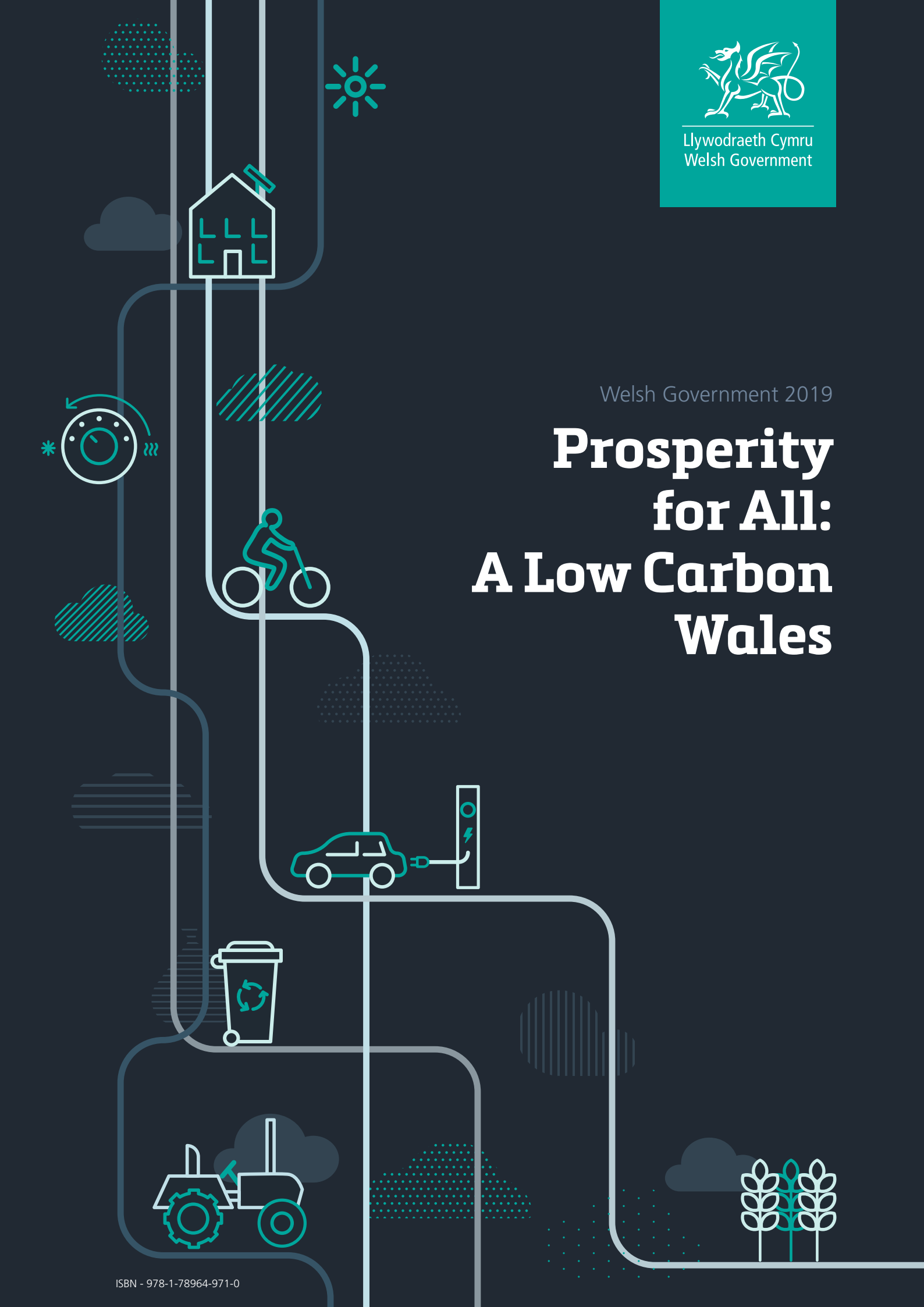

Llywodraeth Cymru
Welsh Government

Welsh Government 2019

Prosperity for All: A Low Carbon Wales

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Wales' commitment to tackling climate change

Sharing the journey, for a better future

March 2019

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Cabinet Foreword

Climate change is the globally defining challenge of our time. The Paris Agreement has set the direction for the international community to come together to take action and the latest Inter-governmental Panel on the Climate Change report was a stark reminder of the urgency that is required across the international community. Climate change is a matter which transcends political and social boundaries and it is often the most vulnerable in our communities who are impacted the most.

Decarbonisation offers enormous opportunities to create a vibrant and socially-just economy. We must make a difference and help create a society here in Wales that ensures well-being and tackles inequality as we decarbonise.

This Plan sets out the Welsh Government's approach to cut emissions and increase efficiency in a way that maximises wider benefits for Wales, ensuring a fairer and healthier society. It sets out 100 policies and proposals that directly reduce emissions and support the growth of the low carbon economy.

Since the passing of the Environment (Wales) Act, guided by the Well-Being of Future Generations Act we have made progress across a range of policy areas. We have set targets and provided additional support for renewable energy and decarbonising the public sector. We have tested new housing models and are gathering evidence on the types of energy efficiency actions needed to decarbonise our existing housing stock. We have invested in public transport, active travel and electric charging points in order to transition to a low carbon transport system which is accessible to all. We are continuing to invest in tree planting and peatland recognising the well-being benefits they provide. We are shaping our land management policy following our withdrawal from the European Union. We are implementing our

Economic Action Plan, which puts decarbonisation as a central pillar for future prosperity and are continuing to deliver our ground breaking policies for reducing waste and move towards a circular economy.

This is our first Plan. Over the coming years we will continue to refine our policies and raise our ambition to accelerate action in line with our pathway towards a low carbon Wales.

Delivering our ambitious decarbonisation targets will require significant leadership, collaboration with our partners and the involvement of society as a whole. Whilst Brexit creates uncertainty, Welsh Government is clear that the path to decarbonisation puts the welfare of our people, the health of our economy, and the protection and enhancement of our natural environment front and centre. This is a critical time for Wales. We now look forward to working with all our partners both here and on the international stage in meeting the challenge of climate change.

Rt Hon Mark Drakeford AM
First Minister of Wales

Rebecca Evans AM
Minister for Finance and Trefnydd

Vaughan Gethin AM
Minister for Health and Social Services

Lesley Griffiths AM
Minister for Environment, Energy and Rural Affairs

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Deputy Minister for Economy and Transport

Prosperity for All: A Low Carbon Wales – What this Plan is about

This Plan sets the foundations for Wales to transition to a low carbon nation. Cutting our emissions and the moving towards a low carbon economy bring opportunities around clean growth for business, as well as wider benefits for people and our environment. This Plan sets out the action we will take to cut emissions and support the growth of a low carbon economy in a way that maximises the wider benefits for Wales, ensuring a fairer and healthier society. This Plan also shows how Wales is leading on the international stage with other States and Regions, contributing to the challenge of global climate change and sharing learning with others.

Statutory Duty

The Environment (Wales) Act 2016 requires Welsh Government to reduce emissions of greenhouse gases (GHGs) in Wales by at least 80% for the year 2050[1] with a system of interim emissions targets and carbon budgets. Under Section 39 of the Act Welsh Ministers must prepare and publish a report for each budgetary period setting out their policies and proposals for meeting the carbon budget for that period. This Plan sets out how Wales aims to meet the first carbon budget (2016-2020) and consequently the 2020 interim target through 100 policies and proposals across Ministerial portfolios. These can be categorised as:

- direct emission reduction activities or ones which support clean growth,
- actions to develop our evidence base to make future decisions,
- knowledge transfer to share learning,
- funding mechanisms and
- the role and establishment of advisory bodies and collaborative groups.

The Plan pulls together 76 existing pieces of policy from across the Welsh Government, UK Government and the EU where decarbonisation is integrated either as a direct outcome or a wider benefit. Some of these are new Welsh Government policies which have come on stream since 2016, such as the Economic Action Plan and Renewable Energy Targets or revamped policy such as Planning Policy Wales where decarbonisation is now a central pillar. We are already over half way through the CB1 and a lot of the focus in this plan is about establishing future actions. We will need to publish our next plan in 2021, which will cover the second carbon budget (2021-2026), where we will be back in step in publishing a Plan at the beginning of each budgetary period.

This Plan comprises of five parts:

Part 1 - Introduction, Vision and Context – explains why we are acting on climate change, our 2050 vision for a low carbon Wales and the wider legislative and international context.

Part 2 - Leadership, Integration, Collaboration and Involvement – sets out the cross cutting actions we are taking through integrating decarbonisation across government policy and delivery. It also sets out how we are thinking more holistically recognising the wider and joined-up

1 Against a 1990 or 1995 baseline, depending on the gas.

systems. The chapter highlights the need for involvement and collaboration across society and the role of others in the low-carbon transition.

Part 3 - Sector Emissions Pathways – sets out the pathways for the different emissions sectors including looking at our sector ambition, emissions profile, the actions we will be taking and how the sector is contributing to our well-being goals. The sector chapter pathways are **Power, Buildings, Transport, Industry, Land Use, Agriculture, Waste and F-gases.**

Part 4 - Methodological Approach – sets out the methodological approach for tracking policies and proposals, how these contribute towards meeting our targets and budgets through our policies and proposals and how we are looking to maximise our contribution to the statutory well-being goals.

Part 5 - Next Steps – highlights the key steps over the next few years in terms of the timeframe for setting our third carbon budget and developing our second delivery Plan.

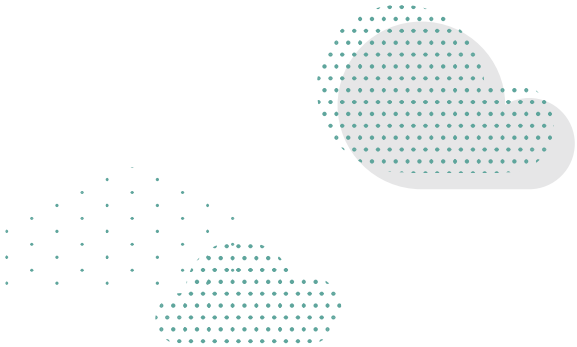
The Annexes set out further information on our accounting framework, how the sectors have been defined, how we have constructed our pathways, as well as the collective list of all of the policies and proposals for action.

Part 1 Introduction, Vision and Context

Introduction

The 2015 Paris Agreement[2] put in place a roadmap for decarbonisation of the global economy. Our economy is changing and being reshaped, driven by the need to respond to the challenge of climate change and ensuring we are keeping pace with the rest of the world. Setting our own decarbonisation pathway provides the certainty and clarity needed to support and drive low carbon action and investment in Wales.

The transition to a low carbon economy brings opportunities around clean growth, quality jobs and global market advantages, as well as wider benefits such as better places to live and work, clean air and water, and better health. If we are to maximise these opportunities and realise the benefits, we need to have a whole government approach and work collectively with businesses, the third sector, and communities and people across Wales.



The well-being goals and the ways of working of the Well-being of Future Generations (Wales) Act 2015[3] guide Wales's decarbonisation action, ensuring we collaborate and involve stakeholders to integrate decarbonisation within the way we work as a government to limit further effects of climate change. Achieving our low carbon pathway provides opportunities to maximise all 7 national well-being goals[4] and Welsh Government's well-being objectives[5]. Further detail around this can be found in Part 4 – Methodological Approach and our Sustainability Appraisal (SA) Report.

We are therefore putting in place the systems and policies required to achieve our long-term targets, across the key areas of agriculture, land use, transport, energy, the public sector, industry and business, waste and homes. We are also putting in place enabling mechanisms such as the skills development and planning arrangements required to drive this transition. This Plan sets out how these collective policies and proposals for future action will meet our first carbon budget from 2016-2020 and consequently the 2020 interim target.

2 https://unfccc.int/process-and-meetings/the-paris-agreement/what-is-the-paris-agreement

3 https://gov.wales/topics/people-and-communities/people/future-generations-act

4 The Well-being of Future Generations Act provides a shared purpose across Public Bodies in Wales through seven well-being goals – A prosperous, resilient, healthier and more equal Wales, with cohesive communities, a vibrant culture and thriving Welsh language and a Wales that is globally responsible.

5 https://gov.wales/docs/strategies/170919-prosperity-for-all-en.pdf

The Case for Change

The climate is already changing and in the most recent State of the UK Climate 2017[6] report, trends show the UK climate is continuing to warm and sea levels continue to rise. In terms of the future, the latest set of climate projections for Wales comes from the 2018 UK Climate Projections. The projections apply state of the art modelling to provide detailed projections of climate change up to 2100 (and to 2300 on sea level rise). The projections are showing an increased chance of milder, wetter winters and hotter, drier summers, rising sea levels and an increase in the frequency and intensity of extreme weather events.

Changes to our climate and weather patterns will have a significant impact on well-being on both current and future generations. Increasing temperatures and extreme weather events caused by climate change are putting pressure on ecosystems, infrastructure, built environment and our unique landscape and cultural heritage, which all contribute to social, economic and ecological resilience.

Climate change is an equality issue as it will disproportionately affect the most vulnerable communities in Wales and indeed the wider world, where in many cases, the most vulnerable communities have historically contributed the least to the problem of climate changing emissions. Vulnerable communities are more likely to be exposed to the risks, and impacts of climate change, without the ability to cope with or recover from those impacts. Although we will be looking to build resilience in Wales through our Climate Change Adaptation Plan, which will be published later this year, it is even more important to reduce our emissions to protect our own well-being and to demonstrate our global responsibility.

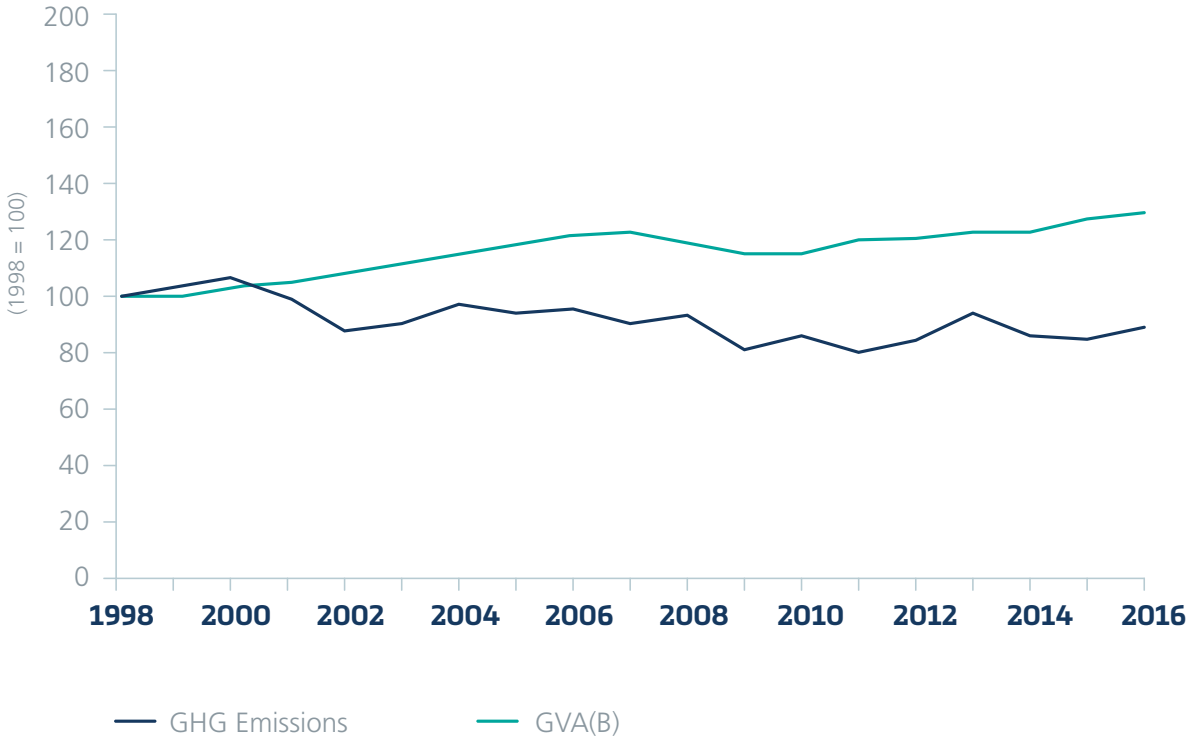
There is also an economic imperative underpinning our need to act. Our low-carbon economy is currently estimated to consist of 9,000 businesses, employing 13,000 people and generating £2.4 billion turnover in 2016[7]. Over the past 20 years carbon GHG emissions have fallen, whilst Gross Value Added (GVA) has risen (see Figure 1). To increase our economic prosperity we must create an environment where all of the Welsh economy contributes to the clean growth aim. Doing so has the potential to prepare the Welsh economy for the markets of the future as the demand for low carbon goods and services emerges. Many products and services can be created and delivered with less carbon intensity and it is therefore not merely the expansion of the low carbon goods and services sector that will deliver our ambitions.

6 https://www.metoffice.gov.uk/news/releases/2018/state-of-the-climate-2017

7 ONS UK Environmental Accounts: Low Carbon and Renewable Energy Economy Survey: 2016 final estimates

Figure 1: Real GVA[8]and GHG emissions in Wales, 1998-2016, Index (1998=100)

Source: ONS Regional Accounts and National Atmospheric Emissions Inventory



UK Government analysis suggests the low carbon economy already supports over 430,000 jobs and is predicted to grow by around 11% per year to 2030 – four times faster than the average growth rate for the UK economy as a whole. It is estimated exports of low carbon goods and services could be worth between £60 billion and £170 billion by 2030[9] for the UK.

Much of our economy has historically been driven by fossil fuels. Fossil fuels have for a long time powered our homes and businesses, transported goods and heated our buildings. There is however, a heavy price paid. Few of the fossil fuels are derived from Wales and therefore the current energy system results in significant economic leakage from Wales. With technological advances and increased leadership we can create an energy system to retain much more of the economic value for Wales by taking the right action.

Our climate change ambitions also have wider implications such as improving the health of our nation and resilience of our natural environment, where we

8 GVA estimates are Experimental Statistics showing annual estimates of 'balanced' regional gross value added (GVA(B)), presented in "real" terms, with the effect of inflation removed.

9 Ricardo Energy and Environment for the Committee on Climate Change (2017) UK business opportunities of moving to a low-carbon economy (supporting data tables) https://www.theccc.org.uk/publication/uk-energy-prices-and-bills-2017-report-supporting-research/

all live and work. Air pollutants can have a cooling or a warming effect on the atmosphere. Some may affect the concentrations of GHGs through their impact on ecosystems, for example nitrogen deposits increasing plant growth and therefore carbon uptake, and ozone having the opposite effect. Conversely, changes in the climate can affect air quality. For example, hot summers may lead to a higher frequency of summer pollution episodes, such as smog[10].

Action on climate change can also make a real difference to improve community cohesion, through investing in communities in areas such as renewable energy projects or tree planting, which can have direct economic benefits back to the community and or help to reduce risks such as flooding.

Therefore the policies and proposals that we put in place for this carbon budget and future carbon budgets must be shaped to maximise the goals and the opportunities a low carbon future provides.

Vision

In 2050, Wales will be among the best places in the world to live, learn, work and do business. Our businesses, public services, third sector and government will have worked together to achieve the goals that we set in the ground-breaking Well-being of Future Generations Act and the target to reduce emissions by at least 80% against the 1990 baseline.

We will have thought more about the long-term, worked better together, taken early action and engaged with citizens on this journey to a low carbon economy and society. Wales will have faced up to the complex challenges outlined in our Future Trends reports. We will have created quality jobs that are future-proofed for the globalised low carbon economy and have the right growth and skills to lift people out of poverty whilst at the same time improve their health and local environment. Our environment and communities will be more resilient to major environmental problems, such as addressing declining biodiversity. We will be healthier, achieving our potential and making Wales a more equal society.

We will have reduced our emissions in part by changing the products we buy, use and produce. We will have spent years doing things differently, looking forward so the choices we make will have secured a safe and prosperous future for ourselves and future generations. We will have been clear and consistent in describing the Wales we want, through setting long-term frameworks that provide clarity and certainty for low carbon investment.

There will be different energy systems that will be ready to fully exploit the inter-relationships and synergies between the power, heat and transport sectors. We will also

10 https://uk-air.defra.gov.uk/assets/documents/reports/aqeg/fullreport.pdf

see greater energy efficiency in buildings and appliances, and the use of new building fabrics turning buildings into power stations

Through localised production we will be harnessing more direct benefits to our local communities through skills, quality jobs and a greater retention of economic value. Our buildings will be more resource efficient and designed for adaptability and deconstruction at the end of their lives. Thanks to designing and running our buildings differently, buildings will be cheaper to run and people will be able to adapt to their buildings easily so they can stay in their homes longer in life.

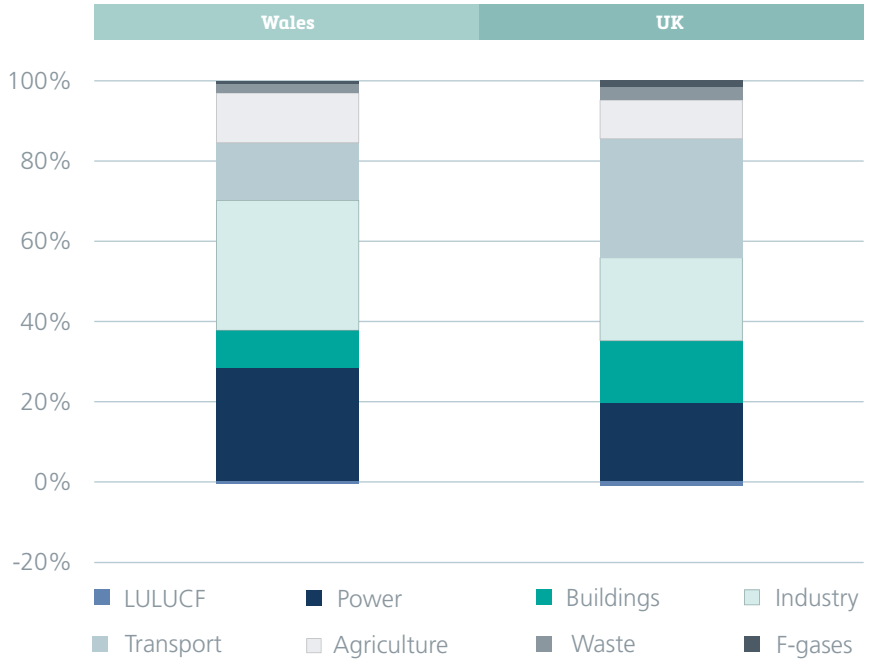
In terms of our waste, we will have moved from a model of use and disposal to one where we recover and regenerate in new ways to create new products. Our businesses and industries will use resources more efficiently, as well as grasping the market opportunities from a low carbon global economy and driving world-leading innovation and solutions. We will be more efficient and have less impact in the way we produce our food and manage our land and natural resources. We will have capitalised on the opportunities for carbon storage through increased tree cover. Walking and cycling will be common for more people, improving the health and safety of the nation. Public transport will be clean and efficient, stimulating local industries.

Signatories to the Paris Agreement and the UN Sustainable Development Goals will have responded to their international commitments and cut their emissions. We will have learnt from what has worked elsewhere and found our own solutions, drawing on the strength of our local communities and building on our shared values.

Wales' Greenhouse Gas Emissions and Development of a Decarbonisation Pathway

Wales' GHG emissions profile is unique, driven by a range of factors including a high share of UK industry and manufacturing. Wales also hosts a disproportionately high proportion of the UK's gas power generation capacity. As a result a large proportion of our emissions are from a few point source sites across Wales. We also have more homes off grid and a higher proportion with inefficient solid walls. Our agriculture sector consists of thousands of often small farms. The share of Wales emissions across sectors in comparison to UK emissions is shown below in Figure 2.

Figure 2: Sectoral shares of emissions in Wales and the UK (2015)



Source: : NAEI 2017.

Notes: Transport includes emissions from international aviation and shipping

Here in Wales we have ambitious legislation driving our action, given our emissions profile. The Environment (Wales) Act 2016 set a target of reducing GHG by at least 80% from their pre-1990 levels by 2050. The Act also establishes a rigorous and comprehensive statutory process in establishing the level of the interim emissions targets for 2020, 2030 and 2040 and carbon budgets. The Act requires Ministers to set five yearly carbon budgets, with associated delivery Plans setting out how we expect to live within the corresponding carbon budget.

In December 2018, the National Assembly for Wales agreed to set in secondary legislation five sets of regulations, which sets the framework for how we account for our emissions and what we are aiming for:

- The Carbon Accounting (Wales) Regulations 2018
- The Climate Change (Carbon Budgets) (Wales) Regulations 2018
- The Climate Change (Interim Emissions Targets) (Wales) Regulations 2018
- The Climate Change (International Aviation and International Shipping) (Wales) Regulations 2018
- The Climate Change (Net Welsh Emissions Account Credit Limit) (Wales) Regulations 2018

These regulations were informed by advice received from our statutory advisors, the UK Committee on Climate Change (UKCCC), with detailed analysis and advice provided on suggested levels. Our interim emissions targets and first two carbon budgets, have been set at the following levels[11]:

- 2020: 27% reduction
- 2030: 45% reduction
- 2040: 67% reduction
- Carbon budget 1 (2016-20): Average of 23% reduction
- Carbon budget 2 (2021-25): Average of 33% reduction

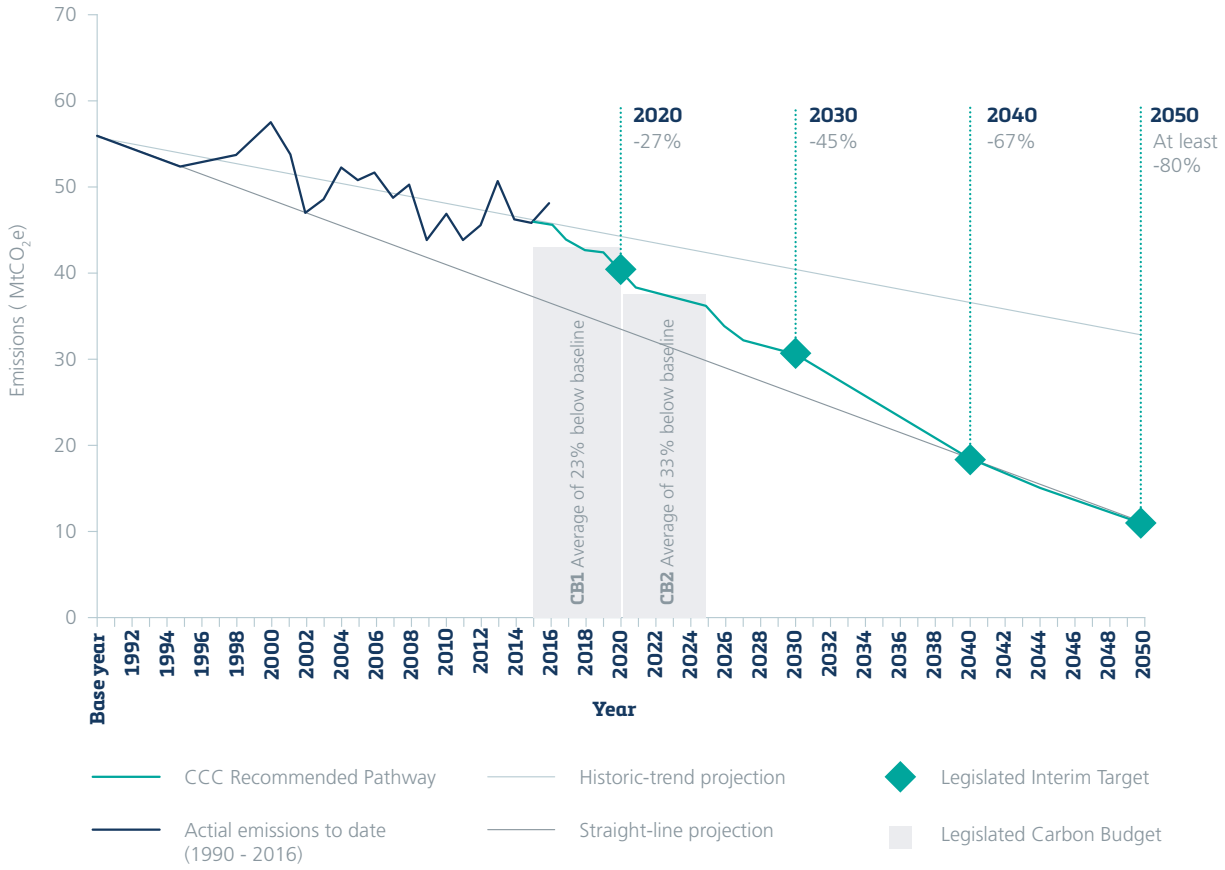
The UKCCC highlights achieving an 80% reduction in Wales is more challenging than the equivalent reduction for the UK as a whole due to Wales having a greater share of 'hard to reduce[12]' emissions and fewer suitable sites to store CO_2.

We have undertaken our own analysis and drawn similar conclusions to the UKCCC, but we have decided to accept the UKCCC's advice and have therefore set a more ambitious 2030 target than the EU's pledge under the Paris Agreement.

11 Against a 1990 or 1995 baseline, depending on the gas

12 Building a low-carbon economy in Wales, UKCCC https://www.theccc.org.uk/wp-content/uploads/2017/12/CCC-Building-a-low-carbon-economy-in-Wales-Setting-Welsh-climate-targets.pdf

Figure 3: Total Welsh emissions – historic data and future projections incorporating UKCCC advice



What are we accounting for?

We will account for all emissions in Wales, resulting in a simple and transparent approach. **We will include all direct emissions including the Welsh share of International Aviation and International Shipping emissions and only use offset schemes towards our targets and budgets that are considered robust and recognised by international reporting guidelines.**

Further details on what and how we are accounting for our emissions are contained in Annex 1.

Consumption emissions

Consumption emissions are generated where Wales imports energy, goods or services, which have associated embodied emissions (i.e. their production has resulted in emissions being released to the atmosphere from other parts of the world). For example, a significant amount of the clothes we wear are produced in other countries. These emissions are not counted as Welsh emissions within our targets and budgets.

Therefore, whilst we maybe making progress in terms of reducing our emission in Wales, we could be increasing them in

other parts of the world, where overseas production may not have the same environmental or social standards as we have in Wales with potential impacts on the environment and communities of those countries. This does not accord with our commitments in the Well-being of Future Generation Act to be a globally responsible Wales.

Similarly, Wales also produces goods, which are consumed by others. For example, Wales produces much more power (electricity and gas) than we consume. Whilst we do not benefit from this power, we are accounting for it. Therefore, the hosting of carbon intense export production makes our targets and budgets more difficult to meet. Addressing the issues of carbon intense global trade both in and out of Wales and how this interacts with our domestic targets is not simple and there are lots of issues to consider. For example, the businesses which produce goods to export outside of Wales create much needed jobs for local communities. Therefore when reducing our emissions, we need to consider a number of wider issues to avoid carbon leakage, where we are effectively just moving the problem elsewhere.

Recognising our Global Responsibility the Environment Act requires us to not only publish our emissions from what we produce in Wales, but also what we consume in Wales. Under the Act, at the end of each budgetary period, Welsh Ministers are required to report on the "Welsh consumer emissions" whether emitted in Wales or elsewhere that may reasonably be attributed to the consumption and use of goods and services in Wales.

Wales' place within the world

The Global Context

Internationally, the world is coming together to take action on climate change. The United Nations (UN) has put in place a 2030 framework to drive forward sustainable development and climate change through the UN Sustainable Development Goals[13] and the UN Framework Convention on Climate Change (UNFCCC) Paris Agreement. In December 2015, the UK and 194 other countries endorsed the Paris Agreement to limit global temperature rise this century to "well below 2°C" above pre-industrial levels and to "pursue efforts towards 1.5°C"[14]. Signatories committed to making pledges to reduce emissions (Nationally Determined Contributions or NDCs) and to reviewing these pledges every five years to steadily increase ambition over time. Most recently at the UN's Conference of the Parties in Poland (COP24), countries agreed many of the rules required to implement the Agreement.

