high share of emissions is matched by the relative availability of technological and behaviour change interventions.

A future scenario

9.2.12 By 2032 transport emissions should have reduced by 4.2 $MtCO_2e$ or more compared to today.

9.2.13 Low emission cars and vans will be widespread and becoming the norm; low emission HGVs will be more common; a third of the ferries owned by the Scottish Government will be low carbon; aircraft fleets will be on the cusp of radical new designs; and ground operations at airports and ports will already involve low carbon solutions.

9.2.14 As one of several key results, air quality will have noticeably improved; and we will be enjoying the social, health and economic benefits from these improved transport systems.

Infrastructure

9.2.15 By 2035, we expect fully functioning market solutions for low carbon transport. Freight infrastructure will feature more efficient HGVs operating from out-of-town consolidation centres. Plug-in vehicles will be commonplace, with improved battery technology providing longer ranges and infrastructure supporting both electric and hydrogen powered vehicles.

Traffic management

9.2.16 Journeys made on our road network will also be more efficient due to the deployment of Intelligent Transport Systems (designed to ease the flow of traffic) and widespread uptake of fuel efficient driver training.

9.2.17 Low Emission Zones will limit the access of vehicles that exceed emissions benchmarks, while permitting unrestricted access for clean buses, vans and cars, as well as smaller goods vehicles relaying goods from consolidation centres.

9.2.18 Other measures, such as parking policies, will also incentivise public transport and active travel, as well as reducing congestion and contributing to improved air quality.

Wider synergies

9.2.19 Low emission vehicles will also play a role in the wider energy system. Electric and hydrogen vehicles will have a role in energy storage. The adoption of smart technologies could allow battery electric vehicles to play a wider role in balancing the grid.

The ultimate goal

9.2.20 By 2050, Scotland will be free from harmful tailpipe emissions from land transport, with other transport modes decarbonising at a slower pace, resulting in a healthier, more active population.

9.3 Policy outcomes, policies, development milestones and proposals

Policy outcome 1: Average emissions per kilometre of new cars and vans registered in Scotland to reduce in line with current and future EU/UK vehicle emission standards.

There are four policies, two policy development milestones and one proposal that will contribute to the delivery of policy outcome 1.

Policies which contribute to the delivery of policy outcome 1

1) With the EU and UK, negotiate stretching emission standards for new cars (and vans) beyond 2020 (and 2021).
2) With the UK, negotiate vehicle excise duty differentials between ultra-low emission vehicles (ULEVs) and diesel/petrol vehicles to support and encourage the uptake of ULEVs.
3) With the UK, negotiate biofuels policies that will enable them to be used sustainably in the decarbonisation of the whole transport sector.
4) Support fuel-efficient driver training.

Policy development milestones which contribute to the delivery of policy outcome 1

1) With local authorities and others, evaluate the scope for incentivising more rapid uptake of electric and ultra-low emission cars and vans, as through public procurement policies and preferential local incentives (such as access management and parking policies).
2) With local authorities and others, evaluate the scope for urban-wide low emission zones with a specific focus on CO_2 emissions, as well as air pollution more generally.

Proposals which contribute to the delivery of policy outcome 1

1) Collaborate with a local authority to model reductions in congestion and improvements in use of public transport, in possible association with a low emission zone.

Relative significance of policies, policy development milestones and proposals to the delivery of policy outcome 1

9.3.1 Outcome 1 will account for a significant proportion of overall emissions reduction, as cars currently emit 44% of all transport emissions.

Policy outcome 2: Proportion of ultra-low emission new cars and vans registered in Scotland annually to reach or exceed 40% by 2032.

There are six policies, one policy development milestone, and four proposals that will contribute to the delivery of policy outcome 2.

Policies which contribute to the delivery of policy outcome 2

1) With the EU and UK, negotiate stretching emission standards for new cars (and vans) beyond 2020 (and 2021).
2) With the UK, negotiate vehicle excise duty differentials between ultra-low emission vehicles (ULEVs) and diesel/petrol vehicles to support and encourage the uptake of ULEVs.
3) Enhance the capacity of the electric vehicle charging network (ChargePlace Scotland):
   - provide funding until at least August 2019 in order to support the on-going expansion of the publicly available network of EV charge points;
   - provide funding to support the safe and convenient installation of domestic and workplace charge points.
4) Provide interest-free loans through the Energy Saving Trust to enable the purchase of EVs by both consumers and businesses until at least March 2020.

5) With local authorities, review licensing regulations and consider introducing incentives to promote the uptake of ULEVs in the taxi and private hire sector, with loan funding for vehicle purchase until at least March 2020.
6) Promote the benefits of EVs to individuals and fleet operators and increase awareness and confidence in the viability of EVs as an alternative to fossil-fuelled vehicles.

Policy development milestone which contributes to policy outcome 2

1) Work with the UK Government, local authorities and other public and third sector partners to identify annually a package of financial and convenience ULEV incentives, such as free parking, access to LEZs and interaction with proposed workplace parking levies.

Proposals which contribute to the delivery of policy outcome 2

1) Building Standards:
   - consider draft proposals in the Energy Performance of Buildings Directive, relating to the provision of EV charge points/wiring in new residential and commercial developments
   - investigate how such measures could potentially be trialled in Scotland and consider developing guidance on charge point provision to support planning authorities
2) Continue to investigate the role that other alternative fuels, such as hydrogen, gas and biofuel, can play in the transition to a decarbonised road transport sector. Consider the scope for market testing approaches to alternative fuels infrastructure and supply.
3) Work with Scottish Enterprise, the UK government and other bodies to investigate the potential to undertake trials of connected and autonomous vehicles in Scotland.
4) Work with Scotland Excel, COSLA and other partners to determine whether a new procurement policy could be introduced in Scotland, which introduces a presumption that all new vehicles purchased by public sector organisations in Scotland are ULEVs.

Relative significance of policies, policy development milestones and proposals to the delivery of policy outcome 2

9.3.2 Policy outcome 2 will account for a significant proportion of overall emissions reduction, as cars currently emit 44% of all transport emissions.

9.3.3 The policies and proposals under policy outcome 2 are focused on removing some of the key domestic barriers identified to a more rapid take-up of in particular battery electric vehicles. There is a strong read across to the measures in policy outcome 1.

Policy outcome 3: Average emissions per tonne kilometre of road freight to fall by 28% by 2032.

There are four policies, two policy development milestones, and two proposals which will contribute to the delivery of policy outcome 3.

Policies which contribute to the delivery of policy outcome 3

1) With the EU and UK, negotiate an emission standard for Heavy Goods Vehicles from 2025.
2) With the UK, negotiate biofuels policies that will enable them to be used sustainably in the decarbonisation of the whole transport sector.
3) Deliver our Rail Freight Strategy.
4) Continue to support local authorities in delivering the ECO-Stars programme, reducing fuel consumption for HGVs, buses, coaches and vans.

Policy development milestones which contribute to the delivery of policy outcome 3

1) Consult on Intelligent transport Systems (ITS) Strategy by the end of March 2017.
2) With local authorities and others, evaluate the scope for urban-wide low emission zones with a specific focus on CO_2 emissions, as well as air pollution more generally.

Proposals which contribute to the delivery of policy outcome 3

1) Collaborate with a local authority to put in place a pilot low emission zone by 2018, examining the feasibility of low emission zones (LEZs) mitigating CO_2 emissions via the National Low Emission Framework.
2) Work with the freight sector to examine the scope for new freight logistics and infrastructure (potentially including freight consolidation centres on the outskirts of cities and urban areas following the introduction of LEZs); and to support market testing of local initiatives.

Relative significance of policies, policy development milestones and proposals to the delivery of policy outcome 3

9.3.4 Policy outcome 3 will account for a moderate proportion of total emissions reduction. Road freight carried on HGVs accounts for 1.7 $MtCO_2e$, and implementation of all the policies and proposals could reduce emissions from HGVs by 28% by 2032.

Policy outcome 4: Proportion of the Scottish bus fleet which are low emission vehicles has increased to 50% by 2032.

There is one policy, one policy development milestone and two proposals which contribute to the delivery of policy outcome 4.

Policy which contributes to the delivery of policy outcome 4

1) Provide financial support for the purchase and operation of low carbon buses.

Policy development milestones which contribute to the delivery of policy outcome 4

1) In the context of the current review of the National Transport Strategy and Transport Bill, we will examine the scope for climate change policies, as in relation to bus, across the public sector in high-level transport legislation, strategies and policies.

Proposals which contribute to the delivery of policy outcome 4

1) With local authorities and others, evaluate the scope for urban-wide low emission zones with a specific focus on CO_2 emissions, as well as air pollution more generally.
2) With local authorities and others, model and pilot reductions in congestion and improvements in use of public transport, in possible association with a low emission zone.

Relative significance of policies, policy development milestones and proposals to the delivery of policy outcome 4

9.3.5 Policy outcome 4 will account for a small proportion of overall emissions reduction, as bus and coach emissions account for under 4% of total transport emissions.

9.3.6 Any behavioural switch from private to public transport is likely to be limited by capacity of the sector to absorb significant new traffic.

Policy outcome 5: By 2032 low emission solutions have been widely adopted at Scottish ports and airports.

There is one policy that will contribute to the delivery of policy outcome 5.

Policy which contributes to the delivery of policy outcome 5

1) Encourage and support Scottish port authorities and airports to adopt low emissions solutions. These could include: cold ironing (the use of shore power by ships whilst in harbour); and measures to reduce emissions associated with airport ground operations and while planes are on the ground (for example single engine taxiing, the use of ground power for planes at stand, and low emission ground vehicles).

Relative significance of policies, policy development milestones and proposals to the delivery of policy outcome 5
Policy outcome 5 will account for a small proportion of overall emissions reduction. The key drivers in emission reduction from aviation and shipping will come from international organisation agreements and from ongoing improvements in design and materials.

Policy outcome 6: Proportion of ferries in Scottish Government ownership which are low emission has increased to 30% by 2032.

There is one policy development milestone that will contribute to the delivery of outcome 6.

Policy development milestone which contributes to the delivery of policy outcome 6
1) Examine the scope for procuring hybrid and low carbon powertrains in the public sector marine fleet as part of our vessel replacement programme.

Relative significance of policies, policy development milestones and proposals to the delivery of policy outcome 6
9.3.7 Policy outcome 6 will account for a small proportion of overall emissions reduction, as domestic maritime activity only accounts for 0.3 $MtCO_2e$ or 2.5% of transports total emissions.

Policy outcome 7: We will have electrified 35% of the Scottish rail network by 2032.

There is one policy development milestone that will contribute to the delivery of outcome 7.

Policy development milestones which contribute to the delivery of policy outcome 7
1) Electrification of the rail network in the High Level Output Statement for Control Period 6 (2019-2024).

Relative significance of policies, policy development milestones and proposals to the delivery of outcome 7
Policy outcome 7 will account for a small proportion of overall emissions reduction, as rail makes up less than 1.5% of total transport emissions.

Policy outcome 8: Proportion of total domestic passenger journeys travelled by active travel modes has increased by 2032, in line with our Active Travel Vision, including the Cycling Action Plan for Scotland Vision that 10% of everyday journeys will be by bike by 2020.

There are two policies which will contribute to the delivery of outcome 8.

Policies which contribute to the delivery of policy outcome 8
1) Active travel: maintain funding for infrastructure and behaviour change programmes until at least 2021.
2) Support the Smarter Choices Smarter Places (SCSP) programme to encourage travel behaviour change.

Relative significance of policies, policy development milestones and proposals to the delivery of policy outcome 8
9.3.8 Policy outcome 8 will account for a small proportion of overall emissions reduction, as most journeys under a mile are already undertaken by walking.

9.4 Wider impacts

9.4.1 The following co-benefits and adverse side effects have been identified for policies in the transport sector:

Co-benefits to be realised

9.4.2 Many of the policies and proposals will bring additional co-benefits to communities, businesses and the third sector.

9.4.3 Individuals and businesses will benefit from increased electric vehicle uptake through improved air quality. Low emission zones, consolidation centres on the periphery of urban areas and support for the purchase of low emission buses will ensure the most polluting vehicles do not enter our towns and cities. Adverse health effects from exposure to pollutants are estimated to cause up to 50,000 deaths per year in the U.K. and reduce the average life expectancy by 7-8 months. Significantly reducing vehicle emissions in our towns and cities will improve health, reduce pollution related illnesses and consequently bring savings to healthcare.

9.4.4 Businesses and individuals will benefit from more reliable, faster deliveries in areas covered by consolidation centres. This is because the smaller vans travelling out of consolidation centres can travel directly to their locations, where as an HGV would travel round its delivery stops sequentially. A fleet of electric light goods vehicles will allow freight to be transported to its destination. Freight operators will be able to make more efficient use of their vehicles as they will not be delayed in congestion when delivering to inner city areas.

9.4.5 Further benefits will result from reduced noise pollution, which has a negative impact on health and wellbeing. The combined value of air quality improvements as a result of reduced emissions may be in excess of £500 million per year.

9.4.6 Taking cost projections for petrol and diesel cars into account, and the expected impact of future technological change, electric vehicles should become significantly cheaper to purchase and operate. This offers individuals and businesses the opportunity to make savings through reduced fuel and vehicle operating costs. Fuel efficient driving and travel planning offer further cost savings, as well as potentially reducing the risk of traffic accidents.

9.4.7 In the future, electric vehicles may be able to provide services to the power grid, smoothing out demand by drawing and returning power as needed by acting as a means of energy storage.

9.4.8 An increased number of journeys made by active travel will further reduce congestion and pollution, in addition to the associated benefits that come through living an active lifestyle. Active travel and lift sharing offer a potential route to combat transport poverty by increasing the availability of low-cost, low carbon transport options and reducing the need to own a car. Car clubs will allow households to access efficient vehicles without the costs associated with car ownership.

Adverse side effects to be managed

9.4.9 A significant proportion of the up-front funding required to implement many of these policies is likely to fall on the public sector. With electric vehicles, the Scottish Government has funded the roll out of the ChargePlace Scotland network of charge points and funds their operation. It is expected that there will be a need for the public sector to continue to incentivise electric vehicle uptake until they are competitive with conventional vehicles. As the price of electric vehicles fall, individuals and businesses will be encouraged to invest in low carbon alternatives.

9.4.10 The introduction of freight consolidation centres may present some disruption for logistics organisations, resulting from the need to relocate premises. Low emission zones may also present challenges to fleet operators as it will impact on fleet renewal decisions.

9.4.11 Other measures, such as the implementation of low emission solutions at ports and airports and the roll out of low emission solutions in the bus and maritime sectors will likely require initial public sector support.

9.4.12 These additional public sector costs should be balanced against the potential health, social and economic benefits arising.

9.4.13 The Scottish Government will ensure that potential adverse impacts are appropriately managed.

9.5 Summary of policies, development milestones and proposals

Policy outcome 1: Average emissions per kilometre of new cars and vans registered in Scotland to reduce in line with current and future EU/UK vehicle emission standards

Table 9-1: Policies that contribute to the delivery of policy outcome 1

Policy	EU, UK or Scottish policy	Public sector partners	Delivery route
With the EU and UK, negotiate stretching emission standards for new cars (and vans) beyond 2020 (and 2021)	EU and UK	N/A	Vehicle emission standards are currently set at a European level. Vehicle efficiencies have improved considerably over recent years, driven in large part by the existing EU vehicle emission standards. The current standards specify that average emission of new cars in 2021 must be 95 gCO_2/km and for new vans, 147 gCO_2/km by 2020. We will work with the EU and the UK Government to press for strong future emissions standards beyond those currently in place.
With the UK, negotiate vehicle excise duty differentials between ultra-low emission vehicles (ULEVs) and diesel/petrol vehicles to support and encourage the uptake of ULEVs	UK	N/A	VED differentials are in place for lower emission vehicles compared to higher emitting petrol and diesel vehicles. Zero emission vehicles are exempt, with a graded scale of differential for vehicles up to 100 gCO_2/km. Changes coming into force on 1 April 2017 may impact on adoption of low carbon vehicles as only zero emission vehicles will have reduced VED after year one on a vehicles life. It will be important to maintain this VED differential into the 2020s, as although the total cost of ownership premium between an ULEV and a petrol or diesel vehicle is likely to decrease in this period, some level of premium will still remain. VED is set by the UK Government, and we will continue to work with them and press the need for a VED differential for ULEVs through the 2020s.
With the UK, negotiate to introduce biofuels policies that will enable them to be used sustainably in the decarbonisation of the whole transport sector.	UK	N/A	The EU biofuels target is currently implemented in the UK through the Renewable Transport Fuel Obligation (RTFO) but is currently scheduled to end in 2020. We will press the UK Government to extend the RTFO (or equivalent) to ensure that biofuels (primarily as drop-in fuels) will make up a growing proportion of transport fuel and enable them to be used most effectively as a finite resource in the decarbonisation of transport.
Support fuel efficient driver training	Scottish	Local authorities	We will continue to fund Fuel Efficient driver training, improving fuel efficiency and encouraging safer driving. Almost 6,000 drivers completed training in 2014-16.

Table 9-2: Policy development milestones that contribute to the delivery of polcy outcome 1

Policy development milestone	Delivery route
With local authorities and others, evaluate the scope for incentivising more rapid uptake of electric and ultra-low emission cars and vans as through public procurement policies and preferential local incentives (such as access management and parking policies)	Procurement policies can be used to increase penetration of ULEVs through direct procurement by the public sector or by setting contract conditions for companies operating services for local authorities. Since 2014, Transport Scotland's Switched On Fleets initiative has provided £3.5 million to enable Scottish local authorities and their community planning partners to introduce an estimated 350 new electric cars and vans in the Scottish public sector fleet. There is potential to build on this strong foundation by strengthening public procurement policies in Scotland to positively favour ULEVs. We will therefore work with Scotland Excel, COSLA and others to determine whether a new procurement policy could be introduced in Scotland which introduces a presumption that all new vehicles purchased by public sector organisations in Scotland are ULEVs, unless there are very clear operational or technical reasons for not doing so. We will also encourage the public sector in advance of this work to set contract conditions for their suppliers, specifying the requirement for ULEV use. We will publish our findings by the end of 2017.
With local authorities and others, evaluate the scope for urban-wide low emission zones with a specific focus on CO_2 emissions, as well as air pollution more generally	We will build on the work being undertaken for the National Low Emission Framework (NLEF) to establish read across to low emission zones focusing on CO_2 emissions.

Table 9-3: proposals which contribute to the delivery of policy outcome 1

Proposal	Delivery route
Collaborate with a local authority to model reductions in congestion and improvements in use of public transport in possible association with a low emission zone	National Transport Strategy engagement begins in 2017.

Table 9-4: Policy outcome 1 over time

Policy outcome 1	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Total change in average gCO_2e/km (cars)	111	107	103	99	95	-	-	-	-	-	-	-	-	-	-	-
Total change in average gCO_2e/km (vans)	175	165	156	147	-	-	-	-	-	-	-	-	-	-	-	-

Policy outcome 2: Proportion of ultra-low emission new cars registered in Scotland annually to reach 40% by 2032

Table 9-5: Policies that contribute to the delivery of policy outcome 2

Policy	EU, UK or Scottish policy	Public sector partners	Delivery route
With the EU and UK, negotiate stretching emission standards for new cars (and vans) beyond 2020 (and 2021)	EU and UK	N/A	Vehicle emission standards are currently set at a European level. Vehicle efficiencies have improved considerably over recent years, driven in large part by the existing EU vehicle emission standards. The current standards specify that average emission of new cars in 2021 must be 95 gCO_2/km and 147 gCO_2/km by 2020 for new vans. We will work with the EU and the UK Government to press for strong future emissions standards beyond those currently in place.
With the UK, negotiate vehicle excise duty differentials between ultra-low emission vehicles (ULEVs) and diesel/petrol vehicles to support and encourage the uptake of ULEVs	UK	N/A	VED differentials are in place for lower emission vehicles compared to higher emitting petrol and diesel vehicles. Zero emission vehicles are exempt, with a graded scale of differential for vehicles up to 100 gCO_2/km. It will be important to maintain this VED differential into the 2020s, as although the total cost of ownership premium between an ULEV and a petrol or diesel vehicle is likely to decrease in this period, some level of premium will still remain. VED is set by the UK Government, and we will continue to work with them and press the need for a VED differential for ULEVs through the 2020s.
Enhance the capacity of the electric vehicle charging network (ChargePlace Scotland): • provide funding until at least August 2019 in order to support the on-going expansion of the publicly available network of EV charge points • provide funding to support the safe and convenient installation of domestic and workplace charge points	Scotland	All property owning public sector partners	Given the importance of an extensive and reliable EV charging network across Scotland to enabling the widespread adoption of EVs, TS will continue to provide funding to support the on-going expansion of the publicly available ChargePlace Scotland network. We will also continue to support the installation of domestic and workplace charge points and we will work with partners to identify solutions for households without off-street charging. The composition of this funding package will be reviewed annually to ensure funding is deployed in such a way as to maximise support for EV uptake. A review will be undertaken before August 2019, prior to the end of the current agreement with our network operator, Charge Your Car.

Policy	EU, UK or Scottish policy	Public sector partners	Delivery route
Provide interest-free loans through the Energy Saving Trust to enable the purchase of EVs by both consumers and businesses until at least March 2020	Scottish	N/A	In addition to the UK Government's plug-in car and van grant, TS are providing over £7 million of funding to EST in 2016/17 for a Low Carbon Transport Loan Scheme for both consumers and businesses. Individuals can apply for a loan of up to £35,000 to cover the cost of purchasing an ULEV, while businesses can apply for a loan of up to £100,000 which can be used towards a wide range of measures to reduce the business' transport carbon footprint (including the purchase of ULEVs, up to £35,000 per vehicle). Current Loan provision will continue until at least March 2020 and will be reviewed on a yearly basis to ensure it is proportionate to the level of demand.
With local authorities, review licensing regulations and consider introducing other incentives to promote the uptake of ULEVs in the taxi and private hire sector with loan funding for vehicle purchase until at least March 2020	Scottish	Local Authorities	There are more than 20,000 taxis and private hire cars in Scotland, offering potential for increased adoption of EVs. We will continue to fund the Energy Savings Trust's Low Carbon Transport Loan which offers an interest-free loan of up to £100,000 to businesses, including licensed taxi and private hire operators, to encourage them to switch to EVs. In addition, 'Hackney cab' operators can apply for a loan to replace cabs that are at least eight years old with a lower emission alternative. We will also consider expanding the loan scheme to include ultra-low emission 'Hackney cabs', when they are available to buy (expected 2017). At present, fewer than half of Scotland's local authorities allow EVs to be licensed as taxis and private hire vehicles. We will therefore work with EST to encourage authorities to review their interpretation of licensing regulations, learning from areas such as Dundee and Edinburgh, where EVs are already being used as taxis or private hire vehicles.
Promote the benefits of EVs to individuals and fleet operators and increase awareness and confidence in the viability of EVs as an alternative to fossil-fuelled vehicles	Scottish	Community Planning Partnerships	A combination of Greener Scotland marketing campaigns, major annual events such as Greenfleet Scotland/Evolution and a series of EV road shows by EST have enabled engagement with a significant number of individuals and businesses. This engagement has focused on promoting EV benefits, dispelling myths and providing test drives for a wide range of vehicles. This activity will continue, the exact nature and composition of the communication and marketing initiatives being determined on an annual basis to ensure maximum levels of engagement from available budget.

Table 9-6: Policy development milestones that contribute to the delivery of policy outcome 2

Policy development milestone	Delivery route
Work with the UK government, local authorities and other public and third sector partners to identify annually a package of financial and convenience ULEV incentives, such as free parking, access to LEZs and interaction with proposed workplace parking levies.	It is forecast that the cost of electric vehicles will fall and annual sales increase. This means that, over time, Government will review the incentive packages available to ensure these reflect market conditions. Instead, ongoing financial or time benefits that provide an incentive in the order of £1,000 over the vehicle lifetime are likely to play an increasing role. These could include discounted use of ferries (as previously trialled on all routes to Mull and Bute), free parking (already in place in Dundee), access to LEZs, interaction with proposed workplace parking levies and reduced licence fees for electric taxis. Furthermore, indirect or perceived financial incentives (such as permitted bus lane running and prioritised parking spaces for EVs) may also have a role to play in encouraging EV uptake. Such measures would be implemented at a local authority (LA) level, and financing options will be discussed as this develops. The Scottish Government role would be to address any legislative barriers; provide guidance and potentially financial support. Transport Scotland recently published a National Framework of Local Incentives for Electric Vehicles, providing guidance and technical assistance and an overview on the barriers and challenges associated with introducing such measures. As a next step, TS will work with partners and, by the end of 2017, publish initial plans for the introduction of a package of EV incentives in Scotland.

Table 9-7: Proposals which contribute to the delivery of policy outcome 2

Proposal	Delivery route
Planning/Building Standards Consider draft proposals in the Energy Performance of Buildings Directive, relating to the provision of EV charge points/wiring in new residential and commercial developments Investigate how such measures could potentially be trialled in Scotland and consider developing guidance on charge point provision to support planning authorities	The review of the Energy Performance of Buildings Directive (EPBD), contains proposals regarding the provision of pre-cabling and charging points in new residential and non-residential developments respectively (and those undergoing major renovations). SG has already strengthened the guidance in both Third National Planning Framework and the Scottish Planning Policy 2014, recognising the importance of considering plug-in vehicle charging infrastructure in new developments. Furthermore, as of August 2016, eleven (34%) out of 32 Local Development Plans (LDPs) include the consideration for provision of charge points in new developments. Building on this work, SG will consider the draft proposals in the EPBD, and investigate undertaking a trial with a developer in Scotland. The outputs of any trial would help shape potential national rollout of such provisions. In addition, when development plans are reviewed and updated, changes at the national level will filter down. Whilst it is important to maintain the flexibility that local authorities have to do what is best for local development in their own areas, Transport Scotland will consider developing guidance on charge points to support planning authorities.
Continue to investigate the role that other alternative fuels, such as hydrogen, gas and biofuel, can play in the transition to a decarbonised road transport sector Consider the scope for market testing approaches to alternative fuels infrastructure and supply	Building on our investment in both the Aberdeen H2 bus project and the Levenmouth community energy project, we will continue to work with key partners to investigate the use of hydrogen as a transport fuel, as well as exploring wider environmental and economic opportunities of using hydrogen for energy applications – especially in promoting renewables, energy balancing and storage. We will also continue to engage with our partners, including fuel supply companies, local authorities and developers on the role lower carbon intensive fuels such as liquid petroleum gas, compressed natural gas and biofuels can play in the transition towards a near zero emission road transport sector by 2050.
Work with Scottish Enterprise, the UK Government and other bodies to investigate the potential to undertake trials of connected and autonomous vehicles in Scotland	Over the next few years advances in connected and automated vehicle technologies will likely have a an impact on our transport system, with the potential to deliver major benefits; fewer crashes on our roads; freedom to travel for those who currently find that difficult; more efficient transport networks that are safer, smoother, and swifter; and, new jobs in the technology and automotive sectors. We want to make sure that Scotland is prepared for this potential transformation. We will work with partners and investigate the possibility of Scotland hosting large scale autonomous and connected vehicle trials.

Proposal	Delivery route
Work with Scotland Excel, COSLA and other partners to determine whether a new procurement policy could be introduced in Scotland, which encourages new vehicles purchased by public sector organisations in Scotland are ULEVs	Procurement policies can be used to increase penetration of ULEVs through direct procurement by the public sector or by setting contract conditions for companies operating services for local authorities. Since 2014, TS's Switched On Fleets initiative has provided £3.5 million to enable Scottish local authorities and their community planning partners to introduce an estimated 350 new electric cars and vans in the Scottish public sector fleet. There is potential to build on this strong foundation by strengthening public procurement policies in Scotland to positively favour ULEVs. We will therefore work with Scotland Excel, COSLA and others to determine whether a new procurement policy could be introduced in Scotland which introduces a presumption that all new vehicles purchased by public sector organisations in Scotland are ULEVs, unless there are very clear operational or technical reasons for not doing so. We will also encourage the public sector in advance of this work to set contract conditions for their suppliers, specifying the requirement for ULEV use. We will publish our findings by the end of 2017.