As well as Nation States coming together, States and Regions from around the world are also taking action. The Under2 Coalition[15] provides a global forum

13 https://sustainabledevelopment.un.org/?menu=1300

14 https://unfccc.int/process-and-meetings/the-paris-agreement/what-is-the-paris-agreement

15 https://www.under2coalition.org/

for sub-national governments to work together to reduce their emissions to the necessary limit to keep global warming to well under 2°C by the end of this century.

Currently the coalition has 206 jurisdictions, from 43 countries, 1.3 billion people and collectively represents nearly $30 trillion in GDP, equivalent to nearly 40% of the global economy.

The latest evidence shows that international action needs to happen faster and sooner. As part of the Paris Agreement, the UNFCCC invited the Intergovernmental Panel on Climate Change (IPCC) to explore the impacts of global warming of 1.5°C and related global emission pathways[16]. The IPCC published its report in October 2018 and the key findings include:

- The world is already 1°C warmer than pre-industrial times, with many regions experiencing even greater warming. Most or all of this warming is a direct result of human activity.
- The world is not currently on track to limit warming to 1.5°C (or even 2°C); current pledges under the Paris Agreement are not enough to meet its long-term temperature goals.
- At current rates of warming, the world would reach 1.5°C by around 2040, which would result in serious negative impacts for humans and the environment.
- There are multiple benefits of limiting warming to 1.5°C, compared to 2°C, where impacts of the changing climate would be significantly worse.
- There are still a range of pathways that could be followed to limit warming to 1.5°C, but they all require a profound and unprecedented cross-sectoral transformation of our energy, land, urban and industrial systems.

In response to the IPCC report, we have asked the UKCCC for advice on how meeting the goals in the Paris Agreement might affect our long-term targets[17]. We expect the advice in May 2019.

Across the United Kingdom

Both the Scottish and UK Government have similar legislation driving their ambition. **The UK Climate Change Act 2008** introduced a similar duty on the UK Government as the Environment (Wales) Act 2016 puts on the Welsh Government. UK Government must reduce GHG emissions in the UK by at least 80% of 1990 levels by 2050, following a system of five-yearly carbon budgets. The first five UK carbon budgets have been put into legislation and run up to 2032. UK Government has also asked the UKCCC for advice on how meeting the goals in the Paris Agreement might affect the long-term targets for the UK.

Welsh Government has full control over some policy areas, partial control over others, and some are non-devolved and managed by UK Government. Where UK Government retains partial or full control over policies affecting emissions in many

16 The IPCC is a group of scientists and economists that provides policymakers with regular assessments of the scientific basis of climate change, its impacts and future risks, and options for adaptatiowwn and mitigation. http://www.ipcc.ch/news_and_events/docs/factsheets/FS_what_ipcc.pdf

17 https://www.gov.uk/government/publications/uk-climate-targets-request-for-advice-from-the-committee-on-climate-change

sectors in Wales, we will consistently and actively seek the UK Government's commitment to the delivery of action to reduce emissions recognising their significance in achieving the Welsh targets and carbon budgets.

UK Government remains committed to decarbonisation and published its Clean Growth Strategy in October 2017 with the overarching aim of growing the UK's income while cutting emissions[18].

Leaving the EU – Brexit

A substantial body of legislation has been developed which helps reduce Wales' green house gas emissions and protects Wales' environment and social well-being.

The UK's withdrawal from the EU does not affect the need for action now but it could impact on emissions through potential changes:

- to the EU Emissions Trading Scheme (EU ETS);
- to the standards that drive emission reduction across different sectors;
- to the way energy is traded, potentially resulting in higher emissions; and
- in trade deals affecting where our goods and services are produced.

A number of key EU Directives help to drive emission reduction. In leaving the EU, we need to be insistent that protections and standards which benefit our citizens, and the well-being of society as a whole, are not eroded.

Welsh Government's ambitious plans for decarbonisation operate within a wider landscape over which we have a varying degree of control, not least the performance of the UK economy as a whole. The performance of Welsh and UK economy will affect both the level of emissions from within Wales and the emissions created outside of Wales due to our demands.

Welsh Government will act to deliver the best outcome for Wales from Brexit and maintain our ambition to deliver both the targets and wider positive outcomes of a low carbon economy. As part of the transition, we need to ensure that standards are not lowered through any new trade deals and action is transferred into UK or Welsh policy or legislation where applicable. However, we must recognise the targets we have set and the actions in this Plan may be significantly affected by our departure from the European Union.

18 https://www.gov.uk/government/publications/clean-growth-strategy

Part 2 –Leadership, Integration, Collaboration and Involvement

Introduction

Parts 2 and 3 of the Plan sets out how we will reduce our emissions. It is important when we are looking at how we decarbonise our economy to look at our emission sectors in an integrated manner, as they are part of wider, joined-up systems requiring involvement and collaboration from all levels of society. Therefore this part of the Plan sets out the:

- cross cutting policies currently being implemented or developed across sectoral emission boundaries;
- strategic work underway to develop joined up actions for a whole energy system approach;
- the roles and responsibilities of key players and organisations and what we expect from recipients of Welsh Government support; and
- the actions and wider leadership required and being encouraged from the public sector.

Integration across our Strategic Policies

There is a range of strategic and cross cutting policies across government helping to drive forward decarbonisation. How government develops policy, spends its money, builds capacity and raise awareness will all have a significant impact on reducing carbon emissions. These types of interventions require us to change our corporate processes and the way we do things. How this is being done is explained below:

Prosperity for All: the National Strategy

We have made decarbonisation one of our top six cross-government priorities in Prosperity for All: the national strategy.[19] We recognise that early intervention to tackle emissions and co-ordination across services can have a significant impact and make an important contribution to a number of our well-being objectives, primarily:

- drive sustainable growth and combat climate change;
- promote good health and well-being for everyone;
- build healthier communities and better environments;
- build resilient communities, culture, and language; and
- deliver modern and connected infrastructure.

The benefits of reducing emissions will be felt widely and contribute to many of our other priorities, leading to improved health and well-being and opening up new economic opportunities.

19 Prosperity for All: the national strategy, Annual report 2018 https://gov.wales/docs/strategies/181002-prosperity-for-all-annual-report-en.pdf

How we develop policy

In developing policy we need to look at what evidence is available and the likely intended and unintended effects. Impact Assessments (IAs) are policy tools which help us to assess policy in a systematic way. In 2018, Welsh Government introduced a new Integrated Impact Assessment tool, which brings together the range of impact assessment duties. It also helps officials assess:

- how they will apply the five ways of working (Long Term, Prevention, Integration, Collaboration and Involvement) under the Well-being Act;
- how the policy fits with our national strategy and well-being objectives; and
- the effects on social, cultural, economic and environmental well-being.

This will ensure that carbon emissions will be taken into account in policy development across government within the framework of the Well-being for Future Generations Act.

We have also developed a Well-being Matrix tool to assess and develop policy in a way that focuses on reducing our carbon emissions but also trying to drive wider economic, social, cultural and environmental benefits. Examples of some of our policy assessments are included in each of the sector pathway chapters.

We will build on this in developing future proposals that maximise the goals and reduce unintended consequences to inform our next Plan, to be published in 2021.

We have made good progress in building capability and capacity across Welsh Government through raising awareness, developing evidence and providing support. We will continue to work with the Future Generations Commissioners Office, aligning with the involvement and collaboration principles of the Well-being Act, to guide our work. This will include maintaining and building upon the networks across government and widening our reach through training and guidance to support areas. Further information on how we will involve stakeholders is set out in the *Involvement, Collaboration and Roles and Responsibilities* part of this Plan.

To support our future policy development it is essential to have a robust evidence base across the range of sectors. Going forward we need to further develop our evidence base to help understand the impact of our policies. This will include the development of an emissions modelling tool and further refinement of our integrated Well-being Matrix tool. We will also look at our evidence needs across our emissions sectors.

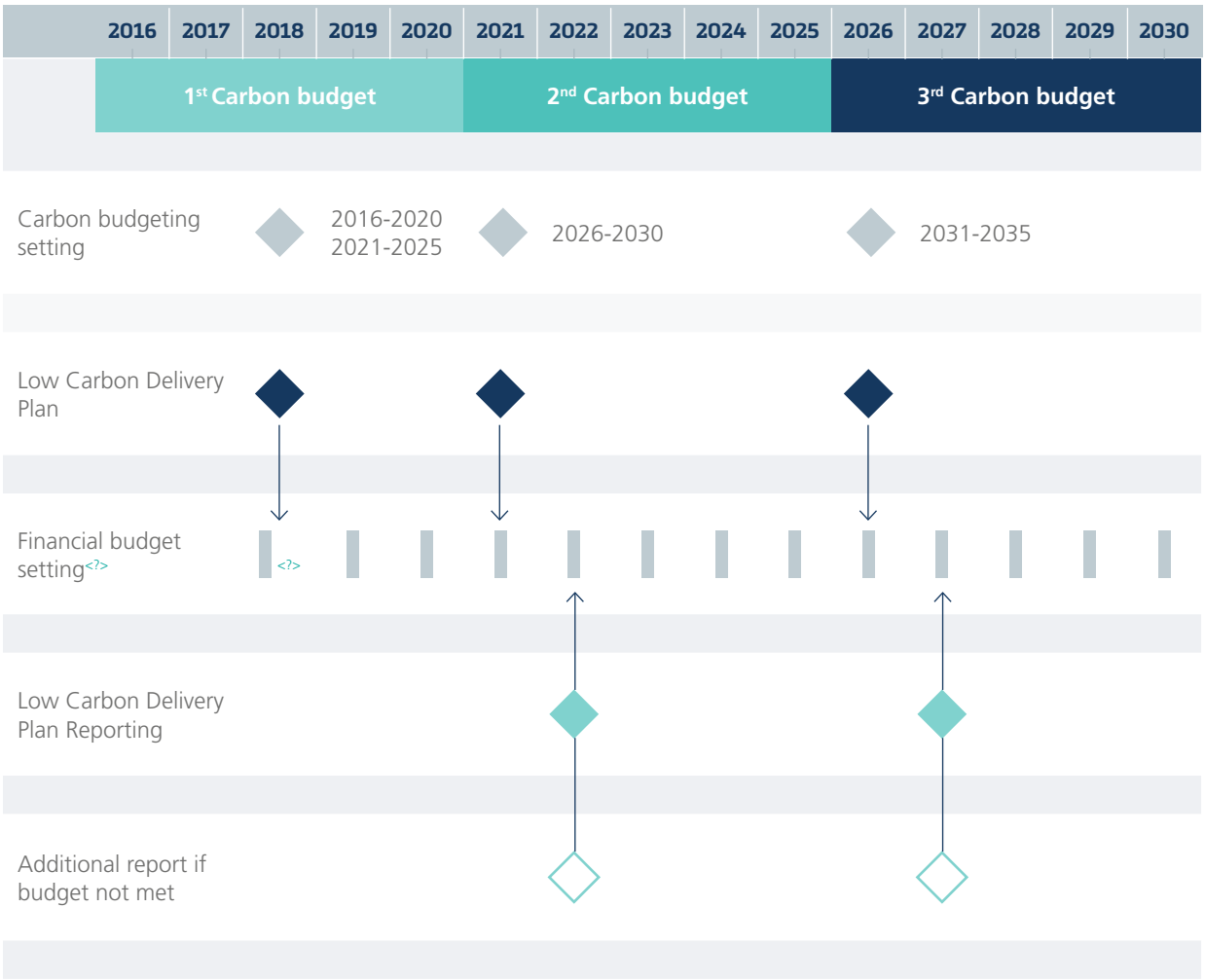
Policy 1 – To continue to develop our evidence base around decarbonisation (including the social, cultural, economic and environmental) to inform the levels of future carbon budgets and the policy intervention required to meet them.

How We Spend Our Money

We are working to bring the financial and carbon budget cycle into alignment and to integrate the processes incrementally to inform our decision making. Our Prosperity or All: A Low Carbon Wales Plan will be updated every five years; the financial budget is usually set for one to four years depending on the UK spending review period.

Aligning financial and carbon budgeting cycles is more challenging in the first carbon budget period due to the timing of Prosperity for All: A Low Carbon Wales. The diagram below sets out the long-term cycle.

Figure 4: Linking the Financial and Carbon Budget Cycle long term



Policy 2 – We will continue to align the carbon and financial budget cycle incrementally

In addition, we are also trying to improve financial decision making through our capital allocation process such as the Wales Infrastructure Investment Plan (WIIP), where we are prioritising low carbon activities in our decision making.

Infrastructure

Our low carbon pathway requires us to decarbonise across a number of sectors such as power, buildings, transport and wider areas. This means we need to ensure that long-lived infrastructure for these sectors support low carbon options and avoid locking-in high-carbon infrastructure and behaviours. It also means investing in infrastructure in the low carbon economy is a huge area for potential opportunities and growth.

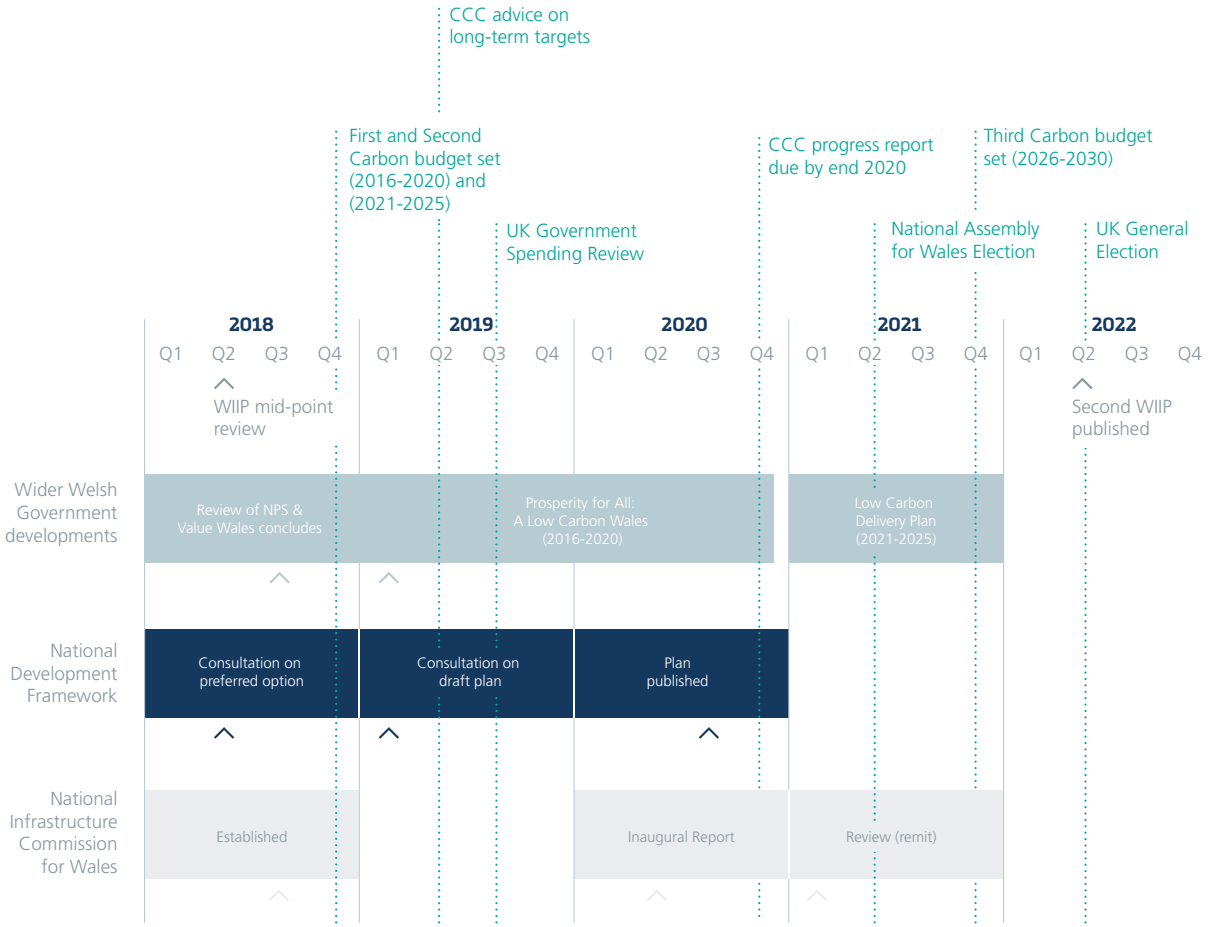
Low carbon infrastructure can help ensure we reduce emissions and increase efficiency through the way we produce and transmit energy, how we design and construct our buildings and assets, and how we transport people and goods. Using our levers, we can help to ensure we take account of decarbonisation in our infrastructure planning and delivery.

WIIP provides the investment framework and strategic approach for our economic, social, environmental and cultural infrastructure over the short to medium term. In strengthening our approach

to prioritisation, we have reviewed and changed how we set capital budgets. Previously, budgets were set by rolling forward historic budget baselines, adjusting to absorb real-terms reductions and retaining funds centrally to allocate during the year, in line with our strategic investment priorities set out in the WIIP. At the start of this Assembly term, we carried out a review and have changed how we do it. To help deliver emissions savings as we move towards a low carbon economy, we are now considering carbon impact when allocating capital funding.

We are ensuring all new health and education buildings funded through Welsh Government capital are designed and built to maximise energy efficiency. Funding is conditional on projects being designed to achieve an A rating on Energy Performance Certificates (EPCs), as well as an excellent accreditation under the Building Research Establishment Environmental Assessment Methodology (BREEAM) to demonstrate sustainability. In addition, contracts must specify that 15% recyclates are used during construction. We will continue to mainstream decarbonisation in to key infrastructure planning over the carbon budget period and start setting the long term framework.

Figure 5: Key milestones over the first carbon budget period with infrastructure development and investment



Welsh Government has established the National Infrastructure Commission for Wales (NICW) to support independent, better informed advice on a longer-term strategy of infrastructure investment, which enshrines the principles of the Well-being of Future Generations (Wales) Act 2015.

The NICW is a non-statutory, advisory body. Its remit is to focus on the economic and environmental infrastructure needs of Wales over 5 – 30 years. It will also consider the interactions of these needs with 'social infrastructure'; such as schools, hospitals and housing. The advice provided by the NICW will be strategic and forward looking in nature. Advice on existing or upcoming infrastructure schemes that have already been agreed will not be part of the NICW's remit.

How we develop skills for the future and drive innovation

The long term challenge of decarbonisation across different sectors and regions throughout Wales requires us to focus on our future skills needs to ensure we transition our workforce and maximise the opportunities presented by global clean growth. The skills and training needs for a low carbon economy may need us to focus around the up skilling and re-skilling of people around new technologies, industries, trades and approaches.

The supply of the right skills to support the low carbon challenge underpins this Plan. Our National Strategy "Prosperity for All" has employability and skills as a key cross-cutting theme. We want an economy that increases both our wealth and our well-being through inclusive growth, leading to a fairer distribution of the benefits of economic growth against the challenge of spatial inequality, uncertainty and global pressures. Ensuring we have a low carbon society is central to this aspiration.

In Wales, we have the challenge of breaking the cycle of low-skill, low-wages and low-productivity compared to the rest of the UK. Although skills levels have improved over the last decade, we are not yet seeing the dividends in terms of improved productivity and wage levels.

Employability

Welsh Government published its Employability Plan in March 2018[20]. Working Wales is the name of our new employability programme which will commence delivery in 2019. The programme will consolidate Welsh Government's current suite of employability support to deliver a new joined-up approach to employability and skills support, designed to meet individuals' needs rather than aligning them with narrow programme eligibility criteria. Work Advice Wales/ Cyngor Gwaith Cymru will facilitate access to employability support, delivered by Careers Wales.

Regional Skills Partnerships

Regional Skills Partnerships (RSPs) have a key role in producing regional intelligence informed by employers. There is an opportunity for RSPs to review heat-intensive industrial sectors at a regional level and make recommendations to help reduce GHG emissions and improve energy efficiency. They also have a role to review skills gaps and shortages to help ensure a supply of suitably skilled candidates to meet the demand for skills in these sectors. The Economic Action Plan (EAP) set out the Welsh Government approach to drive improvements in the economy, including the development of Regional Compact Agreements. It prescribes a regionally focused economic development model. The three RSPs are:

20 https://beta.gov.wales/employability-plan

- North Wales Economic Ambition Board – Regional Skills Partnership North Wales (NWEAB - RSP);
- South West and Mid Wales Regional Learning and Skills Partnership; and
- Cardiff Capital Region Skills Partnership.

Welsh Government will work closely with RSPs to identify low carbon related skills needs at a regional level working with employers. This information will be captured in the form of Annual Reports submitted to Welsh Government and used to inform the deployment of skills funding, via a new strategic planning system for post-16 education.

We need the network of further education colleges to be increasingly responsive to decarbonisation, and be able to offer flexible courses held through the medium of Welsh and English that support this policy drive.

We need to consider how best to develop and promote the importance of courses that support decarbonisation and the availability of these across Wales.

Apprenticeships

Aligning apprenticeships with the needs of the Welsh economy is at the centre of our skills policy. We are building our skills system to better respond to industry changes to enable Wales to compete globally by having workers equipped with high level technical and professional skills. RSPs inform the prioritisation of apprenticeship delivery and there is an opportunity for RSPs to identify regional priorities specifically around the decarbonisation agenda.

In February 2017, the Welsh Government published Aligning the *Apprenticeship Model with the needs of the Welsh Economy* (2017)[21] setting out the Welsh Government's strategy to invest in training which provides economic and social returns; investing in growth sectors and occupations to address skill shortages and gaps that hold back productivity and growth.

Our priorities are:

- investing in higher level skills particularly in STEM and technical areas;
- driving inclusivity, equality equity of opportunity;
- responding to current and projected skills gaps; and
- delivering apprenticeships through the medium of Welsh and/or bilingually.

Policy 3 – Welsh Government to commission RSPs to review current skills gaps and shortages across regional priority sectors that support the decarbonisation agenda. This would form an element of their funding contract from April 2019.

21 https://beta.gov.wales/sites/default/files/publications/2018-03/aligning-the-apprenticeship-model-to-the-needs-of-the-welsh-economy.pdf

Innovation

We need new technologies, radical approaches and solutions across all sectors to achieve our ambitious emissions reduction targets. This requires the public and private sectors, academia and the voluntary sector to collaborate in supporting the development of new innovative low carbon products, processes and services.

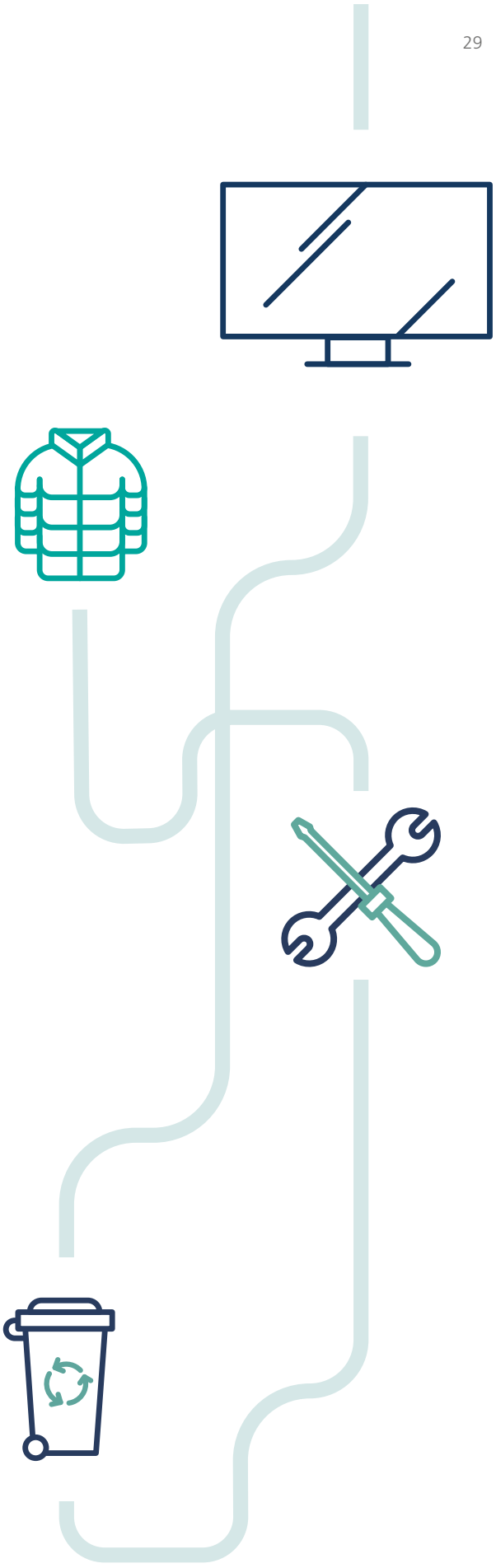
Welsh Government currently provides wide-ranging support for innovation including direct financial assistance for Welsh businesses to develop new technology and services. We also assist academia to collaborate with industry. Our support helps attract additional public and private funding, maximising the impact of our intervention.

As a result of the recent *Achieving our Low Carbon Pathway to 2030* consultation many respondents noted that innovation was a priority to stimulate the shift to a low carbon economy, noting its importance especially around energy, transport and buildings. Whilst some innovation is progressing in these areas (see innovation examples in sector chapters in Part 3) more needs to be done to understand whether we are maximising our impact. Opportunities include:

- Buildings - new products and delivery models for low carbon new-builds and retrofitting;
- Industry - new technologies and processes, including Carbon Capture Usage and Storage (CCUS);
- Transport - delivering a new ultra low carbon transport system and ensuring the welsh supply chain benefits from the opportunity;
- Power - new holistic solutions to reduce energy consumption at source, generate renewable energy and optimise its distribution; and
- Resource management - new processes to optimise the sustainable use of resources and assist our transition to a more Circular Economy.

There is potential for governments to stimulate innovation. This maybe by policy and/or other forms of intervention for instance Welsh Government has successfully used pre-competitive procurement of the Small Business Research Initiative to offer specific challenges to industry to resolve and via Welsh Government's Innovative Housing Programme has incentivised industry to develop appropriate solutions and deploy demonstrators.

It is understood that the development and introduction of new technologies and solutions can take time to commercialise so multiple interventions may be required to meet targets. We need to encourage technology to be developed in Wales and also ensure that Wales benefits from progress made elsewhere.



The complexities of decarbonisation also mean that we need to work across the emission sectors and understand the interconnections. For example, the energy and transport sectors are starting to converge with the increased uptake of electric vehicles, where the energy system needs to evolve to cope with very different demands on the network.

To further explore and understand such areas and provide a robust evidence base to identify where innovation can help to deliver decarbonisation targets, we will establish a Task and Finish Group representing each decarbonisation sector.

The Group will be tasked to critically assess evidence relating to innovation and our decarbonisation pathway and consult with external stakeholders. The Group will be established in 2019 and will be asked to provide Welsh Government with key recommendations.

Policy 4 – Establish Task and Finish Group to explore innovation and decarbonisation

How we set the strategic direction

Our low carbon pathway requires us to decarbonise across all sectors so it is important we west the strategic direction through key strategic policies to drive action.

Planning Policy Wales

The planning system has an important role in facilitating decarbonisation. Our refreshed National planning policy is set

out in Planning Policy Wales (PPW) 1[22], launched in December 2018 and will underpin all future planning decisions. It puts emphasis on people and places and ensures developments built today leave a legacy of well-designed, sustainable places which improve lives. The new policy has a firm focus on 'placemaking' – an approach to development which ensures communities have all the services they need within easy reach and development is of high quality. Wales will be the only country in the UK to take this approach to planning. Other key changes to Wales' planning policy which are designed to help Wales lower its carbon emissions at the same time as creating places people can live well, include:

- Promotion of **Active Travel (walking and cycling)** to create good places and support health and well-being. Services will need to be easily accessible by active travel and a new transport hierarchy is being introduced for planners to consider;
- A new policy on **Ultra Low Emission Vehicles (ULEVs)** which requires new non-residential developments to have charging points in at least 10% of the spaces available. This is the first national policy of its kind in the UK;
- Promoting **renewable energy developments** (wind, solar and other renewables). It will require planning authorities to define areas where wind and solar developments will be permitted and set renewable energy targets;
- **Restricting extraction and use of fossil fuels (including fracking)** by placing them at the bottom of the energy hierarchy. It states proposals for opencast or deep-mine development should not be permitted and oil and gas (including fracking) should be avoided. It will be supported by a new Notification Direction which will state the Welsh Government must be notified of any planning applications which local planning authorities intend to approve for new coal and petroleum developments.

22 https://beta.gov.wales/sites/default/files/publications/2018-12/planning-policy-wales-edition-10.pdf

National Development Framework

We are also preparing a National Development Framework (NDF), which will be a development plan for the whole of the country. It will set out national planning policies for the next 20 years and express spatially our long-term economic, social and environmental objectives. The NDF will form part of the statutory plan for determining planning applications and will assist in the determination of Developments of National Significance.

We have consulted on the issues, options and preferred option for the NDF[23]. The preferred option states that the NDF will ensure the planning system in Wales plays a key role in facilitating clean growth and decarbonisation, and helps build resilience to the impacts of climate change. Achieving our strategic decarbonisation goals is highlighted as a key driver, which all development plans must support. We will be consulting on the Draft NDF in Summer 2019.

Policy 5 – Planning Policy Wales

Policy 6 – National Development Framework

Wales Marine Plan

The Welsh National Marine Plan (WNMP has recently been subject to formal consultation. Although we do not have all the levers required to make all the changes in relation to planning decision and financial support mechanisms, we are supporting the low carbon transition by delivering changes where we can, and the Plan contains supportive policies.

From April 2019, Welsh Ministers will have greater responsibility for energy consenting decisions, as part of changes arising from the Wales Act 2017. This will include consenting decisions for offshore energy generation assets up to 350 MW, via Section 36 of the Electricity Act1989[24].

Welsh Government will explore what challenges and opportunities we have in Wales to improve the marine consenting process in Wales to maximise the well-being opportunities but is also mindful that the Welsh coastline is heavily designated to protect the unique environment. Our aim is to accelerate and streamline the environmental requirements associated with consents for novel marine renewable technologies.

The purpose of the plan is to guide the sustainable development of our marine area by setting out how proposals for use will be considered by decision makers including, in particular, consenting authorities.

Policy 7 – Wales Marine Plan

Natural Resources Policy

As we acknowledge in our Natural Resources Policy, there are strong synergies between biodiversity and climate change[25], while the Paris Agreement notes the importance of "ensuring the integrity of

23 https://beta.gov.wales/national-development-framework-issues-options-and-preferred-option

24 https://gov.wales/topics/environmentcountryside/energy/publications/future-potential-for-offshore-wind-in-wales/?lang=en

25 https://gov.wales/topics/environmentcountryside/consmanagement/natural-resources-management/natural-resources-policy

all ecosystems, including oceans, and the protection of biodiversity"[26]. Limiting changes to the climate by reducing emissions will support biodiversity and well-functioning ecosystems to provide natural solutions that build resilience. This in turn helps society create jobs, support livelihoods and well-being, adapt to the adverse impacts of climate change and contribute to sustainable development.