Table 9-8: Policy outcome 2 over time

Policy outcome 2	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Total share of sales that are classified as low emissions	2.5%	3.0%	3.5%	4.1%	4.9%	5.9%	7.2%	8.8%	11%	13%	15%	18%	22%	27%	32%	40%

Policy outcome 3 Average emissions per tonne kilometre of road freight to fall by 28%* by 2032

Table 9-9: Policies that contribute to the delivery of policy outcome 3

Policy	EU, UK or Scottish policy	Public sector partners	Delivery route
Lobby the EU and UK Governments to introduce an emission standard for new Heavy Goods Vehicles in line with proposals arising from the EU European Strategy for Low-Emission Mobility	EU and UK	N/A	We will work with the UK Government and our EU partners to encourage the introduction of a new binding carbon emission standard for new HGVs registered and operating in Scotland (and the rest of the UK/EU). Currently new HGVs must meet Euro VI standard – but this is focused on pollutants and does not include a CO_2 standard. The introduction of a fuel efficiency standard for newly registered HGVs (as has existed in the US for some time) will encourage HGV manufacturers to bring forward new models which are more efficient and produce lower levels of carbon emissions. As these new vehicles penetrate the HGV fleet operating in Scotland and replace higher emission vehicles more road freight miles will be driven in the most up to date, fuel efficient vehicles – thereby leading to a reduction in CO_2 emissions from the freight sector. The EU European Strategy for Low-Emission Mobility proposes a post 2020 strategy for lorries, buses and coaches. Given the 10 year average life of an HGV, the Commission argues that steps to address emissions must be in place by 2020. A first step will be the proposed legislation on monitoring/reporting of Heavy-Duty Vehicle fuel consumption and CO_2 emissions, with further proposals due in 2017. We will support efforts at this level to address emissions.
With the UK, negotiate biofuels policies that will enable them to be used sustainably in the decarbonisation of the whole transport sector	Scotland	N/A	See above.
Deliver our Rail Freight Strategy	Scotland	Network Rail, Scotrail, Local authorities, Office of Rail Regulation	"Delivering the Goods" Scotland's Rail Freight Strategy was published in March 2016 and set out 22 actions that Transport Scotland and/or other industry partners will take forward with a range of organisations to develop a sustainable rail freight industry, with identifiable growth potential over time. Currently, per tonne of freight, rail freight produces 76% less CO_2 than road freight so there is potential to reduce emissions by switching more freight from road to rail. A report setting out progress against the Strategy's six critical success factors will be published by June 2018 including the success factor of: longer, faster, greener freight trains. In the shorter-term a number of actions in the strategy relate to the Scottish Government's planning for the next rail control period and the ORR's periodic review both of which relate to the period 2019-2024.

Policy	EU, UK or Scottish policy	Public sector partners	Delivery route
Continue to support local authorities in delivering the ECO-Stars programme, reducing fuel consumption for HGVs, buses, coaches and vans	UK	Local authorities	ECO Stars is a UK wide fleet recognition scheme covering HGVs, buses, coaches, vans and taxis. The ultimate aim is to reduce fuel consumption and thereby lower emissions of both CO_2 and air pollutants. The scheme provides recognition for best operational practices and guidance for making improvements. Currently the Scottish Government provides funding support for 11 local authorities to operate ECO Stars schemes for HGVs, buses, coaches and vans, and three authorities for taxis. As of May 2016, these schemes collectively covered 148 unique members and 13,070 vehicles, representing approximately 11% of Scotland's HGV fleet and 23% of the public transport fleet.

Table 9-10: Policy development milestones that contribute to the delivery of policy outcome 3

Policy development milestone	Delivery route
Consult on Intelligent transport Systems (ITS) Strategy by the end of March 2017	The ITS strategy will set out our high level priorities for ITS development and asset management over the next 10 years and will be supported in due course by a series of action plans and delivery programmes. The strategy and its associated plans and programmes will address the changing roles that ITS systems and services will play in providing our road users with accurate and relevant traffic and travel information, incident response and transport resilience. The Strategy will take into account recent, current and near-future developments in information technologies, including an assessment of where customers want and expect to go for their traffic and travel information, and the role of Transport Scotland in the provision of these services. The Strategy will also consider existing ITS assets, in particular in respect of the maintenance, renewal and replacement of existing infrastructure.
With local authorities and others, evaluate the scope for urban-wide low emission zones with a specific focus on CO_2 emissions, as well as air pollution more generally	We will build on the work being undertaken for the National Low Emission Framework (NLEF) to establish read across to low emission zones focusing on CO_2 emissions.

Table 9-11: Proposals which contribute to the delivery of policy outcome 3

Proposal	Delivery route
Collaborate with a local authority to put in place a pilot low emission zone by 2018 examining the feasibility of low emission zones (LEZs) mitigating CO_2 emissions via the National Low Emission Framework.	The Cleaner Air for Scotland strategy calls for a reduction in greenhouse gas emissions whilst delivering co-benefits for air quality, The National Low Emission Framework (NLEF) is a transport-based air quality appraisal which will inform discussions with individual local authorities on the most appropriate locations for any Low Emission Zones (LEZ). NLEF decision making will rely on National Modelling Framework (NMF) outputs, which can examine carbon emission trends in tandem with air pollution. In preparing the first LEZ to be put in place by 2018, we will work with local authorities to explore and assess the potential for co-benefits. This first LEZ will provide a legacy upon which other Scottish LEZ's could be introduced, perhaps in conjunction with other award schemes such as the Freight Facilities Grants.
Work with the freight sector to examine the scope for new freight logistics and infrastructure (potentially including freight consolidation centres on the outskirts of cities and urban areas following the introduction of LEZs); and to support market testing of local initiatives.	Through the Scottish Freight and Logistics Advisory Group (ScotFLAG), we are working with our partners across the public and private sectors to identify and facilitate any opportunities to increase the efficiency and sustainability of freight movements in cities – including exploring opportunities for load consolidation. A Scottish Freight and Logistics Advisory Group (ScotFLAG) Urban Freight sub-group has been set up with a remit to identify opportunities, share best practice, , and co-ordinate activity aimed at increasing the sustainability, safety and efficiency of freight movements in Scotland's urban areas' . This sub-group is Chaired by the Freight Transport Association.

Table 9-12: Policy outcome 3 over time

Policy outcome 3	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Total emissions (gCO_2e) per tonne kilometre of road freight Index 2017 =100[51]	100	98	96	94	92	91	89	87	85	83	81	79	78	76	74	72

51 This is our initial indicator based on readily available and published data. We will work with the industry and other interested parties to assess and if necessary develop a more appropriate indicator with which to measure the emissions efficiency of the HGV sector.

Policy outcome 4: Proportion of the Scottish bus fleet which are low emission vehicles has increased to 50% by 2032

Table 9-13: Policy development milestones that contribute to the delivery of policy outcome 4

Policy development milestone	Delivery route
Provide financial support for the purchase and operation of low carbon buses	Transport Scotland has developed targeted interventions to encourage operators to purchase and operate low emission buses in the Scottish fleet. These help the government to meet its aims for improved air quality and reductions in emissions of greenhouse gases. A review of the SGBF is currently underway and we are considering changing the basis for assessing applications, widening the criteria to include aspects such as technological ambition, amount of carbon saved/passenger/vehicle, value for money and previous organisational experience. Infrastructure is unlikely to be included as other funding processes (such as the Bus Investment Fund) could be used to help with these costs if funding is available. The SGBF will likely remain an annual fund. The intervention to help with the costs of low emission bus operation forms part of the Bus Service Operators Grant. The green incentive is worth 100% uplift in 2016/17 (28.8p/km compared with a basic rate of 14.4p/km) though this level of incentive is not sustainable and will be reviewed in 2017. The green incentive was worth £762,00 in 2013/14 but has now grown to £3,498,000 in 2015/16 and is forecast for £5,606,000 in 2016/17. It has proved successful in encouraging operators to invest in low emission buses, purchasing them outwith the SGBF as they become more commercially viable to operate. We are working with Confederation of Passenger Transport (CPT) and the Low Carbon Vehicle Partnership to more closely target the available funding to maximise the outputs. We are designing a more sophisticated and future-proofed green incentive scheme which will be banded to weight subsidy towards the most carbon efficient buses and to ensure better value for money across the BSOG incentive. That scheme will also be time limited, unlike the current one, to better reflect bus payback periods. Both of these schemes are flexible and scalable which enables them to respond to progress against targets.
In the context of the current review of the National Transport Strategy and Transport Bill, we will examine the scope for embedding climate change policies, as in relation to bus, across the public sector in high-level transport legislation, strategies and policies	National Transport Strategy engagement begins in 2017.

Table 9-14: Proposals which contribute to the delivery of policy outcome 4

Proposal	Delivery route
With local authorities and others, evaluate the scope for urban-wide low emission zones with a specific focus on CO_2 emissions as well as air pollution more generally.	We will build on the work being undertaken for the National Low Emission Framework (NLEF) to establish read across to low emission zones focusing on CO_2 emissions.
With local authorities and others, model and pilot reductions in congestion and improvements in use of public transport, in possible association with a low emission zone.	National Transport Strategy engagement begins in 2017.

Table 9-15: Policy outcome 4 over time

Policy outcome 4	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Proportion of bus fleet made up of low emission vehicles	10%	13%	15%	18%	20%	23%	25%	27%	30%	33%	36%	39%	42%	45%	48%	50%

Policy outcome 5: By 2032 low emission solutions have been widely adopted at Scottish ports and airports

Table 9-16: Policies that contribute to the delivery of policy outcome 5

Policy	EU, UK or Scottish policy	Public sector partners	Delivery route
Encourage and support Scottish port authorities and airports to adopt low emission solutions. These could include cold ironing (the use of shore power by ships whilst in harbour); and measures to reduce emissions associated with airport ground operations and whilst planes are on the ground (for example – where appropriate – single engine taxiing, the use of ground power for planes at stand, and low emission ground vehicles)	Scotland	HIAL, Prestwick Airport, Local authorities, Ferry operators, Shipping companies, Ports, Maritime Industry bodies	We will work with port authorities, the shipping industry and airports to encourage and support them to introduce low emission solutions on a voluntary basis. For example, we will work with port authorities to identify the potential costs and benefits of cold ironing (the use of shore power by ships whilst in harbour) and other low emission measures to ship owners and operators. Similarly, we will work with airport owners [and operators?] to identify measures that can be taken to reduce emissions associated with ground operations and whilst planes are on the ground (for example (where appropriate) single engine taxiing, the use of ground power for planes at stand, and low emission ground vehicles). We will work with ports and airports, ship owners/operators and airlines to overcome barriers to the voluntary adoption of these measures and ensure they are taken into account when considering their future investment plans.

9.6.1 There are no appropriate quantifiable indicators here for measuring this activity as there will be ad-hoc specific actions by individual organisations, largely in the private sector.

Policy outcome 6: Proportion of ferries in Scottish Government ownership which are low emission has increased to 30% by 2032

Table 9-17: Policy development milestones that contribute to the delivery of policy outcome 6

Policy development milestone	Delivery route
Examine scope for procuring hybrid and low carbon powertrains in the public sector marine fleet as part of our vessel replacement programme	We are developing a programme of procurements to replace vessels in the CMAL ferry fleet with lower emission powertrains. For each project we will consider diesel-electric hybrid and liquid natural gas (LNG) fuelling options; in addition CMAL will continue to pursue technical designs which improve fuel efficiency and CFL will continue its operational work on reducing fuel consumption. We are supporting the Scottish-based Hyseas consortium with its initiative to trial a hydrogen-powered ro-ro vehicle ferry. We publish annual Vessel Replacement and Deployment Plans which will set out our evolving plans and projects in more detail.

Table 9-18: Policy outcome 6 over time

Policy outcome 6	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Number of low emission ferries in Scottish Government ownership	3	3	4	4	5	5	5	6	6	7	7	7	8	8	9	9

Policy outcome 7: We will have electrified 35% of the Scottish rail network by 2032

Table 9-19: Policy development milestones that contribute to the delivery of policy outcome 7

Policy development milestone	Delivery route
Electrification of the rail network in the High Level Output Statement for Control Period 6 (2019-2024)	We will continue to roll out electrification across the rail network with plans announced as part of the High Level Output Statement for Control Period 6 (2019-2024). It is estimated that the use of electric trains across the rail network will result in an average reduction in emissions of 18% when compared with equivalent diesel trains. We will also investigate hybrid train and other emerging technologies to determine the suitability for application on Scotland's railways as a potential energy and cost-saving alternative to overhead wire electrification.

Table 9-20: Policy outcome 7 over time

Policy outcome 7	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Percentage of rail track electrified (kilometres)[52]	*26%*	*27%*	*27%*	*28%*	*29%*	*29%*	*30%*	*30%*	*31%*	*32%*	*32%*	*33%*	*33%*	*34%*	*34%*	*35%*

52 Commitments in kilometres electrified do not extend beyond the current control period. The Italicised figures are simply indicative at this point and future plans will be announced as part of the new control period.

Policy outcome 8: Proportion of total domestic passenger journeys travelled by active travel modes has increased by 2032, in line with our Active Travel Vision, including the Cycling Action Plan for Scotland Vision that 10% of everyday journeys will be by bike by 2020

Table 9-21: Policies that contribute to the delivery of outcome 8

Policy	EU, UK or Scottish policy	Public sector partners	Delivery route
Active travel: maintain funding for infrastructure and behaviour change programmes until at least 2021	Scottish	Local authorities are our main delivery partners and have a critical role to play. In addition, Regional Transport Partnerships, the NHS, Further and Higher Education Institutions, Scottish Canals and the Trunk Road Operating Companies will all have a role to play	Increasingly we will plan infrastructure improvement projects that re-prioritise road space in our largest settlements away from cars in favour of walking and cycling. This will make out urban areas more liveable, increasing safety and enabling people to choose walking and cycling for short trips, for example through the Community Links Plus design competition. We will maintain the annual budget for active travel at until at least 2021 and will look to increase it whenever possible. That budget will fund both improvements and extensions to the infrastructure for walking and cycling throughout the country (particularly in our towns and cities) and a range of behaviour change initiatives that encourage and support people to choose walking and cycling for everyday journeys. Integration between walking, cycling and public transport will also be improved (for example through more and better bike parking and the development of a network of active travel hubs at public transport interchanges). We will continue to work with a range of delivery partners (including Cycling Scotland, Paths for All, Sustrans, Living Streets, Cycling UK Scotland and local authorities) to deliver behaviour change programmes that support people to overcome information, awareness, skills, confidence and attitudinal barriers to walking and cycling for everyday journeys. The exact mix of funding for infrastructure and behaviour change initiatives and the programmes that it supports will be reviewed regularly in partnership (e.g. through the National Walking Strategy Delivery Group and the Cycling Action Plan for Scotland Delivery Forum) to ensure that our approach is most effective in bringing about change in people's travel habits to encourage more active travel.
Support the Smarter Choices Smarter Places (SCSP) programme to encourage travel behaviour change	Scottish	Local authorities, Regional Transport Partnerships, Paths for All, Third Sector Delivery Partners	SCSP partnership project with COSLA is designed to increase walking and cycling for short journeys, car sharing and public transport use for longer journeys. Local Authorities target specific populations for travel behaviour change interventions. The projects include travel planning (at work, school or home), public awareness events, signage and mapping, supporting car clubs and work with public transport operations.

9.6.2 There are no appropriate quantifiable indicators here for measuring this activity as there will be ad-hoc specific actions by individuals and organisations.

9.6 Progress since RPP2

Table 9-22: Progress on RPP2 policies

RPP2 Policies	Summary of progress
EU Cleaner Vehicle Directives	EU regulations specify average emissions of new cars in 2021 must be 95g CO_2/km. These regulations have been the primary driver of reduced emissions in cars. The annual rate of car emissions reduction increased from 1% per year in the year before implementation to 4% per year in years afterwards. Efficiency improvements in fossil-fuelled cars will likely be significant in reaching the 2021 emissions targets.

Table 9-23: Progress on RPP2 proposals

RPP2 Proposals	Summary of progress
EU Biofuels target as implemented through the UK Renewable Transport Fuel Obligation (RTFO)	The main mechanism for the promotion of biofuel use, the Renewable Transport Fuel Obligation (RTFO), set by UK Department for Transport, results in the use of available biofuel across the whole of the transport sector. The UK DfT is currently developing a successor mechanism to RTFO from 2017 and there are indications that this may focus the deployment of sustainable biofuel on sectors such as heavy freight or aviation, that are difficult to decarbonise through electrification. Scottish Ministers support this principle, which could mean that sustainable biofuel penetration into those sectors could reach higher percentages than the expected maximum average across the wider transport sector.
Continued roll-out of EV charge points through ChargePlace Scotland	We have continued to expand our network of EV chargepoints since this proposal. The ChargePlace network now comprises over 1,200 charging, including 150 'rapid' chargers, one of the most comprehensive networks of rapid charge points in Europe.
Switched-on Fleets	Switched-on Fleets offers evidence based analysis to identify opportunities for the deployment of EVs in each of Scotland's 32 CPPs. Transport Scotland has provided £2.5 million to enable local authorities to buy or lease plug-in vehicles. The first phase of Switched-on Fleets resulted in over 240 EVs being introduced across 50 public sector fleets. Another £1.2 million of funding will be provided in 2016-17.
Scottish Green Bus Fund (SGBF)	Since its launch in 2010, six rounds of the SGBF have provided nearly £15 million to support the introduction of 315 new low carbon vehicles into the Scottish bus fleet. The fund is complemented by the Bus Service Operators' Grant, which currently pays double the standard rate of grant for services operated by low carbon vehicles.
Ferries Plan	Three diesel-electric hybrid ferries using a combination of battery and conventional diesel power have been procured and delivered within the last six years and are now all operating daily scheduled ferry services on the west coast.
Use of Intelligent Transport Systems (ITS) and Average Speed Cameras on the Trunk Road Network	Transport Scotland have utilised ITS to inform transport network users of issues, alternative routes and methods of travel to minimise transport disruption. Variable message signs located at key points along the trunk road network and regularly spaced overhead lane signals advise drivers of incidents and delays. Traffic Scotland provide real time information in response to traffic problems through their website, mobile app and radio.

RPP2 Proposals	Summary of progress
Development of community based travel planning strategies	Personalised travel planning was provided to over 5,000 households, 49 employers and 2101 staff across 85 schools in 2015 through the Smarter Choices, Smarter Places programme. Further behaviour change measures, including personal travel planning, will be delivered under the additional £5 million of funding for the SCSP enhanced roll-out in 2016-17. In 2015-16 and 2016-17 the £10 million funding attracted over £13 million in match funding for the local projects. Over 340 projects have been supported locally. The programme of work started on 1 April 2016 and has attracted £6.8 million in local match funding.
Cycling and walking	The second Active Travel Summit took place on 2 November 2016 in Stirling and the third iteration of CAPs was published in January 2017, reaffirming the Scottish Government's commitment to the 10% vision of everyday trips by bike by 2020. The Programme for Government (2016) further commits to maintaining record levels of funding to support active transport, such as cycling and walking for the remainder of the parliamentary term.
Car Clubs	There are car clubs in 25 locations in 16 Local Authority areas. There are approximately 10,000 members across Scotland, with access to 342 vehicles. 23% of the Scottish Car Club fleet is electric.
Support for Workplace Travel Planning and fuel efficient driving	A new Scotland wide travel planning site, 'TravelKnowHow Scotland', was launched in September 2016 with 100 organisations registered. In addition, over 20 Business Improvement Districts took part in European Mobility week events. The Energy Savings Trust has trained over 13,400 drivers in fuel efficient driving techniques, which deliver an average 15% improvement in efficiency.
Freight Efficiencies	Annually, MSRS enables around 2.5 million tonnes of freight to move by rail rather than road, removing 100,000 HGV road journeys and delivering more than £7 million in environmental benefits. In addition, FFG funded operations deliver around £3.5 million in environmental benefits. Through ScotFlag and its Urban Freight and Last Mile Connections sub groups, we continue to engage with the industry and key stakeholders to increase efficiencies in respect of urban deliveries and connectivity to intermodal hubs.
Additional Emissions Reduction Potential from transport in 2025	We will continue to explore and consider alternative policies and proposals to achiaeve additional emissions reduction potential in transport.

10. Services

Services covers all non-domestic buildings in the public and commercial sectors.

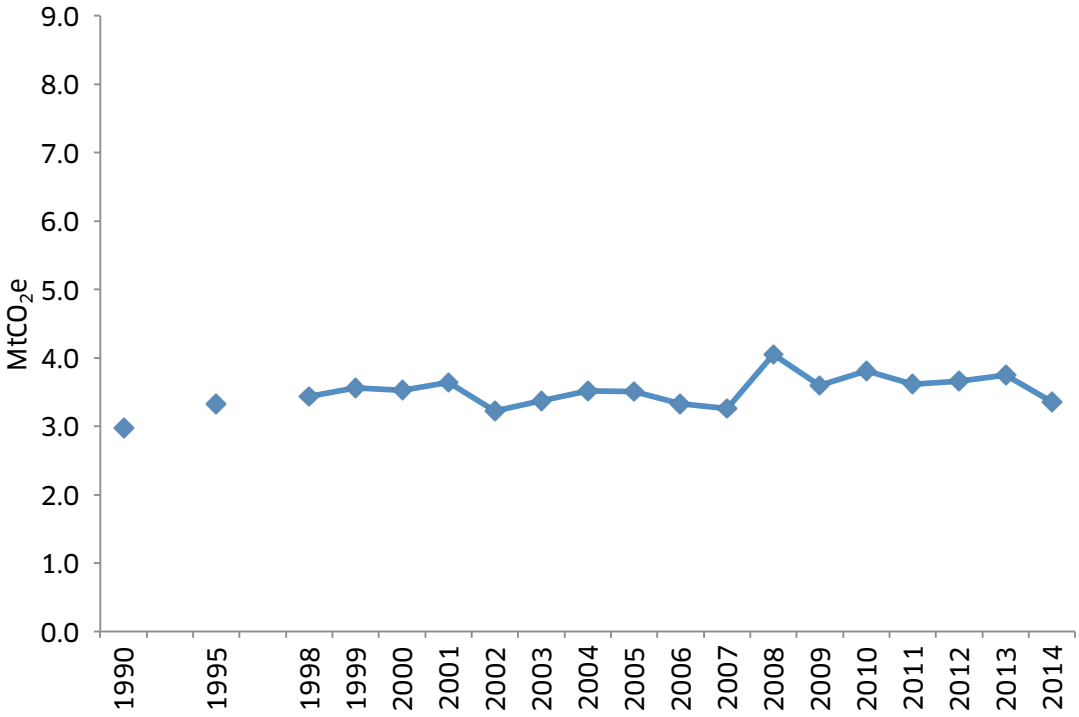
10.1 Where we are now

10.1.1 Total service sector emissions in 2014 were 3.4 $MtCO_2e$. Emissions have remained relatively steady between 1990 and 2014, although they have varied annually, driven by fluctuating external temperatures. Since the Climate Change (Scotland) Act 2009 was passed emissions have fallen by 7%.

10.1.2 Historical data on the profile of non-domestic building stock for the services sector, and its energy use, have been limited. Whilst research preceding introduction of the Assessment of Energy Performance of Non-domestic Buildings Regulations 2016 did suggest a total size of the non-domestic building stock, based upon a relatively large amount of interpolation, it did not then look at statistical reporting on performance as this was not required to inform regulation.

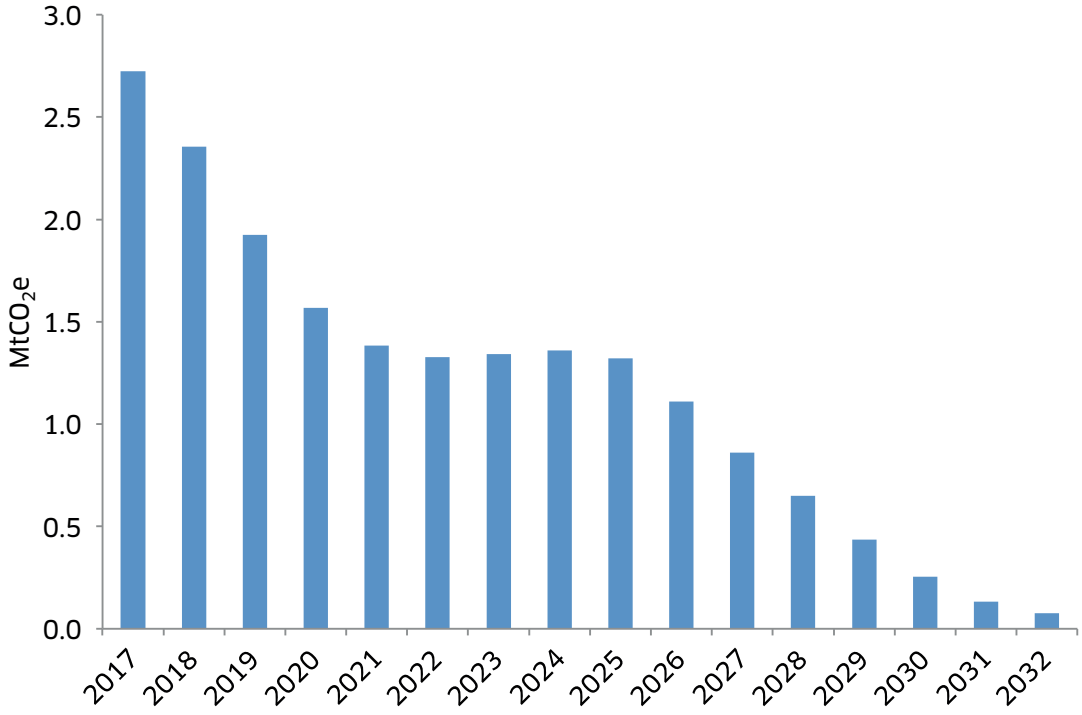
10.1.3 Data are now available for those non-domestic buildings which have had an EPC assessment, as required by the EU Energy Performance of Buildings Directive 2004, for the period since data were first recorded in 2013. But as yet, given levels of market turnover since 2013, the dataset that is available does not constitute a complete data set on energy performance of non-domestic buildings. The Scottish Government is currently undertaking further analysis to establish a baseline for non-domestic buildings' energy and emissions data, against which progress under the Climate Change Plan can be measured, and in doing so, is drawing upon UK-wide data sets and building-specific meter-point data.

Figure 15: Services historical emissions



10.2 Our ambition

Figure 16: Services carbon envelopes



10.2.1 By 2032, through Scotland's Energy Efficiency Programme (SEEP), we will have transformed the energy efficiency and heating of our non-domestic buildings in the services sector so that, wherever technically feasible, and practical, buildings are near zero carbon. This will make our shops, offices, schools and hospitals warmer and easier to heat, and by reducing energy demand, we can help businesses improve their energy productivity and competitiveness and release savings in the public sector for front line services.

10.2.2 By 2032 the majority of commercial and public buildings will be connected to low carbon heating systems, rather than using natural gas. The sustained effort over the period to 2032 will help to shift public attitudes, and energy efficiency and a low carbon heat supply are now considered desirable attributes for business competitiveness and public sector efficiency. The high energy efficiency of the building stock will help to, in part, minimise the impact of any future fuel price rises on bills.

10.2.3 Over their lifetime our programmes and policies will have supported thousands of jobs across Scotland and create a substantial Scottish market and supply chain for energy efficiency and renewable heat services and technologies. Furthermore, they will have helped businesses and the public sector to save millions of pounds in fuel bills, money which could be recycled into local economies and help to regenerate communities – by improving the appearance of the built environment as well as contributing to improving employee health and well-being outcomes.

To help guide us towards meeting our climate change targets we set the following milestones out to 2050:

- By 2032, 94% of non-domestic buildings' heat and cooling[53] is supplied using low carbon heat technologies[54].
- By 2050, all non-domestic buildings across Scotland will be near zero carbon.

53 Includes both space heating and water heating

54 This includes the electrification of heat. Currently, around 50% of non-domestic buildings' heat is supplied using electricity which, over time, will see an increase in the low carbon feedstock.

10.3 Policy outcomes, policies, development milestones and proposals

Policy outcome 1: Improvements to the fabric of Scotland's non-domestic buildings results in a 10% reduction in their heat demand by 2032[55].

There are three policies, five policy development milestones, and two proposals which will contribute to the delivery of policy outcome 1.

Policies which contribute to the delivery of policy outcome 1

1) Low Carbon Infrastructure Transition Programme supports investment in decarbonisation of business and the public sector through £76 million funding to 2018.
2) Public Sector Energy Efficiency Procurement Framework/Project Support Unit. Enables potentially £300m worth of investment across public sector estate.
3) Non-domestic energy efficiency finance (Salix Loans (public sector), SME Loans (business), District Heating Loan Fund) continues as part of development of SEEP.

Policy development milestones which contribute to the delivery of policy outcome 1

10.3.1 Energy Efficiency was designated as a national infrastructure priority in June 2015. In that context, the Programme for Government commits the Scottish Government to significant policy development on heat and energy efficiency improvements in buildings across Scotland. Scotland's Energy Efficiency Programme (SEEP) is a long term programme to improve the energy efficiency and reduce the environmental impact of Scotland's domestic and non-domestic buildings. It will build on our existing successful delivery programmes and include the development of a package of policies, across the following themes, that will contribute to the delivery of the policy outcome:

1) Regulation and Standards
2) Financial Incentives
3) Advice and Information
4) Delivery Programmes
5) Evidence and Evaluation

10.3.2 In the Programme for Government, Scottish Ministers committed to £500 million for SEEP over the first four years of the programme. The Scottish Government will undertake initial consultation on the design of delivery programmes within SEEP in January 2017, alongside consultation on the Energy Strategy, and will publish a SEEP Routemap in 2018.

Proposals which contribute to the delivery of policy outcome 1

1) Regulation – review of The Assessment of Energy Performance of Non-domestic Buildings (Scotland) Regulations 2016.
2) Regulation – Review of energy standards within buildings regulations.

Policy outcome 2: By 2032 94% of non-domestic buildings' heat[56] is supplied using low carbon heat technologies[57]

There are four policies, five policy development milestones, and one proposal which will contribute to the delivery of policy outcome 2.

55 Fabric improvements relate to the installation of insulation and controls for lighting and heating.

56 Includes both space heating and water heating

57 This includes the electrification of heat. Currently, around 50% of non-domestic buildings' heat is supplied using electricity which, over time, will see an increase in the low carbon feedstock.

Policies which contribute to the delivery of policy outcome 2

1) District Heating Loan Fund and Heat Network Partnership.
2) Non-domestic Renewable Heat Incentive (ends 2020/21) and associated SG supportive programmes.
3) Low Carbon Infrastructure Transition Programme supports investment in decarbonisation of business and the public sector through £76 million funding to 2018.
4) All small and medium sized non-domestic premises to be offered a smart meter by 2020.

Policy development milestones which contribute to the delivery of policy outcome 2

10.3.3 Energy Efficiency was designated as a national infrastructure priority in June 2015. In that context, the Programme for Government commits the Scottish Government to significant policy development on heat and energy efficiency improvements in buildings across Scotland. Scotland's Energy Efficiency Programme (SEEP) is a long-term programme to improve the energy efficiency and reduce the environmental impact of Scotland's domestic and non-domestic buildings. It will build on our existing successful delivery programmes and include the development of a package of policies, across the following themes, that will contribute to the delivery of the policy outcome:

1) Regulation and Standards
2) Financial Incentives
3) Advice and Information
4) Delivery Programmes
5) Evidence and Evaluation

10.3.4 In the Programme for Government, Scottish Ministers committed to £500 million for SEEP over the first four years of the programme. The Scottish Government will undertake initial consultation on the design of delivery programmes within SEEP in January 2017, alongside consultation on the Energy Strategy. As part of this consultation, we will consult specifically on regulation of district heating. The Scottish Government will publish a SEEP Routemap in 2018 alongside the launch of the programme.

Proposal which contributes to the delivery of policy outcome 2

1) Develop and identify the best approach to the long-term decarbonisation of the heat supply, to commence after 2025. We intend to include a proposal on how we may realise this potential, in a future Climate Change Plan, taking into account decisions that the UK Government will take on the future of the gas network and the outcomes of the consultation on the draft Energy Strategy.

10.3.5 Full details of policies, policy development milestones and proposals are set out in the tables below. The delivery of these will be tracked through the monitoring framework (see section 6).

10.4 Wider impacts

10.4.1 The following co-benefits and wider impacts have been identified for the Services sector:

Co-benefits to be realised

10.4.2 Support through SEEP for investment to improve the energy efficiency of non-domestic buildings has the potential to deliver improved energy productivity and therefore enhanced competitiveness for business and the third sector, if costs are lower. Warmer and more comfortable workplaces could ensure better employee health and well-being. Investment in building fabric improvements for commercial and public buildings can support wider regeneration and better place outcomes.

10.4.3 These policy outcomes will affect all users of public and commercial buildings, whether as employees, or those accessing services. Impacts through improvements to non-domestic buildings could be more noticeable for those in areas of poverty which would benefit from regeneration, and this would apply equally in urban and rural areas given the intended nationwide coverage of SEEP.

10.4.4 SEEP's delivery programmes will be designed to emphasise cost-effective energy efficiency and heat decarbonisation measures that reduce energy bills and enhance competitiveness.

10.4.5 SEEP will help to support jobs and businesses within the local and national economy. Scottish Government analysis suggests that for every £100 million spent on energy efficiency measures, approximately 1,000 full-time equivalent jobs are supported across the Scottish economy. SEEP will help to realise economies of scale helping to drive down the cost of energy efficiency measures. There will be opportunities for SMEs and third sector organisations to deliver and/or support the delivery of energy efficiency measures.

Adverse side effects to be managed

10.4.6 If the capital costs of improving the energy performance of non-domestic buildings and of installing low carbon heat technologies, and the operating costs of running them, are higher than current systems, the public and commercial sectors could find energy bills are less affordable, which could have adverse effects on business competitiveness.

10.4.7 The Scottish Government will work with business and the public sector to ensure that SEEP's delivery programmes will be designed to emphasise cost-effective energy efficiency and heat decarbonisation measures that reduce energy bills and enhance competitiveness. We will work with business and the public sector on how to ensure that SEEP supports these cost-effective measures, including on evidence and evaluation where needed.

10.5 Summary of policies, development milestones and proposals

Policy outcome 1: Improvements to the fabric of Scotland's non-domestic buildings results in a 10% reduction in their heat demand by 2032[58]

Table 10-1: Policies that contribute to the delivery of policy outcome 1

Policy	EU, UK or Scottish policy	Public sector partners	Delivery route
Low Carbon Infrastructure Transition Programme supports investment in decarbonisation of business and the public sector through £76 million funding to 2018	Scottish	Scottish Government Scottish Enterprise Highlands and Islands Enterprise Scottish Futures Trust Resource Efficient Scotland	A range of support mechanisms including project development, expert advice and funding (where applicable) is available through the Low Carbon Infrastructure Transition Programme (LCITP) to support the development of substantive private, public and community low-carbon projects across Scotland. The intervention will focus on supporting the acceleration of projects to develop investment grade business cases allowing them to secure existing streams of public and private capital finance. In addition, the programme will collate evidence on recurring barriers and challenges to projects and share this intelligence with investment communities to ensure the refinement of all parts of the system to support the transition to a low carbon economy where possible. It is expected that information about supported projects will be shared as required on a confidential basis between the partners without affecting applicants' commercial sensitivity. This work will continue as part of the development of SEEP, supporting non-domestic energy efficiency and heat projects for decarbonisation.

58 Fabric improvements relate to the installation of insulation and controls for lighting and heating.

Policy	EU, UK or Scottish policy	Public sector partners	Delivery route
Public Sector Energy Efficiency Procurement Framework/ Project Support Unit. Potentially £300 million worth of investment across public sector estate			The Scottish Government has put in place a non-domestic energy efficiency (NDEE) procurement framework for the Scottish public sector, launched on 1 March 2016, that supports energy performance contracting, sharing the delivery risk to the private sector, whilst the public sector secure carbon and financial benefits NDEE projects will retrofit buildings with a range of energy efficient measures, creating savings in energy and maintenance costs, reducing carbon emissions and improving the environmental comfort of buildings, and this work will continue as part of the development of SEEP.
Non-domestic energy efficiency finance (Salix Loans (public sector), SME Loans (business), District Heating Loan Fund) continues as part of development of SEEP	Scottish UK	Scottish Government Salix Finance Resource Efficient Scotland Energy Saving Trust	The Scottish Government's non-domestic energy efficiency finance will continue as part of the development of SEEP, building on existing funding frameworks which already support business and the public sector with low cost loan finance. SEEP will develop financial incentives to enable business and the public sector to meet the objectives for improvement in energy efficiency of non-domestic buildings – these will support compliance with any regulations for improved building performance introduced as part of SEEP.
Provide £9m funding to support SEEP Pilots in 2016/17 and make available further funding to support pilots in 17/18 to test innovative delivery mechanisms for energy efficiency and low carbon heat	Scottish	Local Authorities	Pilot projects funded to test innovative approaches to integrated, area-based energy efficiency and heat decarbonisation programmes across domestic and non-domestic sectors from 2016-20. Will be evaluated and contribute evidence to design of Programme for SEEP.

Table 10-2: Policy development milestones that contribute to the delivery of policy outcome 1

Policy development milestone	Delivery route
SEEP – Regulation and Standards	The Programme for Government commits the Scottish Government to consult on regulation and standards for energy efficiency and for heat. This includes a commitment to consult on the phased regulation of existing buildings, and to look at financial incentives. The Scottish Government will undertake initial consultation on the wider role of regulation and standards within SEEP in early 2017, alongside consultation on the Energy Strategy, and this will then inform future programme development. As part of this consultation, we will consult specifically on regulation of district heating.
SEEP – Financial Incentives	The Programme for Government delivers the Infrastructure Investment Plan 2015 commitment to long-term multi-year financing for SEEP, and includes a commitment to £500 million for SEEP over the first four years of the programme. Availability of loan finance, grants and appropriate incentives introduced at the right times will be necessary to stimulate the market for investment or to help building owners and tenants to meet energy efficiency or heat standards set by regulation. The Scottish Government will undertake initial consultation on the role of financial incentives within SEEP in January 2017, alongside consultation on the Energy Strategy, and this will then inform future programme development.
SEEP – Advice and Information	Our existing advice and support services for residential (Home Energy Scotland), business and public sectors (Resource Efficient Scotland) will continue to deliver during the design phase of SEEP. As SEEP develops over the longer term, we will consider the future provision of advice and information to homes, businesses, and the public sector, to support them in improving the energy efficiency and decarbonising the heat supply of their buildings. The Scottish Government will undertake initial consultation on the role of advice and information within SEEP in January 2017, alongside consultation on the Energy Strategy, and this will then inform future programme development.
SEEP – Delivery Programmes	SEEP will build on our existing successful delivery programmes for domestic and non-domestic buildings by developing new, integrated programmes to offer advice, information, financial incentives, and access to managed, trusted installers, to building owners and tenants. The eventual delivery programmes will build on the evidence and lessons learned from existing programmes and from pilot projects, such as the £9.1m announced in September 2016. The Scottish Government will undertake initial consultation on the design of delivery programmes within SEEP in January 2017, alongside consultation on the Energy Strategy, and this will then inform future programme development.
SEEP – Evidence and Evaluation	The Scottish Government is currently undertaking further analysis to establish a baseline for non-domestic buildings' energy and emissions data against which progress under the Climate Change Plan can be measured, drawing also on UK-wide data sets and building-specific meter-point data.
SEEP – Route Map	The Scottish Government will publish a SEEP Route Map in 2018 setting out the steps we will take to deliver our commitments on energy efficiency and low carbon heat.

Table 10-3: Proposals which contribute to the delivery of policy outcome 1

Proposal	Delivery route
Regulation – Review of the Assessment of Energy Performance of Non-domestic Buildings (Regulations) 2016	Regulations introduced in September 2016 require assessment and improvement in the energy performance and emissions of larger non-domestic buildings (those over 1,000 m²). Initially, an option to defer improvement where reporting on annual operational energy use is available to building owners. Improvement delivered under these regulations will be monitored, to inform early review of both the scope and level of improvement sought from existing buildings, with an intent to review from 2018 leading to amended regulations in 2020.
Regulation – Review of energy standards within building regulations	Staged improvements to energy standards within building regulations have resulted in emissions from buildings built to current standards being, on aggregate, around 75% lower than those of buildings built to standards in force in 1990. A further review of energy standards will commence in 2017 and will investigate a number of topics that offer the potential for further abatement from new buildings and where work is undertaken in existing buildings.

Table 10-4: Policy outcome 1 over time

Policy outcome 1	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Improvements to the fabric of Scotland's non-domestic buildings results in a 10% reduction in their heat demand by 2032[59]				4%					6%							10%

59 Fabric improvements relate to the installation of insulation and controls for lighting and heating.

Policy outcome 2: By 2032 94% of non-domestic buildings' heat[60] is supplied using low carbon heat technologies[61]

Table 10-5: Policies which contribute to the delivery of policy outcome 2

Policy	EU, UK or Scottish policy	Public sector partners	Delivery route
District Heating Loan Fund and Heat Network Partnership	Scottish	Scottish Government Scottish Enterprise Scottish Futures Trust Resource Efficient Scotland Local Authorities Energy Saving Trust Scotland	The District Heating Loan Fund helps address the financial and technical barriers to district heating projects by offering low interest loans. The scheme is open to local authorities, registered social landlords, small and medium sized enterprises and energy services companies with less than 250 employees. During the development of SEEP, we will consider what sort of funding mechanisms are needed to continue to support the expansion of district heating networks. The Heat Network Partnership is a collaboration of agencies focused on the promotion and support of district heating schemes in Scotland. Through its support to local authorities and practitioners, it is building capacity and project development capability to support heat planning and programme delivery work that will be developed by local authorities, the Scottish Government and its partners, as part of the wider SEEP programme in future.
Non-domestic Renewable Heat Incentive (ends 2020/21) and associated SG supportive programmes	UK	UK Government	The Renewable Heat Incentive is a UK-wide scheme created by the UK Government (with the agreement of the Scottish Government). The non-domestic scheme helps businesses, public sector and non-profit organisations meet the cost of installing renewable heat technologies such as biomass, heat pumps (ground source, water source and air source), deep geothermal, solar thermal collectors, biomethane and biogas, combined heat and power (CHP) systems. Payments are made over 20 years and are based on the heat output of the system. There is no commitment to funding the RHI beyond 2020/21 and during the development of SEEP we will consider what sort of funding mechanisms are needed into the 2020s and 2030s to enable continued take-up of these technologies.

60 Includes both space heating and water heating.

61 This includes the electrification of heat. Currently, around 50% of non-domestic buildings' heat is supplied using electricity which, over time, will see an increase in the low carbon feedstock.

Policy	EU, UK or Scottish policy	Public sector partners	Delivery route
Low Carbon Infrastructure Transition Programme supports investment in decarbonisation of business and the public sector through £76 million funding to 2018	Scottish	Scottish Government Scottish Enterprise Highlands and Islands Enterprise Scottish Futures Trust Resource Efficient Scotland	A range of support mechanisms including project development, expert advice and funding (where applicable) is available through the Low Carbon Infrastructure Transition Programme (LCITP) to support the development of substantive private, public and community low-carbon projects across Scotland. The intervention will focus on supporting the acceleration of projects to develop investment grade business cases allowing them to secure existing streams of public and private capital finance. In addition, the programme will collate evidence on recurring barriers and challenges to projects and share this intelligence with investment communities to ensure the refinement of all parts of the system to support the transition to a low carbon economy where possible. It is expected that information about supported projects will be shared as required on a confidential basis between the partners without affecting applicants' commercial sensitivity. This work will continue as part of the development of SEEP, supporting non-domestic energy efficiency and heat projects for decarbonisation.
All small and medium sized non-domestic premises to be offered a smart meter by 2020	UK	UK Government	The UK Government is committed to ensuring that every home and business in the country is offered a smart meter by 2020, and to delivering this as cost effectively as possible. Smart meters provide the opportunity for a greater understanding of final energy consumption; an accurate metering and billing system which eradicates estimated bills; the potential for positive behavioural change and a reduction in energy costs; as well as creating opportunities for innovation. Smart meters will be offered to all homes and smaller and medium sized non-domestic premises. In the wider non-domestic market, energy suppliers are already required to ensure that energy supplied to larger electricity sites (defined as those within profile classes 5-8) and larger gas sites (defined as those with consumption above 732MWh per annum) is measured by an advanced meter. The smart meter rollout focuses on the remaining, smaller sites – those in electricity profile classes 3 and 4, and those with gas consumption below 732MWh per annum. The smart meter rollout is a supplier-led obligation.

Table 10-6: Policy development milestones which contribute to the delivery of policy outcome 2

Policy development milestone	Delivery route
SEEP – Regulation and Standards	The Programme for Government commits the Scottish Government to consult on regulation and standards for energy efficiency and for heat. This includes a commitment to consult on the phased regulation of existing buildings, and to look at financial incentives. The Scottish Government will undertake initial consultation on the wider role of regulation and standards within SEEP in January 2017, alongside consultation on the Energy Strategy, and this will then inform future programme development. As part of this consultation, we will consult specifically on regulation of district heating.
SEEP – Financial Incentives	The Programme for Government delivers the Infrastructure Investment Plan 2015 commitment to long-term multi-year financing for SEEP, and includes a commitment to £500 million for SEEP over the first four years of the programme. Availability of loan finance, grants and appropriate incentives introduced at the right times will be necessary to stimulate the market for investment or to help building owners and tenants to meet energy efficiency or heat standards set by regulation. The Scottish Government will undertake initial consultation on the role of financial incentives within SEEP in January 2017, alongside consultation on the Energy Strategy, and this will then inform future programme development. Through this programme we will also consider impacts of UK Government's GB subsidy regime beyond the potential end of the RHI in 2020/21, particularly on off gas grid businesses; including how any changes can be mitigated to maintain uptake of low carbon heat technologies.
SEEP – Advice and Information	Our existing advice and support services for residential (Home Energy Scotland), business and public sectors (Resource Efficient Scotland) will continue to deliver during the design phase of SEEP. As SEEP develops over the longer term, we will consider the future provision of advice and information to homes, businesses, and the public sector, to support them in improving the energy efficiency and decarbonising the heat supply of their buildings. The Scottish Government will undertake initial consultation on the role of advice and information within SEEP in January 2017, alongside consultation on the Energy Strategy, and this will then inform future programme development.
SEEP – Delivery Programmes	SEEP will build on our existing successful delivery programmes for domestic and non-domestic buildings by developing new, integrated programmes to offer advice, information, financial incentives, and access to managed, trusted installers, to building owners and tenants. The eventual delivery programmes will build on the evidence and lessons learned from existing programmes and from pilot projects, such as the £9.1m announced in September 2016. The Scottish Government will undertake initial consultation on the design of delivery programmes within SEEP in January 2017, alongside consultation on the Energy Strategy, and this will then inform future programme development.

Policy development milestone	Delivery route
SEEP – Evidence and Evaluation	The Scottish Government is currently undertaking further analysis to establish a baseline for non-domestic buildings' energy and emissions data against which progress under the Climate Change Plan can be measured, drawing also on UK-wide data sets and building-specific meter-point data.
SEEP – Route Map	The Scottish Government will publish a SEEP Route Map in 2018 setting out the steps we will take to deliver our commitments on energy efficiency and low carbon heat.

Table 10-7: Propsals which contribute to the delivery of policy outcome 2

Proposal	Delivery route
Develop and identify best approach to the long term decarbonisation of the heat supply, to commence after 2025.	We will work with our partners, including UK Government, Local Authorities and utility providers to determine the best approach to heat decarbonisation for buildings currently heated by natural gas, which are not in areas of sufficient heat demand where district heating is a low regrets option. This will include consideration of technological solutions, including district heating, electric heat pumps, repurposing of the gas network for use of biogas and/or hydrogen, etc. We will look to put forward a more detailed proposal on how we will realise this potential in subsequent Climate Change Plans as our understanding of the best approach develops. The Gas Network is reserved to the UK Government (whatever gas is transported through those pipes). The UK Government is developing work considering long term heat decarbonisation – post 2030. This will over the coming years gather evidence and analysis and try to fill key gaps relating to options such as future of the gas grid, electrification of heat and district heating and the significant impacts on infrastructure requirements that picking one or a mix of these options would have. Policy decisions are not expected to be made by the UK Government until the next parliament, i.e. from 2020.

Table 10-8: Policy outcome 2 over time

Policy outcome 2	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
By 2032 94% of non-domestic buildings' heat[62] is supplied using low carbon heat technologies[63]				64%					65%							94%

62 Includes both space heating and water heating.

63 This includes the electrification of heat. Currently, around 50% of non-domestic buildings' heat is supplied using electricity which, over time, will see an increase in the low carbon feedstock.

10.6 Progress since RPP2

Table 10-9: Progress on RPP2 policies

RPP2 Policies	Summary of progress
Smart Meters	Roll-out of "smart" meters to small and medium-size businesses to encourage better energy management. The UK Government has committed to offering a smart meter to small and medium-sized businesses by 2020.
CRC Energy Efficiency Scheme	This scheme has operated throughout the UK since 2010 and was evaluated in 2015 by the UK Government. The evaluation concluded that whilst increasing energy costs have been the biggest driver on energy efficiency there is evidence that the CRC had a beneficial impact on energy efficiency behaviour and reduced carbon emissions growth by 6-8% between 2010-12 compared with the 2010 Impact Assessment prediction of a 2% annual reduction under the original policy design, and led to a reduction in electricity consumption growth of least 3-5%. The UK Government has announced its intention to abolish the CRC and replace it with increased rates of Climate Change Levy and a new business energy reporting framework.
Buildings Energy Standards (2010) – New Build Properties.	This policy was implemented on 1 October 2010 and results in lower emissions from new buildings. Standards set under this policy were further strengthened by a subsequent review which introduced further improvements to energy standards in October 2015 (See RPP2 proposals). Improved energy standards encourage both innovation and the deployment of low carbon solutions in construction.
Green Deal and Supporting Policy	The Non-Domestic Green Deal, a GB wide policy was ended by the UK Government, without notice, in 2015 as part of a series of announcements reducing support for energy efficiency. SEEP will draw on the lessons learned from this failed scheme, in the development of finance options for non-domestic property owners and occupiers.
EU products policy	EU Products policy is addressed through the Eco-design Framework Directive. An important element of this is improving the energy efficiency of products. This reduces electricity consumption and heat output. The emissions savings from using less electricity are factored into the RPP2 calculations in the energy sector. The reduced heat output is shown here, reflected in a slight increase in emissions resulting from compensatory use of space heating. The overall effect, however, is to reduce total emissions. These policies continue.
Renewable Heat Incentive (RHI – Non Domestic)	The Renewable Heat Incentive is a UK-wide scheme created by the UK Government (with the agreement of the Scottish Government). The non-domestic scheme helps businesses, public sector and non-profit organisations meet the cost of installing renewable heat technologies such as biomass, heat pumps (ground source, water source and air source), deep geothermal, solar thermal collectors, biomethane and biogas, combined heat and power (CHP) systems. Payments are made over 20 years and are based on the heat output of the system. There is no commitment to funding the RHI beyond 2020/21 and during the development of SEEP we will consider what sort of funding mechanisms are needed into the 2020s and 2030s to enable continued take-up of these technologies.
Low Carbon Heat (Non Domestic)	The Scottish Government published the Heat Policy Statement in June 2015, setting out our heat hierarchy and the actions and policies we are taking to reduce demand for heat and ensure its decarbonisation. The development of SEEP will continue to deliver the actions set out in the HPS, alongside development of the new Energy Strategy, including ongoing support for the Heat Network Partnership and funding for district heating via the District Heating Loans Fund.

Table 10-10: Progress on RPP2 proposals

RPP2 Proposals	Summary of progress
New-build non domestic energy standards for 2014	Proposal is now a policy, implemented in October 2015 and delivering intended outcomes. Energy standards for new non-domestic buildings, emissions from new buildings are now in the region of 75% lower than for buildings constructed to the standards applicable in 1990. Standards continue to encourage both innovation and the deployment of low carbon solutions in construction but show poorer cost/benefit as performance sought is more challenging.
Assessment of Energy Performance and Emissions Regulations (Non Domestic Buildings)	Proposal is now a policy. From 1 September 2016, The Assessment of Energy Performance of Non-domestic Buildings (Scotland) Regulations 2016 require owners of buildings over 1,000 m^2 offered for sale or rental to assess and ultimately improvement the energy performance and emissions of their building. Under these initial regulations, improvement may be deferred by reporting of annual operational energy use.
Public Sector (additional potential)	Public Sector (additional potential) Analysis by SFT indicated an investment opportunity of £300 million in energy efficiency projects across public sector estate delivering 174k tCO_2e reduction and could lead to potential energy bill reductions in the region of £30 million per annum for the public sector. To support their delivery of this activity SG has put in place a national procurement framework and project development unit to accelerate the delivery of these estate wide projects across the public sector estates . Working with the Scottish Futures Trust, COSLA, Resource Efficient Scotland and NHS and supplemented by public sector loans funding through Salix we are supporting the delivery of energy efficiency project across the public sector estate and will continue to support delivery of the greener street lighting programme and delivery of district heating projects.

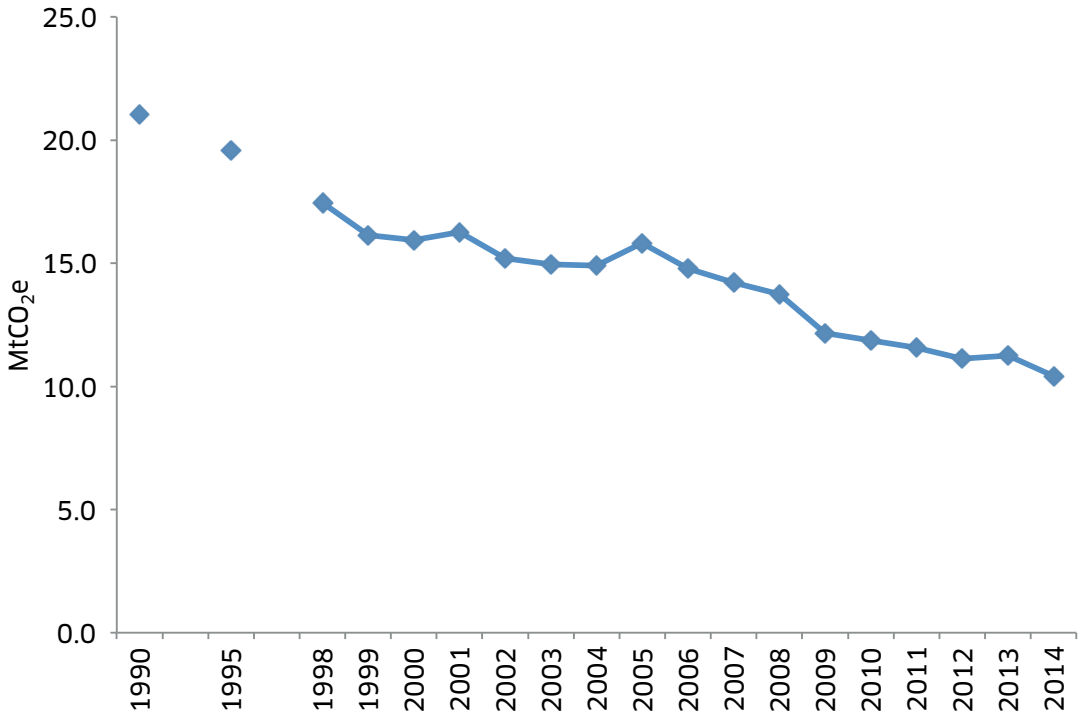
11. Industry

This sector includes all industrial activity and manufacturing in Scotland, including the energy-intensive industrial sectors covered by the EU Emissions Trading System.

11.1 Where we are now

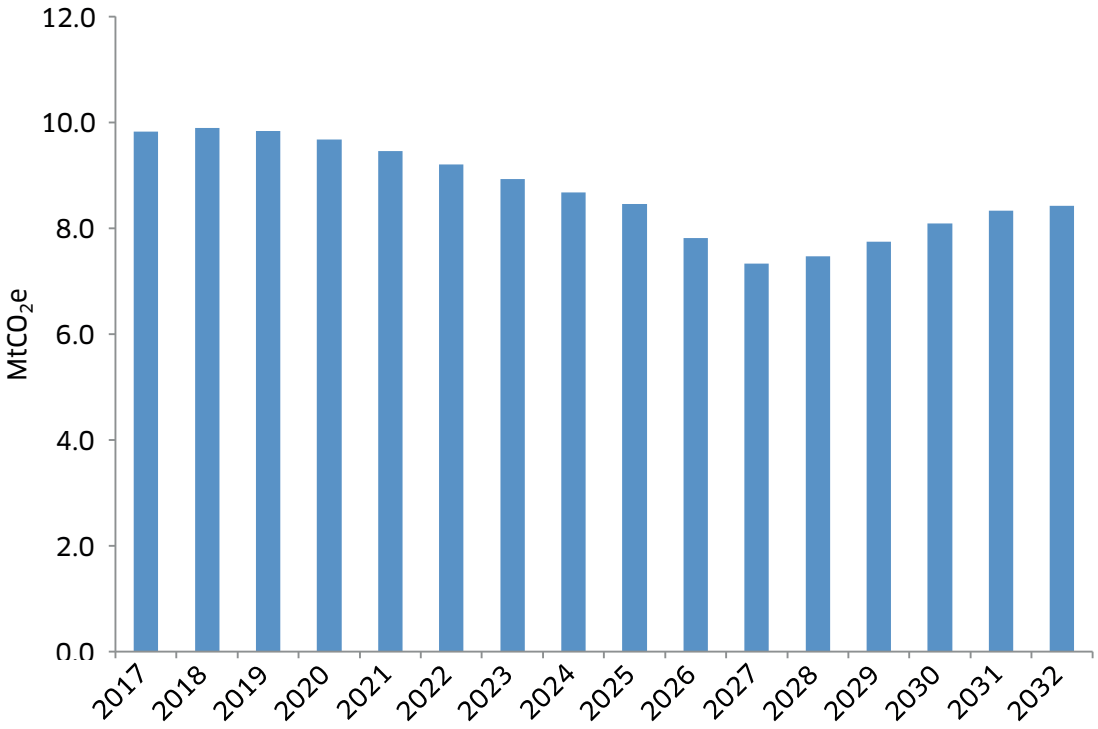
11.1.1 The industry sector has seen a 10.6 $MtCO_2e$ (50.5 %) fall in emissions between 1990 and 2014. Much of this decrease occurred between 1990 and 2000 – linked to a decline in emissions from manufacturing and the iron and steel industry over this time period. There has been a further smaller decrease between 2008 and 2009, coinciding with the recession. Figures have then been more level in recent years, albeit with small fluctuations in emissions from this sector since 2009. There was another decrease (0.8 $MtCO_2e$; 7.3 %) in emissions in this sector between 2013 and 2014. This has been driven by a number of factors, which include a reduction in emissions from combustion in the petrochemicals industry, and from the space heating of offices, which is partly linked to external temperatures. There was also a smaller drop in emissions from pulp and paper making.

Figure 17: Industry historical emissions



11.2 Our ambition

Figure 18: Industry carbon envelopes



11.2.1 Scotland's industrial sector has already delivered substantial emissions reduction. The Scottish Government wants to ensure that further decarbonisation between 2017-2032 will be achieved by supporting industry to make the investments in measures that will enhance its productivity, improve its competitiveness, and realise new manufacturing opportunities in global markets. Set in that productivity and growth context, there are two key policy outcomes that the Scottish Government wants to see for industry under this Climate Change Plan:

- Industrial emissions fall by around 19% between 2014 and 2032, through a combination of fuel diversification, cost saving energy efficiency and heat recovery and participation in EU carbon markets. This will mean by 2032, industrial emissions will be in total, 60% lower than 1990.
- Technologies critical to further emissions reduction are demonstrated at commercial scale by 2030.