Our Natural Resources Policy sets out the national priorities, opportunities and challenges for managing Wales' natural resources sustainably. Among the opportunities that are relevant to reducing emissions are the ways in which managing our natural resources promote clean growth and innovation and support a more resource efficient economy. We also recognise climate change and the decline in biological diversity is a key challenge facing our natural resources. We have developed three national priorities for managing our natural resources:

- delivering nature-based solutions to the big societal challenges we face;
- increasing renewable energy and resource efficiency; and
- taking a place-based approach to deliver better results at the local level.

The Natural Resources Policy drives action across Welsh Government and also through Natural Resources Wales' area statements, which will deliver the policy in a local context (see Policy No 62).

Air Quality and Greenhouse Gas Emissions – Integrating Policy

Air pollutants can have a cooling or a warming effect on the atmosphere. Some may affect the concentrations of GHGs through their impact on ecosystems, for example nitrogen deposits increasing plant growth and therefore carbon uptake, and ozone having the opposite effect. Conversely, changes in the climate can affect air quality. For example, hot summers may lead to a higher frequency of summer pollution episodes, such as smog.

Measures taken to mitigate climate change can help to reduce emissions of air pollutants, resulting in improvements for public health and ecosystems. However, some measures that benefit climate change have the potential to worsen air quality and vice versa.

In 2018 a Clean Air Programme was established and is considering evidence and developing and implementing actions required across government departments and sectors to achieve Clean Air for Wales. A key action under this programme is the publication of a consultation on cross-government Clean Air Plan for Wales. The aim of the Plan will be to reduce the burden of poor air quality on human health and the natural environment. In delivering the Plan, we will ensure the potential for climate change to exacerbate the impacts of poor air quality are considered.

Welsh Government is therefore taking an integrated approach to tackling air quality

26 https://unfccc.int/files/essential_background/convention/application/pdf/english_paris_agreement.pdf

and climate change through effective linkages between the sector work streams of the Clean Air Programme for Wales and the Decarbonisation Programme. The emissions that pollute our air and those that warm the planet have many common sources: vehicles, buildings, domestic combustion, power generation, agriculture and industry. In this budget period, we will be designing the policies and proposals for future Plans so that they are aligned at strategic and local level.

Policy 8 – Integrating policy development

Figure 6: The alignment between decarbonisation and air quality

Beneficial to Decarbonisation	Beneficial to Decarbonisation & Air Quality	Beneficial to Air Quality
› Biomass › Combined Heat and Power	› Energy Efficiency in buildings, vehicles and industry › Demand Reduction e.g. shift to active travel › Low carbon and renewable energy production (electricity and heat) › Shift to electric and other ultra low carbon vehicles › Carbon Capture Usage and Storage › Tree planting	› Flu Gas › Desulphurisation › Three way catalysts - Petrol › Particulate Filter › Measures to tackle emissions from poultry

Public Health and Low Emission Behaviour – Integrating Policy

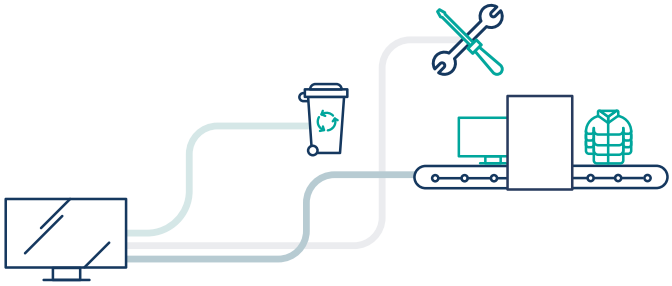
Meeting air quality and carbon emissions reduction targets will involve transformation across all sectors and levels of society. In particular measures to improve air quality and reduce carbon emissions will have many co-benefits relating to improved public health. The type of interventions required in different areas will vary.

Taking action to improve air quality and reduce the effects of climate change provides an excellent opportunity to deliver further benefits. These could include improvements in domestic energy conservation, improved industrial process efficiency and measures designed to modify the behaviour of individuals so as to reduce the impact of their activities on the atmosphere. Given the significant influence of transport emissions, co-benefits could be realised through actions such as reducing the use of road vehicles, promoting ultra low carbon vehicles and renewable sources of electricity which do not involve combustion. Over the budget period Welsh Government will work with the new Centre for Climate Change and Social Transformations to explore the options to pilot a campaign to encourage people to use their cars less with a view of improving health outcomes through transport modal shift and reduce carbon emissions. The findings of the campaign will be used to inform future policy development

Well-being Goal Spotlight – Healthier Wales

> Active travel, such as walking and cycling provide significant health benefits. Lack of exercise is linked to a range of illnesses, which can be reduced by greater use of active travel. The Welsh Government Active Travel Fund is investing £60 million between 2018 and 2020 for local authorities to deliver their plans. We also encourage and promote walking and cycling through Safe Routes in Communities, the Local Transport Fund, and the Active Journeys and Eco schools programmes.

Proposal 1 - Design a public communications campaign to encourage people to use their cars less.



How we join up action together

The challenge and opportunities of decarbonisation requires us to work differently. Organisations and sectors are part of complex interconnected systems. By looking at decarbonisation in a more joined up way, we can maximise the benefits and avoid unintended consequences.

Regional approach

The new Chief Regional Officers (covering North Wales; South West and Mid Wales and South East Wales regions) were put in place to build on existing work, to listen and engage with stakeholders in the regions of Wales and promote regional issues and interests in Welsh Government. As part of this work, it will be important to understand the challenges and opportunities of decarbonisation and what it potentially means for different regions to ensure we drive sustainable growth. Going forward we will look at how we maximise the opportunities across the different sectors focusing on-collaboration across the public and private sectors and supporting national regional and local place based approaches.

Leadership in the Circular Economy

The development of a circular economy (where the value of products, materials and resources are maintained within the economy for as long as possible and waste is minimised) is important to realise a range of Welsh Government objectives. We need to achieve changes to upstream resource and materials efficiency hand in hand with downstream waste management. Such resource efficiency and the underpinning innovation required to develop a **circular economy is good for business and prosperity**. If we can make Welsh industry and businesses more resource efficient, this should cut their costs and make them more competitive on the international stage as costly waste is reduced and competitive advantage is secured. It also reduces carbon emissions and social harm and utilises vital natural resources, such as biodiversity, air, soil and water at a rate that can be naturally replenished.

For those creating new products, we need to see production design and production processes support the development of a circular economy. Many of today's products currently cannot be repaired because of their design, or because spare parts or repair information are not available. Better design assists in creating products that are durable and easy to repair, upgrade or remanufacture. Production processes also need to be efficient to avoid waste and maximise wider business opportunities. For example, the reuse and repairs sectors are labour-intensive and therefore offer significant employment opportunities. In a circular economy, waste materials can be recycled back into the economy as new raw materials, increasing the security of supply without the extraction of further natural resources. Waste management practices have the ability to positively impact on the quantity and quality of secondary raw

materials, which currently account for a small proportion of the materials used in production processes as can the reduction in toxic materials used in the primary product.

The choices made by consumers are also vital, but they need to be helped with information alongside a supportive regulatory framework. National, regional and local Government has an important role in developing and enforcing design and labelling standards and introducing systems for waste management. There is therefore a significant role for government in supporting the development of the circular economy, mandating and enforcing standards and also facilitating appropriate waste management. However, business and citizens must also play their part, demanding and providing resource efficient materials and products which can more easily be re-purposed and recycled.

Decarbonising products manufactured in Wales

Our aim in moving towards a more resource efficient (circular) economy is to decarbonise the products manufactured in Wales. This reduces the energy used (and associated GHG emissions) in manufacturing and using products to reduce the overall carbon footprint of Welsh products. We will utilise fewer raw materials in production and throughout the life of products, including designing for longevity, repair, remanufacture, reuse and recycling. We will increase the use of waste materials as a replacement raw material. This will impact the direct emissions of the power, business and industry sectors. Current action to support this includes:

- funding support to Waste and Resources Action Programme (WRAP) Cymru to support businesses to become more 'circular' and increasing the resource efficient public procurement;
- support WRAP and Fareshare on circular economy and resource efficiency activity through, involvement as a partner in the Interreg funded 'Circular Economy for Small and Medium-sized Enterprises (SMEs) (CESME) project;
- promotion of and funding support for the Collections Blueprint for local authorities; and
- the introduction of powers under the Environment Act to require the separate collection of key recyclable wastes and ban their use in Energy from Waste plants and landfill.

We will continue to support a circular economy by creating new opportunities for resource efficient manufacturing through embedding resource efficiency within our programme of innovation support to SMEs and using public sector procurement to stimulate the market. Moving towards a more circular economy will be the central pillar of our forthcoming waste strategy consultation in 2019.

Policy 9 – Maximising the innovation opportunities presented by moving towards a more a circular economy.

A Whole Energy System Approach

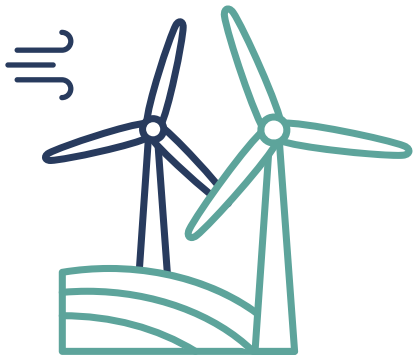
The rapid decarbonisation of energy necessary to meet our carbon targets presents both enormous challenges and opportunities. In recent times, the provision of power, heating and transport fuel has been largely separate and centralised. This system is now undergoing significant change, with energy generation and delivery becoming more distributed in the communities where the energy is used.

The boundaries between the systems are also becoming blurred, with energy being converted into different forms to address a range of needs. This approach is often termed a multi-vector system and will be required to fully exploit the inter-relationships and synergies between the power, heat and transport sectors. We are committed to this whole systems approach to the energy transition, which will underpin our work on decarbonisation.

The National Grid's Future Energy Scenarios present four visions of energy systems from today to 2050 and give insights into how integrated power, buildings and transport systems could meet our future needs. By 2030 we might expect Electric Vehicle (EV) batteries to transfer electricity from workplace solar charging to homes to supply them during the evening peak demand. Heating may be from hybrid heat pump and boiler systems that decide whether electricity or gas is the fuel that will place least demand on the system at that time. We are likely to see low carbon gas in the form of biomethane or hydrogen playing a greater role. We may also increasingly see electricity generated from renewable sources being stored when demand is low by conversion to gas. The gas may then be converted back to electricity through combustion or used as a heating or transport fuel.

A multi-vector system could deliver the low carbon energy transition at a cost to citizens which is lower than if systems were not integrated, preserving security of supplies even at peak demand. The UK National Infrastructure Commission report *Smart Power*[27] identifies that interconnection, storage, and demand flexibility have the potential to displace part of the need for new generating capacity, saving costs for businesses and domestic consumers and helping the UK meet its climate reduction targets. They believe these savings could be as large as £8 billion a year for energy users across the UK by 2030.

This more affordable, high security, low carbon energy transition offers an attractive low carbon investment at both a large central and smaller local scale. New SMART use of energy and



27 https://www.nic.org.uk/our-work/smart-power/

storage will be driven by the powerful global digital revolution and be much more locally determined. Distribution and transmission networks will provide the grid balancing and security of supply. The work of the Institute of Welsh Affairs' Re-energising Wales project[28] has looked at potential pathways to such a system, and evaluated the potential economic costs and benefits of the low carbon transition in Wales.

We will also see greater energy efficiency in buildings and appliances, and the use of new building fabrics facilitating the generation, use and storage of energy. For instance, more than 26 full-scale demonstrator sites incorporate various aspects of the active buildings concept. As well as showcasing the technologies, the demonstrators are used to monitor and develop systems under realistic conditions and in a range of building uses. Proving the concept in real buildings is critical for its adoption by industry, regulators and consumers.

This is a very different model from the current separate and historic centralised system and may create even greater system complexities, especially in our electricity markets. This Plan sets out the policies and proposals in relation to power, buildings and transport but also recognises and responds to the changes underway in our energy system as a whole.

Energy Systems Planning

We estimate renewable electricity generation delivered sufficient energy to deliver *48% of Wales' electricity consumption in 2017*. Although energy demand is currently reducing, we expect this trend to reverse into the 2020s and 2030s as electric vehicles become increasingly common and heat is electrified.

Whilst the national planning policy is well developed, we recognise the need for more local or regional energy planning in order to inform, guide and drive action. Detailed energy planning and modelling developed and owned at the local or regional level could also ensure that specific opportunities and constraints are considered within the context of an evolving energy system. At the national level, such local plans could provide the basis for national infrastructure planning, as well as developing coherence between regional plans.

Local authorities have a significant role to play in this agenda and some have interesting work already under way, such as the Local Area Energy Strategy being developed by Bridgend County Borough Council with the Energy Systems Catapult (ESC), using the Energy Path Network tool. However, it can be difficult for public bodies to address these challenges alone.

28 https://www.iwa.wales/wp-content/uploads/2018/04/IWA_WP5_FrameworkforAction_v6-3.pdf

Case Study 1 – Bridgend Energy Catapult – Energy Path Network Tool

Energy Path Networks enables the gathering and analysis of a wide range of data to create a representation of all energy demand and supply for a local area. It maps the impact of future growth on local energy systems and develops pathways for a cost-effective low carbon energy transition taking into account:

- building fabric insulation;
- heat conversion and storage at a network and building level; and
- gas, electricity, heat and other distribution network installation, upgrade, maintenance or decommissioning.

This can enable the unique characteristics and priorities of different local areas to be considered in the context of impacts on the **whole energy system** and enable the planning and design of cost-effective local energy systems for the UK.

Welsh Government Energy Service is now further developing the strategic thinking with regard to a more locally focussed energy system. The aim is to raise both understanding and ambition regionally on energy systems, with the aim of developing decarbonisation activities, with local leadership aiding the retention of local economic benefit whilst delivering on the 2030 targets for public sector decarbonisation and local ownership of renewable energy.

Policy 10 - Energy Systems Planning

Support innovation and commercialisation of new products, processes and services in the energy system

In recent years Wales has developed disruptive technology and capacity in smart energy. This includes the active building concept, capacity building in smart systems and heat, introducing new approaches to maximising grid usage, such as medium voltage direct current test beds, and defining and creating a zero carbon area.

As part of this work, we have the potential to build on our existing successes and host strategic innovation demonstrators which will showcase examples of innovative housing designs, small modular (nuclear) reactors, lower carbon technologies, smart systems and heat and multi-vector fuel sources, such as hydrogen, for heat and ultra-low emission transport in the short to long-term timescales. All this activity needs a high degree of innovation in order to work effectively and meet people's expectations of reliability and affordability.

We have provided significant funding to support innovation within the energy system. EU funding from Horizon 2020, Interreg and other Research and Development sources has also supported innovation in this field. Working with the Innovation Task and Finish Group and a range of key stakeholders we will explore how to build on our existing work to compete for funding for the future.

Wales will proactively exploit and scale its energy innovation credentials through deployment of the foundational work in

numerous demonstrator areas to create the right environment for innovative actions to take place. This will allow us to promote Wales as a place where we encourage businesses to participate in scaled, accredited demonstrators where they can pilot and test innovation across the core strands (buildings, power and transport with read across to health and skills) to develop commercial marketable outcomes. The establishment of the Innovation Task and Finish Group will help support this work (see Policy No 4).

Welsh Government Energy Service and Smart Living

Public sector action in the energy system is increasing, supported, not least by the extensive Welsh Government investment in the Welsh Government Energy Service. This new service recognising the need for the public sector, communities and business to work together on regional energy systems, which brings together Welsh Government's public sector energy support offer, previously known as the Green Growth Wales Programme and our community energy offer, formerly the Local Energy Service.

Our Welsh Government Energy Service has invested over £60m of zero-interest loans across the public sector in Wales between late 2015 and early 2018 and also supported the delivery of a further £27.5m of energy and energy efficiency projects, where finance was secured from alternative routes. This programme helps to reduce the running costs of public bodies across Wales. The carbon savings within the current carbon budget period alone is estimated to be close to 53,000 tonnes. We are on track to deliver business case targets of 2.5m tonnes of total CO2 savings from measures installed and will save the public sector over £650m in avoided energy costs over the life of the assets installed. The projects currently being supported also serve as an entry step into the energy system. The service is supporting community and public sector bodies to deliver.

Welsh Government Energy Service is now further developing the strategic thinking with regard to a more locally focussed energy system. The aim is to raise both understanding and ambition regionally on energy systems, with the aim of developing decarbonisation activities, with local leadership aiding the retention of local economic benefit whilst delivering on the 2030 targets for public sector decarbonisation and local ownership of renewable energy.

Smart Living Wales is creating an open learning demonstrator platform to encourage innovation and novel projects which will test and inform future smarter activities as well as provide multiple benefits for Wales. Demonstrators are focusing on needs-led and place-based solutions so they are aligned to objectives of all those participating from research through to delivery. The Smart Living Programme is supporting a range of demonstrators as described in Figure 7 below.

Figure 7: Example of Smart Demonstrator projects

Smart Demonstrators - Driving Innovation

Transforming Heat
Heat smart systems and tools
BRIDGEND

Catalysing local energy
Creating energy platforms
BLAENAU GWENT

Smarter management of networks
Controlling local networks - direct current
ANGLE DC - ANGLESEY

Virtual Private Wires
The charging case for local generation & use
FLINTSHIRE

Smart / Low Carbon Programme
From the Citizen Perspective
NEATH PORT TALBOT

Creating Zero Carbon Areas
Milford Haven Port Waterfront
PEMBROKESHIRE

Hydrogren
Heat, Fleet and Power
RCT & MONMOUTHSHIRE

Utilising Sustainable Fuels
Ultra Low Vehicles and Fuels
CARDIFF, DENBIGHSHIRE & FLINTSHIRE

Smart Living
Fair futures fuel poverty
WELL BEING PILOT TORFAEN

In addition to demonstrators and lessons learned, we have progressed additional activities including:

- Welsh Government has published a report[29] on the role of government in establishing a local electricity supply company;
- Welsh Government and European funding is supporting the FLEXIS (Flexible Integrated Energy Systems) and SPECIFIC (the Sustainable Product Engineering Centre for Innovative Functional Industrial Coatings) initiatives to drive forward and commercialise innovation in energy systems and active buildings;
- the Energy Systems Catapult is working with Bridgend to understand potential pathways to decarbonise heat;
- District Network Operators are developing their understanding of the increasing pressure on their electricity and gas networks;
- Cardiff University, working with the Institute of Welsh Affairs, has published half hourly demand data for domestic and commercial buildings; and
- the Institute of Welsh Affairs (IWA) has also produced a study[30] under their Re-energising Wales project exploring the potential for decarbonising the energy system in the Swansea Bay City Region area and the economic costs and benefits of doing so.

Policy 11 – Welsh Government Energy Service & Smart Living

29 https://gov.wales/topics/environmentcountryside/energy/publications/an-energy-company-for-wales/?lang=en

30 https://www.iwa.wales/wp-content/uploads/2018/09/EconomicImpactofEnergyTransition-2.pdf

Involvement, Collaboration, Roles and Responsibilities

Government action alone cannot tackle climate change. We need to involve and collaborate with others and play a part in tackling this global challenge.

Our Future Generations

Education about climate change needs to be taught in schools to influence behaviour change amongst the next generation. In our *Achieving our low carbon pathway to 2030* consultation[31], it was clear that that the education of young people was deemed crucial to grow awareness and understanding of climate change, emissions, energy use and waste generation.

Currently Eco-Schools and Size of Wales are currently the main platforms Welsh Government has to engage directly with children and young people on sustainable behaviours, climate change and natural resource priorities. Size of Wales has been running an education programme across schools in Wales for over five years. Each year around 100 workshops and assemblies are run reaching around 20,000 pupils and raising awareness of the challenges of climate change and the importance of tropical forests. We will continue to look at ways to support pupil-led real-world learning that gets the whole school and the wider community involved in hands on environmental projects.

With the work being under taken to reform our Welsh Curriculum so that our young people develop higher standards of literacy and numeracy, become more digitally and bilingually competent and grow to be enterprising, creative and critical thinkers. There is an opportunity to lead the way and look at what is relevant to our young people now and plan for the changing future. Raising awareness of the sustainability of the planet, including encouraging learners to understand their dependence on and show their commitment to the planet and consideration of the impacts of their actions is crucial.

Educating young people now will prepare them for the jobs of the future embracing innovation and new technologies as they develop. An understanding of environmental issues is vital for our young people. Therefore we are committing through the new flexible framework, within the new curriculum, ways to ensure our learners are equipped with the skills they need for the changing environment and green economy.

31 https://beta.gov.wales/sites/default/files/consultations/2018-08/low-carbon-pathway-to-2030-consultation.pdf

Policy 12 – Work with key partners to expand and refocus education to include sustainability and decarbonisation

Well-being Goal Spotlight – Vibrant Culture and Welsh Language

> In developing this Plan, we recognised the importance of involving young people about our low carbon future. We developed a competition for schools to produce a video to show their low carbon vision for 2050, to raise awareness around decarbonisation and involve young people in the solutions.
>
> We built on this by publishing a children and young people's version with our consultation *Achieving our low carbon pathway to 2030* in the summer, which received over 90 responses. Young people told us they felt that climate change was not taken seriously enough in Wales. We will harness the levers at our disposal such as education, to ensure we involve young people in the discussion about climate change.

People

Meeting our targets in a way that maximises our well-being goals, will involve transformation across all sectors and levels of society. Some progress has been made in areas such as domestic recycling but there remain areas more resistant to change, such as reducing car travel and increasing active travel. Low carbon behaviours have many co-benefits for people such as improving individual health, public health and household income. The move to more flexible, integrated systems that balance supply and demand will bring some opportunity for change but it could largely depend upon securing 'buy in' from individuals. We want citizens to be central in designing this transition and we will continue to develop the vision for the Wales we want in 2050.

From May 2019, Cardiff University will be the lead organisation tasked with establishing a new Centre for Climate Change and Social Transformations (CAST). This is a major investment from the Economic and Social Research Council, which is providing £5million for this Centre for at least an initial 5-year period. The aim of this new research Centre is to understand how to achieve the rapid and far-reaching transformations needed to bring about a sustainable, low carbon society in line with the ambitions of the Paris Agreement. The Centre will undertake theoretically-informed, interdisciplinary research, to inform and trial solutions for changing individual lifestyles, organisations, and systems of governance for Wales, the UK and internationally.

Welsh Government has worked closely with researchers at Cardiff University and its other partner organisations to shape the projects planned by the Centre. In particular, we will work with the Centre to focus on four particularly challenging areas: transport, the heating of buildings, material consumption and food/agriculture. The collaboration will pursue opportunities to align approaches with Welsh Government's Well-being Act

in looking at multiple benefits of taking action, and other areas, where there are wider benefits for decarbonisation and other areas (e.g. health and employment). The aim of the collaboration is for new research insights which are able to be effectively embedded in policy approaches in Wales and beyond.

Policy 13 – Work with partners to help understand how to transform individual lifestyles and systems of governance for a sustainable, low carbon future

As we design policy, we must implement the prevention principle of the Well-being Act, learn from any mistakes from the past and be mindful of unintended consequences. This includes dealing with fairness and equity and making decisions in line with the legislative framework.

The people of Wales will be central in designing the future changes and low carbon initiatives needed in moving towards a low carbon future. A key part of this approach will be to establish a climate just advisory group to advise government on the transition away from a fossil fuel-based economy.

We will develop an evidence programme exploring how social and behavioural science might be integrated into effective policy or infrastructure design for achieving behaviour change. This will also enable citizen engagement with climate change and emissions reduction and well as personal and societal well-being.

These interventions will allow us to address in more detail the various challenges that we face in society around food/diet, smart energy technologies, materials use, transport, and home heating/cooling. The findings will be used to feed into developing future policy proposals for sectors such as Buildings, Industry & Business, Energy, Transport, Agriculture and Land Use & Waste. Further information will be announced on this later this year.

Proposal 2 – Establish a Climate Just Advisory Group on the transition to a low carbon society

Well-being Goal Spotlight – A More Equal Wales

> The transition away from a fossil fuel based economy to a low carbon future could negatively impact on our industries and the communities where they are located. In addition it is often the most vulnerable in society who are impacted by the effects of climate change.
>
> It is therefore vitally important that we understand the economic, environmental social and cultural impacts and that fairness and equity underpins our decisions. Welsh Government will establish a climate just advisory group to explore these issues as we collectively develop the measures to decarbonise to a low carbon economy that is fair for all. The Group will be made up of members from a range of sectors, from heavy industry to the citizen and will advise Welsh Government on a range of decarbonisation policies, considering how they can deliver fair work and tackle inequalities. They will also help to identify any unintended consequences of decarbonisation action.

In the development of this Plan we have worked with our stakeholders across all levels of society and sectors. We have sought to involve and collaborate with key external stakeholders across all sectors in setting the carbon budgeting framework through a series of events, roundtables and workshops between 2016 and 2019. We also worked closely with key stakeholders in developing the Ideas for Action in our Achieving our low carbon pathway to 2030 Consultation last year. Over the duration of the Programme our stakeholders have told us the benefit of having cross-sector events to share ideas. We also want to build on our work with young people and work with educators, the arts and media to involve communities in the low carbon transition.

This will enable closer and earlier collaboration of all interested parties to help shape our policy development, providing richer evidence in support of meeting our well-being objectives and allowing us to further understand the impacts of any action. The Welsh Government will continue to involve and collaborate with our stakeholders over the duration of this Plan including holding a regular Climate Change Conference to discuss progress and develop future ideas.

Policy 14 – Hold a Climate Change Conference to collaborate with and involve all sectors and levels of society.

Third Sector and Local Leadership

Voluntary organisations are uniquely placed to promote decarbonisation and influence others. Through awareness campaigns and education programmes the third sector can grow interest, helping people take personal pledges and commitments to reduce their emissions. The totality of the contribution of what citizens can achieve when they are being informed through trusted organisations should not be underestimated.

Welsh Government provides financial support to involve communities take action on climate change. These grants range from funding to support community action to improve our natural resources in residential areas, through to working with young people directly in schools.

Well-being Goal Spotlight – Resilient Wales

> In September 2018, Welsh Government launched the Enabling Natural Resources in Wales grant to support implementation of the Natural Resources Policy and make clearer links between Wales' natural resources and well-being[32]. The grant arrangements focus on supporting cross-sector collaborative projects. These projects will bring a broad range of environmental, economic, social and cultural benefits for communities around Wales. It has been designed under the Rural Communities Rural Development Programme and focuses on pilot and demonstration projects promoting cooperation and collaboration to around green infrastructure, improving environment quality and increasing resilience of our ecosystems.

Communities are already showing leadership and are joining together to take action themselves across Wales to tackle climate change. Machynlleth Town Council recently declared a climate emergency driven by the local community and will be consulting on measures to reduce emissions and improve community well-being; through cost savings, health benefits and providing a sense of community cohesion in doing something they believe in. Welsh Government would like to see more communities show leadership by taking action on climate change.

Policy 15 – Provide funding to enable action on climate change in schools and communities

32 https://gov.wales/topics/environmentcountryside/environment-grants/enabling-natural-resources-and-well-being-in-wales-2019-2023-call-for-grant-proposals/?lang=en

Table 1: Example of funding schemes for the communities and young people supporting action on climate change

Name of Funding Grant/mechanism	Purpose
Enabling Natural Resources and Well-Being in Wales 2019-2023	The grant focuses on supporting cross-sector collaborative projects to enhance natural resources in urban areas to realise environmental, economic, social and cultural benefits. Further information
Sustainable Management Scheme (SMS)	The scheme is designed to support the delivery of Welsh Government's commitment to sustainable development as set out in the Well-being of Future Generations (Wales) Act 2015 and the Environment (Wales) Act. Further information
Wales for Africa (formed 2006)	The grant scheme provides funding and support for small-scale Wales-Africa projects. Supported projects consist of projects aiming to improve health, sustainable livelihoods, lifelong learning and climate change and environment. Further information
Big Lottery fund (formed June 2004)	The grant focuses on supporting grassroots and community activities, aiming to improve life for local people and neighbourhoods. Further information
Landfill Disposals Tax Communities Scheme	The grant focuses on supporting local community and environmental projects in areas affected by the disposal of waste to landfill. Further Information
Eco schools (founded in 1994)	Designed to inspire young people to make positive environmental changes to their school and wider community. Further information
Size of Wales	Brings people in Wales and beyond together to help protect four million hectares of tropical forests, helping to reduce deforestation as part of Wales' response to the challenge of climate change. Working with schools, colleges, businesses, government and communities in Wales in understanding and sharing responsibility for the protection of the world's forests. Further information
Dormant Accounts	To benefit people and communities across the UK, by channelling funds from dormant accounts towards good causes in the United Kingdom. Dormant accounts have been used to help vulnerable people find appropriate housing and employment. Further information

Business and the Economic Action Plan

Many businesses are already maximising the cost saving opportunities of clean growth. A greater consumer awareness will only increase the need and appetite for business to act to reduce emissions if they are to retain competitive advantage. For example, more than 100 global businesses have already signed up to The Climate Group's RE100 campaign[33], publicly committing to only using 100% renewable electricity, demonstrating business leadership on climate change – which is crucial alongside robust government policy to boost investor confidence.

Delivering an affordable and beneficial low carbon transition is paramount for Wales. We need growth of a resilient economy where we can continue to exploit our capabilities in new low carbon technologies and markets, underpinned by a mature, innovative and competitive industrial base.

A potential consequence of an uncompetitive business environment is industries will not remain in the UK, with their output substituted by imported products produced with higher carbon emissions.

Many of our companies operate in both UK and international markets and are subject to considerable price sensitivity. Which businesses and sectors survive and fail has historically defined the shape and direction of the economy. The key to securing the viability of businesses lies in seizing the opportunities presented by the move to a low carbon economy. Whether it's retrofitting/refurbishing buildings to cut energy, costs and carbon, embracing new modes of transport, or pioneering and manufacturing vital technologies for domestic and international markets, the potential is there to be grasped.

Our approach to business and the economy is set out in our Economic Action Plan (EAP) published in 2017. This sets out the range of actions we are taking to drive inclusive growth and future-proofed the economy. Decarbonisation is a clear and consistent thread throughout the EAP and features strongly in our new approach for delivering direct support for businesses. This is centred on the Economic Contract, Calls to Action and the Economy Futures Fund. To access direct financial support through the Economy Futures Fund, businesses must demonstrate that they share our values (the Economic Contract) and that they are delivering investment that is future proofing (the Calls to Action). As part of the Economic Contract, we test businesses' attitude to managing and lowering their carbon footprint, whilst decarbonisation forms one of five Calls to Action designed to target future proofing investment.

Moreover, innovation and Research and Development (R&D) feature within other calls to action and are highly relevant given that decarbonisation will in part be shaped by technological advances, driven by innovation and R&D.

33 https://www.theclimategroup.org/RE100

Our EAP recognises the close integration between business and the economy in Wales and the wider UK. Significant policy levers are held at a UK level and UK Government policy can have a material impact on outcomes in Wales. This makes it important that we seek to influence the UK Government's agenda for the benefit of Wales. This includes continuing to press the case for Wales through the UK Industrial Strategy.

Policy 16 – Economic Action Plan

Role of UK Government

We have decided to count all emissions in Wales against our targets as this is the most transparent and simplest way of measuring progress. However, we are not responsible for policy in a number of important areas. For example, the UK Government retains responsibility for most economic and fiscal policy, large-scale power generation, electricity transmission, heating, vehicle standards and licensing, and heavy industry. Among other things, we are responsible for agriculture and land use, most planning matters, building standards for new properties, smaller-scale power generation, public transport and waste. We also set policy for public services, such as schools and hospitals.

As a result many emissions in Wales are produced in areas that are the responsibility of UK Government. We are therefore working closely with UK Government on the implementation of their Clean Growth Strategy to ensure they deliver the reductions we need and Welsh households and businesses are able to access UK-wide funding.

Playing our part on the World Stage

Promoting Wales as a world leader on climate change and engaging with the international community on climate related issues are crucial aspects to ensure that we take the required step change towards our a low carbon pathway. Climate change is not an issue we can address as individual nations - we need to take collective action.

Wales has established a strong presence internationally over many years through Ministerial attendance at annual Conferences of the Parties to the UNFCCC and through active participation in international climate programmes.

We will be building on our international reputation further through our new International Strategy, which will be founded on a clear set of values which will help to present Wales internationally – including a commitment to sustainability and future generations, the promotion of the principles of Fair Work and a fundamental belief in the fact that we want to achieve more through our use of digital technology, by tackling poverty and inequality, by taking on environmental challenges and climate change, and by working together across territorial boundaries.

In joining the Under2 Coalition, we have committed to keeping global temperature rise to well below 2°C and working with state and regional governments from around the world to accelerate climate action[34].

Welsh Government has been involved in both initiatives from the outset and is currently a member of the steering group of the Under2 Coalition.

We have ensured Wales has always been represented at the UN dialogue to demonstrate the important role states and regions play. In 2016, the Minister for Environment, Energy & Rural Affairs was elected to be a Steering Group member of The Climate Groups States and Regions Alliance. Welsh Government also fully recognises our global responsibility and has contributed to the Climate Groups Future Fund, focusing on developing and emerging economy regions already being affected by the impacts of climate change. This is in addition to our Wales for Africa work.

In 2017 we, Welsh Government and Size of Wales held an event in Bonn showcasing our unique Welsh Size of Wales project. In 2018, we took part in the Global Climate Action Summit, where Wales was once again confirmed as a Steering Group Member for Europe as part of the Under2 MOU network. At the event we also signed up to the *Powering Past Coal Alliance*[35] led by Canada and UK Government, which consists of governments, cities and organisations who are committed to moving the world from burning coal to cleaner power sources.

Wales has had a long standing partnership with Africa. Our Wales for Africa Programme encourages projects that support learning, the exchange of skills, joint working and tackling climate change. In partnership with the Size of Wales project we are supporting the Mbale Trees Programme which has so far has distributed over 9 million trees. This includes one for every child born or adopted in Wales, as part of Welsh Government's PLANT! scheme.

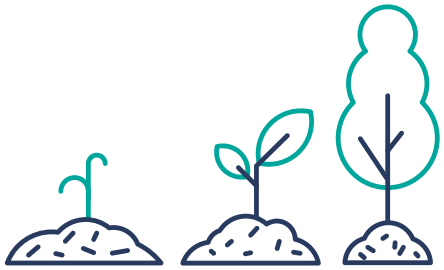
We will continue to build on this and by 2030 provide fruit, shade and fuel trees for the entire Mount Elgon region, Uganda.

Policy 17 - Provide fruit, shade and fuel trees for the entire Mount Elgon region, Uganda by 2030

Policy 18 – Ensure our new International Strategy is founded on sustainability with a decarbonisation as a key part, working with other like-minded States and Regions and through our engagement with international networks and organisations.

34 https://www.under2coalition.org/

35 https://www.gov.uk/government/publications/powering-past-coal-alliance-declaration



Well-being Goal- Spotlight – Globally responsible Wales

The Wales for Africa programme supports and encourages civil society, business and public bodies in Wales to take action on poverty in Africa. This is done through skills exchanges and mutual learning, partnership working and climate change action in support of the UN Sustainable Development Goals. A major part of the programme is our support for the Mbale Trees Project in Eastern Uganda, in association with the Size of Wales. This is a long-term partnership with local authorities, community-based organisations and a Fairtrade coffee co-operative to promote agroforestry on Mount Elgon, a previously heavily-forested region near the equator. The project promotes sustainable livelihoods, climate change adaptation and climate change mitigation to subsistence farmers.

Public Sector Leadership

Delivering our ambitious decarbonisation targets will require significant leadership, collaboration with our partners and the involvement of society. Our first Plan very much focuses upon the actions Welsh Government is taking to stimulate decarbonisation. However, Welsh Government whilst holding a crucial enabling and delivery role, will assist other actors to take the lead where they are best able to. This means encouraging, supporting and, where required, mandating businesses, the public sector, third sector, communities and citizens to contribute.

Leadership must become much more dispersed, not only to achieve the decarbonisation aims, but do so in ways which improves the economic, social, cultural and wider environmental performance of Wales.

Under the UKCCC scenarios, the public sector is combined with the buildings sector and does not have its own long-term scenario.

Since 1990, we have reduced emissions by 56% through more efficient use of fuels and a switch to gas-fired heating for many public sector buildings. However, the public sector must take an early leadership role in driving toward a low carbon future. The reasons are multiple. The public sector shoulders a significant burden caused by the fossil fuel based and wasteful economy of old. The public sector deals with the implications of poor health caused or exacerbated by poor air quality from transport or from poorly performing homes. The public sector also deals with the impacts of an energy system, which exports significant economic value, driven by fuels sourced from outside of Wales. A more self-sufficient, energy system where Welsh actors develop and invest in the infrastructure required of a smarter, more locally based energy system offers the opportunity to retain significant economic value, thereby creating greater resilience in communities. The public sector is already exploring or investing in the energy system, but efforts to date must be just the start.

The public sector also has wider levers. The public sector in Wales procures £6 billion of goods and services annually, much of which creates revenues for Welsh businesses. The public sector can use procurement rules positively to help drive emissions reductions in a number of areas including ultra-low-emission vehicles and low carbon products. Success in changing our procurement approaches can not only drive down emissions in Wales by sending appropriate signals, it also has the ability to prepare the Welsh supply chain for the wider low carbon markets of the future.

The transport sector is also changing, with the adoption of ULEVs and the expectation of autonomous vehicles becoming widespread in urban areas in the 2020's, all of which provide challenges

and opportunities for public services to be delivered differently for the wider benefit of Wales. With better planning, our transport options can be better connected to create safer, more cohesive and prosperous towns.

It is for these reasons that in 2017, Welsh Government set the ambition of achieving a carbon neutral public sector by 2030.

Carbon Neutrality and the Public Sector

Welsh Government has set out its ambition for the public sector to be carbon neutral by 2030 and the subsequent call for evidence[36] resulted in broad support for the ambition, that clarity was needed on scope and scale of ambition. Support has been provided to the public sector to develop the framework for baselining, monitoring and also achieving the aim.

Historically, our efforts to reduce carbon emissions have been based on delivering improvements to the efficiency of public sector buildings and the development of renewable energy solutions. However, public sector emissions are more wide ranging. In order to better understand how public sector organisation could baseline emissions across their full range of activities, Welsh Government financially supported Natural Resources Wales' (NRW) Carbon Positive Project[37].

Case Study 2 – Understanding Carbon Footprint

The Carbon Positive Project evaluated Natural Resources Wales' net carbon status, accounting for both GHG emissions and carbon sequestration across the whole of NRW's owned and managed estate. NRW calculated emissions across the full range of their activities and operations, including buildings, transport, land, assets, and the procurement of goods and services.

The findings of the project suggest that whilst buildings are important, other areas are far more important. For example NRW estimated nearly 60% of their emissions were a result of the procurement of goods and services.

Latterly, the NHS Wales Shared Services Partnership commissioned a carbon footprint assessment of the NHS Wales Carbon footprint on behalf of Welsh Government. The report provided a comparison to a similar exercise undertaken in 2009/10. The exercise found the NHS Wales carbon emissions were:

- Building Use – 30%
- Transport – 21%
- Procurement – 49%

36 https://gov.wales/topics/environmentcountryside/climatechange/public-sector-decarbonisation/?lang=en

37 https://naturalresources.wales/about-us/corporate-information/carbon-positive-project/?lang=en

> The exercises described clearly illustrate the need for public sector bodies to consider their full range of services in reducing carbon emissions.

One of the first next steps is to gain a better understanding of the current situation in our public bodies to best target further support. We need to be able to monitor and report on progress to achieving our ambition and identify the impacts we are making. A number of Public Bodies already measure and report on some energy use through the CRC Energy Efficiency Scheme. With the CRC coming to an end after the 2018/19 reporting year, we will be considering a replacement reporting scheme for the Welsh public sector. We are currently scoping options, and will be sharing our conclusions in 2019.

Policy 19 – Welsh Government to consult on options for successor Carbon Reduction Commitment Scheme in summer 2019

Welsh Government will continue work with NRW to make a toolkit available for others to follow and develop further steps, to include defining the elements of scope 3 emissions to be included. Support will be delivered through a number of routes, including the new Welsh Government Energy Service. Any new framework for assessing public sector progress towards carbon neutrality will replace the CRC. The following policies look to accelerate the ambition for the sector to be carbon neutral by 2030.

Policy 20 – Support the public sector to baseline, monitor and report progress towards carbon neutrality

Leadership of Public Sector in the decarbonisation of Heat

Heat is one of the more challenging areas to decarbonise. The public sector must show leadership by finding the most suitable approaches to decarbonise its own heat requirements. There must be an exploration of four elements:

The ability of public sector bodies to adopt low carbon heat systems, such as those supported through the Non-Domestic Renewable Heat Incentive;

- Further develop low carbon district heating systems as currently being supported by Welsh Government;
- Identify and implement more innovative solutions, particularly on new build, for example, solutions being developed by SPECIFIC; and
- Support the development of the market for renewable gas. Exploration is required of the opportunity for the Welsh public sector to adopt a 100% renewable gas buying approach, in line with electricity.

Welsh Government, through the Green Growth Wales and Smart Living programmes and now the Welsh Government Energy Service has supported a range of proposed heat n etwork developments over a number of years.

Case Study 3 –Bridgend – Low Carbon Heat

Support continues to be provided to Bridgend County Borough Council, which assisted the Authority to be selected to be part of the UK Smart Systems and Heat Programme in October 2014, alongside Greater Manchester and Newcastle. This ambitious programme marks out Bridgend as being one of the leading low carbon heat local authorities in the UK, which will be evidenced through their development of two demonstration heat projects in the county.

1. A pioneering geothermal scheme in Caerau, utilising groundwater in former mine shafts in the Llynfi Valley along with heat pump technology, providing heat to the Caerau Community, supported by Welsh Government's Smart Living programme; and
2. Bridgend town centre district heating scheme involving public and civic buildings, leisure centre and some residential, supported by the Welsh Government Energy Service.

While developing these demonstrator projects, Bridgend CBC is hosting trials of smart initiatives developed by the Energy Systems Catapult (ESC), including 'EnergyPath' - a suite of software tools to assist Local Authorities to create designs for future-proofed and economic local heating solutions, specific to the Authority. The developments establishing Bridgend as an energy innovation area for others to trial heat developments as well as those being driven by the Local Authority. This is exemplified by the hosting of the FREEDOM (Flexible Residential Energy Efficiency Demand Optimisation and Management) project, a hybrid scheme sponsored by PassivSystems, Wales & West Utilities and Western Power Distribution.

Policy 21 – Provide continued support to identify, develop and invest in district heat systems.

Public Sector Procurement

Public sector procurement plays an important role in reducing CO2 emissions through its supply chains. As well as ensuring its buildings and vehicle fleets are efficient, the public sector must also take steps to reduce emissions more widely through its procurement of goods, works and services. The systems in place within public bodies must act to prompt the question 'are we doing all we can to reduce carbon emissions through our procurement of goods and services?

Welsh Government's Value Wales team is responsible for ensuring positive socio-economic, environmental and cultural outcomes are achieved through public procurement in Wales. This is being done by developing procurement policy, building procurement capability and helping support authorities with legislative compliance e.g. with public procurement regulations and our Well-being Act.

As part of its decarbonisation work, Value Wales has adopted the approach taken by Natural Resource Wales' Carbon Positive Project and taken it further to develop a Decarbonisation Dashboard for the Welsh public sector. This has enabled Value Wales to view the carbon emissions associated with the £6bn public sector spend in Wales, using ''carbon ratings' for each category. This has resulted in us estimating baseline CO2 emissions for all categories of spend and identifying the high emitting categories for carbon reduction.

The next tranche of work will see further analysis of these high emitting categories and the provision of expert advice to help identify interventions, advise on usage reduction, buying different or less carbon intensive products and services. .

In addition, tools have been developed for use in National Procurement Services Food Frameworks. These include tools to:

- measure and track the suppliers' carbon footprint through the lifetime of the framework agreement; and
- measure the carbon emissions associated with transport within the Community Benefits Measurement Tool

Consideration is now being given to developing a carbon planning tool for use at the start of a procurement to help inform high level decision making around the low carbon sourcing of goods, works and services.

The work carried out so far will help inform development of a 'Decarbonisation through Procurement' toolkit in due course, which will comprise guidance, training and tools for public sector bodies to utilise. The focus of this work will be to provide the wider public sector with the tools, skills and confidence to positively impact their carbon footprint and in doing

so contribute towards meeting the goals and ambitions set out by the Well-being Act and the Environment Wales Act.

Policy 22 – Value Wales to promote and encourage carbon reduction through procurement to support Welsh Government's Prosperity for All: A Low Carbon Wales.

Proposal 3 – Development of a Decarbonisation Dashboard to baseline emissions across the Welsh public sector and identify high priority categories for intervention / carbon reduction supported by new guidance and a carbon measurement tool, enabling public bodies to embed low carbon approaches through procurement and measure progress.

Well-being Goal Spotlight – Prosperous Wales

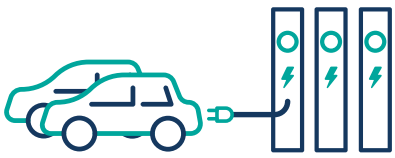
Welsh Government has announced that it will work with stakeholders to develop a new procurement strategy, which clarifies the future operating model and enables the full value of procurement to be realised nationally, regionally and locally[38]. Our aim is to maximise procurement spend in Wales while also using the £6bn annual procurement spend to support sustainable jobs and growth; decarbonisation, fair work and employment practices; infrastructure and construction investment; use of public assets and improve the resilience of local businesses and their communities. Being clear about what we expect, in terms of decarbonisation from the goods and services we procure, will send important signals and enable the Welsh supply chain to develop lower carbon goods and services

Case Study 4 – NHS Wales and Using Procurement to reduce environmental impact

NHS Wales Shared Services Partnership has adopted a range of environmental sustainability objectives:

1. to achieve a 3% year-on-year reduction of carbon emissions generated at sites;
2. to identify opportunities by introducing a system for staff to identify suggestions for improvement;
3. to minimise waste working Towards Zero Waste Strategy;
4. to comply with the Well-being of Future Generations Act (Wales) 2015 and the Sustainable Development Principle; and
5. to support Welsh Government's 'Wales Procurement Policy Statement', utilising Sustainability Risk Assessments for all relevant procurement frameworks in excess of £25,000 and applying a 'Community Benefits' approach to all relevant procurement.

38 https://gov.wales/written-statement-review-national-procurement-service-and-value-wales-commencement-order



Undertaking a Sustainable Risk Assessment (SRA) is designed to identify opportunities in the supply chain to address environmental, social and economic impacts as a consequence of the services and goods delivered to NHS Wales. The output of the SRA supports and stimulates innovation, providing sustainable solutions and reducing the consumption of resources. It does this by working with and encouraging the supply chain to work to lower the environmental impacts of relevant activities such as production processes and materials, packaging and transport and recyclability.

Public Sector Fleet

Penetration of ULEVs in the public sector is low and patchy, but increasing. The low take-up is due to a combination of:

- cost;
- a lack of available charging infrastructure – the UKCCC has estimated nearly 29,000 charging points are required across Great Britain to meet 2030 charging needs[39]; and
- a lack of understanding of which areas of fleet might be suitable to move to low emission vehicles.

However, the cost of ULEVs in the small vehicle sector is reducing and whole-life costs for EV fleets are currently comparable to or approaching that of internal combustion engines. NRW conducted a strategic fleet carbon review, which identified opportunities to reduce diesel reliance and associated emissions, whilst providing value for money. The review concluded NRW could save up to 27% emissions from their fleet and deliver a 5% cost saving through the use of existing low emission technologies. Whilst not all of NRW's fleet use is suitable for current ULEV use, they calculated that replacing 56% of it with electric vehicles could save £136,000 and 413 tonnes of CO_2e per year.

We need the public sector to take a proactive approach to considering and implementing opportunities to reduce emissions from their transport activities. This action would focus on scope 1 emissions (vehicles owned by the public sector body).

39 https://www.theccc.org.uk/wp-content/uploads/2018/01/Plugging-the-gap-Assessment-of-future-demand-for-Britains-EV-public-charging-network.pdf

Case Study 5 – Swansea City Council and Ultra Low Emission Vehicles

Swansea Council is at the forefront in the adoption of ULEVs in Wales. Air quality in Swansea, like most urban areas, is a concern, with the Council fleet of 800 vehicles from small cars to 32 tonne trucks contributing to the problem. Swansea has been reducing the impact of its fleet for some time. Over a decade ago the Council secured 125 LPG vans and installed a refuelling station and converted 35 small tippers to hybrid vehicles. Then in 2012, the Council took delivery of 10 fully electric vehicles. This approach enabled the Council to learn early lessons, which were supplemented by detailed analysis of fleet use, utilising telematics, dash mounted driver monitoring and route optimisation.

Armed with this knowledge, experience, a strong political expectation to deliver a step change in fleet management and a rapidly maturing market in light commercial ULEVs, Swansea Council took the bold step of taking delivery of 40 new electric vans in early 2018.

Swansea Council have also found, payload and range are not a barrier and only small working pattern changes were required. The use of slow chargers have proved perfectly adequate, given vehicles largely return to depots at the end of the day and has avoided the cost of fast or rapid chargers. Further analysis has shown most council sites have the ability to accommodate slow chargers. Furthermore the approach to procurement has delivered financial benefits. The electric vans are expected to cost 5% less than their diesel equivalents. Whilst Swansea Council are continuing to learn lessons, overall, the 40 new electric vans are deemed to be a great success.

Proposal 4 – All new cars and light goods vehicles in the Public Sector fleet are ultra low emission by 2025 and where practicably possible, all heavy goods are ultra low emission by 2030

Public Sector Buildings

From April 2017, the National Procurement Service has secured 100% renewable electricity for existing public sector partners, including Welsh Government. This approach is at little additional cost to the consumer, but must continue and be adopted by all public sector bodies. Low carbon heat is more difficult to achieve, however technologies do exist to support the move to low carbon heat and a green gas market is emerging.

Case Study 6 – The Welsh Government Estate

Welsh Government sets a high standard of environmental performance for the public sector in Wales. By 31 March 2018, we had reduced our carbon emissions by 57% from the baseline year of 2010-11. Water consumption reduced by 11 % and carbon emissions from gas and electricity by 14% in 2017/18 compared to the previous year. The amount of waste recycled also improved from 81.5% to 88%, further exceeding the 2020 target of 80% over the same period.

Reducing environmental impact remains a priority. Having made significant gains by reducing the size of the estate and installing energy efficiency measures, the focus is moving towards the further benefits to be gained from technological energy management solutions and renewable energy.

Alongside the administrative estate, Welsh Government has invested in buildings and factory units on its wider estate to support developing industry. Currently Welsh Government is on target to reduce overall emissions from buildings and fixed infrastructure by at least 30% by 2020 against a 2010 baseline. In 2018, Welsh Government achieved a 29% carbon emission reduction against this target.

Proposal 5 – Public Sector buildings should be supplied with renewable electricity by 2020, or as soon as contractually able and, where practicably possible, are supplied with low carbon heat by 2030.

21st Century Schools

We are committed to the creation of a sustainable estate and require that all of our new buildings achieve BREEAM Excellent and an EPC 'A' rating. Welsh Government also encourage local authorities and further education institutions to consider provision of EV charging points in schools and colleges. Road transport is a significant source of carbon emissions and harmful air pollution and our 21st Century Schools projects process includes testing business cases to ensure that they are compliant with the

Active Travel Act. Charging infrastructure can also encourage take-up of electric vehicles and is not typically cost prohibitive when built in at design stage. Welsh Government also encourages access to the workplace charging scheme, administered by the UK Office for Low Emission Vehicles.

Policy 23 – Continue to drive low carbon schools through 21st Century Schools

Hospitals

The latest NHS Wales carbon footprint report will be used to develop a range of actions to reduce emissions. Particular focus will be on reducing the emissions linked to building energy, travel and indirect procurement (which is reliant on the supply chain). Actions will be agreed with all relevant stakeholders to ensure that any actions and related targets are challenging but achievable.

The NHS Clean Air Guidance contains commitments for the NHS to promote, encourage and support zero emission travel among residents, visitors and commuters and advocate for different yet complementary approaches to promote active travel. There is an objective to developing and implementing environmental sustainability strategies to assess and minimise air quality impacts of decisions made on new policies; services; projects and actions to reduce emissions from services and facilities.

Policy 24 – Continue to reduce emissions in the health sector

Fossil Fuel Divestment

In parallel to developing policies to reduce emissions in Wales, we must also recognise the decisions we make to increase emissions both in Wales and globally. Fossil fuel based companies have long been a source of investments for pension fund managers. Over a relatively short time horizon however, a decision to divest from fossil fuel companies and consciously make investments in industries delivering sustainable products and services. In 2018, for example, Monmouthshire County Council voted to request the Greater Gwent Fund, which handles pensions for Mommouthshire, Torfaen, Blaenau Gwent, Caerphilly and Newport Councils to make an ordered withdrawal from fossil fuel based companies. The fund at the time was estimated to hold £245m of investments in fossil fuel based companies.

Taking such an approach provides important signals. Fossil fuel based companies view divestment as a significant risk to their business, providing an important stimulus to encourage alternative business models, products and services.

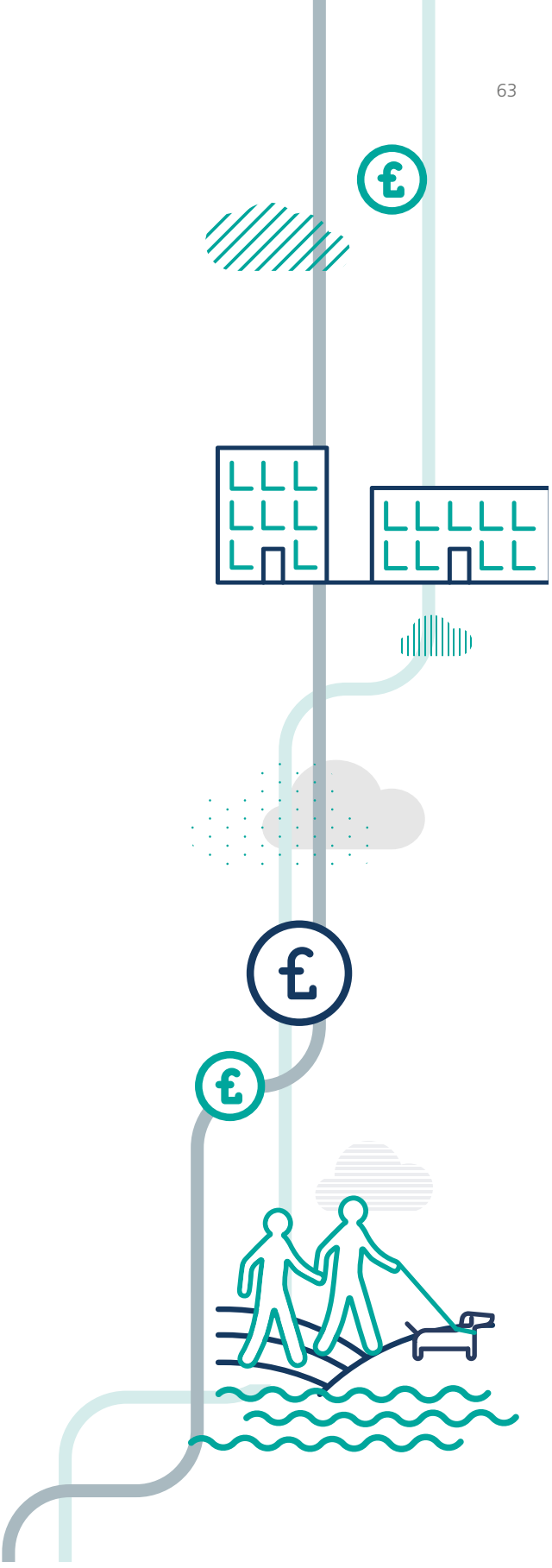
Proposal 6 – Commission research to gain a better understanding of Welsh public sector investment profiles to stimulate discussion about future investment strategies.

Tourism

Sustainability will always be a key priority when developing tourism in Wales. Contribution to the environment is one the of the core assessment criteria for both capital and revenue funds and tools and information available online have been developed specially for the sector.

Visit Wales is implementing the commitment for an Environmental Growth Plan for Wales, through the Economy Futures Fund Tourism Investment Support Scheme. An economic contract is established with tourism businesses seeking support to develop the product, which entails a focus on decarbonisation (in terms of e.g. energy efficiency, and supply chain activity). In the case of new build, compliance with BREEAM standards is also required. As part of the offer of funding, Visit Wales requires the applicant's commitment to four elements of an 'economic contract', and for this to form an understanding with the business, including 'progressing in reducing carbon footprint'.

Visit Wales has developed a number of supporting programmes and tools[40] over recent years which are aimed at helping destinations as well as individual businesses become more sustainable.



Policy 25 – Continue to promote and market tourism in Wales in a sustainable way

40 https://businesswales.gov.wales/tourism/working-together#guides-tabs--6
https://businesswales.gov.wales/dmwales/sites/dmwales/files/documents/climate-change.pdf

Part 3 – Sector Emission Pathways

Introduction

The sector pathways chapters in this Plan set out how policies and proposals contribute to meeting sector emission reduction pathways. The chapters align with the UKCCC sector emission pathways: Power, Buildings Transport, Industry, Land Use, Agriculture, Waste and F-gases. Further information around the breakdown of the sectors for this Plan can be found in Annex 2.

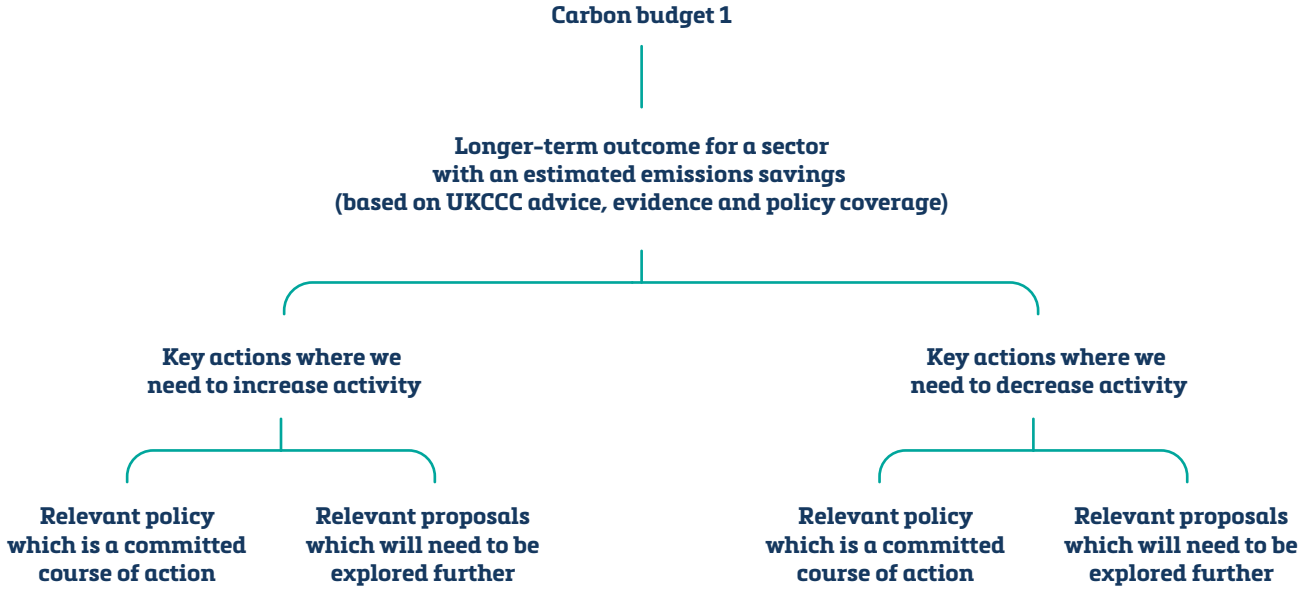
Each chapter sets out the modelled contributions relating to our 2020 target and our first carbon budget 2016 to 2020, which have been derived from the UKCCC's recommended emission pathway. Further information around these emissions pathways can be found in Annex 3.

For each sector pathway we have also developed a Policy Framework consisting of a Policy Outcome, Policies and Proposals.

A policy is a committed course of action to which a policy outcome can be attributed with a reasonable level of confidence. 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. Further information on the methodology can be in Part 4.

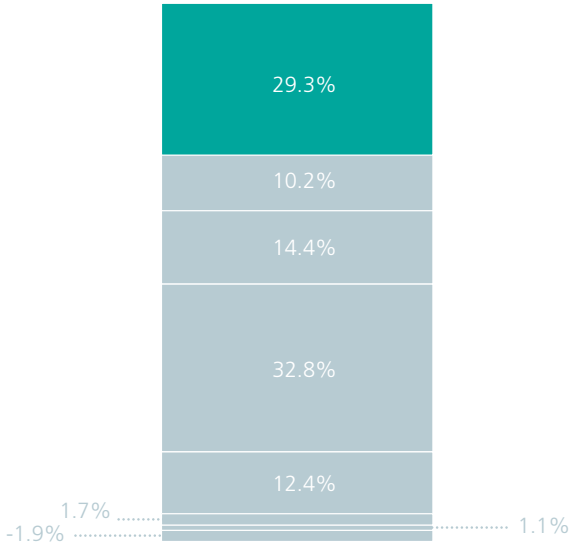
For a full list of all policies and proposals please see Annex 6.

Figure 8: Policy Framework explained



Power

The Power sector covers electricity generation in Wales from fossil fuel and renewables.



1. Ambition

We need low carbon electricity to become the main source of energy in Wales. Renewable electricity will be used to provide both heating and transport in addition to power. Gas will also have an important transitional role in power generation. Nuclear will make a contribution to the UK energy supply mix, and there will also be a role for fuels such as biomethane and hydrogen produced from low carbon mechanisms.

Renewable generation will continue to increase to meet a large portion of power in a decarbonised system. However, the intermittent nature of renewables means they alone cannot currently meet an electricity demand that varies considerably by time of day and season and will increase with the penetration of electric vehicles and electric heating.

Our highest priority is to reduce demand wherever possible and affordable, and this is principally covered in the sections devoted to the built environment and industry. We also expect overall power demand to increase as a result of growing electrification of transport. In order to ensure future demand can be met, significant investment will be needed in energy generation, transmission and distribution infrastructure.

The system will need to integrate renewable generation with storage and other flexibility services, in order to minimise the need for new generation and system reinforcement to serve large peak demands. Targeted investment in a multi vector system will help find the most effective solutions to serving peak demand. Smart systems and time-of-use pricing may help smooth consumption patterns and reduce peaks. Ofgem's current review of charging regimes is considering these issues.

The power sector will clearly need to deliver significant reductions in order to meet our 2050 and interim targets and carbon budgets. This will be challenging, particularly given the 22% increase in emissions from power stations seen in 2016, and the high load factors on gas fired generation in the relatively hot, dry and windless summer of 2018.

We therefore need to take forward policies that will drive the low carbon transition, using the levers we do have in Wales.

We originally set out our vision for the low carbon transition in *Energy Wales*[41] and have built on this by setting ambitious renewable energy targets in 2017. However, in order for the power sector in Wales to contribute to meeting our decarbonisation targets, we will need to concentrate on reducing emissions from fossil fuel sources.