11.2.2 We will work with businesses and others to achieve these outcomes through two principal means:

1) By ensuring a continued level playing field for regulation through EU and UK frameworks for industrial decarbonisation

11.2.3 The regulatory environment is underpinned by existing and planned EU and UK regulatory frameworks – the EU Emissions Trading System Phase III (2014-2020) and Phase IV (2021-30), and UK carbon taxes and related reliefs (e.g. Climate Change Levy, Climate Change Agreements, Energy Intensive Industries package)[64]. These regulatory frameworks ensure continuing access to the level-playing field for industry across the UK and EU, and support investment in the industrial decarbonisation pathways necessary to meet the EU and UK's

64 The impact of the UK's exit from the European Union on the role of emissions trading is not factored into the draft Plan, since the UK Government has not yet commenced negotiations with the EU, and has not yet taken a position on the UK's future relationship with the EU Emissions Trading System. The EU ETS remains a fundamental part of UK and Scottish climate change legislation. Powers exist under the Climate Change Act 2008, to create emissions trading schemes in the UK..

contributions to the Paris Agreement, including continued access where required to free allocation of allowances for those sectors at risk of international carbon leakage[65]. The Committee on Climate Change has already confirmed that it expects that "available rules for future phases of the EU ETS will imply a reduction in Scottish net emissions in these sectors of 34% from 2013 to 2030"[66]. The ETS cap will therefore make a major contribution to the 19% emissions reduction envelope for industry from 2014 to 2032[67].

- At the EU level:
  1. By 2020 – Industrial Emissions covered by the EU Emissions Trading System cap will be 21% below 2005 levels, consistent with the EU's 2020 emissions reduction target and commitment to the Kyoto Protocol second period.
  2. By 2030 – Industrial Emissions covered by the EU Emissions Trading System cap will be 43% below 2005 levels, consistent with the EU's 2030 emissions reduction target and commitment to the Paris Agreement.
  3. By 2050 – Industrial Emissions, covered by the EU Emissions Trading System cap would be 90% below 2005 levels, which would be consistent with the EU's 2050 emissions reduction target.

2). By providing incentives and business support via our manufacturing action plan (MAP), A Manufacturing Future for Scotland, and Scotland's Energy Efficiency Programme (SEEP).

11.2.4 These programmes use a combination of existing support from the Scottish Government, Scottish Enterprise, Highlands and Islands Enterprise (and their partners), and will develop new financial products for industry to invest in energy efficiency and decarbonisation through approaches such as industrial heat recovery to district heating networks. This policy framework builds on the existing ESOS (Energy Savings Opportunity Scheme) audits which set out cost-effective energy efficiency and decarbonisation measures that will save industry money, maximising substantial economic opportunities through improved productivity. The policy on '*Delivery of our suite of waste reduction, recycling and landfill diversion targets and regulation up to 2025'*, in the waste chapter of this Climate Change Plan, summarises our approach to delivering those targets. Our circular economy strategy, Making Things Last' sets out our ambitions and priorities to keep products and materials in high value use for as long as possible, reducing waste and carbon emissions and delivering economic benefits through improving productivity, opening up new markets and improving resilience. This includes achieving a 70% recycling rate by 2025 – increasing the supply of recycled materials on the market which, when used by industry in place of virgin materials, will also provide significant 'upstream' energy efficiency savings for Scottish industry.

11.3 Policy outcomes, policies, development milestones and proposals

11.3.1 There are two policy outcomes for industry.

Policy outcome 1: Industrial emissions fall by around 19% between 2014 and 2032, through a combination of fuel diversification, energy efficiency and heat recovery and participation in EU carbon markets.

There are four policies and three policy development milestones which will contribute to the delivery of policy outcome 1.

65 http://ec.europa.eu/clima/policies/ets/allowances/leakage/index_en.htm

66 https://www.theccc.org.uk/wp-content/uploads/2016/03/Scottish-Emissions-Targets-2028-2032.pdf

67 Figures for Phase V of the ETS (post-2030), covering the Scottish carbon budget to 2032 are not available, since the EU's contribution to the Paris Agreement is currently only set out to 2030. We can expect further tightening of the ETS cap beyond 2030 to meet the EU's 2050 target of 80% emissions reduction.

Policies which contribute to the delivery of policy outcome 1

1) EU Emissions Trading System (EU ETS) cap delivers a 43% reduction on 2005 EU emissions levels by 2030 and we will argue for a share of that cap in line with meeting Scotland's domestic ambitions.
2) UK Climate Change Levy (CCL) and Climate Change Agreements (CCAs) incentivise shift from gas to alternative fuels, and deliver agreed energy efficiency and emission reduction targets for energy intensive industrial sectors.
3) Non-domestic Renewable Heat Incentive (ends 2020/21) and associated Scottish Government supportive programmes will continue to encourage the uptake of renewable heat technologies.
4) Our manufacturing action plan (MAP) *A Manufacturing Future for Scotland* – industrial energy efficiency and decarbonisation workstream supports investment in energy efficiency and heat recovery.

Policy development milestones which contribute to the delivery of policy outcome 1

1) National Infrastructure Priority for Energy Efficiency – Scotland's Energy Efficiency Programme (SEEP) – regulation delivery route.
2) Our manufacturing action plan (MAP) *A Manufacturing Future for Scotland* – Energy Saving Opportunities Scheme (ESOS) audit pilot.
3) EU-ETS beyond 2030.

Policy outcome 2: Technologies critical to further industrial emissions reduction (such as carbon capture and storage, carbon capture and utilisation, and production and injection of hydrogen into the gas grid) are demonstrated at commercial scale by 2030.

There is one proposal which will contribute to the delivery of policy outcome 2.

Proposal which contributes to the delivery of policy outcome 2

1) Our manufacturing action plan (MAP) *A Manufacturing Future for Scotland*, – sets out our industrial policy for energy efficiency and decarbonisation workstream.

11.3.2 Full details of policies, policy development milestones and proposals are set out in the tables below. The delivery of these will be tracked through the monitoring framework (see section 6).

11.4 Wider impacts

Co-benefits to be realised

11.4.1 There are potential co-benefits for business competitiveness and energy productivity of investment in industrial energy efficiency, which reduces operating costs and can protect against any rise in energy prices, and industrial heat recovery, which could provide an income stream. These enhancements in the competitiveness and productivity of Scotland's manufacturing sector will complement wider investment in innovation and skills to contribute to the Government's wider objectives of sustainable economic growth, and will ensure that high quality manufacturing jobs continue to be located in Scotland, benefiting all people across Scotland, in both urban and rural areas.

11.4.2 Demonstration at commercial scale of industrial emissions reduction technologies such as CCS or hydrogen would protect Scottish business against future carbon price rises. It could also secure economic benefit in the supply chain for knowledge transfer of technology expertise to other businesses in international markets. In addition, support for industrial clustering will help businesses to reduce costs through shared infrastructure such as district heating networks and through co-location of production processes and where industry is currently a producer of waste heat deployment of district heating creates new revenue streams to help competitiveness of the business.

11.4.3 The Scottish Government will maximise these co-benefits through working with our public sector partners and industrial trade associations to support the investment necessary for these improvements in energy efficiency and productivity through our manufacturing action plan (MAP) *A Manufacturing Future for Scotland,* and through SEEP, which will deliver our national infrastructure priority for energy efficiency.

Adverse side effects to be managed

11.4.4 Reducing global emissions to a level consistent with the Paris Agreement will require a significant reduction in the carbon intensity of the global economy – and comparative effort from other major economies. The pathway set out in this Plan is broadly consistent with the level of emissions reduction expected in the EU ETS cap out to 2030, and with the EU's contribution to the Paris Agreement. By remaining within EU and UK regulatory frameworks, we ensure that industry in Scotland retains the EU-wide and UK-wide level playing fields for emissions reduction, which avoids the risk of 'carbon leakage'. This is where business relocates from one country to another where there is more liberal emissions control. The net effect is to leave global emissions unchanged whilst damaging the economy of the country from which industry relocated.

11.4.5 Provisions to protect sectors at greatest risk of carbon leakage are included within the EU ETS, and hence this is why it remains our major regulatory instrument for tackling industrial emissions in the fairest way possible, as part of collective effort with our EU partners. Those working in the manufacturing sector would be at severe risk if industries were to close or relocate from Scotland as a result of carbon leakage. Energy intensive businesses, that were not required to make similar emissions reductions in other locations outside Scotland, would potentially see Scotland as an unattractive location for new investment in manufacturing.

11.4.6 To help businesses decarbonise within the EU ETS cap and under UK carbon taxes, we will support investment in energy efficiency and heat recovery, and also support business in accessing EU funding necessary for demonstration of significant technologies, such as CCS or hydrogen, that can drive further decarbonisation of manufacturing beyond the 2020s.

11.5 Summary of policies, development milestones and proposals

Policy outcome 1: Industrial emissions fall by around 19% between 2014 and 2032, through a combination of fuel diversification, energy efficiency and heat recovery and participation in EU carbon markets.

Table 11-1: Policies that contribute to policy outcome 1

Policy	EU, UK or Scottish policy	Public sector partners	Delivery route
EU Emissions Trading System (EU ETS) cap delivers 43% reduction on 2005 EU emissions levels by 2030 and we will argue for a share of that cap in line with meeting Scotland's domestic ambitions	EU	SEPA Scottish Government UK Government Welsh Government Northern Ireland Executive Environment Agency	The EU ETS will continue to cover energy intensive industries from present to 2030 under proposed ETS Phase IV, (steel, cement, paper, chemicals, glass, ceramics, refining etc), with a steeper annual linear reduction factor (from 1.74% p.a. in 2013-20 to 2.2% p.a. in 2021-30). Many of these sectors will still benefit from high levels of free allocation of allowances in order to protect them from carbon leakage risk and to avoid decarbonisation by deindustrialisation in the absence of any comparative effort from other major economies under the Paris Agreement. Delivery of the EU ETS in Scotland will continue to be a partnership between the Scottish and UK Governments, and the other devolved administrations, with SEPA as the major enforcement body[68].
UK Climate Change Levy (CCL) and Climate Change Agreements (CCAs) incentivise shift from gas to alternative fuels, and deliver agreed energy efficiency and emission reduction targets for energy intensive industrial sectors	UK	UK Government	Carbon taxation is a reserved matter, and the UK Government has set out that it will concentrate its carbon taxation in a single instrument (CCL) from 2019 onwards, with a stated intention that it will rebalance rates, working towards a ratio of 1:1 (electricity: gas) by 2025 (from the current 2.9:1 ratio where electricity contributes almost 3 times as much to the CCL tax take as gas). The UK government has said that it intends that this will more strongly incentivise reductions in use of gas by business, in support of UK climate change targets. For those sectors that benefit from a Climate Change Agreement, in return for a commitment to reduce energy use and carbon dioxide emissions, operators receive a discount on the CCL of 90% on electricity bills, and 65% on other fuels. CCAs are available for a wide range of industry sectors from major energy-intensive processes such as chemicals, paper and supermarkets to agricultural businesses such as intensive pig and poultry farming.

68 The impact of the UK's exit from the European Union on the role of emissions trading is not factored into the draft Plan, since the UK Government has not yet commenced negotiations with the EU, and has not yet taken a position on the UK's future relationship with the EU Emissions Trading System. The EU ETS remains a fundamental part of UK and Scottish climate change legislation. Powers exist under the Climate Change Act 2008, to create emissions trading schemes in the UK.

Policy	EU, UK or Scottish policy	Public sector partners	Delivery route
Non-domestic Renewable Heat Incentive (ends 2020/21) and associated SG supportive programmes	UK	UK Government	The Renewable Heat Incentive is a UK-wide scheme created by the UK Government (with the agreement of the Scottish Government). The non-domestic scheme helps businesses, public sector and non-profit organisations meet the cost of installing renewable heat technologies such as biomass, heat pumps (ground source, water source and air source), deep geothermal, solar thermal collectors, biomethane and biogas, combined heat and power (CHP) systems. Payments are made over 20 years and are based on the heat output of the system. There is no commitment to funding the RHI beyond 2020/21 and during the development of SEEP we will consider what sort of funding mechanisms are needed into the 2020s and 2030s to enable continued take-up of these technologies by business.
Our manufacturing action plan (MAP) *A Manufacturing Future for Scotland*,– industrial energy efficiency and decarbonisation workstream supports investment in energy efficiency and heat recovery	Scottish	Scottish Government Scottish Enterprise Highlands and Islands Enterprise Scottish Manufacturing Advisory Service Resource Efficient Scotland SEPA Skills Development Scotland	The manufacturing action plan (MAP) *A Manufacturing Future for Scotland*, commits the Scottish Government and its partners to a programme of activity to support industrial energy efficiency and decarbonisation: • Advice and support: Develop expert advice for Scotland's energy intensive companies to develop feasible and cost effective business plans to implement ESOS (Energy Savings Opportunities Scheme) audit recommendations. This may include support to achieve ISO 50001. • Energy efficiency and heat recovery: As part of the new energy efficiency national infrastructure priority, consider how to best incentivise additional energy efficiency and heat recovery opportunities within businesses. • Work with the UK Government to develop new incentive or regulatory mechanisms to deliver this. • Benchmarking performance: Establish a more detailed baseline of Scottish industrial energy, heat and emissions performance, to benchmark against EU standards. • Low carbon technology demonstration: Explore the scope for supporting and accessing finance for cross-sector technology demonstrator projects identified in UK roadmaps (CCS, heat electrification, industrial biomass etc), including EU ETS Innovation Fund and support for industrial clustering, in key sites such as the Grangemouth area, to realise co-location and shared infrastructure benefits.

Table 11-2: Policy development milestones which contribute to policy outcome 1

Policy development milestone	Delivery route
National Infrastructure Priority for Energy Efficiency – Scotland's Energy Efficiency Programme (SEEP) – regulation	The Programme for Government commits the Scottish Government to significant policy development on heat and energy efficiency improvements in all buildings across Scotland through the national infrastructure priority. Scotland's Energy Efficiency Programme will improve the energy efficiency and reduce the environmental impact of Scotland's domestic and non-domestic buildings through a programme of measures including: regulation, financial Incentives, advice and support. This will enable building owners and tenants to make extensive fabric improvements e.g. loft and wall insulation and investment in decarbonisation of their heat supply such as through expansion of and connection to district heating, installation of heat pumps, biomass boilers, or repurposing of the gas grid for new technologies such as hydrogen or biogas, where feasible. For industrial buildings, this could include support for investment in industrial energy efficiency in processes and equipment, and industrial heat recovery to district heating networks through a combination of: potential development of new financial products for industry to invest in energy efficiency, heat recovery, and decarbonisation; alongside support, where eligible or available, via existing financial mechanisms of Scottish Ministers and Scottish Enterprise. We will consult on regulation of district heating alongside development of the Energy Strategy, in January 2017, in response to the recommendations of the Expert Commission on District Heating Regulation in 2016, which includes recommendations on regulation of industrial heat recovery. SEEP is currently under development and consultation, and once this is complete, it will offer the range of policies necessary to improve the energy efficiency and decarbonise the heat supply of non-domestic buildings.
Our manufacturing action plan (MAP) *A Manufacturing Future for Scotland* – Energy Saving Opportunities Scheme (ESOS) audit pilot	Existing ESOS audits set out cost-effective energy efficiency and decarbonisation measures that will save industry money and improve productivity. The manufacturing action plan (MAP) *A Manufacturing Future for Scotland*, commits Scottish Enterprise and HIE to build on the existing pilot of follow-up to audits, with the roll-out of a Scotland-wide programme of targeted advice to industry, to offer relevant investment support and access to finance through existing funds or new funds developed under SEEP. Further development could include consideration of the potential to require mandatory implementation of ESOS audit findings where they are demonstrated to be cost-effective and save industry money and improve productivity, if this is within devolved competence. Stakeholder engagement would be undertaken to inform any further development of the ESOS scheme.

Policy development milestone	Delivery route
EU-ETS beyond 2030	Figures for Phase V of the ETS (post-2030), covering the Scottish carbon budget to 2032 are not available, since the EU's contribution to the Paris Agreement is currently only set out to 2030. We can expect further tightening of the ETS cap beyond 2030 to meet the EU's 2050 target of 80% emissions reduction, and the European Commission has said that under the ETS continuing, by 2050, emissions would be reduced by around 90% compared to 2005 levels – though this is subject to further provision in EU law to extend the ETS beyond 2030[69].

Policy outcome 2: Technologies critical to further industrial emissions reduction (such as carbon capture and storage, carbon capture and utilisation, and production and injection of hydrogen into the gas grid) are demonstrated at commercial scale by 2030.

Table 11-3: Proposals which contribute to the delivery of policy outcome 2

Proposal	Delivery route
Our manufacturing action plan (MAP) *A Manufacturing Future for Scotland* – industrial energy efficiency and decarbonisation workstream	The MAP commits the Scottish Government and its partners to explore the scope for supporting and accessing finance for cross-sector technology demonstration projects identified in UK industrial decarbonisation roadmaps. This includes carbon capture and storage, heat electrification and the diversification of fuel supplies and feedstocks to new sources such as hydrogen. This includes support for industrial decarbonisation technology demonstration under the proposed EU ETS Innovation Fund which is expected to operate from 2020 to 2030. MAP partners will work with energy intensive businesses and trade associations to develop potential demonstration projects in Scotland.

69 http://ec.europa.eu/clima/policies/ets/cap_en

Table 11-4: Policy outcome 2 over time

Policy outcome 2	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Industrial emissions fall by around 19% between 2014 and 2032				7%					19%							19%
Technologies critical to further industrial emissions reduction (such as carbon capture and storage, carbon capture and utilisation, and production and injection of hydrogen into the gas grid) are demonstrated at commercial scale by 2030					ETS Innovation Fund becomes available for application by industrial sectors for demonstration of industrial emissions reduction technologies at commercial scale				Industrial CCS demonstration begins in EU for sectors that need it (oil refining, chemicals, steel, cement)					Industrial CCS is proven at commercial scale in the EU and adoption begins, driven by EU carbon price and level of free allocation under Phase IV.		

11.6 Progress since RPP2

Table 11-5: Progress on RPP2 policies

RPP2 Policies	Summary of progress
Renewable Heat incentive (RHI – Non Domestic	The Renewable Heat Incentive is a UK-wide scheme created by the UK Government (with the agreement of the Scottish Government). The non-domestic scheme helps businesses, public sector and non-profit organisations meet the cost of installing renewable heat technologies such as biomass, heat pumps (ground source, water source and air source), deep geothermal, solar thermal collectors, biomethane and biogas, combined heat and power (CHP) systems. Payments are made over 20 years and are based on the heat output of the system. There is no commitment from UK Government to funding the RHI beyond 2020/21 and during the development of SEEP we will consider what sort of funding mechanisms are needed into the 2020s and 2030s to enable continued take-up of these technologies.

Table 11-6: Progress on RPP2 proposals

RPP2 Proposals	Summary of progress
Low Carbon Heat (Non Domestic)	The Scottish Government published the Heat Policy Statement in June 2015, setting out our heat hierarchy and the actions and policies we are taking to reduce demand for heat and ensure its decarbonisation. The development of SEEP will continue to deliver the actions set out in the HPS, alongside development of the new Energy Strategy, including ongoing support for the Heat Network Partnership and funding for district heating via the District Heating Loans Fund. We will consult on the regulation of district heating during 2017 as part of the wider consultation on the Energy Strategy, and this will include consultation on industrial heat recovery.

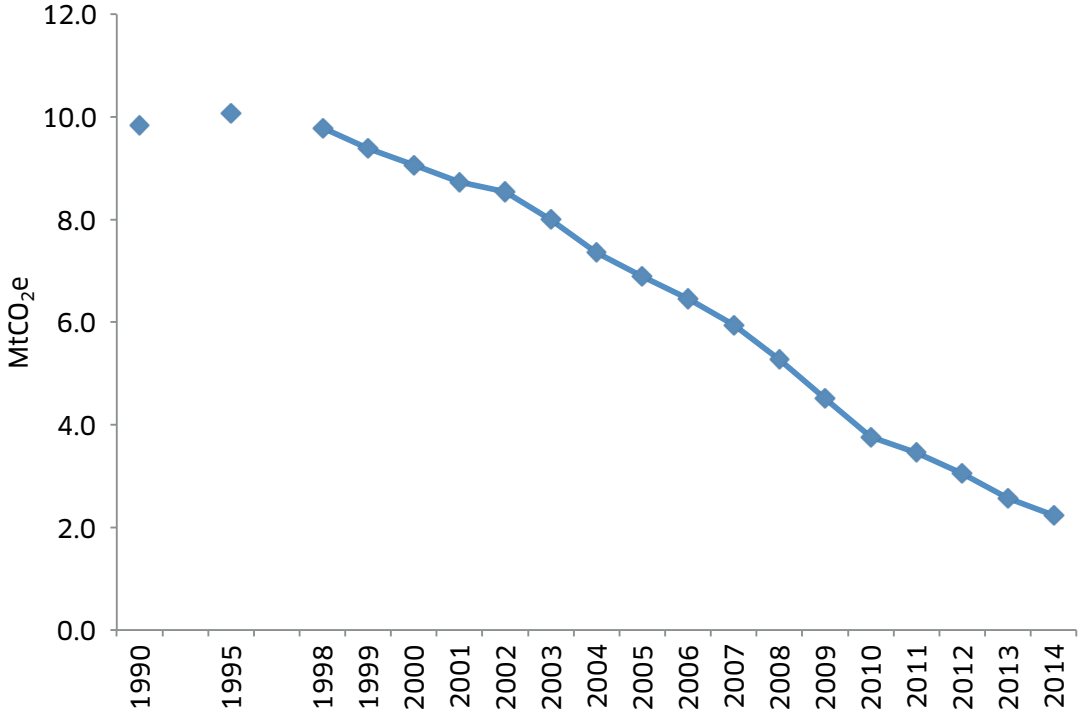
12. Waste

The Waste Sector covers the use of resources, including maximising the reuse, recycling and recovery of resources rather than treating them as waste.

12.1 Where we are now

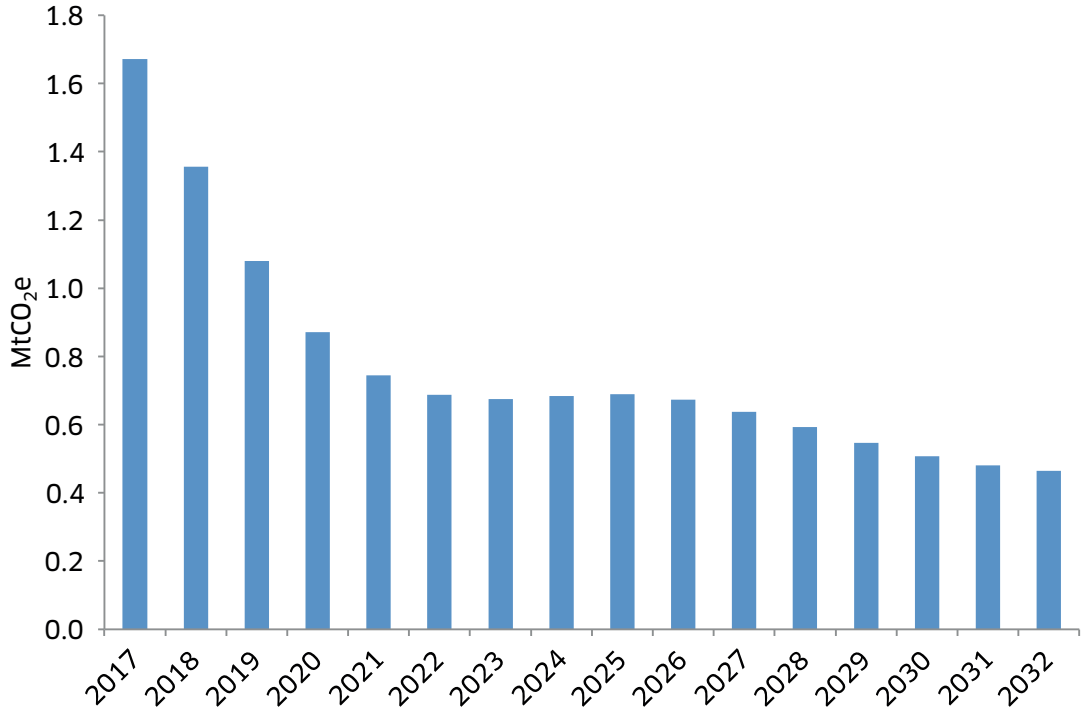
12.1.1 This sector has seen a 7.6 $MtCO_2e$ (77.3%) fall in emissions between 1990 and 2014 – the largest percentage fall of any sector over this time period. This is as a result of (1) the progressive introduction of landfill gas being captured and used for energy and (2) the reduction in biodegradable municipal waste going to landfill. There could also be other factors which contribute to this reduction, such as improvements in the standards of landfill and changes to the types of waste going to landfill. Between 2013 and 2014, the Waste Management sector saw a fall of 0.3 $MtCO_2e$ (12.8%).

Figure 19: Waste historical emissions



12.2 Our ambition

Figure 20: Waste carbon envelopes



12.2.1 The Scottish Government's ambition for a circular economy is set out in our circular economy strategy, Making Things Last, and by 2035, we would expect the principles of a circular economy to be well established. We want more products designed for longer lifetimes, second hand goods to be seen as a mainstream, good value option, and major industrial sectors to be optimising the value of used equipment, such as the reuse of elements of energy infrastructure. As landfilling decreases, we now want to manage the legacy of landfill sites around Scotland, minimising emissions from operational and closed sites, through innovative flaring technology.

- By 2020, the landfilling of biodegradable municipal waste will be phased out, ahead of the statutory ban that applies from 2021.
- By 2030, we expect to be in tandem with the UN Sustainable Development Goals to reduce food waste by 50%.
- By 2050, we aim to be delivering emissions reductions through a circular economy approach in our business and industry sectors.

12.3 Policy outcomes, policies, development milestones and proposals

Policy outcome 1: Reduction in waste sent to landfill.

There is one policy and one proposal which will contribute to the delivery of policy outcome 1.

Policies which contribute to the delivery of policy outcome 1

1) Delivery of our suite of waste reduction, recycling and landfill diversion targets and regulation up to 2025.
   - Target to recycle 70% of all waste by 2025.
   - Target to reduce food waste by 33% by 2025.
   - Ending landfilling of biodegradable municipal waste by 2020 and reducing all waste sent to landfill to 5% by 2025.
   - Reduce waste and establish a more circular economy, where goods and materials are kept in use for longer.

Proposal which contributes to the delivery of policy outcome 1

1) Post-2025 framework for further waste reduction, management and circular economy policies and indicators.

Relative significance of policies, policy development milestones and proposals to the delivery of policy outcome 1

12.3.1 The majority of emissions reductions in the waste sector are as a consequence of policy outcome 1. Together, the policies contribute in an integrated way to the achievement of the policy outcome.

Policy outcome 2: Reduction in emissions from closed landfill sites.

There is one policy and one policy development milestone which will contribute to the delivery of policy outcome 2.

Policy which contributes to the delivery of policy outcome 2

1) Landfill gas capture on closed sites.

Policy development milestone which contributes to the delivery of policy outcome 2

1) 12 sites supported by 2022.

Relative significance of policies, policy development milestones and proposals to the delivery of policy outcome 2

12.3.2 Relatively, policy outcome 2 makes a smaller contribution to emissions reductions in the waste sector than policy outcome 1.

12.3.2 Full details of policies, policy development milestones and proposals are set out in the tables below. The delivery of these will be tracked through the monitoring framework (see section 6).

12.4 Wider impacts

Delivery of waste reduction, recycling and landfill diversion targets and regulation up to 2025

12.4.1 Establishing a more circular economy creates strong economic benefits. Businesses can benefit from improving productivity, opening up new markets and improving resilience in their ability to access materials, through reducing reliance on scarce resources.

12.4.2 Our Making Things Last strategy includes a focus on four parts of the economy where these potential benefits are greatest, food/bio-economy; remanufacture; reuse of energy infrastructure and construction/built environment.

12.4.3 Individuals can benefit from more, lower cost options to access second hand or refurbished goods; or make savings through repairing items rather than replacing them. These lower cost options to access the goods we need also bring opportunities for social enterprise.

12.4.4 Alongside the territorial carbon emissions savings as a consequence of moving to a more circular economy, significant global emissions reductions will result from reducing Scotland's demand for imported products and raw materials.

Landfill gas capture on closed sites

12.4.5 Minimal. There is modest potential for landfill gas from a minority of these sites to be used for energy generation.