2. Where do power sector emissions come from

The power sector covers a large share of Welsh emissions and is comprised of emissions from the production of energy in power stations, along with minor contributions from electrical generators located in Welsh businesses (auto-generators).

At 16.2 $MtCO_2e$, power generation accounted for 34% of Welsh emissions in 2016 making it the single largest sector. In 2016 99.9% of sector emissions were from power stations with the remainder from sewage gas, gas from waste and business sector auto-generators. Practically all power emissions (99.6%) are emissions of carbon dioxide.

Table 2: How the biggest emissions sources in the power sector contribute to the Welsh total

Source	% of total Welsh emissions
Power stations	34%

3. Progress to date

Despite improvements in the efficiency of energy generation and the use of natural gas to replace some coal and other fuels, total emissions from the power sector in Wales have grown by 44% between the base year (1990) and 2016. Over the same period, overall UK emissions from the sector reduced by 60%.

Energy policy is not devolved and Wales is part of an interconnected power system. Since 1990, UK Government has made a number of infrastructure planning decisions which have resulted in significant amount of additional fossil fuel generation being located in Wales, thus increasing overall power sector emissions in Wales.

In 2016, the first year of our budget period, Welsh power sector emissions increased by 22% compared to 2015, driven by an increase in particular from natural gas combustion. These large shifts in emissions are common within the power sector for Wales, which is strongly influenced by shifts in output at a small number of individual power generation sites.

41 https://gweddill.gov.wales/topics/environmentcountryside/energy/energywales/?lang=en

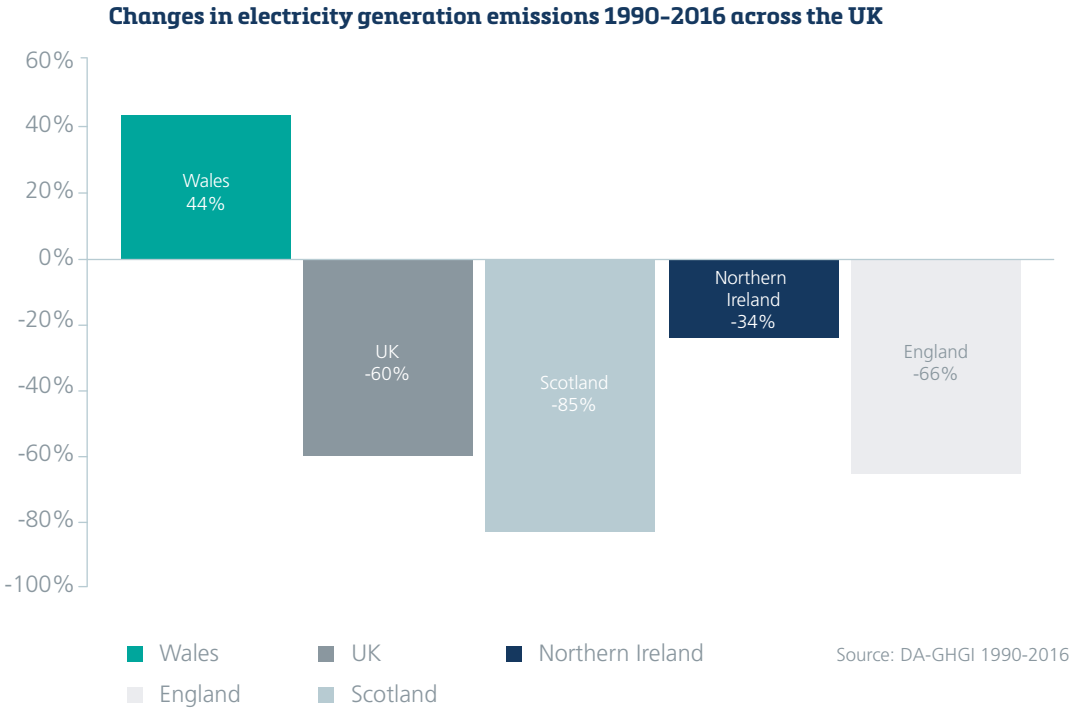
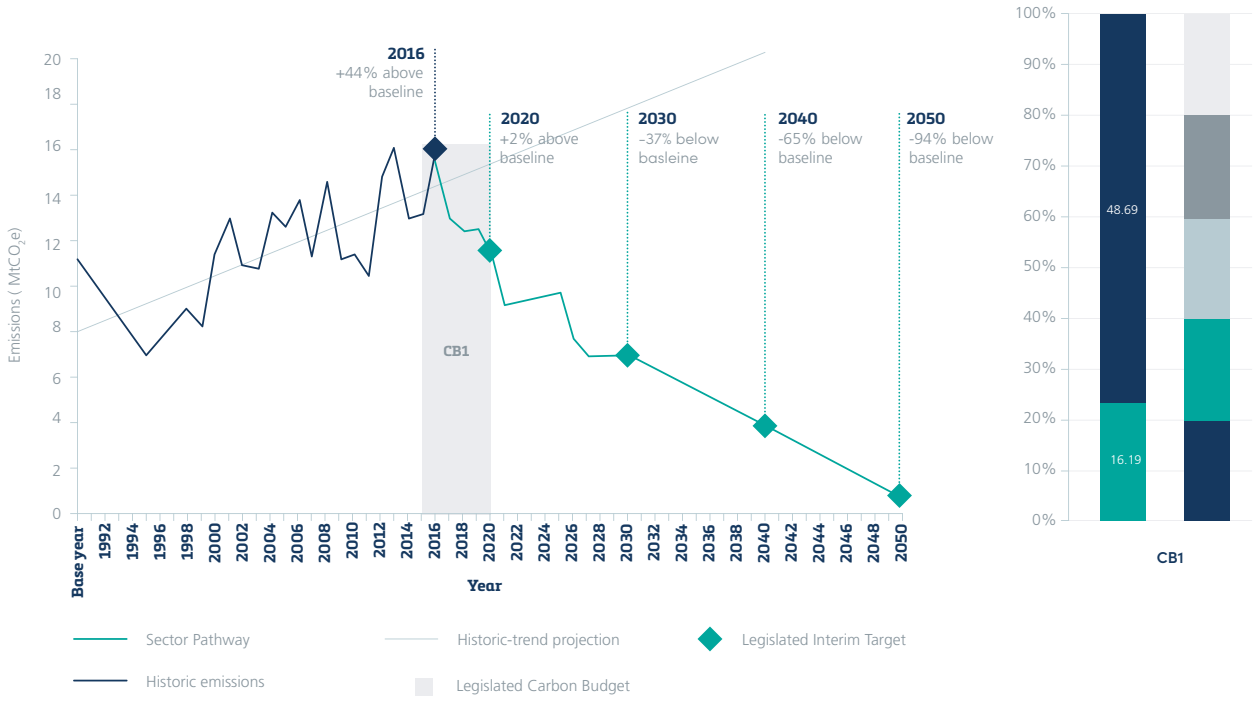


Figure 9: A graph to show historic emissions for the Power Sector and UKCCC modelling to show emission reductions for the first carbon budget (CB1) and a possible route for a contribution to an 80% reduction in all Welsh emissions in 2050



4. What are we aiming for?

2020 emissions target

Emissions in 2020 will be 29% lower than in 2016. This will mean that power sector emissions are 2% greater than the baseline in the year 2020.

Power sector allocation for Carbon Budget 1

The total budget for the power sector for CB1 is estimated to be 64.9 $MtCO_2e$[42]. The Power Sector contributes 29.3% of the total Welsh budget for CB1.

In 2016 the sector emitted 16.2 $MtCO_2e$ using up 25% of the Power Sectors contribution to CB1. However, indications from the 2017 EU-ETS suggest that a significant reduction in emissions from the power sector occurred in 2017.

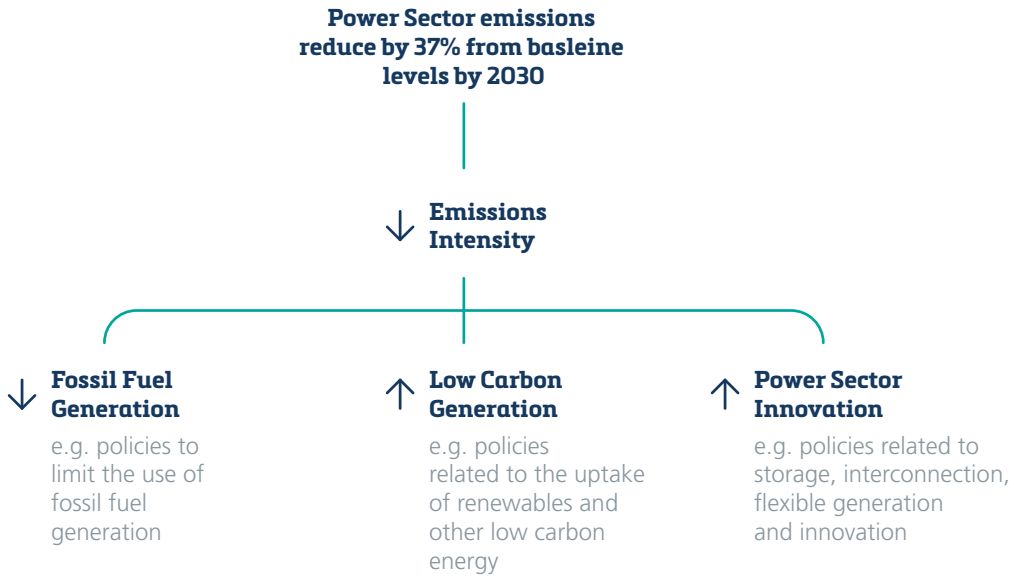
Power sector pathway to 2030

Power sector emissions will reduce by 37% from baseline levels [1990s] by the year 2030 by:

- reducing overall power generation from fossil fuels;
- increasing the deployment of renewable energy to meet the target for Wales to generate 70 per cent of its electricity consumption from renewable energy by 2030; and
- increasing support for innovation in the Power Sector.

5. How we are going to get there?

Figure 10: Policy Framework for Power – Aligning policy action to budgets targets and the 2030 pathway



42 Analysis based on 1990-2016 GHGI. All absolute figure referenced here will vary slightly as our understanding of GHG emissions in Wales improves.

6. Policies & Proposals which contribute to our carbon budgets and targets

We are part of a wider UK energy system where Wales has limited policy levers to influence emissions from fossil fuels in the power sector in the timescale to 2020. This limits our ability to make the necessary emissions reductions. The UK Government is responsible for energy policy and nationally significant infrastructure decisions, as well as energy resilience. Ofgem has a key role in regulating the energy market. Welsh Government has recently received greater permitting powers and will receive further consenting powers in April 2019. We believe these changes will allow us to exercise more influence over levels of emissions from the power sector for developments which have an installed capacity of 350 MW or less. Together with other policies to reduce the use of fossil fuels, increase the deployment of renewables and increasing support for innovation in the Power Sector we will enable the emission reductions require to meet CB1 and the 2020 target.

We will reduce the use of Fossil Fuels for Power Generation through:

Policy 26 – Implementing Energy Consenting, Planning & Permitting policy

Planning is a key lever for Wales in determining the sources of fuel for power generation. Welsh Ministers will have new powers relating to energy consenting arising from the Wales Act 2017. These powers around energy consenting, will be commenced on 1 April 2019 and will expand Welsh Ministers' decision-making remit from the upper limit of 50MW onshore to 350MW both on and off shore (excluding onshore wind, the consenting for which is already fully devolved). We are taking a phased approach to implementing these expanded powers, with interim arrangements coming into force on the commencement date whilst we develop a bespoke and unified consenting process over the longer-term.

Planning Policy Wales (PPW), which was launched in December 2018, will underpin all future planning decisions onshore. It puts an emphasis on people and places and will ensure developments built today leave a legacy of well-designed, sustainable places that improve lives. Changes to Wales' planning policy are designed to help Wales reduce carbon emissions, through restricting extraction and use of fossil fuels (including fracking) by placing them at the bottom of the energy hierarchy. The NDF will also ensure the planning system in Wales plays a key role in facilitating clean growth and decarbonisation, and helps build resilience to the impacts of climate change. Achieving our strategic decarbonisation goals is highlighted as a key driver, which all development plans must support.

The Welsh National Marine Plan (WNMP) will set out the Welsh Ministers' policies for the sustainable development of Wales' seas. The plan will help manage increasing demands for the use of our marine environment, encourage and support the economic development of marine sectors at appropriate locations and incorporate environmental protection and social considerations into marine decision making.

There has been growing consensus in recent years for improved management of our valuable marine natural resources. The plan encourages better management of the seas and aims to ensure sustainable economic growth (blue growth), and to deliver environmental and societal objectives. A sustainable approach to managing our marine environment will ensure its natural resources are available for both current and future generations to benefit from.

The WNMP will sit alongside and interact with existing planning regimes and will be consistent with strategic priorities set out in the NDF on land. The WNMP area will physically overlap with terrestrial planning through Local Development Plan boundaries to ensure marine and terrestrial planning work together.

Policy 27 – Removing barriers to consenting for storage by removing batteries as part of the Development of National Significance process.

Energy storage plays an important part in helping to balance our energy system. for example when there is less demand such as during the night, energy storage can help to balance the system. There are emerging technologies which decarbonise the energy industry and increase energy efficiency in Wales. The cost, efficiency and advancement of storage, particularly batteries, means it is becoming a common and viable part of our energy networks. We support the removal of barriers to such technology. At present, small to medium scale storage projects (between 10MW and 50MW) must seek planning consent from the Welsh Ministers under the Developments of National Significance ("DNS") process. No storage project has yet been consented through this process, as storage operators see the cost and time taken for decisions as prohibitive.

To remove consenting barriers and to reflect the physical scale and impacts of storage technologies being developed, the Welsh Government intends to remove storage projects from the current DNS process, for decision at a local level. We see this as a more proportionate way to determine such projects and we consider this change will stimulate the development of storage projects in Wales.

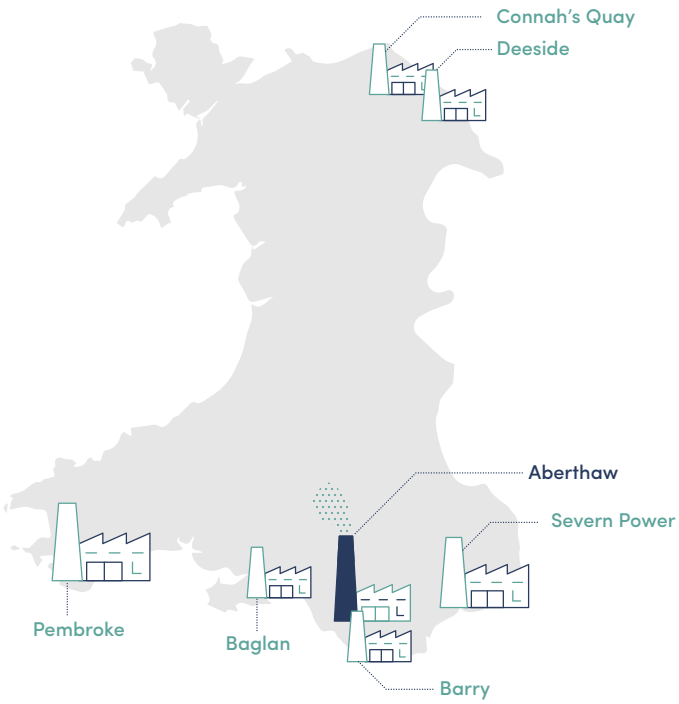
Policy 28 – Phasing out Unabated Coal

The future of the Aberthaw coal-fired plant in South Wales will have a large impact on emissions from electricity generation and is subject to UK Government's commitment to phase out unabated coal generation by 2025.

Aberthaw accounted for 14% of total Welsh GHG emissions and 51% of Welsh power generation emissions in 2015. The UKCCC advice assumes Aberthaw will have lower running hours of 1,500 hours per year from the middle of 2020, due to the Industrial Emissions Directive.

Aberthaw is assumed to cease generating by 2025 at the latest, consistent with UK Government commitments to end unabated coal generation by this date.

There is some uncertainty regarding Aberthaw's immediate future due to factors such as the impact of a 'no deal' Brexit, which may affect generation because of the need for UK based dispatchable generation. UK Government will need to take into account any impacts of continued operation on Welsh Government's climate change targets.



Policy 29 – Developing a Policy on Combustion of Fuels for Power

UK Government holds the key levers for electricity generation in Wales and the phasing out of coal could result in the temporary increase of gas powered generation. Wales currently hosts 19% of the UK's gas fired electricity generation, but uses only 6% of the UK's total electricity[43]. Therefore, our emissions from the combustion of fossil fuels for electricity generation are proportionately greater than the total UK emissions.

> In 2017, 8% of Welsh Power generation was from coal and 69% was from gas[44]. A number of large fossil fuel installations dominate the power sector. Aberthaw coal-fired power station represented 37% of Welsh power emissions and 12% of total Welsh emissions in 2016[45]. Pembroke gas-fired power station represented 30% of Welsh power emissions in 2016[46].

In the short-term we expect gas fired generation in Wales to continue to be seen as a resource to balance the Great Britain electricity system. We have identified planning, permitting and consenting powers as potential ways of reducing the combustion of fossil fuels to generate electricity in Wales up to 350MW.

43 Generation figures:https://www.gov.uk/government/statistics/electricity-section-5-energy-trends
Consumption figures:https://www.gov.uk/government/statistical-data-sets/regional-and-local-authority-electricity-consumption-statistics

44 https://gov.wales/docs/desh/publications/181212-energy-generation-in-wales-2017-en.pdf

45 EU-Emissions trading System (EU-ETS) data: http://ec.europa.eu/environment/ets/oha.do?languageCode=en

46 EU-Emissions trading System (EU-ETS) data: http://ec.europa.eu/environment/ets/oha.do?languageCode=en

We require a robust evidence base to underpin any future action on reducing the combustion of fuels to generate electricity in Wales. Work has already started: the Welsh Government commissioned a study in 2018 to look at the options for implementing policies to reduce emissions from the power sector. This included generation from gas, coal, biomass materials and waste.

Welsh Government will undertake further analysis, consultation and engagement with core stakeholders in CB1 to identify potential risks such as carbon leakage and system costs to energy that increase the wholesale energy price. We will develop a policy on combustion of fuels for power that will be in place by the end of Carbon Budget 1.

In order to meet our carbon targets we will also need to develop a policy regarding new gas generation above 350MW (which will be consented by UK Government) to be consistent with our low carbon pathway in Wales. Welsh Government will continue to make the case to UK Government to consider the role of gas in Wales power generation over the next 10 to 15 years. This is an important issue on which we need clarity.

Policy 30- Continuing to be a part of the EU Emissions Trading System to the end of Phase III

The European Union Emissions Trading System (EU ETS) is a cap and trade scheme operating in 31 countries, aimed at cutting emissions at least cost. The EU ETS covers heavy energy-using installations including large power plants. There are currently 7 fossil fuel power stations Wales, which are all covered by the EU ETS.

The third phase of the EU ETS covers this carbon budget period, covering emissions from 01 January 2013 to 31 December 2020. During this phase, the emissions cap for the scheme reduces by 1.7% per year.

In 2020, emissions from sectors covered by the EU-ETS will be 21% lower than in 2005. In 2030, under the steeper trajectory of the revised system (Phase IV) they will be 43% lower. For more information on the role of Welsh Ministers, the impact of Brexit, and carbon pricing policies for reducing emissions from current EU ETS participants immediately post Brexit and over the longer-term, please refer to the Industry Chapter.

As the EU ETS is a market led mechanism designed to reduce emissions across the EU at least cost, it does not target emissions reduction within specific geographical areas such as Wales. Emissions from all EU ETS installations in Wales have increased from 22.9 million tonnes CO2e in 2005 to 27.3 million tonnes CO2e in 2016. This is largely due

to the commissioning of new gas fired power stations which, though more efficient than older models elsewhere in the EU, still contribute to the overall emissions from Wales. Emissions from power sector installations participating in the EU ETS have increased from 12.1 million tonnes CO2e in 2005 to 15.9 million tonnes CO2e in 2016, an increase of 31%.

We will accelerate the deployment of renewable generation through:

Policy 31 – Delivery of our Renewable Energy Targets

The reduction of electricity generation from fossil fuels must be accompanied by increases in low carbon generation. The energy transition is already under way, with the mix of technologies generating power across the electricity system evolving. Electricity generation in Wales from renewables has increased 26% since 2014. We now have more than 67,000 renewable installations across Wales. More than 80% of these are very small scale generators connected to the distribution network, which changes the dynamics of the electricity system. In 2017, the Welsh Government announced Renewable Energy Targets. These are:

- generating 70% of Wales' electricity consumption from renewables by 2030;
- 1 GW of renewable energy capacity in Wales to be locally owned by 2030; and
- renewable energy projects to have at least an element of local ownership from 2020.

In 2017 Wales generated an estimated 32.5 Terawatt-hours (TWh) of electricity. Of this, 14.6 TWh was consumed in Wales, 15.6 TWh was exported and 2.3 TWh was lost in transmission and distribution. 7.1 TWh of the 32.5 TWh was generated from renewables (22%). Wales is making good progress against our target of 70% of electricity consumption from renewables by 2030: in 2017 we generated electricity equivalent to 48% of Wales' consumption.

We have already made progress in driving action through our positive planning and consenting regimes and support for locally owned energy. We have commissioned evidence on the potential resources in Wales for onshore and offshore wind and solar resource, and are considering the implications of this work for spatial planning and infrastructure. We are also supporting the development of energy planning at the local and regional level.

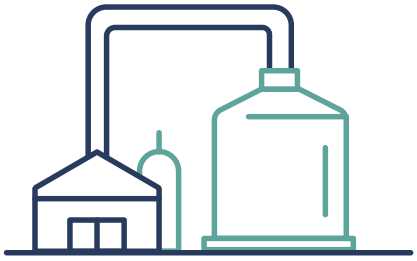
Providing support through our Welsh Government Energy Service

Welsh Government Energy Service provides support for public bodies and communities developing energy efficiency or renewable energy schemes. Building on experience and learning over recent years, it includes services for technical, financial and commercial support. Wales Funding Programme and the Welsh Government

Local Energy Fund are accessed via the service, and together provide loans, including low or interest-free loans, to support installation. The service is developing a pipeline of renewable energy and energy efficiency projects which are being delivered across Wales. For more detail on Welsh Government Energy Service refer to policy 12.

Supporting local and regional bodies around Wales Energy Planning

We estimate renewable electricity generation delivered sufficient energy to meet 48% of Wales' electricity consumption in 2017. We expect power demand to increase into the 2020s and 2030s as electric vehicles become increasingly common and more heating is electrified. We believe there are transformational opportunities in developing local or regional energy plans, driven by network and national/regional energy data, which will help decision-making and enable us to meet our decarbonisation objectives. We will do this through providing support to local and regional bodies to develop insights and energy plans. For further information on Wales Energy Planning please see Policy 11.



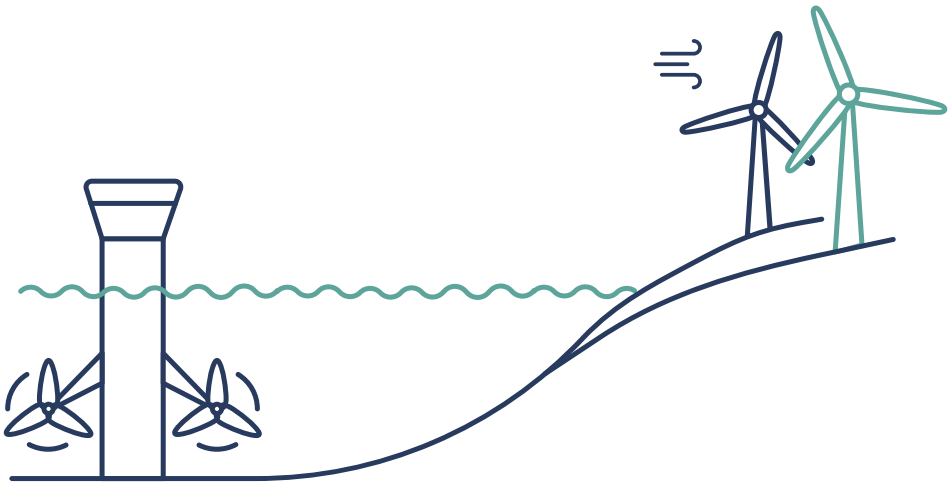
Maximising Waste to Energy

Over the period of the carbon budget, we are maximising the use of our food and residual waste streams to reduce our reliance on producing electricity from carbon-intensive sources. There is, for instance, over 27 MW of Anaerobic Digestion (AD) capacity in Wales from 46 projects totalling around 27 MW of electricity and heat capacity in 2017[47]. Our forthcoming Waste Strategy will set out the next steps in terms of maximising the energy and broader well being benefits of a circular economy. For further information on Waste to Energy please see Policy 74.

Policy 32 – Developing Routes to Market for Renewable Technologies

There must be a clear route to market for new generating capacity in order for Wales to increase renewable electricity generation. By route to market, we mean the ability of a potential project to have sufficient certainty of future income in order that it can source capital funding at a market rate. This responsibility is reserved to UK Government. The UKCCC has recommended a subsidy-free route to market for the cheapest low-carbon generation after 2020 (e.g. onshore and offshore wind, large-scale solar PV). However, whilst the Control of Low

47 https://gov.wales/docs/desh/publications/181113-energy-generation-in-wales-en.pdf



Carbon Levies allows for subsidy-free renewables to be brought forward, there is currently no route to market for them.

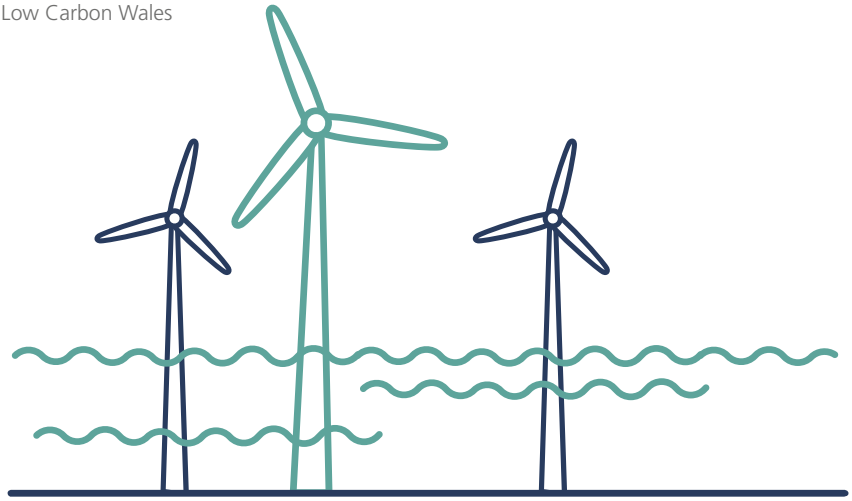
The UK also needs newer and emerging technologies to continue to be developed, to provide a diverse mix of generation, which can also provide economic opportunities in exporting technology and expertise.

The bulk of new generating capacity should be provided from the lowest cost technologies, as recommended by the UKCCC and a range of other industry sources, in order to keep the cost of energy bills down. However, both innovation and development funding is required to support technologies along the path of cost reduction and commercialisation.

Welsh Ministers have repeatedly written to UK Ministers on the need for continuing support for renewable generation, and in 2017 we published a statement in support of onshore wind and solar technologies jointly with a range of Welsh stakeholders. We continue to advocate the need for a route to market for the most affordable renewable technologies, whilst seeking innovative approaches that can enable new generation to continue to deploy within Wales.

UK Government's Clean Growth Strategy indicates that more nascent technologies such as wave, tidal stream and tidal range also have a role in the long-term decarbonisation of the UK. Wales is well placed to take advantage of the opportunities associated with the blue economy including wave and tidal energy. In Wales, significant EU funding through WEFO has already supported investment in wave and tidal stream technologies and demonstration zones, helping to reduce costs and support of the sector's path towards a cost competitive commercial market. However, further investment in the sector will be required to bring costs down to a level where it can compete for revenue support.

Offshore wind in the North Sea has dominated UK Government funding mechanisms recently. We are working with UK Government and the Crown Estate to ensure offshore wind sites in Wales can compete with those in the North Sea.



Case Study 7 – Gwynt Y mor – Renewable Energy

Gwynt y Môr is a 576-megawatt offshore wind farm located off the coast of North Wales and is the fifth largest operating offshore windfarm in the world and Wales' largest wind farm. The output of 1,950 GWh per year is capable of powering around 400,000 homes, or 30% of the homes in Wales. This prevents the release of approximately1.7 million tonnes of carbon dioxide every year.

The potential extension of the Gwynt y Môr site could double the energy generation and take the site up to over 1GW. The Crown Estate is currently considering opportunities for the next leasing round for offshore wind in the UK. There are currently two potential sites for Wales still under consideration for Leasing Round 4.

Welsh Government has commissioned and published research on the future of offshore wind in Wales to gain an understanding of opportunities in Wales. This has identified the following opportunities for offshore wind.

Table 3: Potential opportunities for offshore wind in Wales

Timeframe	Opportunity	Scale	Deployment timeframe
Near-term	Site extensions	0.5-0.6 GW	Mid 2020s
Medium-term	New leasing	1-3 GW	By ~2030
Long-term	Floating wind	Multi-GW	Beyond 2030

Maximising the benefit to Wales from the transition to a low carbon economy

The transformational change necessary to decarbonise the energy system requires change and innovation across the whole system. This change provides opportunity for Wales to benefit. We are working in a number of ways to ensure we capture the maximum possible benefit.

Policy 33 – Increasing local ownership of energy generation

In 2018 Welsh Government held a call for evidence on the benefits of, and challenges in, increasing locally-owned generation[48]. This demonstrated that increasing ownership of energy generation within Wales is likely to increase prosperity and we are now taking forward the actions indicated by the evidence. This includes developing a policy position on ownership of energy generation.

We are providing support through our Welsh Government Energy Service to build partnerships between communities and developers and we have established a working group to help in developing guidance on increased shared and local ownership. We intend to deliver this guidance by the end of 2019. We will further develop evidence of the economic and social benefits of locally owned energy and will consider the need to adopt or develop a preferred methodology for benefit analysis.

Proposal 7 – Exploring potential for investment and new approaches to energy

The need for more local ownership of, and greater benefit from, energy is likely to need added investment and coordination. We have already outlined the support we provide to energy planning, project development and local ownership.

We will explore the need for greater investment in renewable generation and enabling infrastructure (such as storage, smart technology, data and grids). We will also explore alternative delivery models that might add value and accelerate delivery, and the role of Welsh Government in enabling this change.

Policy 34 – Maximise Welsh benefit from major infrastructure projects in Wales

Although the Wales Act 2017 delivers increased powers to Welsh Ministers, there are still many major infrastructure decisions made by UK Government and others. Welsh Government's approach is to ensure we understand the impacts on Wales and ensure we derive the maximum social and economic benefit from the development.

To date we have spent a significant amount of time and opportunity to ensure that the Wylfa Newydd nuclear power station would provide employment, training and a major legacy of benefits to Wales. Though this development is now on hold, if a decision is made to proceed,

48 https://gov.wales/topics/environmentcountryside/energy/renewable/local-renewable-energy-generation/call-for-evidence/?lang=en

we will ensure Wales benefits to the greatest possible extent.

Some consider the future of low carbon energy lies with Advanced Modular Reactors (AMR), which are smaller and less capital intensive developments. We are exploring the potential for Wales to become a leader in this field, developing technical skills that could lead to high value jobs in the Trawsfynydd area.

We will increase support for innovation in the Power Sector through:

Policy 35 – Energy Innovation

Welsh Government is working with the energy regulator, infrastructure owners and operators to ensure that energy infrastructure supports our ambitions, including the increased use of flexibility and storage. Our work will create the conditions for delivery of a smarter energy system: one that manages and moves energy between power, heat, transport and storage uses to match supply and demand.

UK Government has committed that every household will be offered a smart meter by the end of 2020. These are one component of the smart energy system of the future, enabling a range of functions including local balancing, and potentially the future development of local energy markets. Although the supplier led approach UK Government has taken makes it hard to take a coherent approach across Wales, we will continue to work with Smart Energy GB to help householders understand the importance of smart meters as one of many enablers

of an effective smart energy system. We are also working with Community Energy Wales to support and scale up pilots such as the Energy Local approach, which uses smart meters as enablers for local energy use.

We are also exploring solutions in Wales, which will enable the transfer of energy between vectors: i.e. from power to storage, transport or heat. This will maximise power infrastructure assets and build in flexibility that provides affordability, security and low carbon solutions. This is more fully explored in the section outlining our Whole Systems Approach to energy.

We have provided significant funding to support innovation within the energy system. Through the work Wales has developed in disruptive technology and smart energy, we have increased our potential to host strategic innovation projects. These demonstrators will showcase examples of innovative housing designs, small modular (nuclear) reactors, heat and ultra-low emission transport in the short to long-term timescales. This requires a high degree of innovation in order to provide solutions that meet people's expectations of reliability and affordability.

Energy network operators use the

innovation mechanisms administered by Ofgem to demonstrate new approaches to addressing network investment, and our innovation work has encouraged these projects in Wales. Examples of this include the Angle DC project where Scottish Power Energy Networks (SPEN) is trialling the use of direct (as opposed to alternating) current to increase grid capacity between Anglesey and the mainland. If successful, this will enable more power to pass through the existing system, avoiding or delaying the need for new infrastructure.

Wales will continue to support foundational work in the numerous demonstrator areas to create the right environment for innovation. Promoting Wales as a place where we encourage businesses to participate in accredited demonstrators to pilot innovation across buildings, power and transport will situate us as an ideal place to develop commercial marketable outcomes.

We have established a Task and Finish group on innovation to build an evidence base for our approach. We will work with academic and commercial partners to build on FLEXIS[49] and SPECIFIC[50] and other support and funding sources such as Smart Living, to compete for UK funding and develop innovation funding models.

Policy 36 – Market Regulation and Investment

In 2017 UK Government published the 'Upgrading our Energy System: Smart Systems and Flexibility' plan. This set out actions government, Ofgem and industry will take to

- remove barriers to smart technologies (such as storage and demand-side response);
- enable smart homes and businesses; and
- improve access to energy markets for new technologies and business models.

The plan included 29 actions designed to reduce the costs of the energy system and help keep energy bills low for bill payers. We have worked closely with stakeholders in Wales to ensure UK Government takes into account Wales' needs from the transforming energy system in developing their Plan. However, these actions alone are not likely to deliver the smart and flexible energy system we need for Wales. We will continue to work with UK Government, the energy regulator, Ofgem, the network owners and operators to find solutions within the current regime and identify where alternative solutions are required to develop the grid network we need in Wales.

We have also established joint working on the grid in Wales, which will initially focus on local and regional energy planning, as well as the emerging demand from electric vehicles. We are working with network operators to ensure their investment plans provide a grid, which enables the low carbon transition in Wales. If this is not successful there may be a case for further intervention.

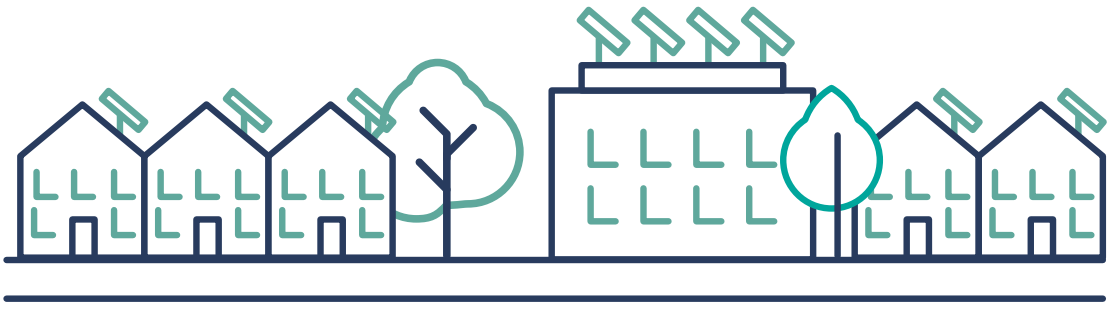
49 http://www.flexis.wales/

50 http://www.specific.eu.com/

7. Well-being

The aim of the policies and proposals for the first carbon budget and subsequent carbon budgets will be to work together to transition our power system from away from fossil fuels to low carbon system at a scale and rate that maximises their contribution to the well-being goals.

The move to cleaner, low carbon generation also provides other benefits to society. For instance, a decentralized system contributes to protecting householders and businesses from high energy costs by locating generation near to demand, improving the resilience and flexibility of our energy system and keeping more economic benefit within local communities. Therefore, the move away from fossil fuels combustion to a more low carbon electricity system contributes significantly to all our well-being goals. For instance our Well-being Matrix tool identified how the local ownership element of our renewable energy policy provides strong benefits in relation to all the well-being goals.



Buildings

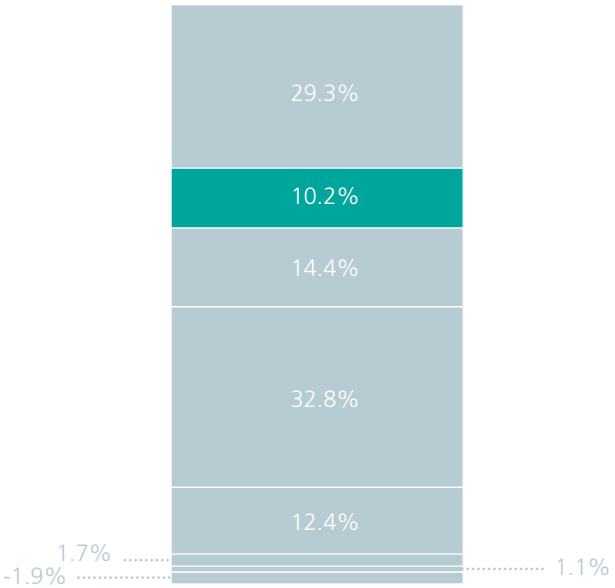
This chapter covers the residential sector (all of Wales' housing including owner occupied, private and socially rented homes) and the non-domestic buildings in the public and commercial sectors. The majority of the emissions in this sector are related to how much energy we use to heat our buildings.

1. Ambition

If Wales is to meet its climate targets, buildings will need to operate at close to zero emissions by 2050. This will require a substantial change in how we heat and power buildings in the future. The amount of energy used in our buildings will have to be significantly lower. The electricity we use to light and increasingly heat our buildings will be from low carbon and renewable sources. When gas is needed for heating to meet demand, as a supplement to other sources, the proportion of green gas such as biomethane or hydrogen will be higher.

Heating our homes is a particular challenge given the current dependence upon fossil fuels and an energy inefficient and old housing stock.

Decarbonisation of heat is likely to have regional variations, taking advantage of local opportunities. The speed of retrofit of existing buildings will need to be greatly increased and new building will need to be built to higher energy standards.



We will also need to continue to decarbonise the heat supply of buildings. How this will be achieved will need to be a local decision, based on building type and the infrastructure and skills available. In some cases, for both off-gas and on-gas grid buildings, there will be low regrets option. In other cases, the best solution will be less clear and further investigation will be needed. These various interventions will make our homes, shops, offices, schools more efficient and more affordable to heat.

Achieving significant emission reduction from the built environment will require changes to behaviours and the adoption and effective use of smart energy technologies. Towards 2050 the decarbonisation pathway will require significant changes to how we interact with our homes and places of work.

2. Where do Building emissions come from

The buildings sector covers emissions from heating and cooking in our homes, businesses and public sector buildings. At 4.3 $MtCO_2e$, buildings accounted for 9% of Welsh emissions in 2016. The dominant source of emissions is from residential buildings, which make up 82% of the sector emissions and 7.5% of total Welsh emissions. Business sector buildings make up 10% of the sector's emissions (0.9% of total Welsh emissions) and public sector buildings make up 8% of the sector (<1% of total Welsh emissions). Practically all building emissions (96%) are emissions of carbon dioxide.

Figure 11: Graph: Buildings sector emissions in 2016[51]

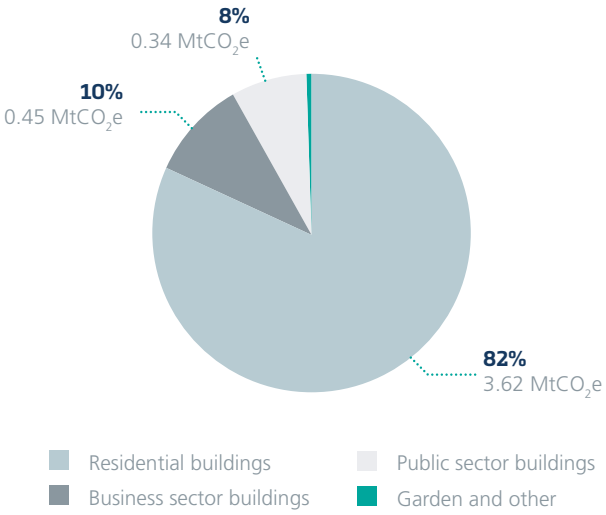


Table 4: How the biggest emissions sources in the buildings sector contribute to the Welsh total

Source	% of total Welsh emissions
Residential buildings	7.5%
Business sector buildings	0.9%
Public sector buildings	0.7%

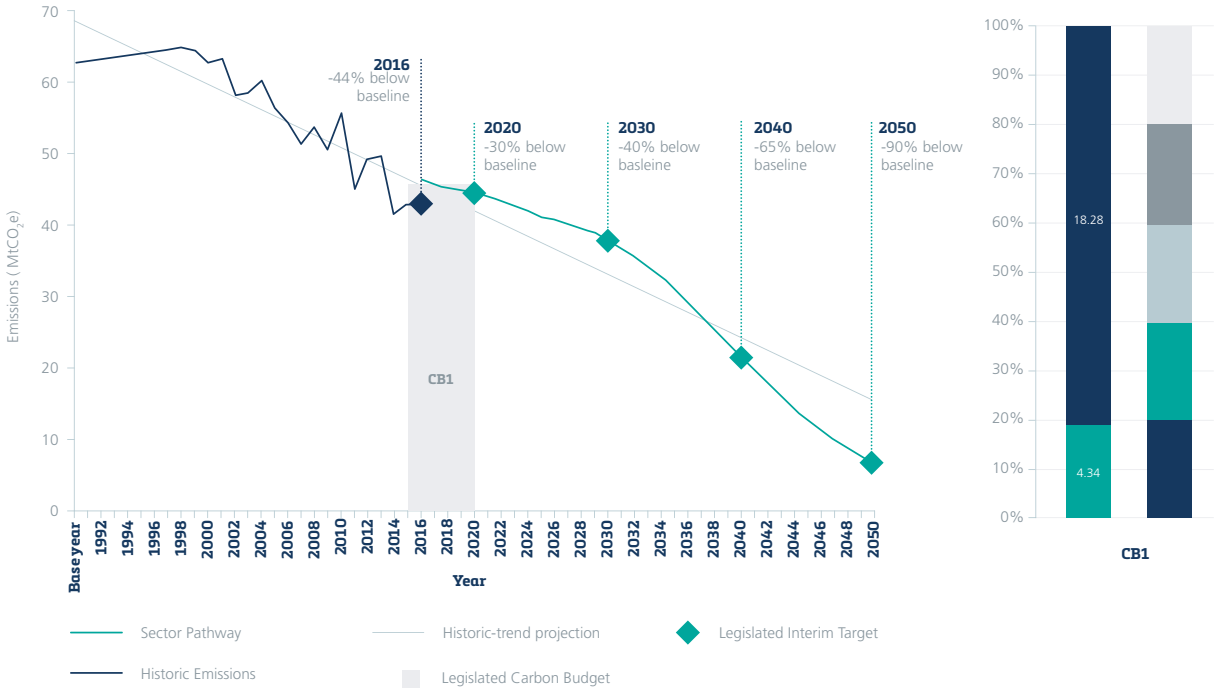
3. Progress to date

Total emissions from the buildings sector in Wales have decreased by 31% between the base year (1990) and 2016, driven largely by a change to the fuel mix from coal to natural gas and energy efficiency measures.

In 2016, the first year of our budget period, emissions from the Welsh buildings sector were broadly unchanged increasing by 0.8% compared to 2015. Our Buildings sector is strongly influenced by temperatures in Wales and there can be significant year-to-year variability.

51 The emissions data is sourced from the Greenhouse Gas Inventories for England, Scotland, Wales & Northern Ireland: 1990-2016 and aligned to the UKCCC sectors as described in Annex 3

Figure 12: A graph to show historic emissions for the Buildings Sector and UKCCC modelling to show emission reductions for the first carbon budget (CB1) and a possible route for a contribution to an 80% reduction in all Welsh emissions in 2050



4. What are we aiming for?

2020 emissions target

Emissions in 2020 will be 1.9% higher than in 2016. This will mean that Buildings sector emissions are 30% lower than the baseline in the year 2020.

Buildings sector allocation for Carbon Budget 1 (CB1)

The total budget for the Buildings sector for CB1 is estimated to be 22.6 MtCO2e[52]. The Buildings Sector contributes 10.2% of the total Welsh budget for CB1.

In 2016 the sector emitted 4.3 $MtCO_2e$ using up 19% of the Buildings Sectors contribution to CB1.

Power Building sector pathway to 2030

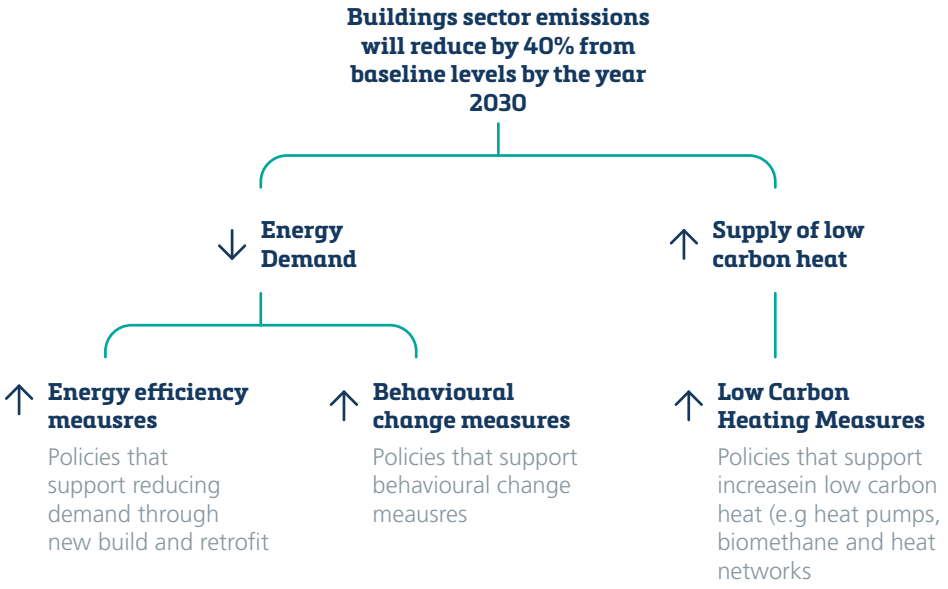
Buildings sector emissions will reduce by 40% from baseline levels by the year 2030 as a result of:

- energy efficiency measures;
- low carbon heating measures; and
- behavioural change measures to the way we run buildings.

52 Analysis based on 1990-2016 GHGI. All absolute figure referenced here will vary slightly as our understanding of GHG emissions in Wales improves

5. How we are going to get there?

Figure 13: Policy Framework for Buildings Aligning policy action to meeting targets, budgets and 2030 pathway



6. Policies & Proposals which contribute to our carbon budget and targets

Energy efficiency measures will be crucial to meeting our carbon budgets and targets. Wales has 1.4 million homes across a wide range of housing types, including a significant proportion of older buildings. Wales has a slightly higher proportion of solid-wall homes than the UK[53], which means more of our housing stock is more expensive to insulate. The decarbonisation of heat is also crucial in reducing emissions from the sector. Around 1 in 5 of our homes is not connected to the gas grid, a higher proportion than the UK as a whole[54]. This means more Welsh homes will require individual low-carbon heating solutions. We are also looking how behavioural change can help to reduce emissions in this sector. The emission reductions required to meet CB1 and the 2020 target will be delivered by the following policies and proposals:

We will Increase the Energy Efficiency of buildings through:

Policy 37 – Funding and Delivery of our Warm Homes Programme

The *Welsh Government Warm Homes Programme* is our domestic retrofit programme targeted at the fuel poor. It is made up of the demand-led Nest and area-based Arbed schemes and tackles fuel poverty by providing energy

53 https://www.theccc.org.uk/wp-content/uploads/2017/12/CCC-Building-a-low-carbon-economy-in-Wales-Setting-Welsh-climate-targets.pdf
54 https://www.theccc.org.uk/wp-content/uploads/2017/12/CCC-Building-a-low-carbon-economy-in-Wales-Setting-Welsh-climate-targets.pdf

advice and improving the energy efficiency of the homes of people on low incomes or living in the most deprived areas of Wales. Between 2011 and March 2018, we have invested over £240 million in Warm Homes to improve the energy efficiency of over 45,000 homes throughout Wales, making them warmer and more affordable to heat. As a result of our efforts and investments, the percentage of households in Wales in fuel poverty has reduced from 29% in 2012 to 23% in 2016.

Between 2016 and 2018 we invested £44.5 million and secured a further £5.7m from the Energy Company Obligation. During this period, we improved 11,000 homes and provided free impartial advice to 29,000 households. Recent research[55] has also confirmed the positive impact of our programmes in addressing chronic health conditions of the participating households – thus reducing longer-term pressures on our health and social care services.

From March 2018 to March 2021, we expect to invest a further £106m, which includes £24m of European funding, to improve a further 20,000 homes and provide advice to a further 45,000 households.

Well-being Goal Spotlight – Cohesive Communities

> Residents under the Arbed scheme have indicated the positive impacts the scheme has had on their communities, in addition to the benefits they received as individual households. Householders were particularly appreciative of the improved visual appearance, which was an added benefit in some schemes and other community benefits such as the creation of local jobs. In addition, scheme managers were required to encourage the participation of Welsh SME's when procuring site contractors and other suppliers. This approach resulted in the creation of over 498 jobs and in many cases local people were employed to work on local schemes. The schemes delivered training including 2842 apprenticeship weeks and further training opportunities through graduate placements and work experience[56]

Policy 38 – Raising standards through our Welsh Housing Quality Standards

Another key policy improving the energy efficiency of existing buildings is the Welsh Housing Quality Standard (WHQS). There are over 225,000 social homes in Wales (16% of total homes) provided by Registered Social Landlords (RSL) and Local Authorities who still have their housing stock and all these properties must meet the WHQS by December 2020 and maintain it thereafter. The average energy efficiency band has improved from Band E in 2008 (Living in Wales Property Survey 2008) to Band D in 2017-18 (Welsh Housing Conditions Survey 2017-18)[57].

55 https://gov.wales/written-statement-fuel-poverty-data-linking-project

56 https://gov.wales/docs/desh/publications/171106-welsh-government-warm-homes-arbed-eu-project-final-report-en.pdf

57 Going from SAP 50 to 61 using SAP 2012 methodology on both years data See WHCS Headline report: www.gov.wales/WHCS

Nearly 204,500 social homes (91% of the stock) now meet the Welsh Housing Quality Standard (subject to acceptable fails) and we are on track to ensure all meet it by the 2020 deadline.

WHQS includes achieving an energy efficiency standard of SAP 65 or higher. This is the equivalent to EPC D rating on a scale of A to G. Currently 200,431 (89%) social homes have achieved SAP 65 or higher and work will continue on this up to and beyond 2020.

Welsh Government provides £108m of capital funding every year to Local Housing Authorities (through Major Repairs Allowance) and Stock Transfer RSLs (through Dowry Gap funding) which helps to fund the improvement works. This enables these landlords to lever in a much larger investment of their own funds every year to the WHQS programme.

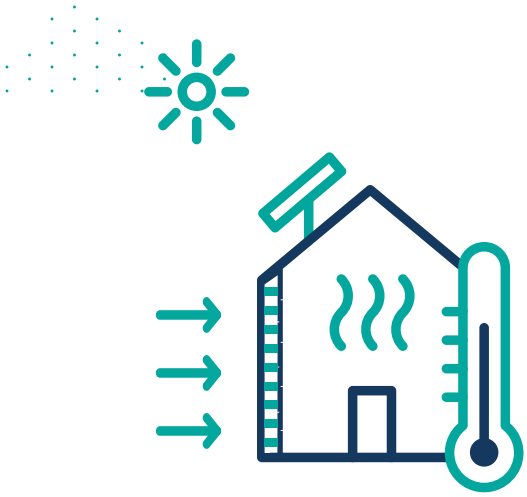
Proposal 8 – Improving our Evidence-base around residential retrofit programme

To meet our carbon reduction targets we need to scale up our retrofit activity especially with those able to pay for energy efficiency measures. Our first step, which is underway, is to develop a long-term, evidence based programme to improve the quality of homes, reduce emissions and tackle fuel poverty. Based on evidence of what works, we are developing a programme of action to decarbonise all homes in Wales by at least 80% by 2050, regardless of their tenure.

To ensure that the programme is founded on a wide-reaching and long-term basis, an industry-led advisory group was formed in Spring 2018. The Advisory Group on the Decarbonisation of Homes in Wales (DAG) consists of a main group, with a wide range of expert membership drawn from industry, landlords, academia, research and third sector bodies, as well as local authorities, trade bodies and Welsh Government. The work of the main group is to consider the evidence needed to develop and deliver a programme and recommend appropriate types of action and support, including levers, incentives and disincentives to increase the uptake of energy efficiency measures. The programme is considering short, medium and long-term actions. There are also a series of sub-groups covering technical and infrastructure, financial, government, customer confidence and community benefits. These groups have been meeting regularly since early summer 2018 and will report on their findings to Welsh Ministers in 2019. This ongoing work benefits from the results from Welsh Housing Condition Survey (WHCS), which was published in December 2018[58].

In spring 2018, a literature and critical review into research and publications around 'what works' in decarbonisation of existing homes was commissioned. This has been followed up by a project relating the findings of the review to the output from the WHCS. This allows consideration of how actions might be implemented, for example by tenure, area, or construction type or a combination of all these

58 https://gov.wales/welsh-housing-conditions-survey-assessment-elements-welsh-housing-quality-standard-april-2017-0



approaches and establishes an overall outline cost for the programmes and potential carbon savings. A 'Value Case' has also been commissioned to establish the wider benefits of well-being and health linked to reductions in health and social care spending as well as tackling fuel poverty, improving the warmth of homes, benefits to communities of major housing regeneration programmes and including the benefits of sourcing materials and skills in Wales. The findings will be published later in 2019. The delivery mechanisms and measures for the scaling up of a retrofit programme will be established based on the findings of the evidence programme and will include how to motivate and stimulate those homeowners who are able to pay for energy efficiency measures, whilst supporting those who need it regardless of tenure. Identifying and achieving behaviour change will be crucial to this.

Policy 39 –Setting higher energy efficiency standards for new builds through reviewing Building Regulations Part L (Conservation of Fuel and Power)

New construction offers opportunities to incorporate new energy systems and to implement much higher standards of energy efficiency.

Building regulations and planning have an impact on what house builders will produce through setting standard of regulated emissions for new housing, changes of use and renovation. Part L of our Building Regulations concerning the Conservation of Fuel and Power was revised in 2014. It has helped achieve emissions reductions of 8% and 20% in new residential buildings and all other buildings respectively.

We have recently commenced a further review of Part L, which is intended to be the next step on our journey towards a low-carbon built environment. This will inform future measures to improve energy efficiency standards for new and renovated buildings. The review will also consider the role of on-site renewable energy sources, the relationship between improved energy performance and indoor air quality and increasing concerns over summer overheating. Many of the recommendations from the recent UKCCC report[59] UK Housing; *Fit for the Future* will also be considered as part of the review. We envisage public consultation during the summer of 2019 leading to final decisions and making necessary regulatory changes towards the end of the year.

59 https://www.theccc.org.uk/wp-content/uploads/2019/02/UK-housing-Fit-for-the-future-CCC-2019.pdf

Policy 40 – Driving innovation through our Innovative Housing Programme

The Innovative Housing Programme (IHP) aims to create demonstrator schemes to help inform Welsh Government about the type of social housing it should financially support in the future. The programme runs to 2020. The programme seeks to support innovation in a broad context covering construction techniques, delivery pathways and housing types across all tenures. Refurbishment of existing residential dwellings is not eligible. A number of schemes have been funded in the first two years, with a total grant commitment of £53 million.

The schemes supported by IHP are assessed by an independent panel of experts against an evaluation framework as set out in the technical specification. Each scheme has to clearly define the proposed innovation and potential for future impact in seven focus areas, relating directly to the Well-being goals.

All IHP schemes are required to participate in the monitoring and evaluation exercise as a condition of funding and is integral to the success of the IHP. Welsh Government intends to build an evidence base to inform future policy and investment decisions. After initial analysis the data collected will be open sourced to enable further analysis and research to take place.

Case Study 8 – Innovative Housing Programme

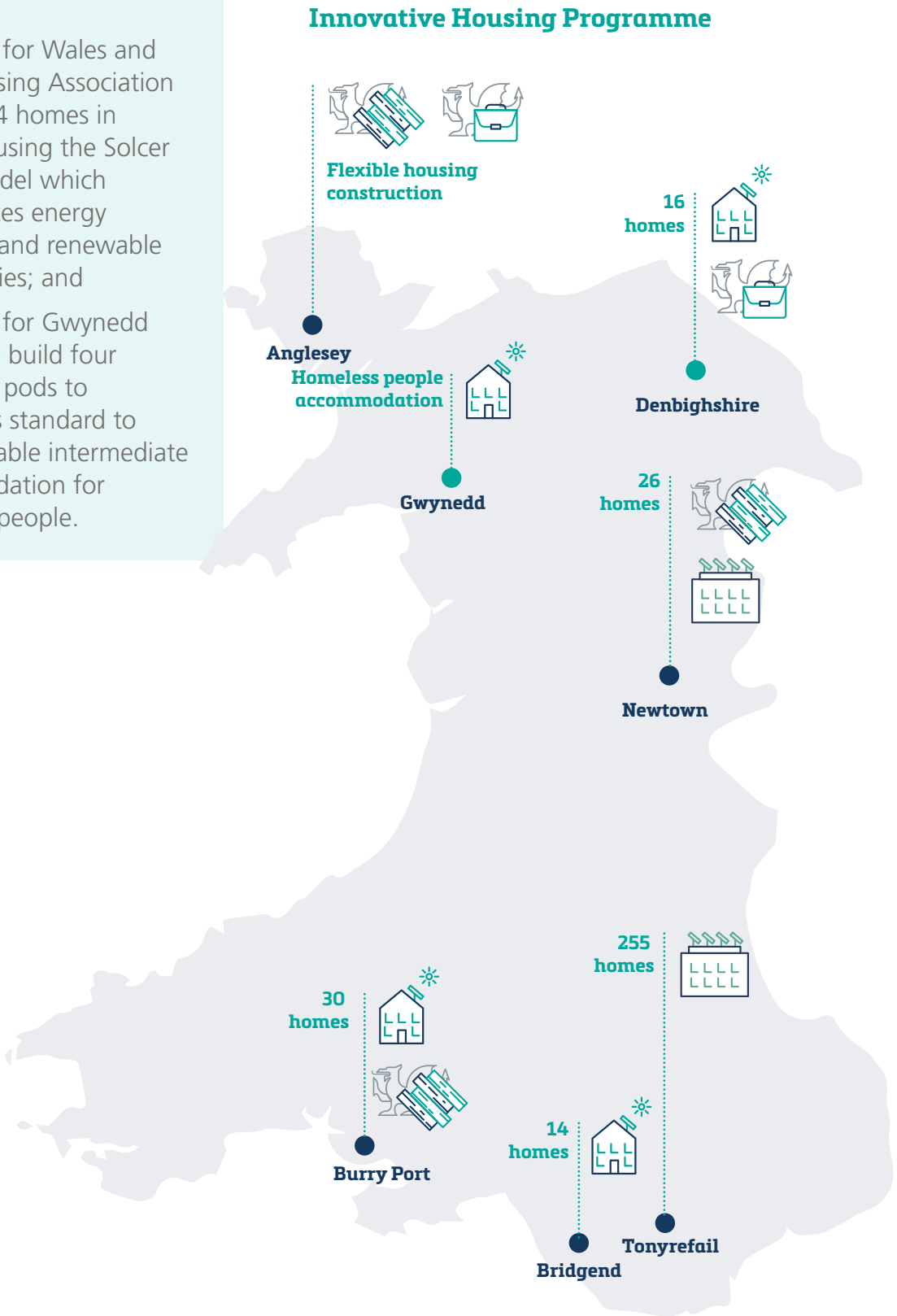
Houses that generate their own power, flats with vertical gardens and homes built using local supply chains are some of the projects to share in £43m of innovative housing funding in 2017. The second phase of the three-year Innovative Housing Programme (IHP) was announced in October 2018, worth £90m in total.

Successful projects include:

- Nearly £7m for Pobl Group who are developing 225 homes near Tonyrefail. The investment will create the infrastructure to ensure the homes can act as power stations – a UK first at this scale;
- £4m for Cartrefi Croeso to build 30 homes in Burry Port using Welsh timber, local off-site manufacturing using local labour and featuring Tŷ Solar panels manufactured in West Wales;
- £650,000 for Denbighshire Council to work with partners to establish a factory to produce timber-framed Passivhaus homes for local social landlords. Cartrefi Conwy will receive £442,000 to build 16 homes using the system. The local supply chain will provide training to local people who might otherwise face barriers to the jobs market;
- £1m for Anglesey Council working with Coed Cymru and social housing providers to deliver an affordable and flexible housing construction system using Welsh softwood and support

the development of a local supply chain;

- £2.6m for Powys Council to build 26 low-carbon homes in Newtown using Welsh timber;
- £839,000 for Wales and West Housing Association to build 14 homes in Bridgend using the Solcer House model which incorporates energy efficiency and renewable technologies; and
- £568,000 for Gwynedd Council to build four adaptable pods to Passivhaus standard to provide stable intermediate accommodation for homeless people.



Case Study 9 – SPECIFIC

Innovation plays a crucial role in the decarbonisation of Wales' built environment and we have been supporting the work of the SPECIFIC Innovation and Knowledge Centre[60]. The Centre is working with industry to develop new technologies and integration methods to support the concept that a building can generate, store and release its own energy. There are now several different "active building" demonstrators using different building methods and technology that could result in significant savings in energy consumption as a result of the buildings generating and storing a majority of their energy demand. Most recently the Centre has worked with POBL in Neath Port Talbot to design 18 active homes that has resulted in a successful application to the Innovative Housing Fund.

Proposal 9 – Developing Innovative construction techniques to reduce and meet the energy demand within buildings and increasing the use of sustainable materials

As well as looking at sustainable building design and techniques, sustainable building materials need to be used to reduce the embedded carbon footprint. For instance, the use of timber in construction can support domestic supply chains and reduce reliance on imported product. Currently around 80% of timber used in construction in the UK is imported. The demand for Welsh timber has previously been constrained by over-specification in design requirements, but these have largely been overcome. Better education and awareness programmes need to be developed and there is also potential for clearer regulation and standard setting.