12.5 Summary of policies, development milestones and proposals

Policy outcome 1: Reduction in waste sent to landfill

Table 12-1: Policies that contribute to policy outcome 1

Policy	EU, UK or Scottish policy	Public sector partners	Delivery route
Delivery of our suite of waste reduction, recycling and landfill diversion targets and regulation up to 2025	Scottish policy	Zero Waste Scotland (not public sector but publicly funded) Scottish Enterprise SEPA Local authorities	The Scottish Government has set out its priorities for action in our circular economy strategy Making Things Last Strategy. We fund Zero Waste Scotland as our main circular economy expert and delivery partner, supporting businesses, local authorities and communities to act. The enterprise agencies also have an important role through mainstream business support; as do local authorities through their responsibilities for waste and recycling; and SEPA as regulator. Delivery (as below) through a combination of: • regulation, including requirements for business and local authority recycling and a landfill ban • targeted funding and the Scottish Landfill Tax • support for business, local authority and community action

Policy	EU, UK or Scottish policy	Public sector partners	Delivery route
Target to recycle 70% of all waste by 2025			Local authorities, waste management companies and other businesses have duties to separately collect food waste and other materials for recycling. SEPA is the regulator for the duties on the private sector, and Zero Waste Scotland provides advice and support. We have agreed the Household Recycling Charter with COSLA, which will introduce more consistent local collections, making it easier for people to recycling and hence improving quantity and quality of recycling. Through Zero Waste Scotland we are supporting Local Authorities to implement food waste collection and change their recycling collections in line with the Household Recycling Charter, in addition to the funding councils receive through the local government settlement.
Target to reduce food waste by 33% by 2025			The baseline for the food waste target was published in November 2016, and a package of actions will be developed with stakeholders in the first half of 2017. The Good Food Nation Bill will provide a legislative vehicle for statutory interventions, if required.
Ending landfilling of biodegradable municipal waste by 2020 and reducing all waste sent to landfill to 5% by 2025			Landfilling of biodegradable municipal waste is banned from January 2021. The Scottish Landfill Tax already provides an incentive to reduce landfilling and prioritise more valuable options such as waste reduction and recycling. We will work, with SEPA and Zero Waste Scotland, to continue to improve the way that we provide and present information on the anticipated capacity requirements for future alternative waste infrastructure, for use by planning authorities and industry – helping ensure the capacity of waste infrastructure developed is appropriate.
Action to reduce waste and establish a more circular economy, where goods and materials are kept in use for longer			Delivery of Making Things Last – A circular economy strategy for Scotland, and our targets to reduce all waste by 15% and food waste by 33% by 2025, including through: • Resource Efficient Scotland – helping businesses reduce food and construction waste in particular • The Courtauld 2025 agreement with food businesses to cut food waste by 20% • The Circular Economy Investment Fund and Service – helping companies transform their business models to design out waste • Making circular economy thinking a core aspect of Scotland's Manufacturing Action Plan and mainstream Scottish Enterprise support for businesses

Table 12-2: Policy outcome 1 over time

Policy outcome 1	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Percentage point fall in proportion of waste landfilled from current (2014) rate	9%	12%	14%	17%	20%	23%	26%	29%	32%	32%	32%	32%	32%	32%	32%	32%

Policy outcome 2: Reduction in emissions from closed landfill sites

Table 12-3: Policies which contribute to policy outcome 2

Policy	EU, UK or Scottish policy	Public sector partners	Delivery route
Landfill gas capture on closed sites	Scottish policy	SEPA Zero Waste Scotland (not public body but publicly funded) Local Authorities	12 suitable sites have been identified in the short term by SEPA. We are supporting installation of equipment through Zero Waste Scotland working with site managers, who are often from local authorities, drawing on SEPA expertise. A forward work programme of projects will be developed.

Table 12-4: Policy development milestones which contribute to policy outcome 2

Policy development milestone	Delivery route
12 sites supported by 2022	12 suitable sites have been identified in the short term by SEPA. We are supporting the installation of equipment through Zero Waste Scotland working with site managers, who are often from local authorities, drawing on SEPA expertise.

Table 12-5: Proposals which contribute to policy outcome 1

Proposal	Delivery route
Post-2025 framework for further waste reduction, management and circular economy policies and indicators	The targets in Making Things Last – A circular economy strategy for Scotland run to 2025. This proposal recognises the need to develop a strategic approach in the future.

Table 12-6: Policy outcome 2 over time

Policy outcome 2	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Number of additional closed landfills with landfill gas capture and treatment	12 suitable sites identified in the short term															

12.6 Progress since RPP2

Table 12-7: Progress on RPP2 policies

RPP2 Policies	Summary of progress
Delivery of Zero Waste Plan	Since RPP2 was published, most of the legislative proposals from the Zero Waste Plan have now come into effect, with new legal requirements for separate collection of food and recyclable waste from households and businesses. Key achievements include the following: • Household waste has decreased by 18%, from 3.0 million tonnes in 2007 to 2.5 million tonnes in 2015. • Resource Efficient Scotland (2013) provides, practical, on-the-ground support to help businesses eliminate unnecessary waste (water, energy and materials), save money and retain a competitive edge. • 1.95 million households (80% of total households) now have access to a food waste collection service, up from 300,000 in 2010. • Since 2008, food waste processing capacity (anaerobic digestion and composting) has increased from 20,000 tonnes per year to around 297,000 tonnes per year. • Scotland's household recycling rate was 44.2% in 2015 – up from around 32% for municipal waste in 2007. 13 councils exceeded 50% in 2015, and four are approaching 60%.

Table 12-8: Progress on RPP2 proposals

RPP2 Proposals	Summary of progress
Enhanced Capture of Landfill Gas from closed landfill sites	Following installation of gas capture at two closed landfill sites in the Scottish Borders, similar gas capture is being installed at two additional sites in Glasgow and East Lothian. Scottish Ministers have also allocated a further £500k for a variety of work at up to six further sites.

13. Land Use (LULUCF)

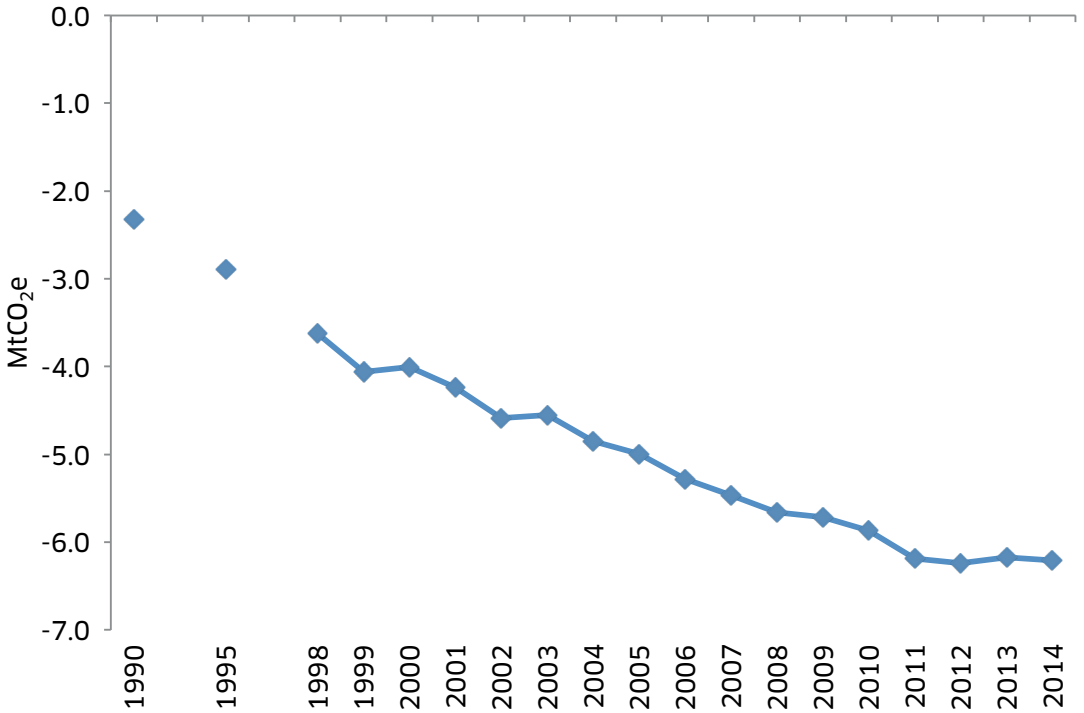
The Land Use, Land Use Change and Forestry (LULUCF) sector is divided into six land use types for reporting carbon emissions and carbon removals from the atmosphere: Forest Land; Cropland; Grassland; Wetlands (Peatland); Settlements; and Other Land. Net carbon stocks from Harvested Wood Products (HWP) are reported under an additional category.

LULUCF is a sector which has the possibility of removing greenhouse gases from the atmosphere.

13.1 Where we are now

13.1.1 This chapter discusses historical emissions and removals arising from the LULUCF sector, and sets out the Scottish Government's ambitions specifically on forestry and peatland up to 2032.

Figure 21: LULUCF historical emissions



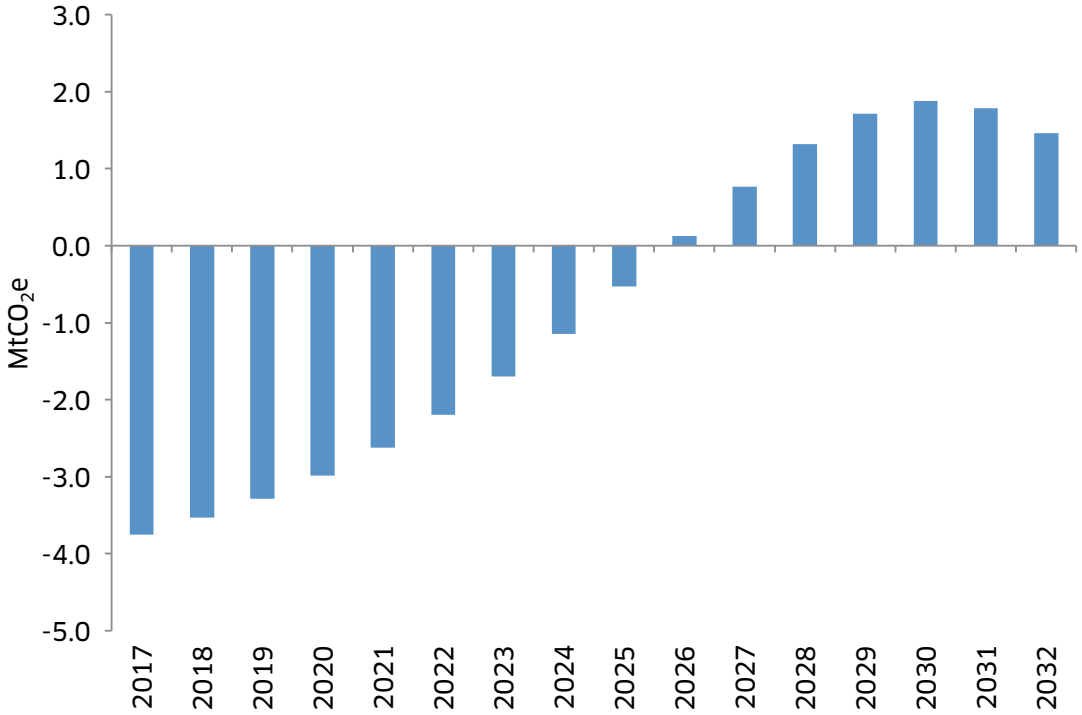
13.1.2 The above figure shows that in 1990, the LULUCF sector as a whole was sequestrating or absorbing a net 2.3 $MTCO_2e$. This represents negative emissions of 2.3 $MTCO_2e$. Since then, there has been a significant increase in net sequestration up to 6.2 $MTCO_2e$ in 2014. Once again this can be represented as negative emissions of 6.2 $MTCO_2e$.

13.1.3 The increase in net sequestration has been driven by a fall in emissions from the conversion of grassland to cropland, an increase in carbon sequestered from grassland and the significant increase in sequestration from forestry. For forestry this is an increase in sequestration from 8.8 $MTCO_2e$ in 1990 to 10.2 $MTCO_2e$ in 2014.

13.2 Our ambition

13.2.1 Net sequestration in the LULUCF sector is expected to decrease in the coming years. LULUCF will switch from being a net sink to being a net source, although the forestry component will remain a sink. Beyond 2032 the LULUCF sector will return to being a net sink as recent woodland creation and replanted forests mature and restored peatland sequester more carbon.

Figure 22: LULUCF Carbon envelopes



13.2.2 The overall decrease in sequestration is driven by a lower volume of emissions sequestered by forestry. This is as a result of the decreasing rate of woodland creation over the last 40 years, and that conifer plantations established in the in the mid-20th century are reaching maturity and being felled and replanted. This decrease has not yet been compensated for by the future increase in sequestration from the recent increase in woodland creation rates, replanting of forests that have been felled, peatland restoration activity, and the fall in emissions generated by agriculture-related land use activity and development (which is not included in the agricultural sector).

13.2.3 The next two subsections set out the forestry and peatland elements of LULUCF in more detail.

13.3 Forestry

The sector covers the expansion of Scotland's forest and woodlands and the increased use of wood products as a natural renewable resource.

Where we are now – Forestry

13.3.1 Woodland creation integrated with other land uses supports fulfilment of Scottish Government's commitments on climate change and biodiversity and the sustainable supply of wood products to the Scottish forestry industry. The forestry sector is worth almost £1 billion per year and employs over 25,000 people in Scotland.

13.3.2 Forests and woodlands cover around 18% of land in Scotland, with the area split between 74% coniferous and 26% broadleaf tree species. Most of these woodlands are independently certified to internationally recognised standards of good forestry practice. The Scottish Government endorses the UK Forestry Standard, a benchmark for sustainable forest management and all woodlands created using Scottish Government funding must meet the requirements of this Standard. In 2015, 83% of all harvested wood products in the UK came from independently certified sources.

13.3.3 Sustainable wood production is currently increasing in Scotland as woodlands planted in the 1960s and 1970s mature. The harvesting and marketing of wood products is becoming an increasingly important economic activity in rural Scotland and over 8.4 million cubic metres of wood products were produced in 2015.

13.3.4 Scotland's forest carbon sink increased between 1990 to 1999 but has remained relatively constant since then, with a slight reduction in sequestration in recent years which is predicted to continue. This is due to the rate of afforestation decreasing over the last 40 years and conifer plantations established in the mid-20th century reaching maturity and being felled and replanted. In 2014, the last time it was measured, forestry was the only sector in which there was a net emissions sink (-10.2 $MtCO_2e$).

Our ambition – Forestry

13.3.5 By 2032, Scotland's woodland cover will increase from around18% to 21% of the Scottish land area. These new woodlands will absorb greenhouse gas emissions and provide confidence for the forest products industry to continue to invest in Scotland and create new jobs. The woodlands will also help mitigate flood risk and improve water quality, as well as making an important contribution to improving biodiversity and people's health and wellbeing. These new woods will be created in accordance with the requirements of sustainable forest management and be integrated with other rural and urban land uses to support the delivery of the Land Use Strategy (2016-2021) objectives, which are:

- Land-based businesses working with nature to contribute more to Scotland's prosperity.
- Responsible stewardship of Scotland's natural resources delivering more benefits to Scotland's people.
- Urban and rural communities better connected to the land, with more people enjoying the land and positively influencing land use.

13.3.6 Furthermore, as this sustainable woodland resource increases and produces more wood fibre, a greater amount of wood products will be used in construction, consequently storing more sequestered carbon in buildings leading to more jobs and investment in the wood product industry.

13.3.7 The focus for delivering our ambition is to:

- increase our long term annual woodland creation target from the current target of 10,000 hectares per year to:
  - 12,000 hectares per year from 2020/21
  - 14,000 hectares per year from 2022/23
  - 15,000 hectares per year from 2024/25
- increase the use of Scottish wood products in construction from the current level of 2.2 million cubic metres to:
  - 2.6 million cubic metres by 2021/22
  - 2.8 million cubic metres by 2026/27
  - 3.0 million cubic metres by 2031/32

13.3.8 Our longer-term ambition is:

- By 2050 Scotland's woodland will be delivering a greater level of key ecosystem services, such as contributing to natural flood management and improving biodiversity. Scotland's forests will also be making a greater contribution towards the country's natural capital stocks, and this renewable natural resource will be sustainably managed to ensure that future generations can realise these benefits.

Forestry policy outcomes, policies, development milestones and proposals

Policy outcome 1: To enhance the contribution that trees make to reducing emissions through sequestering carbon, we will introduce a stepped increase in the annual woodland creation rates from 2020/21.

There are six policies and four proposals that contribute to the delivery of the policy outcome 1.

Policies which contribute to the delivery of policy outcome 1

1) Forestry grants: We will provide funding each year, via the Forestry Grant Scheme, to support eligible land owners to establish appropriate woodlands.
2) Woodland creation: Through a targeted woodland creation programme Forest Enterprise Scotland will create new woodland on the National Forest Estate.
3) Awareness raising: Through working in partnership with representatives from land management organisations, we will design and deliver annual awareness raising programmes which promote the benefits of woodland creation for land managers and encourage more woodland creation.
4) Woodland standards: Through revising the UK Forestry Standard to bring it up-to-date, the Scottish Government will ensure that all new woodlands supported under the Forestry Grant Scheme are designed and established to meet recognised standards of sustainable forestry.
5) Woodland Carbon Code: Through an annual programme of joint promotion with private sector forestry businesses, the Scottish Government will encourage an increased level of investment in woodlands that are accredited under the Woodland Carbon Code.
6) Forestry and woodland strategies: The Scottish Government will support planning authorities in the development and revision of local forestry and woodland strategies, which will indicate preferred and potential areas appropriate for woodland creation.

Proposals which contribute to the delivery of policy outcome 1

1) Forestry Grant Scheme: Deliver improvements to the Forestry Grant Scheme application process (2017).
2) Woodland creation schemes: Identify additional investment opportunities for woodland creation schemes (2017/18).
3) Targeted grants: Develop further targeted grants measures (2018/19).
4) National Forest Estate: Review Forest Enterprise Scotland's woodland creation activity on the National Forest Estate (2019/20).

Policy outcome 2: Increase the use of sustainably sourced wood fibre in downstream industries, such as construction, to reduce emissions by substituting higher embodied carbon construction materials with wood products.

There is one policy that contributes to the delivery of policy outcome 2.

Policy which contributes to the delivery of policy outcome 2

1) The Scottish Government will implement the Timber Development Programme through an annual programme of projects, in collaboration with the private forest sector and other public sector bodies that support the promotion and development of wood products for use in construction.

Wider impacts of emissions reduction in the Forestry sector

Co-benefits to be realised

13.3.9 There are substantial economic benefits from forestry. Sustainably managed forestry contributes almost £1 billion to Scotland's economy and supports over 25,000 jobs. It helps mitigate flood risk and improves water quality and it has beneficial effects on soil. It contributes to improving biodiversity and to people's health and wellbeing through the provision of accessible woodland. Forestry can have a positive effect when new woodlands are designed and delivered to meet the UK Forestry Standard.

13.3.10 Our woodland creation ambition will directly benefit all those that work in forestry (management, wood product supply and recreational activities) and the farmers, crofters and land managers who create woodland on land they manage, as well as having the potential to improve the stewardship of the land where it has been poorly managed in the past. People across Scotland will also benefit from access to new woods for recreation.

13.3.11 The majority of forests producing wood products in Scotland are independently certified against internationally recognised principles and criteria for sustainable forest management. A shift in using building materials obtained from renewable sources has the potential to reduce greenhouse gas emissions. A further benefit is that the revenue from these wood products can be re-invested in sustainable forest management, ensuring a continued cycle of benefits.

13.3.12 Additional benefits may also be derived from reducing the volume of waste materials generated by the construction sector. Construction materials are one of the most significant waste material flows, by weight, in Scotland. The waste from construction using wood products is lower and can readily be recycled. Reducing the amount currently being disposed of in landfill will therefore have further benefits through reducing the negative impacts associated with this waste disposal method.

13.3.13 Forestry provides significant rural employment and an increase in economic forestry activity to produce more wood products for construction will increase economic activity in rural Scotland.

Adverse side effects to be managed

13.3.14 The effects of land use change on the wider environment and communities could be mixed, depending on the scale and nature of changes. For example woodland creation can have significant positive or negative impacts on the landscape, biodiversity and patterns of recreational use. Potential negative impacts can be mitigated if woodland creation schemes are appropriately designed and delivered to meet the requirements of the UK Forestry Standard through adopting good practice. Local woodland and forestry strategies also identify the appropriate location for woodlands to maximise the delivery of public benefits and minimise adverse environmental and landscape impacts. In addition, specific woodland creation proposals must meet the requirements of the statutory processes for assessing impact on designated habitats or the wider environment.

13.3.15 Adherence to the UK Forestry Standard and associated guidelines will ensure the forests managed to produce wood products do not have a negative impacts on soil stability, water quality and biodiversity.

13.3.16 Increased harvesting of wood products will increase the use of the rural road network by heavy vehicles. However, the Scottish Government is working to reduce these impacts to a minimum where possible, through working with the forestry sector and local authorities, and providing support under the Scottish Government Strategic Timber Transport Scheme.

Summary of policies, development milestones and proposals

Policy outcome 1: To enhance the contribution that trees make to reducing emissions, through sequestering carbon, we will introduce a stepped increase in the annual woodland creation rates from 2020/21.

Table 13-1: Policies that contribute to policy outcome 1

Policy	EU, UK or Scottish policy	Public sector partners	Delivery route
Forestry grants: We will provide funding each year, via the Forestry Grant Scheme, to support eligible land owners establishing appropriate woodlands	Scottish	Scottish Government, SEPA, SNH	Continue to operate a grant scheme such as the Forestry Grant Scheme to provide support for woodland creation projects that meet the requirements of the UK Forestry Standard. Make support available for different types of woodland to deliver multiple benefits including greenhouse gas mitigation, production of sustainable wood products, biodiversity and health and wellbeing outcomes.
Woodland creation: Through a targeted woodland creation programme Forest Enterprise Scotland will create new woodland on the National Forest Estate	Scottish	Forestry Commission Scotland, Scottish Government. SEPA, SNH	Forest Enterprise Scotland to deliver an annual contribution towards the overall woodland creation target by creating new sustainable woodland on the National Forest Estate.
Awareness raising: Through working in partnership with representatives from a range of land management organisations, we will design and deliver annual awareness raising programmes which promote the benefits of woodland creation for land managers and encourage more woodland creation	Scottish	Scottish Government	Continue to deliver a programme of farm-based events to demonstrate and support improved productivity through integration of farming and forestry enterprises. An example of this is the Sheep and Trees project, a partnership between the Scottish Government, forestry and the sheep farming sector.
Woodland Standards: Through revising the UK Forestry Standard to bring it up-to-date, the Scottish Government will ensure that all new woodlands supported under the Forestry Grant Scheme are designed and established to meet recognised standards of sustainable forestry	UK	Forestry Commission Scotland, Natural Resources Wales, Forestry Commission England	The Scottish Government is working with the UK and country governments to publish a refreshed UK Forestry Standard that articulates the consistent UK-wide approach to sustainable forestry. The Standard defines how woodland should be created and managed to meet sustainable forest management principles and provides a basis for monitoring.

Policy	EU, UK or Scottish policy	Public sector partners	Delivery route
Woodland Carbon Code: Through an annual programme of joint promotion with the private forestry sector, the Scottish Government will encourage an increased level of investment in woodlands that are accredited under the Woodland Carbon Code	UK	Forestry Commission Scotland, Natural Resources Wales, Forestry Commission England	Increased promotion of the Woodland Carbon Code by Forestry Commission Scotland, in partnership with the forestry sector, to raise the profile of the Code as a potential vehicle for attracting additional investment into woodland creation projects.
Forestry and Woodland Strategies: The Scottish Government will support planning authorities in the development and revision of local Forestry and Woodland Strategies, which will indicate preferred/potential areas for appropriate woodland creation	Scottish	Planning authorities	Forestry and woodland strategies continue to be prepared by planning authorities, with support from Forestry Commission Scotland. They provide a framework for forestry expansion through identifying preferred areas where forestry can have a positive impact on the environment, landscape, economy and local people.

Table 13-2: Proposals which contribute to policy outcome 1

Proposal	Delivery route
Forestry Grant Scheme: Deliver improvements to the Forestry Grant Scheme application process (2017)	An independent review by Jim Mackinnon was carried out to recommend actions to speed up and streamline approval processes for sustainable planting schemes. The review report was published in December 2016. The Scottish Government has accepted the recommendations of the review in principle, and will publish and implement a delivery plan to implement the recommendations.
Woodland Creation Schemes: Identify additional investment opportunities for woodland creation schemes (2017/18)	Work with partners (private sector, community organisations) to investigate the scope of different investment models with the potential to increase private sector investment in forestry projects.
Targeted Grants: Develop further targeted grant measures (2018/19)	We will continually review the potential for further targeted Forestry Grant Scheme support to encourage specific types of woodland creation and/or woodland creation in specific areas.
National Forest Estate: Review Forest Enterprise Scotland's woodland creation activity on the National Forest Estate (2019/20)	Undertake a review of the woodland creation activity on the National Forest Estate.

Table 13-3: Policy outcome 1 over time

Policy outcome 1	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
No. of hectares of woodland created as a result of delivering the associated policies	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000
No. of hectares of woodland created as a consequence of proposals listed above (once policies)	0	0	0	0	2,000	2,000	4,000	4,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000
Total change in policy outcome as a result of policies and proposals	10,000 ha	10,000 ha	10,000 ha	10,000 ha	12,000 ha	12,000 ha	14,000 ha	14,000 ha	15,000 ha	15,000 ha	15,000 ha	15,000 ha	15,000 ha	15,000 ha	15,000 ha	15,000 ha

Policy outcome 2: Increase the use of sustainably sourced wood fibre in downstream industries, such as construction, to reduce emissions by substituting higher embodied carbon construction materials with wood products.

Table 13-4: Policies that contribute to policy outcome 2

Policy	EU, UK or Scottish policy	Public sector partners	Delivery route
The Scottish Government will implement the Timber Development Programme through an annual programme of projects, in collaboration with the private forest sector and other public sector bodies, that supports the promotion and development of wood products for use in construction	Scottish	Scottish Enterprise, Highlands and Islands Enterprise, Construction Scotland Innovation Centre, Architecture and Design Scotland and Zero Waste Scotland	Activities from this policy are delivered through collaborations and partnerships with private and public sector bodies. The main aim is to increase use of wood products in construction. The outputs of the Programme are closely aligned to the objectives of "Roots for Future Growth" the Forest and Timber Technologies industry leadership group strategy, and Scotland's Economic Strategy. The Programme is developed and ratified through engagement with industry representatives on an annual basis and implementation is focused on increasing market demand across the UK.

Table 13-5: Policy outcome 2 over time

Policy outcome 2	2017 Ref. year 2014	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Annual volume of Scottish produced sawnwood and panel boards used in construction (Extrapolated from UK figures) (million cubic metres)	2.2					2.6					2.8					3.0
Increase in wood fibre products being used in construction. (million cubic metres)	0					0.4										

Progress since RPP2 – Forestry

Table 13-6: Progress on RPP2 policies

RPP2 Policies	Summary of progress
Create 100,000 hectare of woodland between 2012-2022 (equivalent to 10,000 hectares per year)	During the period of RPP2 the Scottish Government has supported the creation of 27,500 hectares of new woodland, accounting for over 70% of all the woodland created in the UK. The average annual rate has been 6,800 hectares per year. This is a lower annual contribution than the 10,000 hectare per year required to deliver the overall policy ambition of creating 100,000 hectares between 2012-2022. In response, the Scottish Government has initiated a number of inter-related initiatives to stimulate an increase in woodland creation including: delivering a new Forestry Grant Scheme (FGS); commissioning an independent review to streamline the grant application process; and working with farming stakeholders to establish more woodland on appropriate land on farms. These initiatives have led to an increase in woodland creation activity indicating that the existing annual target will be achieved in the near future.

Table 13-7: Progress on RPP2 proposals

RPP2 Proposals	Summary of progress
Increase use of wood products in construction	This proposal started in 2013 with RPP2. Since then the Scottish Government has worked to identify if there are any regulatory barriers to the use of wood engineered products in construction in Scotland. No regulatory barriers were identified, but guidance for planners and architects was suggested, as well as promoting the benefits of wood products in construction to developers. In response to these suggestions, Scottish Government has supported the supply chain through Scottish Enterprise and the private sector, commissioned research to investigate the viability of Scottish wood products as a structural material, and explored the development of a UK market focused on the use of Scottish wood products in order to encourage private investment.

13.4 Peat

The restoration of degraded peatlands to remove a source of greenhouse gas emissions and to create a source of carbon sequestration.

Where we are now – Peat

13.4.1 Peatlands cover around 20% of land in Scotland or around 1.7 million hectares. Well maintained peatlands are an important source of carbon storage, or sink. However, it is currently estimated that over 600,000 hectares of Scotland's peatlands are in a degraded condition as a result of historic land management decisions. This degraded state means that a substantial proportion of Scotland's peatlands are acting as a source of greenhouse gas emissions, rather than a sink.

13.4.2 Since 2013, through the Peatland Action Initiative, around 10,000 hectares of peatlands have been restored through Scottish Government led action, working with public and private land managers across Scotland. The most recently available estimates suggest that degraded peatland (excluding peatlands used for forestry or agriculture) produces 4 megatonnes of CO_2e emissions per year. These emissions are yet to be accounted for in the national GHG inventory.

Our ambition – Peat

13.4.3 By 2030, 40% of degraded peatland will be restored to good condition. This policy action will have considerable impact by converting peatlands from emitting carbon to acting as a carbon sink as well as reducing emissions from degraded bogs. The restored peatland will also help mitigate flood risk and improve water quality, as well as helping to increase biodiversity in restored areas.

13.4.4 As well as providing increased carbon storage, this large-scale peatland restoration delivery across Scotland will also produce multiple benefits for communities and the economy. The key sectors expected to see benefits are tourism, food and drink and the environment.

13.4.5 To make progress towards this ambition, we will focus on achieving a significant increase in the scale of degraded peatland restored, from a 1990 baseline to:

- 50,000 hectares restored by 2020
- 250,000 hectares restored by 2030

13.4.6 Our longer term ambition is that by 2050, Scotland's expanded peatlands will be thriving habitats, sustaining a diverse ecosystem and sequestering more carbon than ever before.

Peat policy outcomes, policies, development milestones and proposals

Policy outcome 1: To enhance the contribution of peatland to carbon storage, we will support an increase in the annual rate of peatland restoration, from 10,000 hectares in 2017/18 to 20,000 hectares per year thereafter.

There are two policies which will contribute to the delivery of policy outcome 1.

Policies which contribute to the delivery of policy outcome 1

1) Restoration grants: We will provide grant funding to support eligible land managers to deliver peatland restoration. Levels of funding will enable at least 20,000 hectares of peatland restoration per year from 2018/19.
2) Awareness raising: Working through partnership, we will put in place tools and information to develop the capacity, skills and knowledge of land managers, contractors and others, to deliver peatland restoration.

Relative significance of policies to the delivery of policy outcome 1

13.4.7 These two policies are mutually interlinked. Growing the capacity and skills of land managers and others will be essential to delivering practical restoration across Scotland. In addition, the increased involvement and interest of land managers in peatland restoration can also help draw in other forms of funding, including private initiatives such as the Peatland Code.

13.4.8 Full details of policies, policy development milestones and proposals are set out in the tables below. The delivery of these will be tracked through the monitoring framework (see section 6).

Wider impacts of emissions reduction in the Peat sector

Co-benefits to be realised

13.4.9 Peatland restoration will provide a number of co-benefits, including supporting increased biodiversity which, in turn, will help to maintain and improve the status of protected sites. Tick populations have been shown to reduce following restoration, benefitting both human and animal health.

13.4.10 Restoration will also contribute to the water environment through reducing sources of diffuse pollution. This will help improve the ecological status of water bodies and also help reduce the costs of treatment costs of public water supplies. For households and businesses using private water supplies, restoration may also help reduce the water discolouration. Restoration of peatlands can also be an important component of natural flood management, by reducing and displacing flood peaks.

13.4.11 Additional economic benefits may also accrue given the importance of peatlands to Scotland's environmental image, critical to key sectors such as food and drink and tourism. Reduced sources of diffuse pollution will also provide benefits to sectors such as fresh water fisheries.

13.4.12 Communities near peatlands also play a valuable role in their restoration and may also benefit from the improved access to peatlands. In many parts of the Central Belt, bogs provide open space and places for people to walk away from traffic.

13.4.13 Individual businesses and environmental non-governmental organisations (eNGOs) that manage peatlands will also benefit from their restoration. Undertaking restoration action at the large, landscape scale aimed for by this policy outcome should help deliver greater co-benefits than smaller scale and more fragmented restoration projects. Peatland restoration will also provide a common focus for a wide range of upland interests to come together. The restoration activity can also be a catalyst around which improvements to the wider landscape can be delivered.

Adverse side effects to be managed

13.4.14 At the general level, there are no adverse effects. However, at individual site level there might be divergent views locally on the relative merits of restoration compared to other alternative land uses.

Summary of policies, development milestones and proposals

Policy outcome 1: To enhance the contribution of peatland to carbon storage, we will support an increase in the annual rate of peatland restoration, from 10,000 hectares in 2017/18 to 20,000 hectares per year thereafter.

Table 13-8: Policies that contribute to policy outcome 1

Policy	EU, UK or Scottish policy	Public sector partners	Delivery route
Restoration grants: We will provide grant funding to support eligible land managers to deliver peatland restoration. Levels of funding will enable at least 20,000 hectares of peatland restoration per year from 2018/19	Scottish	SNH	Public sector action will be led by SNH through the Peatland Action Initiative. In addition to providing support and advice, this will offer financial support to peatland restoration projects initiated by individual land managers. Experience from the Peatland Action Initiative to date demonstrates significant interest in restoration projects.
Awareness raising: Working through partnership, we will put in place tools and information to help develop the capacity, skills and knowledge of land managers, contractors and others, to deliver peatland restoration	Scottish	SNH, main research providers	This action will be carried out jointly with wider partners, particularly land managers and NGOs. Delivery will be supported through the provision of information and tools on peatland restoration.

Table 13-9: Policy outcome 1 over time

Policy outcome 1	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Hectares of peatland restored per year as a consequence of policies listed above	10,000 ha	20,000 ha	20,000 ha	20,000 ha	20,000 ha	20,000 ha	20,000 ha	20,000 ha	20,000 ha	20,000 ha	20,000 ha	20,000 ha	20,000 ha	20,000 ha	20,000 ha	20,000 ha

Peat progress since RPP2

Table 13-10: Progress since RPP2

Summary of progress
RPP2 highlighted that it had been assessed that it would be technically feasible to restore 20,000 hectares a year and that £1.7 million had been identified to support peatland restoration for the period 2013-2015. Since RPP2 was published the Intergovernmental Panel on Climate Change has published its technical guidance on measuring the greenhouse gas benefits of peatland restoration. This has allowed us to develop peatland restoration further and understand its costs and benefits. Reflecting the multiple benefits of peatland funding was identified in the 2013 spending review to support peatland restoration and through the SNH-led Peatland Action work over 10,000 hectares have been restored since 2013 through support to Peatland Action of £8.6 million.

14. Agriculture

The agriculture sector includes activities related to livestock production and cultivation of land for food or energy crops.

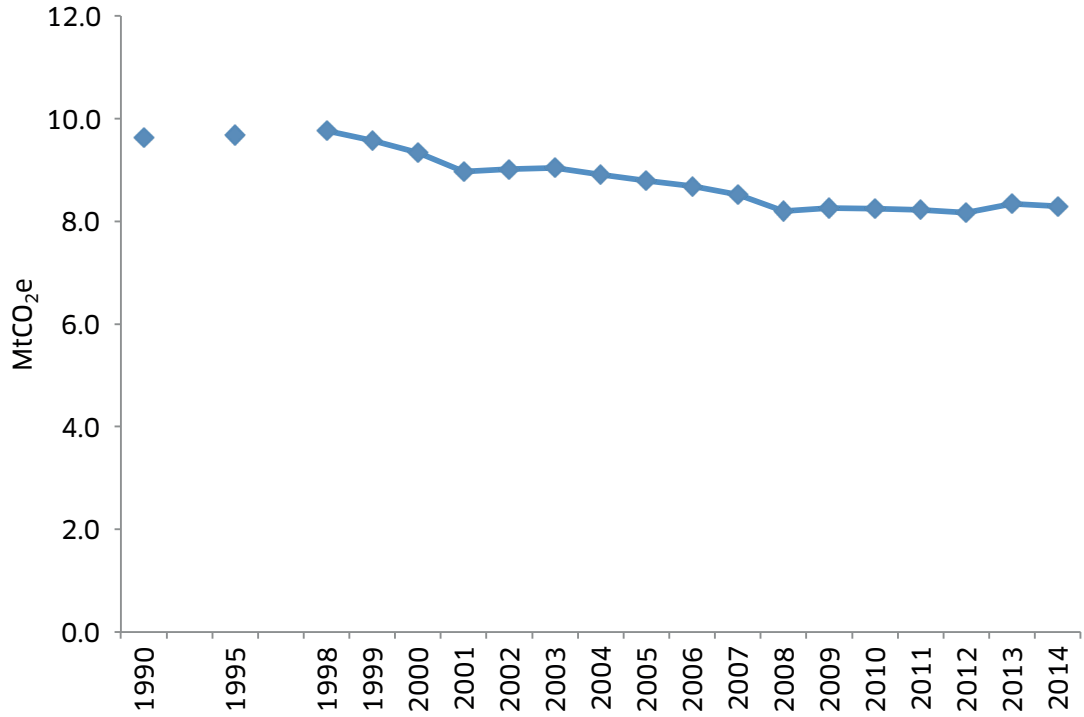
14.1 Where we are now

14.1.1 The Agriculture and Related Land Use sector as defined in the GHG inventory has seen a fall of 3.6 $MtCO_2e$ (25%) in emissions between 1990 and 2014, reducing them to 10.7 $MtCO_2e$ (the definition of the sector used by TIMES shows the decline between 1990 and 2014 levels to be 14%.) This fall is mostly attributable to four factors:

- efficiency improvements in farming, such as higher milk yields per cow
- fewer cattle and sheep
- a reduction in the amount of nitrogen fertiliser being applied
- a reduction in grassland being ploughed for arable production

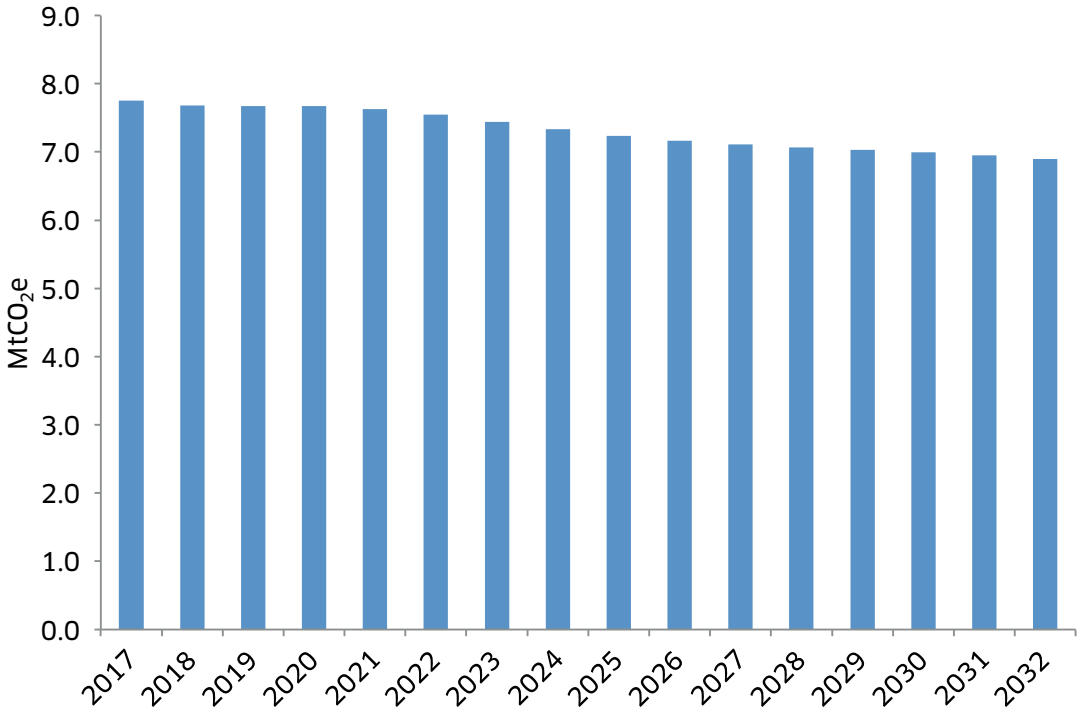
14.1.2 Almost half of the global warming impact of emissions from agriculture is from methane, which has 25 times the global warming effect of carbon dioxide, and around a quarter is from nitrous oxide, which has 298 times the warming effect of carbon dioxide. This is because most of the emissions in agriculture are from biological sources.

Figure 23: Agriculture historical emissions



14.2 Our ambition

Figure 24: Agriculture carbon envelopes



14.2.1 Low carbon farming is not only good for the planet, but also good for food producers' pockets. We want Scotland to be a world-class producer of high quality food: sustainably, profitably and efficiently in environmental and economic terms. The farming and food production sector is key to achieving this ambition – change will only happen with the involvement of primary food producers, so we will work with the sector – particularly tenant farmers – to recognise and realise the economic and environmental benefits of low carbon farming. We will help and support the environmental and economic sustainability of agriculture by encouraging and enabling more farmers and crofters to take up low-carbon farming.

14.2.2 Greenhouse gas emissions are inherent in all food production, so our focus needs to be on maximising efficiency. By protecting and enhancing our soil, tackling livestock disease, utilising the best technology and turning wastes into a resource, we can reduce emissions. These actions will result in improved animal health and welfare, cleaner water and air and increased farm profits. We will strive to turn best practice into standard practice and reduce dependence on expensive fertilisers, cut the associated costs of livestock disease and increase income from renewable energy.

14.2.3 By 2020, to help increase the efficient use of nitrogen fertiliser, we will work with farmers so that they know the pH of the soil on a third of their improved land. Primary food producers need to know how to cut their carbon footprint and to understand that doing so will also improve their profitability. By 2020, we will have encouraged farmers producing a substantial proportion of Scotland's agricultural output to have completed a carbon audit. Many farmers will also know the sources of greenhouse gas emissions from farm activities; and most livestock farmers will be taking new steps to improve the health of their herd to improve fertility, reduce mortality and tackle production diseases.

14.2.4 By 2030 most farmers will know the nutrient value of their improved soil and will be implementing best practice in nutrient management and application. We will have engaged with the agriculture sector to encourage increased planting of woodland/forestry and hedgerows on appropriate agricultural land, and disseminated information on the

related economic benefits of good silvo-management practices. By 2030 we want most farmers to have considered and undertaken appropriate planting of woodland/forestry and hedgerows. Farmers and land managers may also be receiving payments to sequester carbon in soils, woodland/forestry and hedgerows.

14.2.5 By 2050 Scottish farmers will be making full use of technology to apply precision farming techniques across the board, and Scotland's land will be producing healthy, nutritious and high quality food while providing a substantial carbon sink that offsets emissions elsewhere.

14.3 Policy outcomes, policies, development milestones and proposals

Policy outcome 1: Farmers, crofters, land managers and other primary food producers are aware of the benefits and practicalities of cost-effective climate mitigation measures.

There are three policies, two policy development milestones and one proposal which will contribute to the delivery of policy outcome 1.

Policies which contribute to the delivery of policy outcome 1

1) Information and advice on climate change mitigation will be communicated and disseminated: from 2017 we will disseminate information and advice on climate change mitigation measures in agriculture through a range of communication methods, utilising technology and all media to best effect.
2) An agri-tech group will be established to share, disseminate and encourage adoption of advances in agricultural science and technology as widely as possible.
3) Climate Change Young Farming Champions will be recruited and trained to explain, promote and encourage low carbon farming

Development milestones which contribute to the delivery of policy outcome 1

1) Carbon Audits: in 2017, we will consult on how best to ensure maximum take up of carbon audits and how to enable tenant farmers and crofters in particular to benefit.
2) We will explore with Scottish Tenant Farmers Association how best to engage tenant farmers to increase understanding of the environmental and economic benefits of low carbon farming. The aim will be to determine what policies, support and advice tenant farmers need to undertake measures which will help them reduce emissions at farm level.

Proposal which contributes to the delivery of policy outcome 1

1) Marketing scheme: Introduce a Low Carbon Farming marketing scheme.

Policy outcome 2: Emissions from nitrogen fertiliser will have fallen through a combination of improved understanding, reduced application and better soil.

There are three policies and two proposals which will contribute to the delivery of policy outcome 2.

Policies which contribute to the delivery of policy outcome 2

1) Precision farming and nitrogen-use efficiency – communicate and demonstrate the benefits of precision farming and nitrogen use efficiency in order to achieve a reduction in nitrous oxide emissions.
2) Work with industry to develop a science-based target for reducing emissions from nitrogen fertiliser, by establishing the amount of nitrogen fertiliser Scottish soils need to produce an economically optimal crop, taking account of good practice in soil management.
3) From 2018 we will expect farmers to test the soil in all improved land every 5/6 years, and will work with them to establish how best to achieve this. This will be for pH, and we will consult on including testing for potassium and phosphorus.

Proposals which contribute to the delivery of policy outcome 2

1) Minimum leguminous crops in rotation.
2) Plant varieties with improved Nitrogen-use efficiency.

Policy outcome 3: Work with Quality Meat Scotland and others to reduce emissions from red meat and dairy through improved emissions intensity.

There are two policies, two development milestones and one proposal which will contribute to the delivery of policy outcome 3.

Policies which contribute to the delivery of policy outcome 3

1) In 2017, publish emissions intensity figures for beef, lamb and milk.
2) By working with Quality Meat Scotland and livestock producers, we will encourage improved emissions intensity through genotyping, improving fertility, reducing animal mortality and improving farm management practices.

Policy development milestones which contribute to the delivery of policy outcome 3

1) Establish target for reduction in the intensity of emissions for beef, sheep and dairy sectors.
2) Consult in 2017 to determine the nature of livestock health measures that the sector will adopt from 2018.

Proposal which contributes to the delivery of policy outcome 1

1) Livestock feed additives to reduce methane.

Policy outcome 4: Emissions from the use and storage of manure and slurry will have been reduced.

There are two policy development milestones and three proposals which will contribute to the delivery of policy outcome 4.

Policy development milestones which contribute to the delivery of policy outcome 4

1) Determine the potential feasibility of self-financing large-scale anaerobic digesters.
2) Engaging with farmers to explore their support requirements, establish how they can improve the use and storage of manure and slurry, including the potential for co-operatively owned and managed anaerobic digesters.

Proposals which contribute to the delivery of policy outcome 4

1) Inclusion of livestock grazing in rotation on current arable land.
2) Conduct a feasibility study for the establishment of manure/slurry exchange.
3) Determine how to consistently minimise emissions from slurry storage.

Policy outcome 5: The carbon content of soil and agricultural land will have improved through carbon sequestration and expanded woodland/forestry and hedgerows.

There is one policy and two proposals that contribute to the delivery of policy outcome 5.

Policy which contributes to the delivery of policy outcome 5

1) We will explore with the farming and forestry sectors how best to increase planting of trees and hedgerows which optimise carbon sequestration.

Proposals which contribute to the delivery of policy outcome 5

1) Payment for carbon sequestration
2) Woodland cover targets for agricultural land

14.4 Wider impacts

The following co-benefits have been identified for policies in the agricultural sector:

14.4.1 There are substantial potential economic benefits for farm business, and for the wider rural economy as a result, from the policies and proposals in this Plan. Almost all activities farmers can undertake to reduce emissions also make or save money – what is good for the planet is also good for their pocket. This includes identifying avoidable inefficiencies through carbon audits; reducing fertiliser costs and/or increasing yields though understanding the soil pH and increasing it where necessary, and through making use of organic fertiliser where practicable; reducing losses in livestock through infertility, mortality and ill health; and through generating income or cutting energy bills by producing renewable heat and electricity and using energy savings schemes.

14.4.2 There are also considerable potential benefits for air and water quality, animal welfare, soil health, and biodiversity through the policies, while the woodland/forestry proposal could significantly increase the implementation of natural flood management.

14.4.3 Farmers, crofters and land managers; other agricultural workers; and those in the agricultural supply chain. Those living in rural and island communities may benefit from improved air and water quality.

14.4.4 Farm and agricultural businesses should benefit through improved profitability for farming.

14.4.5 We have received extensive advice on optimising co-benefits from environmental, science and industry stakeholders, and this will continue as we consult on the implementation of these policies. Opportunities to optimise economic benefits will be explored through a Business and Regulatory Impact Assessment (BRIA), covering all of the more significant policies. Environmental benefits will be secured through close working within Scottish Government, with agencies, and with other stakeholders. In particular, SEPA have been and will be fully engaged in the development of agricultural policies and proposals for this Plan.

Adverse side-effects to be managed

14.4.6 Improved profitability could encourage greater intensification in farming, with resultant negative impacts on biodiversity. This is not expected to happen, but it is a possibility.

14.4.7 Some communities may be concerned about the creation of new anaerobic digestion plants, and new renewable energy sources such as wind turbines. We will mitigate the potential for misunderstanding through engagement and communication. Existing planning mechanisms will manage any local development issues.

14.4.8 No adverse impacts expected for businesses or the third sector.

Existing agricultural regulation includes measures designed to protect biodiversity, and very substantial funding is provided to encourage uptake of measures that are beneficial to wildlife. These policies can be tailored if adverse side effects for biodiversity are anticipated.

14.5 Summary of policies, development milestones and proposals

Policy outcome 1: Farmers, crofters, land managers and other primary food producers are aware of the benefits and practicalities of cost-effective climate mitigation measures

Table 14-1: Policies which contribute to policy outcome 1

Policy	EU, UK or Scottish policy	Public sector partners	Delivery route
Information and advice on climate change mitigation will be communicated and disseminated: from 2017 we will disseminate information and advice on climate change mitigation measures in agriculture through a range of communication methods, utilising technology and all media to best effect	Scottish/ European	None	We already provide advice to farmers on cost-effective mitigation measures, but these will be expanded principally by: • Increasing funding to Farming For a Better Climate, to expand its communications work. We are currently evaluating this programme and are sympathetic to extending it if there is demand. • Developing a carbon accumulator tool so that farmers can measure and get credit for reducing emissions and sequestering carbon. • Ensuring much of the £4.6 million we provide annually to the Farm Advisory Service is used for advice on mitigation, and funds 1,200 free carbon audits. • Create a Food, Farming and Climate roadshow, backed by a website, to share information with farmers and the public on the climate change issues in food and farming at agricultural shows and science events. • Disseminating specific advice to farmers.
Establish an agri-tech group	Scottish	None	We will create a group including technology and data providers, industry representatives and scientists, to share learning on advances in agriculture technology. This will enable farmers in Scotland to utilise the most appropriate tools, techniques and equipment to optimise crop yield and reduce their emissions intensity.
Recruit Climate Change Young Farming Champions	Scottish	None	Climate Change Young Farming Champions will be recruited and trained to explain, promote and encourage low carbon farming among their peers.

Table 14-2: Policy development milestones which contribute to policy outcome 1

Policy development milestone	Delivery route
Consult on how best to ensure maximum take up of carbon audits	Carbon audits are a great tool for highlighting cost-effective ways to reduce emissions, and many farmers have benefitted considerably through them. In 2017 we will consult on how best to ensure maximum take up of carbon audits, especially to help tenant farmers and crofters.
To develop a low carbon package for tenant farmers	We will explore with Scottish Tenant Farmers Association how best to engage tenant farmers to increase understanding of the environmental and economic benefits of low carbon farming. The aim will be to determine what policies, support and advice tenant farmers need to undertake measures which will help them reduce emissions at farm level.

Table 14-3: Proposals which contribute to policy outcome 1

Proposal	Delivery route
Marketing scheme: Introduce a Low Carbon Farming marketing scheme.	Farmers will be more likely to apply low carbon farming techniques if they can achieve a market premium for their product. In addition, through the policies in this Plan and our existing environmental requirements, farms in Scotland will be producing some of the lowest carbon food in the world. We therefore propose to explore creation of a marketing scheme that would generate recognition among consumers and increase demand for food produced using low carbon methods, similar to Origin Green in Ireland.

Table 14-4: Policy outcome 1 over time

Policy outcome 1	2017	2018	2019	2020	2021
Policy outcome as a consequence of policies listed above	200 farms will have free carbon audits	200 farms will have free carbon audits Farmers will be exposed to advice and information on cost-effective mitigation measures from a wide range of trusted sources Thousands of consumers will interact with information on low carbon food through roadshows and a website	200 farms will have free carbon audits	200 farms will have free carbon audits	200 farms will have free carbon audits
Policy outcome as a consequence of proposals listed above (once policies)	-	-	-	-	-
Total change in policy outcome as a result of policies and proposals	200 farms will have free carbon audits	200 farms will have free carbon audits Farmers will be exposed to advice and information on cost-effective mitigation measures from a wide range of trusted sources Thousands of consumers will interact with information on low carbon food through roadshows and a website	200 farms will have free carbon audits	200 farms will have free carbon audits	200 farms will have free carbon audits

Policy outcome 2: Emissions from nitrogen fertiliser will have fallen through a combination of improved understanding, reduced application and better soil.

Table 14-5: Policies which contribute to policy outcome 2

Policy	EU, UK or Scottish policy	Public sector partners	Delivery route
Precision farming and nitrogen-use efficiency	Scottish	None	Communicate and demonstrate the benefits of precision farming and nitrogen use efficiency in order to achieve a reduction in nitrous oxide emissions.
To develop a science-based target for reducing emissions from nitrogen fertiliser	Scottish	None	Work with industry to develop a science-based target for reducing emissions from nitrogen fertiliser, by establishing the amount of nitrogen fertiliser Scottish soils need to produce an economically optimal crop, taking account of good practice in soil management.
Soil testing	Scottish	None	From 2018 we will expect farmers to test the soil in all improved land every 5/6 years, and will work with them to establish how best to achieve this. This will be for pH, and we will consult on including testing for potassium and phosphorus.

Table 14-6: Proposals which contribute to policy outcome 2

Policy development milestone	Delivery route
Minimum leguminous crops in rotation	Legumes in rotation can significantly reduce nitrogen fertiliser need, though there are considerable economic factors to consider. We will explore the issues around creating a requirement that arable land has to include a leguminous crop in rotation, including any subsidy that farmers would require for doing so.
Plant varieties with improved Nitrogen-use efficiency	This measure would require the establishment of new breeding goals and the development of breeding programmes before improved nitrogen-use varieties would be available to farmers. This significant lead-up time has to be considered when developing policy instruments and accounting for the timing of the mitigation effects.

Table 14-7: Policy outcome 2 over time

Policy outcome 2	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026-2032
Policy outcome as a consequence of policies listed above		More efficient use of nitrogen fertiliser through one sixth of improved land tested for pH	More efficient use of nitrogen fertiliser through one third of improved land tested for pH	More efficient use of nitrogen fertiliser through one half of improved land tested for pH	More efficient use of nitrogen fertiliser through two thirds of improved land tested for pH	More efficient use of nitrogen fertiliser through five-sixths of improved land tested for pH	More efficient use of nitrogen fertiliser through all improved land tested for pH			
Policy outcome as a consequence of proposals listed above (once policies)				Reduction in nitrogen fertiliser applied, and increase in soil nitrogen, through more legume being grown					Reduced nitrogen fertiliser application through uptake of nitrogen efficient crops	
Total change in policy outcome		Reduction in chemical nitrogen fertiliser being applied, and less nitrogen loss from soil	Reduction in chemical nitrogen fertiliser being applied, and less nitrogen loss from soil	Further reduction in chemical nitrogen fertiliser being applied, and less nitrogen loss from soil	Reduction in chemical nitrogen fertiliser being applied, and less nitrogen loss from soil	Reduction in chemical nitrogen fertiliser being applied, and less nitrogen loss from soil	Reduction in chemical nitrogen fertiliser being applied, and less nitrogen loss from soil		Further reduction in chemical nitrogen fertiliser being applied, and less nitrogen loss from soil	

Policy outcome 3: Work with Quality Meat Scotland and others to reduce emissions from red meat and dairy through improved emissions intensity

Table 14-8: Policies which contribute to policy outcome 3

Policy	EU, UK or Scottish policy	Public sector partners	Delivery route
Publish emissions intensity figures for beef, lamb and milk	Scottish	None	In order to reduce the carbon footprint of the food we produce, we need to lower the emissions associated with each kilo of beef or lamb, and each litre of milk. In 2017 we will publish metrics to allow us to measure these figures, so that we can lower emissions without reducing the amount of food we produce.
By working with Quality Meat Scotland and livestock producers, we will encourage improved emissions intensity through genotyping, improving fertility, reducing animal mortality and improving farm management practices	Scottish/EU	None	By working with Quality Meat Scotland and livestock producers, we will encourage improved emissions intensity through genotyping, improving fertility, reducing animal mortality and improving farm management practices.

Table 14-9: Policy development milestones which contribute to policy outcome 3

Policy development milestone	Delivery route
Establish target for reduction in the intensity of emissions for beef, sheep and dairy sectors	Once we have a metric for emissions intensity, we will set targets for reduction in the intensity of emissions. We expect this to be annual percentage targets compared with a baseline year.
Consult in 2017 to determine the nature of livestock health measures that the sector will adopt from 2018	There are four main options available, with a combination of them possible: • The establishment of one or more mandatory disease eradication schemes. This would place requirements on farmers to control the disease, as we have done for BVD. • The establishment of one or more schemes focused on syndromes rather than diseases, such as calf/lamb mortality or infertility. • Vet-approved health plans. • Using market forces by requiring testing and declaration before sale of the most important production diseases. We have conducted research and discussed these options with industry, and will seek to find wide consensus for the type of scheme to be implemented.

Table 14-10: Proposals which contribute to policy outcome 3

Proposal	Delivery route
Livestock feed additives to reduce methane	Assessment of the existing evidence for a wide range of feed additives that have been reported as reducing methane emissions from enteric fermentation suggests that there is some scope to reduce emissions by including lipids (fats) in rations, and in future through new additives not yet ready for market. Further work is being undertaken to establish logistical and supply chain issues such as consumer response, land-use implications from creating the additives, and handling, transportation and storage issues. We also need to identify potential delivery mechanisms to encourage uptake.