To reduce emissions, we need to think about how we design and make buildings, driving innovative approaches such as offsite construction, design for adaptability, energy management and end of life.

Over the budget period we will capture the learning from the IHP and SPECIFIC demonstrators on decarbonising buildings where we are considering using different, more sustainable materials in construction. We will also ensure that energy regulation responds to the potential for new ways to distribute and manage energy within the built environment and in the longer-term, how evolving areas such as vehicle to grid approaches affect this.

Policy 41 – Funding more efficient buildings through our Sustainable buildings funding policy

With some exceptions for smaller projects, new buildings funded by Welsh Government are required to achieve an 'Excellent' rating under the BREEAM scheme (Building Research Establishment Environmental Assessment Method). The scheme assesses the long-term environmental impact of new buildings and the environmental performance of both new and existing buildings. BREEAM

60 http://specific.eu.com/

2018 New Construction is the latest version of the BREEAM Scheme. It covers many types of development including commercial offices, industrial units and retail (shops, retail park, showroom, restaurant, hot food takeaway). Typically BREEAM Excellent achieves between 8-11% higher energy performance than current building regulations.

Funding the Welsh Government Energy Service to drive energy efficiency projects across the Public Sector

As well as building in energy efficiency into homes, we are also taking action through the public sector. Over £60m of finance has been committed since early 2016 to fund the Welsh Government Energy Service. The service provides a range of support, including low cost finance, to support the public sector to deliver large scale energy efficiency and renewable energy projects. Energy efficiency measures vary widely and the focus to date has been on reducing heat and power demand. Longer-term activity is focused on delivering renewable heat and power locally.

For further information, please see Policy 11.

Policy 42 – Reducing emissions from listed buildings and scheduled monuments

Cadw has formed a Strategic Skills Partnership Agreement with Construction Industry Training Board (CITB), Historic England and Historic Environment Scotland to address the identified skills and vocational training needs of the construction industry in respect of the conservation, repair and maintenance of traditional buildings, and appropriate works of improvement to them, using sustainable methods of construction. The agreement and action plan identify eight areas of common interest and strategic importance, one of which is 'promoting the right knowledge and skills for energy efficiency retrofit and climate change adaptation of traditional (pre-1919) buildings'.

The suite of guidance produced to support the Historic Environment (Wales) Act 2016 also encourages owners to keep their buildings in a good state of repair in order to help reduce their carbon footprint, and to consider well-informed energy-efficiency measures. With regard to microgeneration, Cadw continues to promote its good practice guide 'Renewable energy and your historic building', which is available on their website.

Cadw actions on this over the past 12 months include organising three two day courses to deliver the Level 3 Award in Energy Efficiency Measures for Older and Traditional Buildings for practitioners. Further courses will be run by the Welsh Traditional Buildings Forum as part of a new four year training programme, which Cadw is grant assisting.

Policy 43 – Providing advice and support through Business Wales

Business Wales provides impartial, independent support and advice to people starting, running and growing a business in Wales. With regional centres across Wales, the service offers a mixture of online and face-to-face support, as well as training workshops and individual advice. This can include advice on energy efficiency measures aimed at encouraging take up and helping to reduce carbon emissions. In line with the EAP, Business Wales provides advice to individuals and businesses on how to become more sustainable and environmentally aware. In-line with the principles of the EAP, Business Wales has introduced a Green Growth Pledge that places a responsibility on companies accessing support to take positive action to reduce the impact that their businesses have on the environment.

Case Study 10 – Green Growth Pledge

The Green Growth Pledge is part of the specialist sustainability support available through Business Wales and is open to all Welsh SMEs regardless of their industry sector. It provides a practical way for businesses to demonstrate their positive impact on the people and places around them and join a growing community of forward-thinking organisations.

By signing up to the pledge, each company is asked to make a commitment to one or more actions to help them reduce impact or ensure sustainable performance.

The key role of Business Wales will be one of education and information dissemination to SMEs across Wales, including Micro enterprises which make up about 95% of businesses. This will be done through online, telephone and face to face delivery channels. Business Wales is funded by European Regional Development Fund (ERDF). Planning is underway to consider the shape of the service post EU funding.

We will Increase the use of low carbon heat through:

Proposal 10 – Scoping out the challenges and opportunities around low carbon heat

Heating constitutes a major part of the decarbonisation challenge as heat accounts for almost half of UK energy use and a third of UK carbon emissions. The need for cooling is predicted to increase and should also be considered as part of future energy demand. The Energy Generation in Wales survey estimates Wales produced 2,092 GWh of renewable heat in 2017[61].

- There was 596 MW of renewable heat capacity in 2017.Renewable heat generation in 2017 (2,092 GWh) was the equivalent of 10.5% of estimated Welsh domestic heat demand.
- Biomass made up 66% of 2017 renewable heat capacity.

Further work is needed to decarbonise fossil fuel heat in Wales, both through decarbonising the existing gas network and finding alternative sources of heat. We also need to consider the implications of more integrated heat, power and transport. Some forms of bioenergy are being used to generate electricity and others to power transport. Given the need to decarbonise both heat and transport, there may well be competition between vectors for the same resource.

As part of our approach to energy planning, we are mapping the sources of renewable energy potential in Wales. This will include the resources that might generate heat, from waste heat to agricultural slurry to geothermal sources such as disused mine workings. This mapping can be considered against sources of current and future demand, both for heat and transport. For example, in Wales there is currently only one connection injecting biomethane into the gas grid. Given Wales' agricultural strength there appears to be considerably more potential here. Mapping biofuels against the gas networks might indicate potential for gas injection or potential off grid solutions.

There is considerable uncertainty about the best options for decarbonisation of heat (with the exception of some low regrets actions such as injection of biogas into gas grids). Decisions regarding heat infrastructure, such as the potential for conversion of the gas network to hydrogen and regulatory frameworks, are likely to be made at a UK level. Welsh Government is focused on ensuring decisions and programmes made by UK Government take account of Wales' needs and particular circumstances.

Case Study 11 – The FREEDOM Project

FREEDOM (Flexible Residential Energy Efficiency Demand Optimisation and Management) Project, a joint Wales & West Utilities and WPD £5m innovation project in the Bridgend 'living heat laboratory' in South Wales. Using an air-source heat pump and high-efficiency

61 https://gov.wales/topics/environmentcountryside/energy/renewable/energy-generation-in-wales

gas boiler hybrid system in 75 residential properties, the project clearly demonstrates the value that an integrated approach to deploying low-carbon smart technologies can deliver. Project estimates suggest that a hybrid approach to decarbonising our heating that is combined with green gas growth could lead to as much as an 80% reduction in carbon emissions from domestic heat.

Wales is also participating in the Heat Networks Innovation Programme, a £320 million programme to build capacity in heat network delivery in England and Wales. Heat networks are most effective in densely populated areas and need sizeable anchor customers in order to enable new developments to secure the necessary long-term funding. Most UK projects are being developed by the public sector to deliver regeneration and fuel poverty outcomes. Welsh Government is providing additional capacity to public sector organisations in order to maximise the opportunity for Wales from this programme. However, the largely rural nature of Wales means heat networks are likely to be a small part of the response to decarbonising heat.

Tackling the decarbonisation of homes off the gas grid is a key challenge for Wales and has strong links to fuel poverty. UK Government's Renewable Heat Incentive (RHI) has driven the uptake of low carbon heating. The level of incentive has reduced as deployment of renewable heat has increased. While there has been good take up of biomass boilers and biomethane on the scheme, take up rates for other RHI eligible technologies, such as heat pumps, has been mixed. Increased uptake of renewable technologies will require better public understanding of the available options as well as continued cost reduction and increased education and training among installers and engineers.

UK Government is working with the off gas grid heating industry to explore effective ways of decarbonisation, including replacing fossil heating fuels with lower carbon alternatives, and Wales is represented in these discussions.

Our work on energy planning at the regional and local level will provide stronger insights into the opportunities and priorities for Wales. We are also conducting a review of the available evidence on heat to support development of heat policy for Wales. Wales is already hosting a number of pilots to help develop knowledge in this area and is well placed to derive benefit from developing skills and economic opportunities in relation to heat.

In addition, our national planning policy in *Planning Policy Wales* encourages the consideration of low carbon heat options for new development. Planning authorities are expected to plan positively for the use of locally generated heat, including developing policies and proposals which:

- facilitate the co-location of major developments to enable the use of local heat opportunities;
- maximise the use of water heat;
- promote district heating; and
- promote Combined Heat and Power (CHP) schemes.

Proposal 11 – Increasing the use of Waste Heat and low carbon heat

We are currently supporting the development of a number of heat networks, including a proposed network in Cardiff utilising waste heat from Viridor's Energy from Waste Plant. Cardiff City Council cabinet approved the Outline Business Case in April 2018.

We are already supporting local authorities to develop district heating projects through our Wales Energy service and are supporting them to access the UK Government's Heat Networks Investment programme funding. We will work with industry to consider what support might be needed to increase the level of heat recovery schemes.

Case Study 12 – Cardiff Heat network

The Cardiff Heat Network scheme proposes to distribute heat generated by the Viridor energy from waste plant in Cardiff Bay to local buildings.

The waste heat is significant and a potential source of low carbon heat for the businesses and residences of south and central Cardiff.

Steam generated through the burning of non-recyclable waste at the Trident Park energy recovery facility in the south east of the city would be used to heat water that would then circulate around the network. It would run from the plant through large parts of Cardiff Bay before travelling up to the city centre. Public sector and commercial buildings could be connected, potentially saving on their energy costs. The first phase of the proposed network will serve public sector buildings south of the main Cardiff to London railway line these include Council buildings, along with those of the National Assembly for Wales, Wales Millennium Centre and Cardiff and Vale College.

We will look at the options around behaviour change through:

Policy 44 – Piloting Smart Flexible and Digitalised System to reduce demand

During 2019, we will start to explore how to motivate and stimulate those homeowners who are able to pay for energy efficiency measures, whilst supporting those who need support regardless of tenure. In doing this, we need to involve citizens and be mindful of unintended consequences.

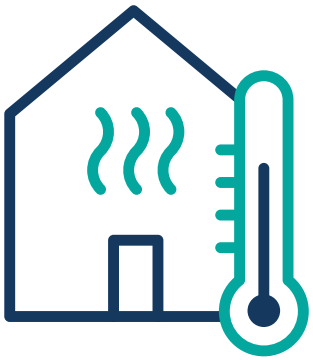
We are working with stakeholders as part of Welsh Government's retrofit decarbonisation programme to explore behavioural change as a potential lever for reducing emissions from homes. The DAG are exploring the complex consumer behavioural interactions with buildings so that they can be taken into account in the recommendations being made to Welsh Government later in 2019 on retrofitting Wales housing stock.

In addition, Smart Living and our Innovative Housing Programme are encouraging the use of using smart and digital systems to help reduce

heat demand at a household level and transition to decarbonised heat. The projects will be monitored over the long-term to provide an evidence base and better understanding on how people behave and interact with these systems. Initial projects include Energy Systems Catapult HESG, Freedom in Bridgend and the Pobl Active Homes Neath project. Also, the Energy Systems Catapult has been conducting trials in 100 homes including Bridgend using their innovative HESG (Home Energy Services Gateway)[62].

Policy 45 – Incentivising energy efficiency of homes through our Help to Buy – Wales

Our current Help to Buy Wales policy allows eligible purchasers to buy new-build homes with assistance from Welsh Government in the form of a shared equity loan. The Help to Buy Wales mortgage calculator now includes an energy efficiency element. This means when people look at the cost of mortgages, they will be given different options depending on the energy efficiency of the property they are looking to buy and loans will be adjusted according to the energy rating of the home they choose.



7. Well-being

The aim of the policies and proposals for the first carbon budget and subsequent carbon budgets will be to work together to reduce emissions from our built environment at a scale and rate that maximises their contribution to the well-being goals.

Policies set out in this chapter that improve the energy efficiency of residential buildings will provide benefits in terms of improved comfort and health outcomes[63] resulting from cold, damp housing. Lower energy consumption, which could lead to lower energy bills, will depend on the extent to which higher internal temperatures are increased as many fuel poor household currently cannot afford to heat their homes to a comfortable level[64]. In addition, the switch away from polluting fuels for heating can also improve air quality.

The new construction of homes offers Wales the opportunity much higher standards of energy efficiency into our buildings for both current and future generations, avoiding the potential of high fuel bills. New construction of buildings also offers the opportunity to drive innovation on construction techniques and creates the skills, jobs and supply chains needed for new low carbon homes. The learning from the innovation housing programme will be crucial in informing new build over the period of this budget. For instance, our Well-being Matrix Tool, identified how the IHP already provides benefits in relation to the well-being goals and in particular strong direct benefits for a more equal, prosperous and, globally responsible Wales.

62 https://es.catapult.org.uk/projects/home-energy-services-gateway/

63 https://gov.wales/written-statement-fuel-poverty-data-linking-project

64 https://www.theccc.org.uk/wp-content/uploads/2017/12/CCC-Building-a-low-carbon-economy-in-Wales-Setting-Welsh-climate-targets.pdf

Transport

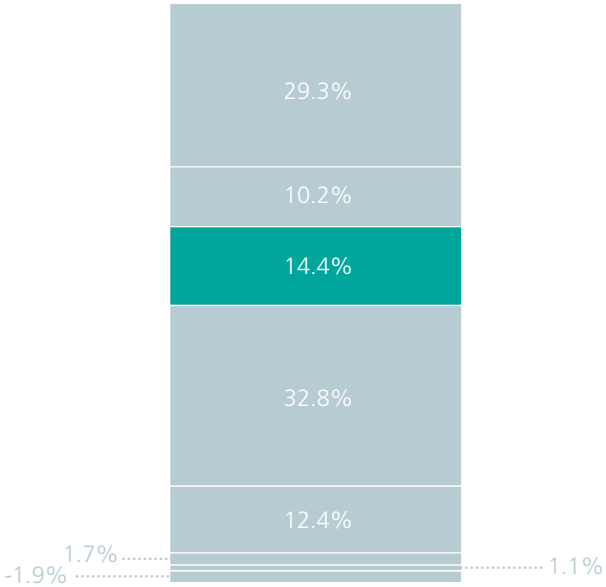
1. Ambition

Welsh Government is putting Wales at the forefront of a shift towards active travel and a low carbon public transport system which is accessible to all and contributes to liveable and sustainable communities. This is backed by a bold ambition for a zero emission bus, taxi and private hire vehicle fleet by 2028.

We have already announced a significant investment in our rail service and the plans for metro style frequency and integrated services will make public transport more attractive and connected. We need to transform the image and the reality of public transport to make it a more desirable alternative to the private vehicle. We are working to reform the bus industry in Wales and a zero emission bus fleet will contribute to improving the attractiveness of bus travel.

The most effective way of reducing CO_2 emissions in the near-term will be to replace car journeys with those using the existing public transport system and active travel. This will require a suite of infrastructure and behavior change measures working in tandem.

Planning Policy Wales sets out a sustainable transport hierarchy for planning and seeks to prevent car-dependent developments that discourage the use of active and sustainable transport. Increased cycling and walking improves health and tackles congestion, poor air quality as well as reducing CO2 emissions.



The decarbonisation of transport presents a serious challenge, but also, other, considerable opportunities. Transport emissions have largely remained steady over recent years despite improvements in vehicle efficiency but there is evidence that we're on the verge of an acceleration in the uptake of electric vehicles.

Wales will embrace the adoption of zero and ultra low emission vehicles in an inclusive manner and supported by the necessary investment in charging infrastructure. This will be a greater challenge away from urban centres. It is why we are investing £2m in the short-term to facilitate a network of rapid EV chargers. We will also assess the opportunities to promote renewable energy to support the increased demand for electricity.

We will show leadership by increasing the use of zero and ultra low emission vehicles in public sector fleets and will look to encourage innovative approaches to reducing emissions in all transport sectors.

2. Where do Transport Sector emissions come from?

The Transport sector includes transport emissions within Wales along with Wales' share of emissions from international aviation and international shipping. At 6.8 $MtCO_2e$, transport accounted for 14% of Welsh emissions in 2016. Transport is our third largest GHG emitting sector, following the power and industry sectors. Practically all transport emissions (99%) are emissions of carbon dioxide.

Figure 14: Graph: Transport sector emissions in 2016 ($MtCO_2e$)[65]

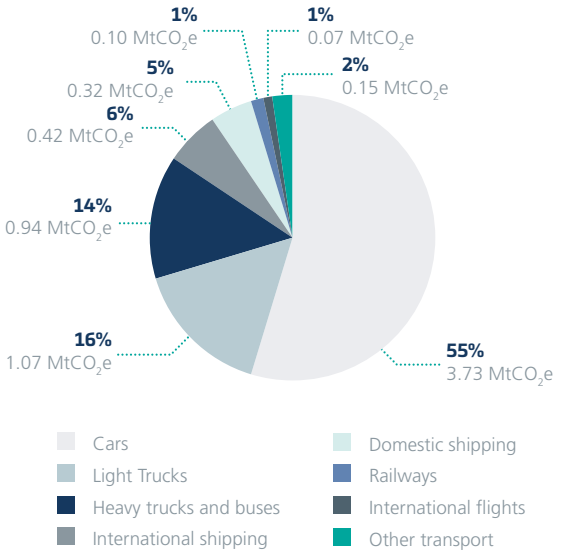


Table 5: How the biggest emissions sources in the transport sector contribute to the Welsh total

Source	% of total Welsh emissions
Cars	7.7%
Light trucks	2.2%
Heavy trucks and buses	2.0%

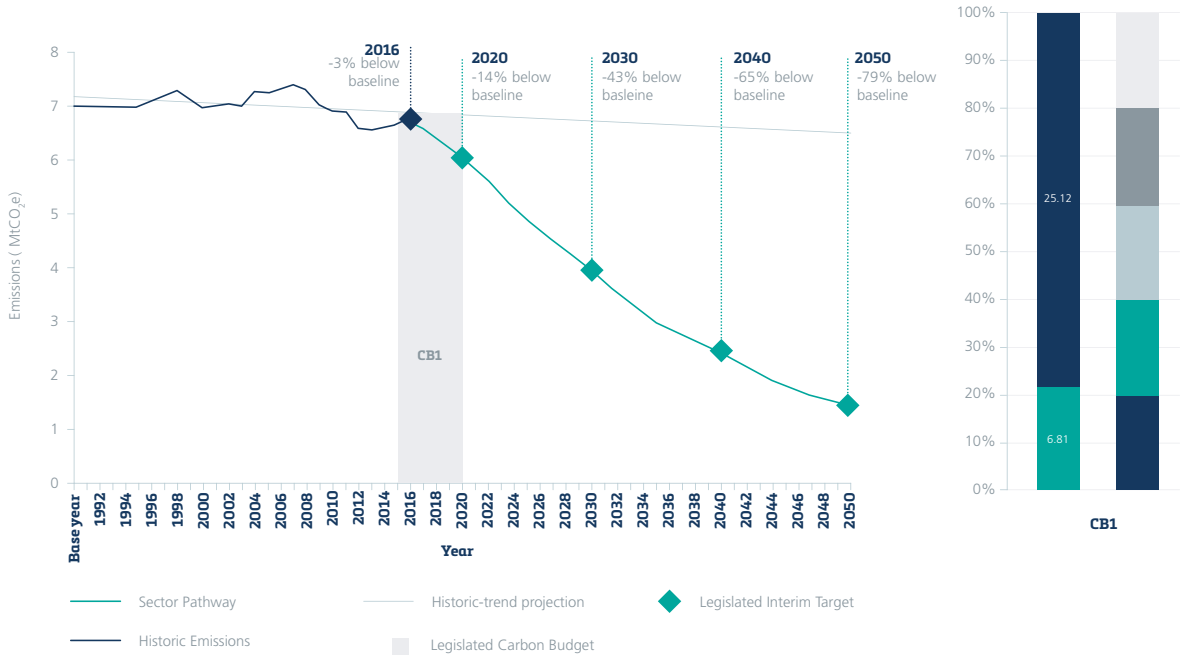
3. Progress to date

Although vehicles are increasingly efficient, we are also travelling more, so overall sector emissions have changed little since the 1990 baseline, declining by just 3% to 2016.

In 2016, the first year of our budget period, Welsh Transport Sector emissions increased by 2% compared to 2015.

65 The emissions data is sourced from the Greenhouse Gas Inventories for England, Scotland, Wales & Northern Ireland: 1990-2016 and aligned to the UKCCC sectors as described in Annex 3.

Figure 15: A graph to show historic emissions for the Transport Sector and UKCCC modelling to show emission reductions for the first carbon budget (CB1) and a possible route for a contribution to an 80% reduction in all Welsh emissions in 2050



4. What are we aiming for?

2020 emissions target

Emissions in 2020 will be 11% lower than in 2016. This will mean that transport sector emissions are 14% lower than the baseline in the year 2020.

Transport sector allocation for Carbon Budget 1

The total budget for the transport sector for CB1 is estimated to be 31.9 $MtCO_2e$[66]. The Transport Sector contributes 14.4% of the total Welsh budget for CB1.

In 2016 the sector emitted 6.81 $MtCO_2e$ using up 21% of the Transport Sectors contribution to CB1.

Transport sector to 2030

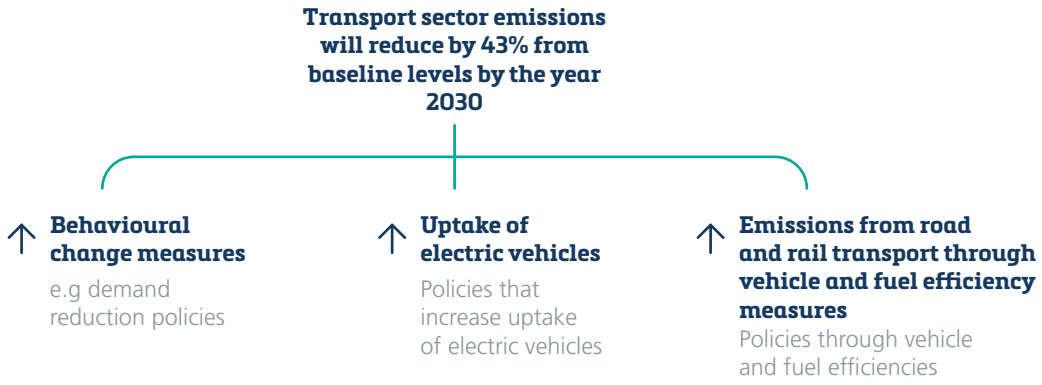
Transport sector emissions will reduce by 43% from baseline levels by the year 2030 through:

- behavioural change measures (modal shift to more sustainable travel);
- increasing uptake of electric vehicles; and
- reducing emissions from road and rail transport through vehicle and fuel efficiency measures.

66 Analysis based on 1990-2016 GHGI. All absolute figure referenced here will vary slightly as our understanding of GHG emissions in Wales improves.

5. How we are going to get there?

Figure 16 – Policy Framework for Surface Transport aligning action with policy action to meeting targets, budgets and 2030 pathway



6. Policies and Proposals which contribute to our carbon budget

Transport in Wales, like many other countries, is dominated by the use of the private car. The car has brought many benefits but is contributing to problems such as air quality issues, congestion and a significant proportion of CO2 emissions (55% of Transport CO2 emissions[67]. We will encourage a shift from an over reliance on the private car to more sustainable transport modes. This shift has a key role to play in emissions reduction in the near-term.

We will support a change in travel behaviours through:

Proposal 12 – working to achieve a modal shift from car dependency to sustainable forms of transport

Pleasant and safe cycling and walking routes are a priority to encourage more people out of cars. Public transport needs to be convenient and connected, utilising new and innovative mobile applications, to be a viable alternative to cars. Provision should be tailored to take into account the differing rural and urban contexts. We will work to integrate public transport interchanges and high quality walking and cycling infrastructure and facilities.

As well as infrastructure, we will look to encourage modal shift by working with partners to influence travel behaviours learning from previous initiatives to promote personalised and workplace travel planning and sustainable travel town initiatives.

We will look to roll out more car clubs and car sharing initiatives, and look at EV car clubs, as they have the potential to change people's attitudes to car ownership. The shift to autonomous vehicles also has the potential to radically shift the way we own and share cars. We will work to increase our understanding of the potential impact

67 DA GHG inventory (1990-2016)

of connected and autonomous vehicles on sustainable transport.

We will learn from the lesson from 'Sustainable Cities' initiatives in England and Wales and seek to increase our understanding of what drives peoples' choices and how they can be influenced. We will add to this work with high quality and comprehensive data and survey data on how, why, when and where people travel.

Case Study 13 - Traveline Cymru

Traveline Cymru is a not for profit business funded by Welsh Government and public transport operators in Wales. It helps to stimulate modal shift from private transport to public transport through the provision of up to date travel information about all local bus services, Bwcabus, TrawsCymru and rail services across Wales through a call centre, website, apps, journey planner and marketing campaigns across Wales.

Campaigns such as New Leaf, the Traveline Challenge and Traveline Heroes have all been designed to reach a wider audience and encourage customers to tell their friends and colleagues about the services provided, to challenge people to make changes to their travel habits and to be more aware of how making those changes can impact the environment.

Policy 46: Increasing Active Travel

We are investing in active travel routes which enable people to walk and cycle more.

Walking and cycling bring benefits in terms of personal health and reduced congestion and transport emissions in towns and cities and should, therefore, become the preferred ways of getting around over shorter distances.

The government is investing an additional £60 million over 3 years to implement our ground breaking Active Travel Act, placing a legal duty on all local authorities in Wales to consult with local communities and develop a safe network for walking and cycling. Highway improvement schemes must now incorporate actions to enhance provision for active travel.

This is further supported by numerous initiatives to break down barriers to everyday walking and cycling and increase the proportion of adults who cycle at least once a week from the current 6 per cent[68] such as Safe Routes in Communities, the Local Transport Fund, and the Active Journeys and Eco-schools programmes.

The public sector has a responsibility to take a leadership role in helping people to make more journeys by walking, cycling and public transport.

We have invested in schemes such as Nextbike in Cardiff, a clear example of the potential to change attitudes to active travel, where users had collectively cycled 140,000km within six months of the scheme launch in March 2018.

68 Active Travel Statistical Bulletin, December 2018, Welsh Government

Case Study 14 – Nextbike

Nextbike UK Ltd has been operating an on street cycle hire scheme in Cardiff since March 2018. The scheme was extended to increase the number of bikes and stations from 500 bikes and 50 stations to 1000 bikes and 65 stations. 250 e-bikes will also be installed in 2019/20.

Since its launch the scheme has made a very high profile and positive contribution to the visibility of cycling as a mode of transport in Cardiff. By October 2018 over 25,000 people had registered as members and over 110,000 rentals had taken place. Bikes are already being used for four trips per day, which is the highest usage statistics outside of London.

The scheme will provide enhanced access to affordable transport by socially and economically disadvantaged people, in particular those living in the Southern Arc areas of Cardiff. Increasing the number of trips made by bike can also play a key role in reducing noise and air pollution and lessening the negative impact of cars on local communities.

This could result in improving quality of life by delivering safe and easy to use transport to key facilities and services.

Proposal 13 – Significantly increasing modal share of active travel for short journeys

We will be reviewing our ambition for active travel, and will be developing challenging targets. We recognise that active travel initiatives will require sustained funding beyond 2020 in order to help realise ambitious plans for each local authority to create a comprehensive network of routes and make active travel the obvious choice for everyday local journeys.

We propose that this will need to be supported by measures to encourage people to use the infrastructure such as cycle training for all ages, personalised travel planning and an expansion of bike-share schemes.

Policy 47 – Increasing travel by rail

There were 30.45 million rail passenger journeys in Wales in 2016-17, the highest level since 1995-96.

A £2 billion investment programme will bring about a step-change improvement in the Wales and Borders Rail Service, benefiting communities the length and breadth of Wales. Delivered by Transport for Wales, the investment will enable new rolling stock, the modernisation of all 247 stations and the provision of new services, encouraging people to use the railway

network. By December 2023 an extra 285 (29%) more services every weekday will be operational. Electrified lines and new rolling stock will result in a 25% reduction in CO2 emissions across the rail network.

Case Study 15 – Metro

The South Wales Metro is an ambitious project connecting people with jobs and leisure opportunities across South East Wales in a fast, efficient and environmentally positive way, linking public transport and active travel.

Phase 2 of the Metro, to be delivered by Transport for Wales by 2023, will transform the current Core Valley Lines rail network to a more frequent and faster service. It will enable four trains per hour to each of the heads of the valleys (Treherbert, Aberdare, Merthyr Tydfil and Rhymney) and direct connectivity into Cardiff Bay from across the Core Valley Lines network. The newly electrified lines will be powered with 100% renewable energy.

We will build on this momentum and extend it to the North Wales and Swansea Bay Metro concepts. We committed an additional £50 million to move forward our plans for the North East Wales Metro.

Our ambitions for rail are greater, and we will continue to press UK Government to fund the development and delivery of an ambitious, realistic, and equitable rail investment programme for Wales to include the electrification of Wales' railway lines.

Policy 48 – Increasing travel by bus

We are working to reform the bus industry to improve quality and integration.

Welsh Government has a strong commitment to bus services in Wales, spending over £220 million each year on bus grants, concessionary fares,'MyTravelPass' young persons' discount scheme, non-emergency health transport, school transport, and the TrawsCymru service. 100 million passenger journeys in Wales are made each year by bus but it is recognised that improvements are needed to address weaknesses caused by the deregulation of the bus market. We also need to support the bus industry by ensuring that bus journey times are not hampered by congestion.

To deliver a truly integrated transport system in Wales, we need to ensure that bus services in Wales meet the needs of passengers and are integrated with rail and other transport services. The Welsh Government launched a White Paper consultation in December 2018 on proposals to legislate to improve the effectiveness of bus services including establishing Joint Transport Authorities, Enhanced Quality Partnerships, use of franchising, enable local authorities to run their own bus services and greater sharing of travel data.

We want to achieve a bus network that works for the people of Wales, that we can be proud of, and is sustainable in the long-term. That means it must work seamlessly with our plans for rail, road, active travel and strategic park and ride in order to create a high quality, low carbon, integrated public transport system across the country.

We published a draft Regulatory Impact Assessment (RIA) in January 2019, which will seek to identify the likely costs, impacts and benefits of the proposed legislative changes.

Policy 49 – Use planning policy to promote sustainable travel and reduce the need to travel

The planning system has a key role to play in reducing the need to travel and supporting sustainable transport. PPW, launched in December 2018 to underpin all future planning decisions, puts an emphasis on people and places to ensure developments built today leave a legacy of well-designed, sustainable places which improve lives.

Welsh Government's commitment to reducing reliance on the private car and supporting a modal shift to walking, cycling and public transport is reflected in the policy. The policy states that development proposals must seek to maximise accessibility by walking, cycling and public transport, by prioritising the provision of appropriate on-site infrastructure and, where necessary, mitigating transport impacts through the provision of off-site measures, such as the development of active travel routes, bus priority infrastructure and financial support for public transport services.

It is Welsh Government policy to require the use of a sustainable transport hierarchy in relation to new development, which prioritises walking, cycling and public transport ahead of the private motor vehicles. We will work to create new mixed use developments at major public transport interchanges which will give people the options to live and work without the need for private cars.

The transport hierarchy also recognises that Ultra Low Emission Vehicles also have an important role to play in the decarbonisation of transport, particularly in rural areas with limited public transport services. New non-residential developments providing 10 car parking spaces or more will now be required to have charging points in at least 10% of the spaces available. We will consult on amending Building Regulations to ensure that new homes and developments in Wales provide for EV charging capability.