Table 14-11: Policy outcome 3 over time

Policy outcome 3	2017	2018	2019	2020	2021	2022	2023	2024	2025-2032
Policy outcome as a consequence of policies listed above	Improvement in livestock health, mortality and fertility, contributing to emissions intensity target (to be set)	Improvement in livestock health, mortality and fertility, contributing to emissions intensity target (to be set)	Improvement in livestock health, mortality and fertility, contributing to emissions intensity target (to be set)	Improvement in livestock health, mortality and fertility, contributing to emissions intensity target (to be set)	Improvement in livestock health, mortality and fertility, contributing to emissions intensity target (to be set)				
Policy outcome as a consequence of proposals listed above (once policies)				Increased use of livestock feed additives to reduce methane from enteric fermentation.	Increased use of livestock feed additives to reduce methane from enteric fermentation	Increased use of livestock feed additives to reduce methane from enteric fermentation	Increased use of livestock feed additives to reduce methane from enteric fermentation	Increased use of livestock feed additives to reduce methane from enteric fermentation	
Total change in policy outcome as a result of policies and proposals	Improvement in livestock efficiency	Improvement in livestock efficiency	Improvement in livestock efficiency	Improvement in livestock efficiency and reduction in methane from enteric fermentation	Improvement in livestock efficiency and reduction in methane from enteric fermentation	Improvement in livestock efficiency and reduction in methane from enteric fermentation	Improvement in livestock efficiency and reduction in methane from enteric fermentation	Improvement in livestock efficiency and reduction in methane from enteric fermentation	

Policy outcome 4: Emissions from the use and storage of manure and slurry will have been reduced.

Table 14-12: Policy development milestones which contribute to policy outcome 4

Policy development milestone	Delivery route
Determine the potential feasibility of self-financing large-scale anaerobic digesters	We will determine the feasibility of one or more viable large-scale AD plants, mostly using slurry and other wastes as feedstock, accounting for end-to-end issues such as use of digestate, grid connection and feedstock availability.
Engage with farmers to explore the potential for co-operatively owned and managed anaerobic digesters	We will determine the feasibility of creating a number of co-operatives of around 10 farms each to operate viable AD plants, mostly using slurry and other wastes as feedstock, accounting for end-to-end issues such as use of digestate, grid connection and feedstock availability. This may see one of the farmers having responsibility to manage the AD plant and transport feedstock and digestate, backed by a maintenance contract. We will encourage use of CARES funding to maximise community benefit. The number, location and timing of these will depend on factors such as planning permission and financing.

Table 14-13: Proposals which contribute to policy outcome 4

Proposal	Delivery route
Inclusion of livestock grazing in rotation on current arable land	Initial evidence suggests abatement could be delivered by restoring livestock grazing in rotation on current arable land. This would reduce the amount of nitrogen fertiliser needed on that land, improve soil health, and increase soil carbon. Further work is required to consider associated emissions and logistics.
Manure/slurry exchange	Evidence suggests that moving manure or slurry from cattle farms to arable farms could be a cost-effective option that delivers abatement through a reduced need to use chemical fertilisers. We will conduct a feasibility study to consider logistics, demand, and the potential for abatement when considering storage requirements and transport.
Minimise emissions from slurry storage	Emission from slurry storage can be minimised through methods such as fixed roofs, slurry bags or floating covers. Initial evidence suggests the cost is high and the amount of abatement low, and there are significant potential health and safety and environmental issues to overcome. However, further evidence is required before decisions can be made.

Table 14-14: Policy outcome 4 over time

Policy outcome 4	2017	2018	2019	2020	2021	2022	2023	2024	2025-2032
Policy outcome as a consequence of policies listed above	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Policy outcome as a consequence of proposals listed above (once policies)				Increase in number of anaerobic digester plants using slurry Greater use of organic fertiliser on arable land More slurry store coverage	Increase in number of anaerobic digester plants using slurry Greater use of organic fertiliser on arable land More slurry store coverage	Increase in number of anaerobic digester plants using slurry Greater use of organic fertiliser on arable land More slurry store coverage	Increase in number of anaerobic digester plants using slurry Greater use of organic fertiliser on arable land More slurry store coverage	Increase in number of anaerobic digester plants using slurry Greater use of organic fertiliser on arable land More slurry store coverage	
Total change in policy outcome as a result of policies and proposals				Increase in number of anaerobic digester plants using slurry Greater use of organic fertiliser on arable land More slurry store coverage	Increase in number of anaerobic digester plants using slurry Greater use of organic fertiliser on arable land More slurry store coverage	Increase in number of anaerobic digester plants using slurry Greater use of organic fertiliser on arable land More slurry store coverage	Increase in number of anaerobic digester plants using slurry Greater use of organic fertiliser on arable land More slurry store coverage	Increase in number of anaerobic digester plants using slurry Greater use of organic fertiliser on arable land More slurry store coverage	

Policy outcome 5: The carbon content of soil and agricultural land will have improved through carbon sequestration and expanded woodland/forestry and hedgerows

Table 14-15: Policies which contribute to policy outcome 5

Policy	EU, UK or Scottish policy	Public sector partners	Delivery route
Increase planting of trees and hedgerows	Scottish	None	We will explore with the farming and forestry sectors how best to increase planting of trees and hedgerows which optimise carbon sequestration.

Table 14-16: Proposals which contribute to policy outcome 5

Proposal	Delivery route
Payment for carbon sequestration	We are exploring mechanisms for paying farmers and other land managers to reduce emissions and/or sequester carbon in woodland/forestry, hedgerows and soils (including peat). This has been a long-term ambition in many countries but working examples are very rare. We will explore options for developing a payment scheme for carbon sequestration and other benefits, but this is an extremely complex area and many issues need to be resolved first.
Woodland/forestry cover targets for agricultural land	The Scottish Government has ambitious woodland creation targets to contribute towards reducing emissions. Using the Land Capability for Agriculture classification, local Forestry and Woodland Strategies, evidence on flood prevention and other appropriate information we will work with stakeholders to identify areas that have potential for sustainable woodland/forestry creation.

Table 14-17: Policy outcome 5 over time

Policy outcome 5	2017	2018	2019	2020	2021	2022	2023	2024-2032
Policy outcome as a consequence of policies listed above		Increase in the area of new woodland/ forestry on agricultural land	Increase in the area of new woodland/ forestry on agricultural land	Increase in the area of new woodland/ forestry on agricultural land	Increase in the area of new woodland/ forestry on agricultural land	Increase in the area of new woodland/ forestry on agricultural land	Increase in the area of new woodland/ forestry on agricultural land	
Policy outcome as a consequence of proposals listed above (once policies)			Evidence-based geospatial targets lead to Scottish agriculture significantly contributing to the annual woodland creation target	Evidence-based geospatial targets lead to Scottish agriculture significantly contributing to the annual woodland creation target If a viable scheme can be developed, we will begin paying farmers and other land owners for sequestering carbon in soils, woodland/ forestry, and hedgerows	Evidence-based geospatial targets lead to Scottish agriculture significantly contributing to the annual woodland creation target	Evidence-based geospatial targets lead to Scottish agriculture significantly contributing to the annual woodland creation target	Evidence-based geospatial targets lead to Scottish agriculture significantly contributing to the annual woodland creation target	
Total change in policy outcome as a result of policies and proposals		Increase in woodland/ forestry on agricultural land	Increase in woodland/ forestry on agricultural land	Increase in woodland/ forestry on agricultural land, and carbon content of soil	Increase in woodland/ forestry on agricultural land, and carbon content of soil	Increase in woodland/ forestry on agricultural land, and carbon content of soil	Increase in woodland/ forestry on agricultural land, and carbon content of soil	

14.6 Progress since RPP2

Table 14-18: Progress on RPP2 policies

RPP2 Policies	Summary of progress
Doubling the number of Climate Change Focus Farms in Farming For a Better Climate from four to eight	Nine new Focus Farmers were engaged and are currently part of Farming For a Better Climate (FFBC). Evidence on the impact of the policy suggests that farmers who engage with it find it very valuable, but not enough are aware of it. We now have a policy to extend FFBC to enable more farmers to benefit from the lessons learned.

Table 14-19: Progress on RPP2 prosposals

RPP2 Proposals	Summary of progress
90% uptake of fertiliser efficiency measures	This proposal has been superseded by the requirement for nutrient management planning on grassland as a result of CAP Greening, the policy outcome of a 10% reduction in emissions from inorganic nitrogen, the policy for soil testing, and the proposal for a nitrogen budget for Scotland.
Developments in agricultural technologies post 2020	Agricultural equipment manufacturers, suppliers and consultants have continued to develop technologies and practices to support precision farming. In this Plan we have policies and proposals that will help encourage uptake of novel and existing agricultural technologies through advice and support for finance.

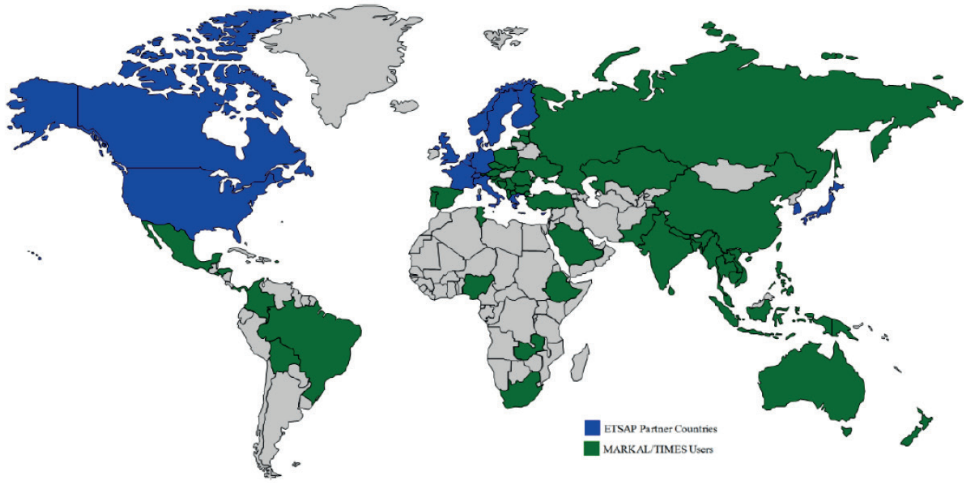
15. Annexes

15.1 Annex A: The TIMES model

Introduction

15.1.1 The development of the draft Climate Change Plan (CCP) and Energy Strategy were informed by the use of a TIMES (The Integrated Markal EFOM System) for Scotland. The TIMES modelling approach was developed by the International Energy Agency – Energy Technology System Analysis Programme (IEA-ETSAP) and is a Whole System Energy Model (WSEM). Such models aim to capture the main characteristics of an energy system and the interlinkages within it. They are particularly useful for understanding the strategic choices that are required to decarbonise an economy. While this is the first time a model like this has been available for Scotland, they are widely used internationally in modelling climate and energy policy choices.

Figure 25: Countries which are members of the ETSAP modelling community or have used TIMES models



15.1.2 The Scottish TIMES model is a high level strategic model, covering the entire Scottish energy system, and containing thousands of variables capturing existing and future technologies and processes.

15.1.3 The model combines two different, and complementary, approaches to modelling energy: a technical engineering approach and an economic approach. The model uses this information to identify the effectiveness of carbon reduction measures in order to provide a consistent comparison of the costs of action across all sectors of the economy. The Scottish model was built by an international consortium of experts from E4TECH, E4SMA, KANORS, SYSTRA and Imperial College London and we are grateful for advice and assistance provided by the analytical team in the UK Department for Business, Energy and Industrial Strategy.

15.1.4 The aim of the model is to capture the main characteristics which effect the deployment of technologies, their costs and associated greenhouse gas emissions for Scotland as a whole given a range of policy and other constraints. This allows consideration of the strategic choices which Scotland faces as it seeks to decarbonise its energy system.

15.1.5 In building Scotland's first TIMES model we have involved both academic, non-governmental organisations and other independent experts in the project and we will continue to develop the model in partnership with ClimateXChange (CXC) and the Scottish academic community.

15.1.6 This technical annex sets out our objectives in commissioning the model, an overview on how it functions and how it was used to inform the development of the CCP.

Objectives

15.1.7 The two previous Reports on Proposals and Policies (RPP1 and RPP2) have necessarily been limited by our inability to consider in detail the system wide impacts of changes in one sector on other sectors. By using a whole system energy model, we are able to address this. The model limits us to the consideration of pathways that are internally consistent so a demand for say electricity in one sector needs to be met by increased generation and any fuel required for that additional electricity generation needs to be sourced from finite supplies.

15.1.8 For example biomass can be used to fulfil a wide variety of different energy needs depending upon how it is processed. In the TIMES model the availability of raw biomass is limited. As a result of this limitation the model will divert the available supply of biomass into its most economically valuable energy use and will ensure that total biomass use across all areas of the economy does not exceed the available supply. This ensures that decisions made in one part of the system have impacts which ripple out across the system and ensures that the resulting pathway proposed by the model is internally consistent.

15.1.9 The insights that this has provided on energy supply are explored in more detail in the complementary Energy Strategy.

15.1.10 As a result of taking this system wide view we have been able to:

- provide a clear roadmap to achieve required reductions in CO_2 at minimum cost to government, industry and householders, whilst taking account of other policy priorities such as maintaining energy security
- consider a range of additional policy options, and to maximise the cost effectiveness of these, as required
- in effect, replicate a significant portion of the IPCC analysis for Scotland

15.1.11 This new approach results in a fundamental change in how we calculate sector emissions and consider cross-sectoral interactions compared to the two previous Reports on Proposals and Policies. The key differences are set out in the box below.

Text box 15-1: Difference between RPP and CCP

Difference in analytical approach between RPP and CCP

Previous approach: For the first two RPPs we did not have access to a whole-system energy model. As a result we estimated a top down 'business as usual' (BAU) set of emissions for each year of the RPP, for each sector, and then netted off the estimated impact of policies and proposals to ensure our net emissions in each year were in line with the targets.

The key limitation with this approach was that, while sectors could consider where they individually felt they could best save carbon, they could not see how the costs of their efforts compared on a consistent basis with other sectors and what the wider system impacts might be of the package of policies and proposals as a whole.

Climate Change Plan approach: In the CCP we are able to take a different, more integrated, approach as a result of our TIMES whole-system energy model. Instead of focusing on future emissions on a sector by sector basis, and then netting off abatement, we can identify the most efficient parts of the system to remove carbon and allocate sectoral carbon envelopes accordingly. This bottom up approach allows us to ensure that cross sectoral effort in each year is in line both with the targets and with the effort in other sectors. This ensures that we take the most economically efficient decarbonisation pathway.

Modelling approach

15.1.12 The former Department for Energy and Climate Change (DECC) built a TIMES model of the UK energy system. This UK TIMES model was used as a starting point for modelling the Scottish energy system. This will enable future linking between the two national models, and provided the core data sets required by the Scottish model. Using UK TIMES as a starting point was justified by the fact that technology costs and performance were found to be common in the majority of cases.

15.1.13 The modelling process was undertaken via the following steps:

1. Model Scope and Architecture
The architecture of the UK TIMES model was reviewed in order to provide a starting point for development of the Scottish TIMES model. The result of this review, alongside a review of available Scottish data was then considered by a Steering Group of officials and reviewed by sector experts.

2. Data Collection
Clarification of model architecture in (1) above led to the description of data required. This data collection step involved an iterative process of identifying the data required, appropriate data sources, data collection and checking. Iteration across this process was required where data was found to be either unavailable or of insufficient quality, leading to minor alterations to model architecture in outlying cases. The data collection phase culminated in a stakeholder data validation workshop. Data collection and improvement is an on-going process and we will continue to adjust the underpinning data as new information becomes available.

3. Sectoral Models Structural Analysis
The Scottish Government has historically employed a range of sector-specific models. This TIMES model development phase considered the structure of these models to ensure that cross-calibration between the whole-system and sector specific models is possible. This activity further refined the architecture of the Scottish TIMES model. TIMES drew on the following Scottish Government Models:

- the Scottish Electricity Dispatch Model (SEDM)
- the Scottish Heat Map
- the National Housing Model (NHM)
- the Transport Model for Scotland (TMfS)
- the Scottish Government Heat Model

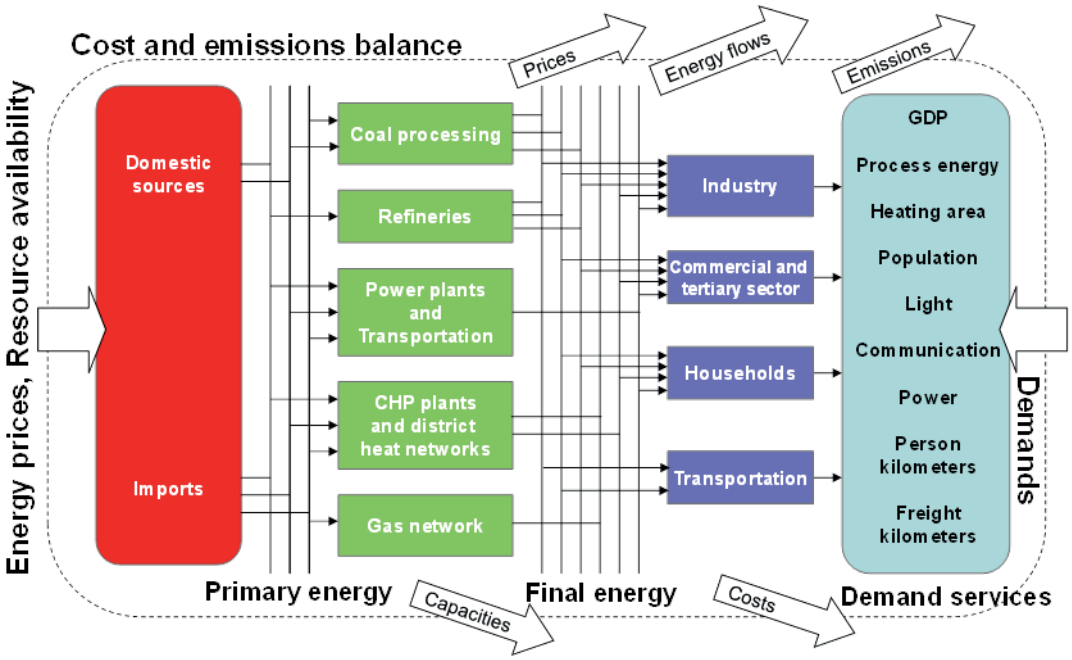
In addition analysts at Transport Scotland commissioned detailed work from Element Energy which informed the transport pathway.

4. TIMES Model Implementation and Calibration
The Scottish TIMES model was then built using a standard TIMES model development process that has been used to construct the models used in other countries. This entailed creation of a depiction of the 'base year' which represents a specific historical year to give model runs a starting point, and characterisation of the set of future technologies available to the model including their technical performance and economic parameters.

Scottish TIMES model architecture

15.1.14 The figure below sets out a simplified overview of the Scottish TIMES model.

Figure 26: Schematic of TIMES inputs and outputs; source (Remme et al., 2001)



15.1.15 The above diagram is a simplified representation of the energy system showing the following main parts:

- Resources (Red) – includes current and potential availability of 'traditional' energy sources such as oil and gas, but also includes sources such as wind, biomass, wave/tidal and solar. Trade is also included in this section.
- Conversion (Green) – includes the range of technologies and industrial processes used to convert resources into usable energy – from the production of petrol to the generators atop wind farms.
- Consumption (Purple) – details the range of potential uses (energy-services) for the energy being converted and distributed by the system, along with the technologies used to convert into a usable form, e.g. light, heat, computing and refrigeration.
- Demands (Light blue) – details a range of information shown to influence the amount of energy-services required. These are generally specified via other models, e.g. future population growth will influence many of these demands.

15.1.16 The model will always satisfy the demands we place on it subject to the availability of sufficient energy resources.

Exploring Scotland's future energy system

15.1.17 A key use of the model is to explore at a strategic level how the energy/climate system in Scotland might change as we move through the period of the Climate Change Plan and the companion Energy Strategy.

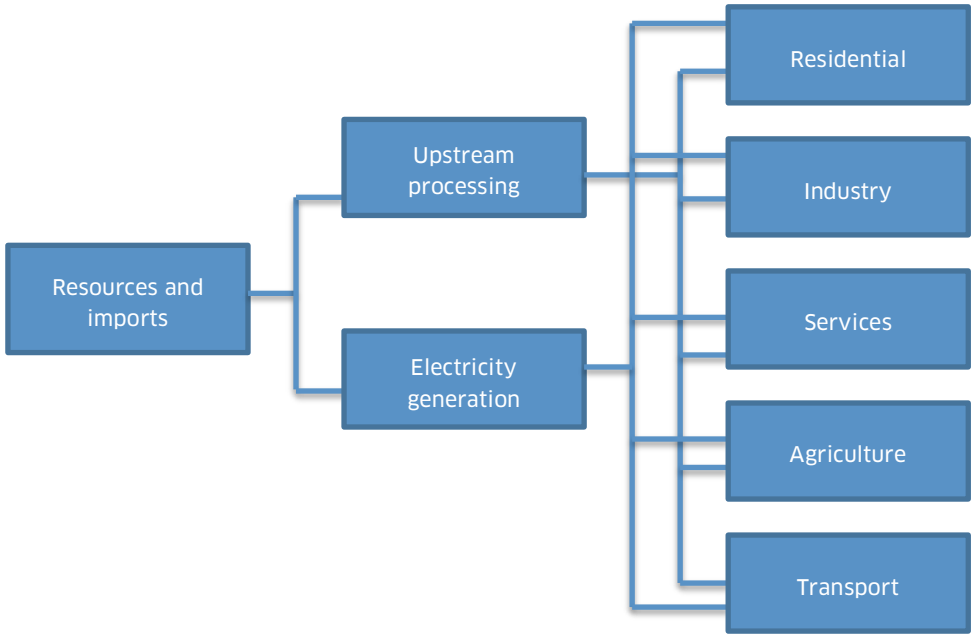
15.1.18 As TIMES looks into the future, existing technologies and processes will require replacement, possibly with more efficient alternatives, as they reach the end of their natural or economic lifetimes and new processes and technologies enter the market.

15.1.19 In responding to these changing conditions and user constraints, the model will make a series of investment decisions to ensure that demands for energy continue to be met. In effect, the model identifies the investments to be made at any given point in time which represent the lowest overall cost solution to meet demand subject to the constraint of delivering this within the emissions permitted by Scotland's climate change targets and other policy considerations.

Sector disaggregation

15.1.20 The Scottish TIMES model is designed following the same structure as UK TIMES, shown in the figure below.

Figure 27: Structure of the Scottish TIMES model



Resources and imports

15.1.21 The resources and imports sector includes all activities related to the trading of primary and secondary fuels into and out of Scotland. The model divides the sector into four subsectors:

- upstream oil and gas transport
- domestic resources
- exports
- imports

15.1.22 The energy resources are available to the model directly, through processing technologies or through infrastructure networks. The model aims to find the cost optimal mix of import, export and domestic creation of primary and secondary energy forms to meet the energy service demands. In future years new processes are available to the model which when implemented increase the import/export capacity of the model, and in the case of hydrogen infrastructure enable the distribution capacity of new energy carriers.

Upstream processing

15.1.23 The upstream sector includes the technologies that convert primary fuels into secondary fuels, excluding electricity and heat generation. The technologies available to the model can convert primary into secondary fuels or transform secondary fuels into other secondary fuels. Scottish TIMES splits the available process technologies into four categories:

- traditional processes such as oil-refining
- bioenergy and waste processes like anaerobic digestion of sewage sludge
- hydrogen production and infrastructure
- carbon capture and storage

15.1.24 The base year includes the traditional process such as oil-refining, and established biomass and waste processes such as landfill gas capture and biomass pelletisation. In the future years, multiple processes are available to the model, which include new feedstocks for fossil fuel production, new bioenergy technologies, and hydrogen technologies. The model also considers the transportation and sequestration potential required for carbon capture and storage from both electricity generation and industrial processes.

Electricity generation

15.1.25 The model treats electricity differently to other energy carriers due to the physical requirements for system balancing and the relative difficulty of electricity storage. Electricity demand is endogenous because of electricity's competition with other fuels to meet the energy services demands. As a result, the load profile for electricity demand will vary with each model run and the electricity sector must meet the peak demand at every period and time-slice, as well as a reserve capacity. A large suite of generation technologies is available to the model to meet the electricity demand each with a set of parameters and constraints. These parameters and constraints are grouped as technical, economic and environmental. The model finds the cost optimal mix of suitable generation technologies to satisfy the electricity demand for each run of the model.

15.1.26 The base year capacity of the generation technologies, broadly categorised as fossil fuel, nuclear and renewable, are calibrated to the actual installed capacity in Scotland in 2012. The future installed capacity of these technologies is estimated according to the current planned or under construction generation projects and constraints on deployment potential.

15.1.27 As the TIMES model is strategic in nature it looks at time periods in blocks rather than chronologically, which allows for manageable model run times while still providing valuable insights. It is the nature of the electricity system however that supply and demand have to match in real time. In order to check that the generation mix being proposed by the selected TIMES scenario fulfilled this criteria it was stress tested using the Scottish Government Electricity Dispatch Model (SEDM). This confirmed that the proposed capacities are technically feasible, alongside use of interconnection with the integrated GB electricity network, relying on existing and under development network projects.

Transport

15.1.28 The transport sector contains the processes related to the movement of goods and people and the required infrastructure and fuel. The sector is composed of 9 subsectors:

- Car
- Bus
- Light goods vehicles
- Heavy goods vehicle
- Motor cycles
- Passenger rail
- Freight rail
- Aviation
- Shipping

15.1.29 The model defines the demands for each of these sectors including variations in car trip length and domestic and international demand for aviation and shipping. The model optimises the cost of the transport infrastructure, the energy carriers and the transport technologies to meet the transport demand whilst adhering to the environmental parameters. Parameters and constraints are applied to infrastructure, energy carrier and technologies.

15.1.30 During the course of the project it became clear that Transport Scotland's commissioned research undertaken by Element Energy offered additional detail over the core TIMES transport module and as such it was used to develop the transport envelopes. Element Energy's work included the construction of a detailed Scottish vehicle database, including number, age and turnover of the Scottish vehicle parc, a peer review of their database of technology costs across transport modes (used to refine their cost models for alternative fuels and technologies) and finally used their consumer demand model to develop realistic scenarios for the take up of alternatively fuelled vehicles, particularly cars. These emissions envelopes resulting from the analysis were then coded into the TIMES run so that their wider impact on the energy system would be costed and considered.

Residential

15.1.31 The residential sector includes all energy service demands and emissions from the Scottish housing stock. Scottish TIMES splits the sector into three broad demand sub-sectors:

- heating (space and hot water heating), using a range of fuels
- cooking (hobs, ovens and other cooking), using a range of fuels
- other demands (lighting, refrigerators/freezers, space cooling, wet appliances, consumer electronics, computers and other appliances), which consume electricity

15.1.32 Assumptions are made for each of the above energy service demands in the base year for urban houses, rural houses and flats. The only demands for which a distinction is made between existing and new dwellings are the space and hot water heating demands. For all other energy service demands, dwellings of all ages are combined, but the distinction between urban/rural/flat is maintained.

15.1.33 The National Housing Model attempts to completely represent all individual housing types and, as such, a very large number of housing 'archetypes' can be extracted from the model. For computational simplicity in TIMES, and following a statistical review, these were aggregated into 6 different types which captured the bulk of statistical variability.

Industry

15.1.34 The industrial sector module in the Scottish TIMES model is composed of six subsectors. The industry sector in Scotland is currently dominated (in emissions terms) by chemicals, with smaller contributions from food and drink, cement, non-ferrous metals, steel works and a range of other small industries. Scottish TIMES uses a process-oriented approach to model energy-intensive industry sectors including iron and steel, cement, pulp and paper. This means that the actual production processes are represented in the model.

15.1.35 The chemicals sector is highly heterogeneous. The high value chemicals and ammonia subsectors are also modelled in a process-based manner and take into account the different process related emissions. The energy services demands are the basis for the production processes of other chemicals.

15.1.36 The remaining, less energy intensive, industrial subsectors such as other chemicals, food and drink as well as other industries and which have a highly heterogeneous production structure, are modelled using an end-use or energy service demand approach. The model optimizes the combination of process technologies to meet the specified level of energy service demand. The final energy service demands are met through the transformation of energy carriers by the process technologies.

Services

15.1.37 The service sector is broadly defined in the same way as the residential sector. The primary energy service demands are space heating, water heating, lighting, computer, cooking, refrigeration, and other electricity. The sector is divided into public and private buildings and within each of those sectors the building stock is split into high and low energy consumption buildings. The technology options available to the model are very similar to those available in UK TIMES with the base year stock adapted to reflect the current capacity in Scotland. Data is currently not available on the split of public to private buildings or the total energy demand in the Scottish service sector. They are estimated based on the current demands estimated in UK TIMES and the public/private sector building greenhouse gas emissions in Scotland from the Greenhouse Gas Inventory.

Agriculture

15.1.38 The agriculture sector includes all energy consuming processes related to agriculture, and land-use and agriculture-related non-CO_2 non-energy greenhouse gas emissions mitigation technologies. Relative to the UK, agriculture is a more important sector in Scotland and has a significant emissions profile. Scottish TIMES considers the energy demands for heat, electricity and transport related to agriculture activities. The model includes greenhouse gas emissions mitigation measures related to agricultural practices and new technologies. The agriculture emissions profile was calculated exogenously following discussion with sector experts and mapped into Scottish TIMES.

Land Use, Land Use Change and Forestry

15.1.39 The model includes greenhouse gas emissions from land use; in particular the carbon sink effects of afforestation and peatland restoration are included. As a result of historic tree planting rates the size of the carbon sink associated with land-use in Scotland is reducing. This basic profile, provided by the Centre for Ecology and Hydrology[70], is included in TIMES and additional abatement associated with increasing tree planting and peatland restoration is added as a policy option.

70 "Projections of emissions and removals of Greenhouse Gases from the LULUCF sector to 2050" released on 26 April 2013 available at: http://naei.defra.gov.uk/

Data sources

15.1.40 In populating the model with data and assumptions, Scottish-specific references were used as far as possible. Given that many of the processes and technologies defined within the model align with those used in UK TIMES, most of the cost and performance characteristics were aligned to UK TIMES. Two key Scottish sources were used in calibrating the base year stock and commodity flows, in particular the energy balance from the Energy in Scotland publication[71] and the Scottish Greenhouse Gas Emissions publication[72]. These allowed for a top-down calibration of commodity flows through each supply and demand sector, as well as an estimate of the installed capacity of technologies in each sector.

15.1.41 The key sources of reference used in each sector are highlighted below:

- **Resources:** Most of the resource flow data (i.e. imports, exports, indigenous production) for the base year is derived from the 2012 Energy Balance[73]. Scottish specific sources were used for fossil fuel reserve potentials, biomass potentials and waste potentials, and are summarised in the Resource sector document. Where data on future resource potentials were not available data from UK TIMES was scaled for Scotland.
- **Upstream processing:** The main processes included in this sector are the refinery activities at Grangemouth, biodiesel production, and various pellet production activities. Publically available estimates of Grangemouth refinery product outputs from the UKPIA[74] were used along with UK TIMES data on costs and future technology options. Publically available reports from the Forestry Commission and Ecofys were used to estimate domestic biofuel production capacity and potential. The assumptions about availability of imported biomass were set following discussion with BEIS.
- **Electricity:** The majority of the data for the Electricity sector was taken from the SEDM[75]. Other data on generation and capacity was taken from DECC[76]. Technology cost and performance characteristics were mostly taken from UK TIMES.
- **Transport:** Data on stock and performance was taken from Scottish Transport Statistics and the TMfS. Future technology performance and costs were mainly taken from UK TIMES.
- **Residential:** Data from the Scottish Household Conditions Survey (SHCS)[77] was used to characterise the base year Scottish building stock energy demands and technology stock.
- **Industry:** Commodity production data was taken from various industry sources. A lack of data on the existing installed technology capacities in each sector meant that estimates had to be made using the emission data for each sector in the Scottish Greenhouse Gas Emissions publication[78]. UK TIMES technology cost and performance characteristics were used.
- **Services:** A lack of data in the services sector meant that UK TIMES assumptions had to be scaled based on the estimated number of service sector buildings in Scotland compared to the rest of the UK.

71 Scotland Energy Balance 2012, Annex A, Energy in Scotland 2015, http://www.gov.scot/Topics/Statistics/Browse/Business/Energy/EIS2015

72 Scottish Greenhouse Gas Emissions 2012, http://www.gov.scot/Publications/2014/06/5527

73 Scotland Energy Balance 2012, Annex A, Energy in Scotland 2015, http://www.gov.scot/Topics/Statistics/Browse/Business/Energy/EIS2015

74 Available at: http://www.ukpia.com/industry_information/refining-and-uk-refineries/Petroineos-grangemouth-refinery.aspx

75 Scottish Electricity Dispatch Model (Scottish Government)

76 Regional Renewable Statistics, BEIS, https://www.gov.uk/government/statistics/regional-renewable-statistics

77 Scottish Household Conditions Survey, see: http://www.gov.scot/Topics/Statistics/16002

78 Scottish Greenhouse Gas Emissions 2012, http://www.gov.scot/Publications/2014/06/5527

- **Agriculture and land-use:** The Scottish agricultural MAC curve was initially used[79] to estimate the mitigation potential for various measures in Scottish agriculture. Following discussions with sector experts this was replaced with an exogenous profile. The BAU land-use emissions, waste emissions and agricultural process emissions came from a mix of sources compiled and adapted by E4tech[80]. Agriculture sector energy demands (e.g. heat, electricity, transport) were estimated by scaling the UK TIMES assumptions for Scotland.

Methodology for projecting service demands

15.1.42 The TIMES models are driven by projections of energy service demands that are in turn based on macro-economic drivers and elasticities. The Scottish TIMES model is driven by exogenous demand specified by the list of each energy service demands (92 split by sector and service), actual values in the base year (calibration) and values for all milestone years till 2050 (projection).

15.1.43 The energy service demand projection in the model (for example amount of car road travel in passenger kilometres, residential lighting, hot water requirements of the services sector, cement production) over the horizon require two sets of parameters: base year demand value and demand drivers. Demand drivers (for example population, GDP, number of households) are usually exogenously obtained via other models or from accepted other sources. The Scottish TIMES model uses exogenous drivers based on macro-economic projections, and where not available data from the UK TIMES model. For each demand a possible driver for the data projection has been identified, based on both the available macro-economic drivers and/or the UK TIMES drivers. These drivers have been used to calculate demands driver rate by period (DDR(t)) and then the energy service demand projection by period based on the following formulas:

$$\mathrm{DDR(t)}=\left(\left(\frac{\text{Demand Driver (t)}}{\text{Demand Driver (t0)}}\right)-1\right) \quad \text{Equation 1}$$

DDR(t) demand driver in period t.
Demand Driver (t) is the demand driver in the actual period t.
Demand driver (t0) is the demand driver in the base year period

$$Demand(t) = Demand(t0)* (1+\mathrm{DDR}(t)) \quad \text{Equation 2}$$

Demand(t) is the demand in period t.
Demand(t0) is the demand in the base year period.

How the model was used

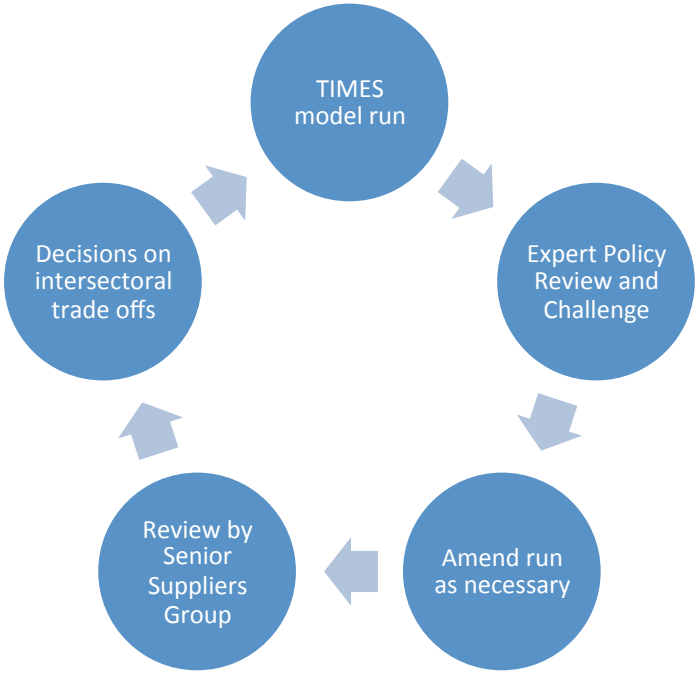
15.1.44 While TIMES is a powerful tool for considering the implications of changes in the energy system on emissions it is simply a guide rather than a predictor of the future. As such an important part of the modelling process has been engagement with sector experts and consideration of the wider consequences of particular pathways.

15.1.45 This engagement was carried out via both analytical working groups and the Senior Suppliers Group of government officials. As a result of this engagement a number of delivery considerations were identified which resulted in additional constraints being placed on the model.

79 'Review and update the UK Agriculture Marginal Abatement Cost Curve to assess the greenhouse gas abatement potential for the 5th carbon budget period and to 2050', Scottish Rural College (2015), https://www.theccc.org.uk/wp-content/uploads/2016/02/MACCUpdate2015_FinalReport-16Dec2015.pdf

80 Calculations by consultants E4tech

15.1.46 This process is summarised graphically below.



15.1.47 Following consideration by the Scottish Government's Cabinet Sub-Committee on Climate Change, sectors were provided with their final high level carbon envelopes. The draft Climate Change Plan explains how it is intended that each sector can meet its envelope.

15.1.48 Given the central role of energy in delivering a low carbon Scotland and the extent of the challenges faced in delivering low carbon energy, a separate Energy Strategy also informed by the TIMES model is being published as a companion document to the draft Climate Change Plan. This explores the options for delivering increasingly decarbonised electricity and heat and the technological options for doing so.

15.2 Annex B: ISM

Why behaviours are important

15.2.1 Understanding what influences people's behaviours is essential to delivering the outcomes in this Plan, and ultimately achieving our climate change ambitions. Many of the policies and proposals in the Plan will require individuals and households to change their behaviour in a way that will help achieve policy goals. For example, becoming less reliant on a car will only happen if individuals change to walking, cycling, public transport and car sharing. It is therefore important to understand why people behave in the way they do, in order to design policies that help people change their behaviours.

Influencing low carbon behaviours

15.2.2 Incorporating behavioural considerations in policies requires insight and understanding of how people's choices and behaviours are influenced. People's everyday behaviours are influenced in various ways – within the values and attitudes that we hold, the habits we have learned, the people around us, and the tools and infrastructure available to us in our day-to-day lives. To influence behaviours successfully, a package of interventions, that takes account of the wider aspects of daily lives, will achieve better outcomes.

The ISM approach

15.2.3 The Scottish Government commissioned the development of ISM: a practical tool designed to support behaviour change interventions, supported by a user guide Influencing Behaviours – Moving Beyond the Individual – A User Guide to the ISM Tool[81], published in 2013.

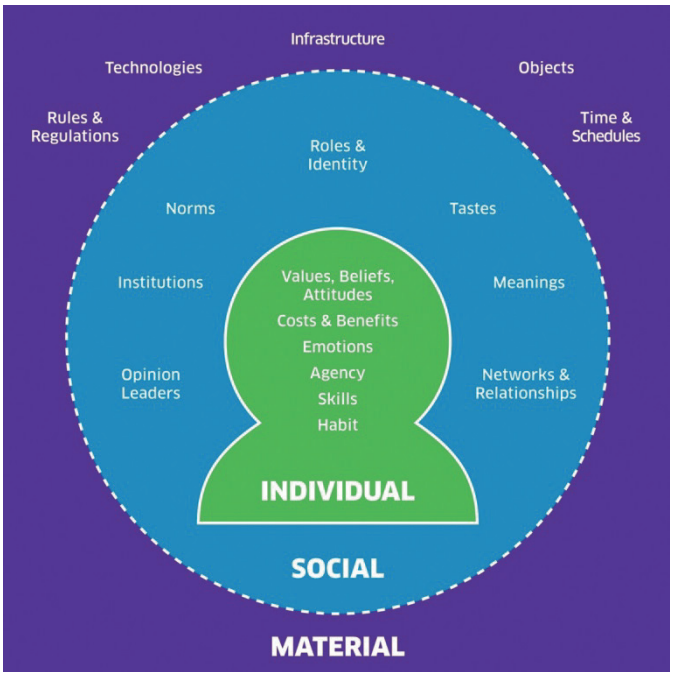
15.2.4 ISM is based on theory and evidence which shows that three different contexts – the Individual, Social and Material – influence people's behaviours. The *Individual* level includes an individual's values, attitudes and skills, the *Social* context includes factors that influence us through networks, relationships and social norms, and the *Material* context covers factors like infrastructure, technologies and regulations.

15.2.5 By understanding the different contexts and the multiple factors within them that influence the way people act, more effective policies and interventions can be developed. One of the key principles is that interventions should take account of the multiple influences across these contexts, I, S and M, in order to achieve long-lasting change.

15.2.6 The ISM model highlights 18 key factors/influences on people's choices and behaviours, seen in the picture below, a head (the individual), in a circle (social context) in a square (material factors).

81 http://www.gov.scot/Publications/2013/06/8511/2

The ISM Model



15.2.7 ISM can help us understand the range of factors which are influencing specific behaviours and generate ideas for how policy can better influence them. For example using an ISM approach can help us:

- understand what factors influence a behaviour we want to change
- understand why behaviour change has happened (or is not happening)
- consider a behaviour in a new way
- design and develop behaviour change policy and interventions

15.2.8 Questions ISM has helped consider include:

- *'What factors will influence ..'* e.g. whether people buy or rent an energy efficient property
- *'How can we..'* e.g. increase the uptake of electric vehicles by the public
- *'Why people do or do not'* e.g. participate in recycling in (specific disadvantaged communities in Edinburgh)
- *'What are the barriers …'* e.g. to the uptake of nitrogen use efficiency practices in Scottish agriculture

ISM approach in the Climate Change Plan

15.2.9 The Scottish Government used ISM workshops to consider the factors that influence the behavioural aspects of the Second Report on Policies and Proposals (RPP2), looking at policy areas including uptake of electric vehicles, solid wall insulation and fuel efficient driving. This work has continued and, in 2016, we initiated a programme of work to ensure that consideration of influences on behaviours is embedded in the Climate Change Plan. The programme should help us understand the influences on behaviours in order to inform the design of interventions to help people change those behaviours.

15.2.10 Workshops have been held to investigate behavioural challenges in a range of areas, including the demand for energy efficient housing for two stakeholder groups, efficient use of heating controls, increasing physical activity through walking and factors that influence woodland creation. Some of these workshops were for initial policy scoping by Scottish Government officials and others involved a range of stakeholders. Further workshops will include the urban school run and sustainable food production.

15.2.11 The ISM approach has been used in various ways to support policy development, including:

- Running smaller workshops to initially explore behaviours, current behaviours landscapes (drilling down into the behaviours and looking at the evidence we have on the behaviour and how this fits within ISM framework), and identifying key stakeholders. This insight helps frame the ISM workshop with key stakeholders.
- Delivering ISM workshops with broad groups of stakeholders. The aim of the workshop is to gather wider views on behavioural challenge, investigating the current landscape and identifying potential barriers and gaps.
- Following up the ISM workshops with a small working group approach focused on action planning and delivery, using insight (potential barriers and gaps) from initial workshops.
- Using the ISM framework to support literature reviews of the behavioural challenge.

15.2.12 We will test the ISM approach later in 2017 as a potential way to engage the public on policies and policy development. Building on the initial housing workshops (which brought together a range of key stakeholders) we are developing an ISM style workshop to engage the public on the same behaviour. The aim is to bring together a small group of members of the public to supplement the initial ISM workshop findings with a public point of view.

15.2.13 Experience of using the ISM approach, across a range of policy areas has highlighted benefits including:

- providing greater understanding of the wide range of factors that will impact on successful delivery of policies
- giving clarity on the areas to be targeted and prioritised
- highlighting the relative importance of different factors in effecting change and using these as levers to change. In particular, the importance of considering the social context in delivering and developing policies.

15.2.14 Using the ISM approach across emissions reductions policy areas will support the implementation of policies and proposals in the Climate Change Plan, and delivery of policy outcomes.

Text box 15-2: ISM Workshop

ISM Housing Policy Workshop: engaging householders with their heating controls

The workshop focused on how to encourage householders to use their heating efficiently through heating controls. It included a diverse range of stakeholders covering energy efficiency scheme management and delivery, energy advice, utility companies, installers, heating control manufacturers and policy makers. The ISM model results generated at the workshop are included below.

Individual factors which were highlighted as barriers to adopting careful management of heating using heating controls include: lack of confidence with new systems, lack of clear advice materials, and a belief by householders that use will not have an impact on bills.

Social factors highlighted include the social expectations regarding heating the home, an assumption by key stakeholders that standard technologies are understood and a perception that this action is less important than other ways to save energy.

Material factors highlighted include the need for less complicated technology and the need for follow up after installation.

The highlighted a number of areas where we could take action.

Some ideas and solutions generated at the workshop include:

1. Change meanings around heating controls to make their use important and relevant to all.
2. Promote heating control use in general via agencies, media etc.
3. Develop case studies/examples on impacts and changes arising from engagement.
4. Develop useful assessments of cost savings.
5. Promote message about comfort and control (not just bill saving).
6. Develop bespoke, tailored advice.
7. Promote manufacturer and installer links to wider support agencies.
8. Encourage installers to increase use of heating controls.
9. Make controls advice/engagement part of gas safety checks.

15.3 Annex C: Climate Conversations

15.3.1 Public understanding, engagement and action are critical to the social and economic transformations required to achieve a low carbon society. The move to a low carbon society will require lifestyle changes for individuals and households across Scotland, and engagement on climate change will be a key element of supporting this cultural shift.

15.3.2 As part of ongoing engagement with the public, the Scottish Government initiated a series of climate conversations across Scotland (starting in summer 2016) to encourage public discussions on climate change. The purpose of these conversations is to 'take the temperature' of public views on climate change and actions that might be needed to tackle it.

15.3.3 These group discussions enable participants to share their views on climate change, on potential policies to tackle climate change, and on potential changes to people's everyday lives. This includes participants discussing what life in a low carbon Scotland in 2030 might look like in the context of a changing climate, and in some conversations exploring views on the respective roles of individuals and government in reducing emissions.

15.3.4 The Scottish Government commissioned 20 formal climate conversations across Scotland in 2016 and findings from these are being fed into the development and communication of the draft Climate Change Plan. Ten conversations were held with local groups of national community-facing organisations. Another ten were held with members of the public, recruited by a market research company to be broadly representative of the local population.

15.3.5 178 participants took part in the 20 conversations, ranging in age from 18 to 90. The conversations were held in locations across Scotland, from Galashiels to Pitlochry to Dumfries.

15.3.6 Organisations involved in climate change activities have also been holding their own conversations. For example Eco-Congregations held six conversations in locations ranging from Orkney to Dumfries to the Borders. Findings from those conversations are incorporated in the key findings below.

Key findings so far

15.3.7 Climate Conversations work as a way to engage with the general public on climate change, and participants enjoyed the conversations.

<u>Knowledge of climate change</u>

- People are generally aware of climate change as both an issue and a problem and were aware that action is necessary to tackle it. There was some confusion between concepts and some factual inaccuracy in the conversations, however many of the participants appeared reasonably well informed.
- Participants want to act on climate change but want more information on climate change, the impacts of climate change and the actions they can take.
- Participants felt they were already taking some action on climate change.

<u>Issues/Themes</u>

- The most prevalent themes concern the impact of a changing climate in relation to transport disruption, wildlife and ecosystems, changing weather patterns, rising sea levels, food supply and land use, and changes to energy generation.
- Local energy and public transport were consistently popular themes in the conversations, with strong support for improvements to the public transport network, and participants favoured increased energy generation through renewables.

- Across the groups there were strong views that improving energy efficiency of homes and sourcing power from renewable energy would both reduce emissions and create significant added benefits to local people's health, wealth and wellbeing.

Going forward

- People want to engage but need help to go from interest to action. The low carbon choice needs to be the easy choice and the fair choice.
- Some groups highlighted an appetite for an ambitious and holistic vision of the future.
- People want a transparent and consistent approach to climate change across government.

Next steps

15.3.8 These conversations are continuing through local groups across Scotland, and we are feeding the results into policy development.

15.3.9 There is potential to improve general public awareness of existing sources of information and advice on climate change and low carbon behaviours. We are developing the climate conversations package to help support this.

Resources

15.3.10 Free resources, including a How to Guide, are available to help as many organisations and community groups as possible to participate in the climate conversations. These resources, based on research undertaken by Climate Outreach on behalf of the Scottish Government and ClimateXChange, can be used to facilitate conversations that move beyond existing approaches, engaging people in meaningful conversation about the wider impacts of climate change and the measures that might be needed to mitigate its causes and effects. These resources are available on the Scottish Government website[82].

82 http://www.gov.scot/Topics/Environment/climatechange/lowcarbonbehaviours/climate-conversations-how-to-guide

15.4 Annex D: Developing the Climate Change Plan – stakeholder engagement

15.4.1 The Scottish Government values the input of stakeholders in developing plans to reduce greenhouse gas emissions in Scotland. In developing the draft Climate Change Plan there has been ongoing engagement with key stakeholders in both specific sectors covered by the draft Plan and general engagement on the process for developing the draft Plan, including an interactive seminar on the TIMES model on 15 September 2016.

15.4.2 In addition to sector-specific meetings and events for stakeholders (such as an Agriculture event on 26 October 2016), we held a major cross-sector stakeholder engagement event on 8 December 2016.

Overview of event

15.4.3 This event provided an opportunity for the Scottish Government to explain the approach to developing the draft Climate Change Plan (including the TIMES model), how this links with the draft Energy Strategy and to share work done to date with stakeholders (setting out an overall pathway and sector carbon envelopes alongside draft policy outcomes and associated policies and proposals.) The event was attended by over 100 stakeholders representing a range of different sectors including public sector, business, third sector and academia.

15.4.4 The delegates took part in two sets of table discussions focused on various aspects of the draft Plan including specific sector policies and proposals. The table discussions covered the following sectors:

- Electricity (the generation and wider electricity system for Scotland)
- Services (non-residential buildings and heat in the public and commercial sectors)
- Residential (all of Scotland's housing, including private social and rented housing)
- Transport (active travel, bus, rail, aviation, maritime, canals, freight and private motoring, together with associated infrastructure)
- Industry (all industrial activity and manufacturing in Scotland, including the heavy industry covered by the European Union Emissions Trading System)
- Agriculture (activities related to the rearing of livestock and cultivation of land for food or energy crops)
- Land use (expanding Scotland's woodland area, and restoring peatland habitats to sequester more carbon)

15.4.5 There were also table discussions focused on the TIMES model, the draft monitoring framework, and emerging findings from the Climate Conversations with the general public. We asked delegates to: provide their initial responses to work done to date on the draft Plan and policies and proposals; identify the main opportunities and challenges ahead; and share their initial thoughts on the respective roles of the Scottish Government and the various partners and stakeholders in delivering across the agenda.

Feedback from stakeholders

15.4.6 The overall reactions from participants were positive and they welcomed the ambitious approach to tackling climate change as a cross-government priority. There was an appetite and support for bold action and change across the whole society and acknowledgment that this will require a concerted effort by all sectors and strong leadership at all levels.

15.4.7 Feedback from table discussions has been considered and reflected in the specific sector chapters of the draft Plan where relevant and will also inform future engagement. Delegates identified a number of key challenges as well as opportunities for Scotland's low carbon future. There was consensus that whilst the technical aspects of the draft Plan and the focus on economy were very important, it was essential that the draft Plan also included wider non-economic benefits of climate change action including health and wellbeing.

Key challenges

15.4.8 Delegates raised concerns about the wider political and financial context at Scottish, UK and international levels and the potential impact this might have on climate change action and the draft Plan. They also identified current societal and cultural attitudes and expectations as a major challenge, travel and transport growth projections; consumption levels and awareness of impact of personal behaviours and habits.

15.4.9 Some participants also expressed concerns about social inequality and climate justice (e.g. fuel poverty) and the need to reflect this in all policies and proposals.

Key opportunities

15.4.10 The attendees identified numerous opportunities arising from the draft Plan including growth and innovation in the low carbon economy and associated job creation as well as wider societal benefits, e.g. public health improvements through improved air quality/more active travel etc.

15.4.11 There was a particular recognition of the role of communities in delivery and the potential wider impact on behaviours/societal transformation as a result of community led action. The engagement of young people was also seen as a key driver for change and many attendees noted that the younger generation's attitudes towards car use and car ownership were different form the older generation and this was seen as a positive trend.

Role of government and delivery partners

15.4.12 The participants noted that there was a key role for the Scottish Government, UK Government, local government and wider public sector as well as business and third sector in delivery. Key themes included:

- appropriate regulation, planning and fiscal policies to enable and incentivise action
- capital investment and funding incentives for business/communities/third sector
- leadership in the public sector
- education at all levels – upskilling and training, facilitating knowledge exchange

Engagement

15.4.13 Communication and engagement were also seen as essential in ensuring successful implementation. There was an appetite for developing a clear, ambitious vision for Scotland's low carbon future. The Climate Conversations were welcomed and there was support for promoting these more widely across Scotland to raise awareness of climate change, get buy in and influence behaviours. There was discussion about how the final Climate Change Plan could be disseminated as widely as possible – 'make all of Scotland own it'. This 'Team Scotland' approach included the roles of business, the third sector, communities, individuals and society as a whole.

Going forward

15.4.14 The draft Climate Change Plan and draft Energy Strategy set out very challenging but achievable goals which will tackle climate change while also boosting Scotland's productivity. We are committed to working even more closely with business, and the public and third sectors, to finalise and implement these plans together, and secure sustainable economic growth driven by investment, innovation, exports and inclusion.

15.5 Annex E: Wider impacts

15.5.1 There is increasing recognition that policies designed to reduce greenhouse gas emissions not only mitigate the risks of climate change but also impact on other societal objectives such as improved air quality and health outcomes. Developing a more detailed understanding of such potential wider impacts has been an important part of the development of this draft Climate Change Plan.

15.5.2 Consequently, the Scottish Government commissioned three evidence reviews of the potential wider impacts of climate change mitigation options, focusing on:

- Agriculture, Forestry, Waste and Related Land Use
- Built Environment
- Transport

15.5.3 The reviews have synthesised qualitative and quantitative evidence relevant to Scotland, indicating the direction and magnitude of potential wider impacts of climate change mitigation actions. In addition, where possible, the reviews identified tools which could quantify and monetise wider impacts and reviewed the evidence from an equalities perspective. An overview of the findings of the reviews is provided below, with the full reports available on the Scottish Government website[83].

Agriculture, Forestry, Waste and related Land Use

15.5.4 There is a wide variety of potential climate change mitigation options within the agriculture, forestry and related land use sectors. Consequently, the evidence review focused on a selection of 12 broad mitigation options. For the waste sector the report focused on potential employment benefits from diverting tonnages from landfill to recycling.

15.5.5 Overall, there is robust evidence of positive wider impacts deriving from all of the selected mitigation options, with multiple positive impacts from on-farm renewable energy, precision farming, anaerobic digestion, agroforestry, optimal mineral nitrogen use, livestock health, reduced livestock product consumption, afforestation and peatland restoration. This indicates the potential for delivering robust and varied co-benefits in a wide range of policy areas.

15.5.6 The positive wider impacts cover a variety of aspects including air quality, water quality, resource efficiency and human health. However, the evidence on the wider impacts of some mitigation options, such as livestock health and optimal soil pH, is weak and therefore there is a need for further research.

15.5.7 Within the waste sector, the evidence base indicates that as waste is moved up the hierarchy, from residual disposal and treatment to recycling, there are employment benefits, with the number of people employed per tonne managed tending to increase.

Built Environment

15.5.8 Overall, the evidence base suggests there are a number of potential co-benefits associated with climate change mitigation measures in the built environment sector, with health and fuel poverty reduction benefits associated with increased energy efficiency identified as a key theme.

15.5.9 There is strong evidence that improved energy efficiency (e.g. through insulation) can result in warmer homes which can lead to substantial physical health benefits. Mental health benefits are also identified and include reductions in stress, e.g. due to mitigation of concerns over high energy bills and household debt.

83 http://www.gov.scot/Topics/Environment/climatechange

15.5.10 The fuel savings associated with increased energy efficiency can be substantial. There is, however, the potential for rebound effects where cost savings may result in the uptake of more carbon intensive behaviours or increased consumption. However, these could be considered as co-benefits if they help increase quality of life and reduce social inequality. Energy efficiency can also offer benefits for the non-domestic sector including cost savings and increased productivity.

15.5.11 Green infrastructure (strategically planned and managed networks of green spaces) offers many benefits including reducing the 'urban heat island' effect, which can reduce health risks to occupants especially the elderly. It can also offer wellbeing benefits, reflecting the importance of access to green spaces on the health of people of all ages.

15.5.12 Behaviour change, e.g. turning down the thermostat, can result in carbon reduction in the short term, and offers participants financial benefits.

15.5.13 The reduction in use of fossil fuels, either through avoided energy consumption, the use of less energy-intensive materials or the use of low carbon energy sources and more efficient heating, cooling and lighting technologies, can offer air quality benefits.

15.5.14 The use of sustainable building materials offers several potential co-benefits, e.g. through the diversification of forestry and agricultural co-products.

Transport

15.5.15 Overall, the evidence base suggests there are a number of potential co-benefits associated with transport climate change mitigation measures. However, the extent of these benefits is dependent on how and where policies are implemented and the extent of consumer uptake and acceptance.

15.5.16 Emerging literature suggests that improvements in vehicle efficiency for example, through the use of electric vehicles, can reduce air quality pollutant emissions.

15.5.17 There is a potential for noise reduction through the use of electric vehicles, however a fuller understanding of the implications of the European Commission's required introduction of sound generating devices on these vehicles is necessary to better understand the extent of this potential reduction.

15.5.18 Modal shift from car to public transport and walking and cycling can potentially bring about reductions in noise, air pollution and congestion. The level of benefit depends on the extent of modal shift in terms of car vehicle kilometres reduced, and where and when these reductions take place.

15.5.19 There is strong evidence that active travel interventions can, through increased physical activity, bring about substantial health benefits, such as reductions in disease and mortality. However, further work is required to enable the quantification of benefits of reductions in disease in the Scottish context.

An errata was issued on 02.2017.

Some editorial changes to structure and grammar have been made on pages: 71, 119, 148, 149 and 150.

Some minor corrections have been made on pages: 86, 89, 116, 149 and 150.

This publication is available at **www.gov.scot**

Any enquiries regarding this publication should be sent to us at
The Scottish Government
St Andrew's House
Edinburgh
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ISBN: 978-1-78652-743-1

Published by The Scottish Government, January 2017

Produced for The Scottish Government by APS Group Scotland, 21 Tennant Street, Edinburgh EH6 5NA
PPDAS86589 (01/17)