We will use measures that increase the uptake of electric and ultra low emission vehicles through:

The transition to ultra-low emission vehicles, essentially battery electric vehicles, hydrogen fuel cell electric vehicles, and plug-in hybrid electric vehicles, is crucial to the achievement of our carbon reduction targets. Global and EU emission targets are driving change through the transport industry and technological advances offer massive opportunities.

Welsh Government believes that 60% of new car sales in Wales must be ultra-low emission vehicles by 2030, in line with the UK Climate Change Committee's central scenario.

Policy 50 – Increasing the proportion of vehicles which are electric and ultra low emission

We will encourage UK Government to retain incentives which promote the uptake of electric vehicles to ensure targets for the decarbonisation of transport are met.

UK Government has set out in 'The Road to Zero' how it will use its reserved powers and levers to promote this transition; to promote the affordability at this early stage of adoption and to support enabling infrastructure across the UK. The comparative costs of electric vehicles with their petrol and diesel equivalent is a key factor influencing their uptake. Price parity is anticipated by the mid 2020s but UK Government must not remove incentives before this is genuinely achieved.

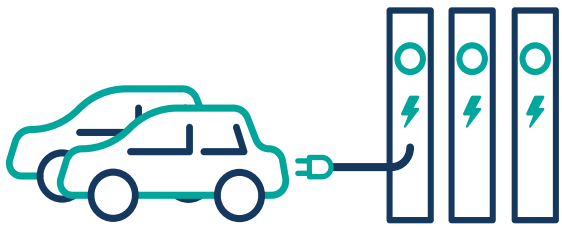
We will take account developments of all ultra low emission vehicle technologies and continue to engage with industry and academia to monitor the opportunities offered by technologies such as hydrogen fuel.

The radical changes which technology is enabling, and the possibilities offered by future Connected and Autonomous Vehicles have the potential to massively accelerate the decarbonisation of transport. The industry chapter of this plan sets out how Welsh Government will support innovation within Welsh businesses to address the challenges and opportunities of tackling climate change with transport will be a key element.

Policy 51 – Plan for and invest in EV charging infrastructure

We will work with UK Government, local authorities, the energy sector and business to plan for and implement the roll out of EV charging infrastructure. By investing £2m by 2020 we will help create a network of rapid charging points to enable longer distance travel by electric vehicles throughout Wales.

Lack of charging infrastructure should not be a barrier to EV uptake in Wales. We will set out a plan for public charging infrastructure to at least meet the demand created by 60% of new sales for cars and vans being electric vehicles by 2030 (around 35% Plug in Hybrid and 25% Battery electric).



Analysis undertaken for the UK CCC in 2018[69] estimates that the number of rapid chargers (43+kW) located near the major roads network needs to increase by 2.5 times by 2030 to meet en route charging requirements. The number of fast chargers (22kW) required for 'top-up' charging needs to increase ten-fold. The increase for both these types is likely to be greater in Wales which has proportionately fewer chargers currently than the rest of the UK.

We expect that business and industry will drive much of the roll out of charging infrastructure but it is essential that UK Government takes into account the differing geographical and economic context for the deployment of charging in more rural areas to ensure that no one is left behind in this transition.

The Road to Zero strategy sets out how UK Government will support the deployment of charging infrastructure throughout the UK through initiatives such as the £400 million Charging Infrastructure Investment Fund. We will work to encourage the uptake in Wales of UK Government grants such as the Electric Vehicle Homecharge Scheme, the Workplace Charging Scheme and the On-street Residential Chargepoint Scheme.

The planned large scale uptake of electric vehicles will place pressures on the electricity grid in Wales; we will work with the energy sector to plan for this. We will also support innovative actions to test and promote smart charging, renewable energy, energy storage and local energy network linked to electric vehicles.

Policy 52 – Aiming to reduce the carbon footprint of buses to zero by 2028

By ensuring that all buses in Wales are zero or ultra low emission we will contribute towards CO2 emission reduction and will help to deliver clean air in our towns and cities.

In addition to the actions to reform the bus industry described above, we will put in place a plan to deliver on the aim contained in Welsh Government's EAP to deliver zero tailpipe emission bus fleet by 2028.

Policy 53 – Aim to reduce the carbon footprint of Taxis and Private Hire Vehicles to zero by 2028

By promoting and facilitating an early transition to ultra low emission taxis Wales will make a big stride forward in decarbonising transport and improving air quality.

As at March 2018, there were just fewer than 10,000 taxis and Private Hire Vehicles in Wales[70]. Reducing emissions from taxis and PHV will contribute to improving air quality in our towns and cities as well as contributing to our decarbonisation targets.

69 Plugging the Gap: An Assessment of Future Demand for Britain's Electric Vehicle Public Charging Network https://www.theccc.org.uk/wp-content/uploads/2018/01/Plugging-the-gap-Assessment-of-future-demand-for-Britains-EV-public-charging-network.pdf

70 https://www.gov.uk/government/statistical-data-sets/taxi01-taxis-private-hire-vehilces-and-their-drivers

Welsh Government launched a consultation on proposals to legislate for reforming the licensing of taxis and private hire vehicles in December 2018. This included proposals that a national standard should apply which specifies requirements for the vehicular emissions of taxis and PHVs.

Proposal 14 – Piloting activity to promote the use of zero and ultra low emission road vehicles

We will assess the potential of pilot activity to trial the adoption of zero tailpipe emission public transport and taxis at specific locations and realise our ambition to establish Wales' first all electric public transport town in advance of wider roll-out. We will also assess the potential to use innovative approaches to link ultra low emission vehicles with community transport and energy schemes and links with renewable energy schemes.

Proposal 15 – Promote the decarbonisation of Private Sector fleets in Wales

Building on the work to decarbonise public transport fleets (covered in the Public Sector procurement section in this Plan) we will work to promote awareness of whole life costs and assess charging infrastructure needs for private transport fleets.

We will reduce emissions from road and rail transport through vehicle and fuel efficiency measures.

Policy 54 – Reduce Transport Emission

Welsh Government supports the use of challenging new vehicle standards to reduce CO2 and other emissions from transport and international policy action to reduce emissions in aviation and shipping. UK Government has pledged to pursue a future approach to vehicle emissions regulation that is at least as ambitious as current arrangements agreed at EU level.

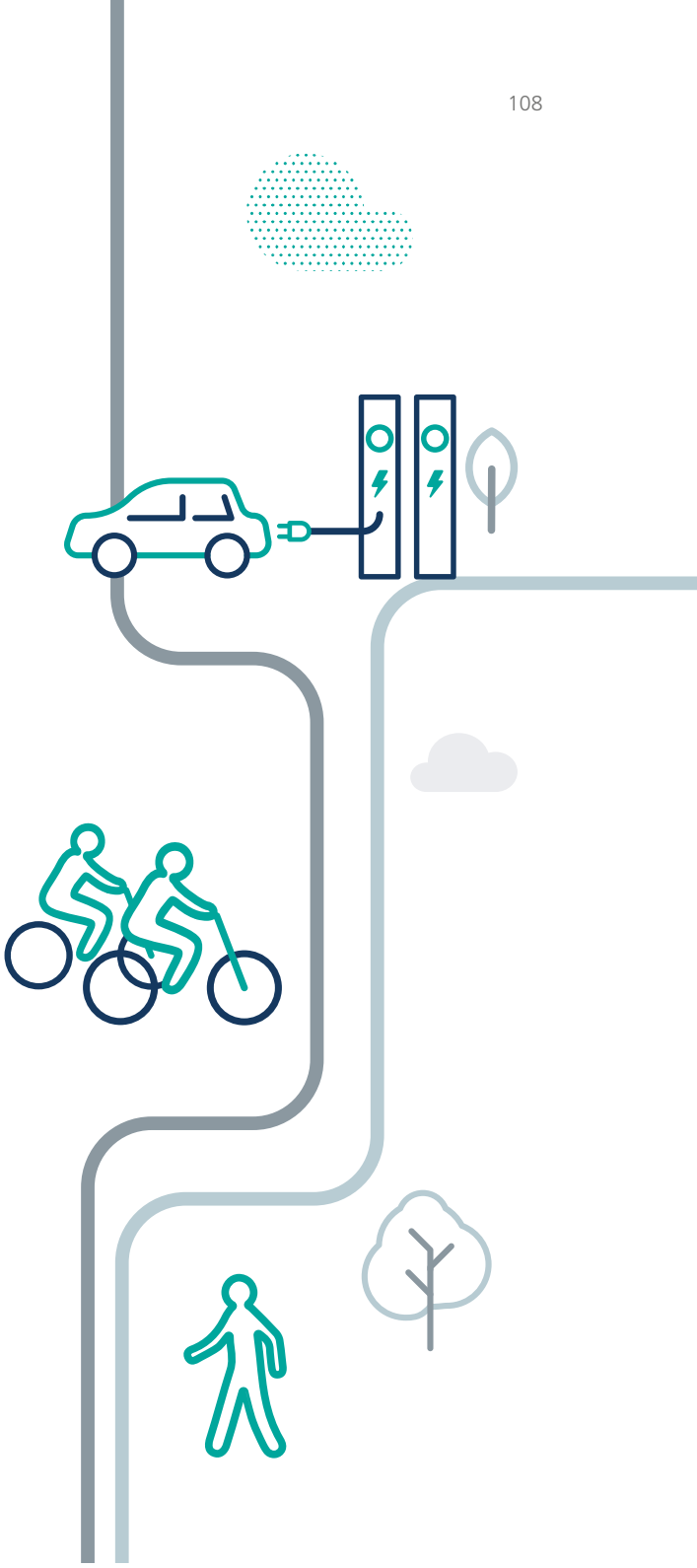
We are acting to reduce poor air quality on the Welsh road network and in towns and cities and have instigated a reduced 50 mph speed limit (current speed limit 70 mph) over 5 discreet stretches of motorway and trunk road to tackle poor air quality. We have developed a Clean Air Zone Framework for Wales which provides guidance to local authorities who are considering options to address local air quality issues. We will also consider the potential impact of a 20 mph limit in urban areas on vehicle emissions and the uptake of active travel taking into account recent assessments by Public Health Wales.

The new Wales and Borders Rail Service will attract new rolling stock that will reduce GHG emissions across the board by 25%. The new rolling stock will be operational by 2022. We will continue to press UK Government to fund the electrification of rail lines in Wales.

Welsh Government supports international efforts to push to reduce emissions from international aviation and shipping.

Improving choice at Cardiff Airport and supporting public transport links also means that air travellers need to travel less by private car to make air journeys.

Cardiff Airport introduced measures in 2016 which ensures operating aircraft use the shortest route to and along their final approach to the runway. This significantly reduces track miles covered by the aircraft. Cardiff Airport also encourages airlines to operate continuous descent approaches which significantly reduce fuel usage and require that aircraft taxiing from stand to runway operate at minimum power to reduce noise and fuel use.



7. Well-being

The aim of the policies and proposals for the first carbon budget and subsequent carbon budgets will be to work together to move towards a sustainability transport system that maximises societal well-being.

Travel in Wales is currently dominated by the private car. Therefore the transition to low carbon vehicles and modal shift to public transport and active travel, will have significant public health benefits in terms of reducing air pollution.

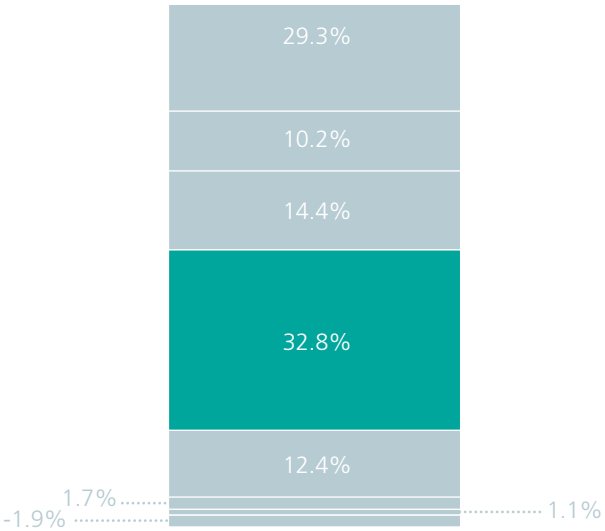
Active travel, such as walking and cycling, also provide other significant co-benefits. Lack of exercise is linked to diabetes, dementia, depression, heart disease and some cancers. This is reduced by greater use of active travel (i.e. walking and cycling). Not only does this have major benefit for health and the NHS in terms of cost savings, it also has major benefit for the transport system as a whole, and for the economy through more efficient use of our transport networks[71].

The Well-being Matrix Tool highlighted how the active travel maps against strong direct and wider benefits in relation to the well-being goals, in particularly against a healthier, more prosperous and cohesive communities Wales.

71 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/371096/claiming_the_health_dividend.pdf

Industry Sector

The industry sector includes manufacturing, construction, cement production, operation of machinery, food processing and the extraction and production of fossil fuels.



1. Ambition

In the low carbon transition, ensuring a sustainable, competitive industry and business environment is paramount. We need to steer the growth of a resilient economy where we can continue to exploit our capabilities in new low-carbon technologies and markets, underpinned by a competitive industrial base.

The UKCCC recognises that Wales has a higher share of emissions from hard to reduce sectors than the rest of the UK, including industry for which paths to very low emissions by 2050 have yet to be identified. The UKCCC modelling projects industrial emissions to fall marginally to the mid 2030s through incremental improvements to energy efficiency alongside switching to bioenergy and electrification of heat.

Emissions from industry include those from energy use and process emissions. Industrial sectors with significant process emissions include iron and steel, chemicals and cement. Energy consumption is a major cost element for companies of all sizes, especially energy intensive businesses and large sized energy users. Environmental policies such as the EU Emissions Trading System and the Carbon Reduction Commitment (CRC) Energy Efficiency Scheme encourage business and industry to operate in a more environmentally friendly way and provide an incentive to closely manage energy production and use, alongside reducing emissions.

Energy intensive industrial sectors, in conjunction with UK Government, have developed decarbonisation and energy efficiency pathways[72] which have identified technically achievable scenarios for further industrial decarbonisation and energy efficiency improvements to 2030 and 2050. These pathways have concluded further incremental carbon reductions can be achieved by a continued focus on energy efficiency technologies, material efficiencies across the sectors and, indirectly, through decarbonisation of the electricity grid.

72 https://www.gov.uk/government/publications/industrial-decarbonisation-and-energy-efficiency-roadmaps-to-2050

Longer term, innovation will be essential if we are to achieve significant industry emission reductions. This is not however, just about technology improvements. It is important that we innovate in developing how industries service their customers and finance investments.

In addition to supporting Wales based businesses to develop new products processes and services through Smart Cymru[73], we see potential for both industry and SMEs to adopt circular economy approaches to how they go about business. This includes being more efficient in the materials they use, utilising efficient local supply chains and considering options for recycling and reuse. Our lead support initiative for resource efficiency in businesses is delivered through the Smart Innovation programme[74].

There remain major barriers to the adoption of ideas including the utilisation of waste heat and carbon capture storage and use. We will continue to work with industry to further understand these challenges and the potential decarbonisation pathways. In addition, UK and EU funding has been targeted at these areas. We need to ensure the knowledge from the research and demonstrators is shared, as a long-term view will be required to take ideas from conception to demonstration.

Welsh Government is working with other funders to raise awareness of opportunities outside of Wales (e.g. Innovate UK) and to help build collaboration. The increase in the UK research and innovation budget offers a window of opportunity for Wales to leverage funding. We need industry to lead on this alongside relevant key partners.

2. Where do Industry sector emissions come from?

The industry sector covers emissions from business (apart from buildings and public electricity generators), energy production (apart from public electricity and heat production) and industrial processes. The sector includes emissions from processes such as chemical and metal production, refineries, manufacturing and construction, cement production, operation of machinery, food processing, and oil and gas extraction.

At 14.0 $MtCO_2e$ the industry sector accounted for 29% of Welsh emissions in 2016. Industrial emissions in Wales are dominated by iron and steel production and petroleum refining. Wider industry including manufacturing and construction, solid fuel production, cement, gas production and distribution, operation of machinery, minerals and mines, chemical production, food and drink processing and manufacture and paper and pulp also account for a significant proportion of emissions. Industrial emissions are largely comprised of emissions of carbon dioxide (95.83%), with smaller amounts of methane (3.54%) and nitrous oxide (0.63%).

73 Smart Cymru is offers financial support to Welsh businesses to help them develop, implement and commercialise new products, processes and services. Funding is provided by the European Regional Development Fund (ERDF) https://businesswales.gov.wales/expertisewales/smartcymru

74 https://businesswales.gov.wales/expertisewales/smartinnovation

Figure 17: Graph showing Industry sector emissions in 2016 [75]

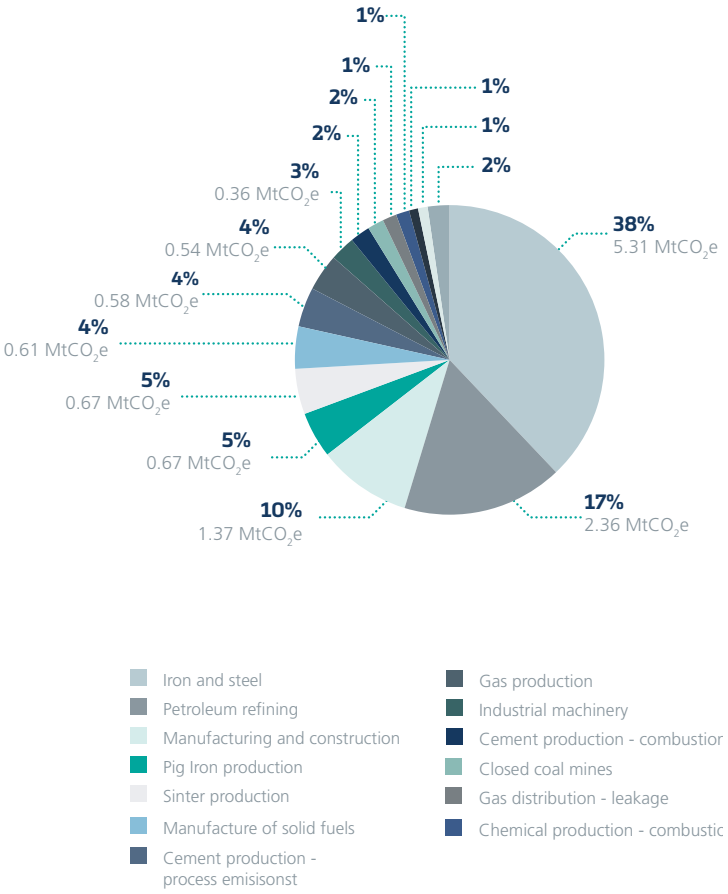


Table 6: How the biggest emissions sources in the industry sector contribute to the Welsh total

Source	% of total Welsh emissions
Iron and steel	11.0%
Petroleum refining	4.9%
Manufacturing and construction	2.8%

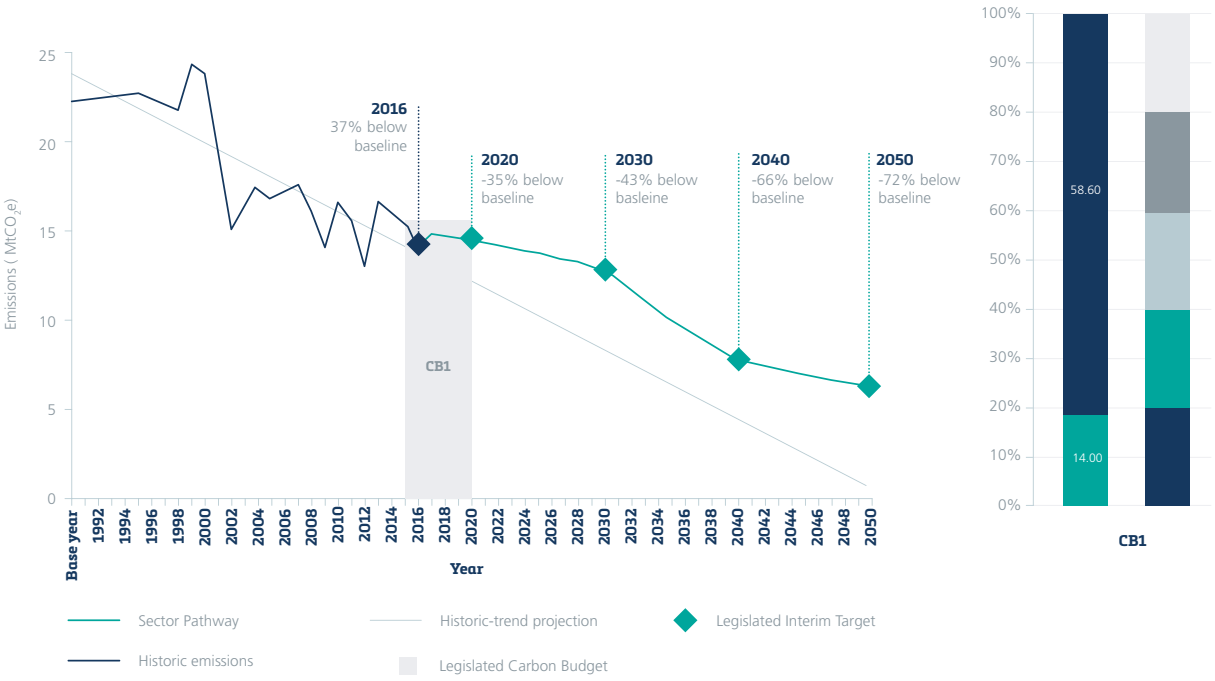
3. Progress to date

Total emissions from the Industry sector in Wales have decreased by 37% between the base year (1990) and 2016, driven largely operational changes, fuel-switching to less carbon intensive fuels and improvements in efficiency of production.

In 2016, the first year of our budget period, emissions from the Welsh Industry sector saw a 9% decline compared to 2015, driven by a significant decline in emissions from the iron and steel sector. Our industry sector is strongly influenced by variation in outputs at individual sites located in Wales and within the overall declining trend in emissions there can be significant year-to-year variability.

75 The emissions data is sourced from the Greenhouse Gas Inventories for England, Scotland, Wales & Northern Ireland: 1990-2016 and aligned to the UKCCC sectors as described in Annex 3.

Figure 18: A graph to show historic emissions for the Industry Sector and UKCCC modelling to show emission reductions for the first carbon budget (CB1) and a possible route for a contribution to an 80% reduction in all Welsh emissions in 2050



4. What are we aiming for?

2020 emissions target

Emissions in 2020 will be 3% higher than in 2016. This will mean that Industry Sector emissions are 35% lower than the baseline in the year 2020.

Industry sector allocation for Carbon Budget 1

The total budget for the Industry sector for CB1 is estimated to be 72.6 $MtCO_2e$[76]. The Industry Sector contributes 32.8% of the total Welsh budget for CB1.

In 2016 the sector emitted 14.0 $MtCO_2e$ using up 19% of the Industry Sectors contribution to CB1.

Industry sector pathway to 2030

Industry sector emissions will reduce by 43% from baseline (1990s) levels by the year 2030 by:

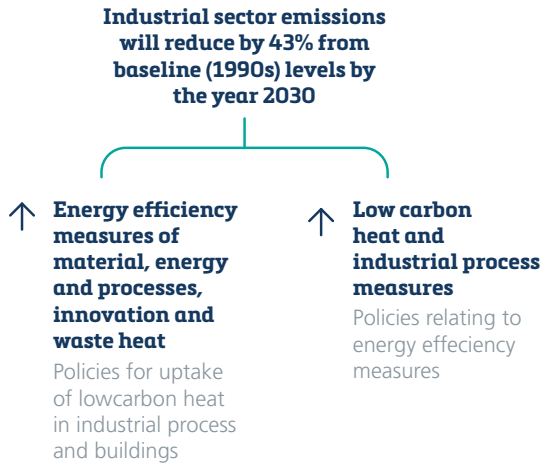
- improving energy efficiency measures of material, energy and processes, innovation and waste heat[77]
- increase of low carbon heat and industrial process measures

76 Analysis based on 1990-2016 GHGI. All absolute figure referenced here will vary slightly as our understanding of GHG emissions in Wales improves.

77 Policy outcome description expanded as per energy efficiency measures set out in CCC advice

5. How we are going to get there?

Figure 19: Policy Framework for Industry aligning action with policy action to meeting targets, budgets and 2030 pathway



6. Policies and Proposals which contribute to our carbon budget

Many of the powers relating to heavy industry are reserved to the UK Government. In addition, the pattern of emissions in Wales differs to that for the UK as a whole, with a much higher share of industry emissions leading to a greater share of emissions covered by the EU emissions trading system. Collaboration between industry, government and communities will be crucial to explore the opportunities around decarbonisation including the use of waste heat, energy efficiency measures and capturing and reusing industrial process gases.

Research development and innovation will be critical to enable longer-term industrial decarbonisation by enabling the development of step-change technological options. We will work with industry to encourage participation in UK Government funding calls to access funding to develop new ideas, exploit new technology and adopt new business models that encourage a circular economy approach.

The emission reductions required to meet CB1 and the 2020 target will be delivered by the following policies and proposals.

We will increase energy efficiency measures through:

Policy – the EU Emissions Trading System (EU ETS) and future emissions reduction policy for the traded sector

The EU ETS is a cornerstone of the EU's policy to combat climate change and is a key tool to reduce GHG emissions cost-effectively. Established in 2005, it is now in its third phase and covers more than 11,000 power plants and manufacturing installations in 31 countries (the EU 28, Norway, Iceland and Liechtenstein). In addition, Switzerland's Emissions Trading Scheme is scheduled to link to the EU ETS in 2020. The EU-ETS is the world's first major carbon market and remains the largest one. It works on the 'cap and trade' principle. A cap is set on the total amount of certain GHGs that can be emitted by installations covered by the system. The cap is reduced over time so that total emissions fall.

Trading brings flexibility that ensures emissions are cut where it costs least to do so at a **European scale**. A robust carbon price also promotes

investment in clean, low carbon technologies. The scheme also includes mechanisms to ensure the global competitiveness of European based industry is protected. However, it is specifically designed as a market led mechanism and therefore it does not target emissions reduction within specific geographical areas such as Wales.

The EU ETS covers heavy energy using installations from industry and power (see further details in the power chapter) including iron and steel, oil refineries, coke ovens, cement clinker, glass, lime, bricks, ceramics, pulp, paper and board, aluminium and petrochemicals. In 2016, emissions from the 67 installations participating in the EU ETS, including the power sector, were responsible for 56% of the total emissions in Wales. This compares to 36% of total emissions in England, 38% in Scotland and 22% in Northern Ireland. Emissions from all EU ETS installations in Wales have increased from 22.9 million tonnes CO2e in 2005 to 27.3 million tonnes CO2e in 2016. This is largely due to the commissioning of new gas fired power stations which are more efficient than older models elsewhere in the EU. For further details see the Power chapter. Emissions from installations of industrial sectors other than power participating in the EU ETS have increased from 10.8 million tonnes CO_2e in 2005 to 11.4 million tonnes CO_2e in 2016, an increase of 6%.

During phase III (01 January 2013 to 31 December 2020) the emissions cap for the scheme reduces by 1.7% per year. In 2020, emissions from sectors covered by the system will be 21% lower than in 2005. In 2030, under the steeper trajectory of the revised system (Phase IV) they will be 43% lower.

Carbon trading policy is a devolved matter. However, the UK's membership of the EU has required the UK to adopt the EU's policies and UK Government lead the negotiations with the other EU Member States. Therefore, the Welsh Ministers' role within the existing system has been to influence UK Government's negotiating position to ensure our position is taken into account in the development of the EU ETS through successive phases. Natural Resources Wales regulate the installations to ensure they are compliant with the requirements for monitoring, verifying and reporting their emissions.

Future policy in this area is subject to the negotiations on the future economic partnership between the UK and the EU. It is heavily dependent on whether UK Government is able to achieve a negotiated deal and the details of any agreement on alignment or equivalency in this policy area. The political declaration which accompanied the draft Brexit agreement (November 2018) states "the Parties should consider cooperation on carbon pricing by linking a United Kingdom national GHG emissions trading system with the Union's Emissions Trading System". UK Government have also expressed a preference for staying in the EU ETS through a transition period to the end of Phase III in the event the UK leaves the EU with a negotiated deal.

When the UK leaves the EU, the devolved nature of the policy means the National Assembly for Wales as the legislature and the Welsh Ministers as the Executive will determine future policy for installations in Wales. UK Government also has a role in reserved aspects relating to fiscal matters. Welsh Government has worked with UK Government and the other Devolved Administrations to agree arrangements for a No Deal outcome. In the short-term, legislation is in place to facilitate a Carbon Tax, set at £16 per tonne for 2019, which will come into force on 1 April 2019. All emissions covered by the EU ETS will be within scope and the system of free allocations currently applied to installations within the EU ETS will be honoured. Additional legislation maintains continuity in the arrangements for monitoring, verification and reporting of emissions.

Over the longer-term, an emissions reduction policy for the current EU ETS installations has been identified as one of the areas where a UK wide framework may be required or highly desirable. Welsh Government is, therefore, exploring options for a long-term carbon pricing scheme with UK Government and the other Devolved Administrations. There will shortly be a joint consultation by

Welsh Government, Scottish Government, Northern Ireland Executive and UK Government to explore stakeholder views on the features of future options including a stand-alone UK ETS, an ETS linked to the EU ETS and a carbon tax. The intention is for the long-term option to be operational from 01 January 2021.

Welsh Government recognises the benefits offered by large and linked trading schemes in establishing a global carbon price driving cost effective action. If a global carbon price were to be established, the level playing field would mean there would be no need for measures within the scheme to protect business competitiveness. However, we would like to explore all options to assess how they might impact on emissions from industrial installations and power stations in Wales and their impact on business competitiveness and carbon leakage.

Policy 55 – Climate Change Levy and Climate Change Agreements

The Climate Change Levy is a tax on energy delivered to businesses in the UK designed to incentivise energy efficiency and reduce carbon emissions.

The Levy applies to most business users across industry, commercial sectors, agriculture and public services and is charged on taxable commodities for heating, lighting and power. Current rates of CCL (to 31 March 2019) are 0.203p/kWh for natural gas and 0.583p/kWh for electricity. From 1 April 2019 to 31March 2020, the rates increase to 0.339p/kWh and 0.847p/kWh respectively.

Climate Change Agreements (CCAs) are voluntary schemes in which operators of facilities receive a discount from the Levy in return for agreeing to energy efficiency improvement targets. They aim to protect industry sectors where competiveness may be affected by tax costs and to incentivise improvements in energy efficiency and carbon reduction.

Agreements allow operators of eligible facilities in some energy intensive sectors to receive a discount on the Levy. Businesses operating mineralogical or metallurgical processes are exempt from the main rates of Levy to ensure the UK tax treatment of highly energy intensive processes is in line with tax treatments elsewhere in the EU. UK Government has confirmed that energy intensive industry will continue to benefit from Agreement until 2023.

The Climate Change Agreements: biennial reports published in November 2017[78] identified the energy efficiency improvements and emission reductions achieved by operators and sectors against their targets for the period 1 January 2015 to 31 December 2016. The total reported CO2 emissions under the CCA scheme was 45.5 million tonnes (mt) compared with 45.7 mt in the first target period (1 January 2013 to 31 December 2014). The Levy and Agreement will continue to operate over the budget period.

78 https://www.gov.uk/government/publications/climate-change-agreements-cca-biennial-report

Policy 56 – Carbon Price Floor

The Carbon Price Floor (CPF) is a UK Government policy implemented to support the EU ETS by underpinning the price of carbon in the UK at a level that drives low carbon investment. The CPF taxes fossil fuels used to generate electricity via Carbon Price Support (CPS) rates set under the Levy. The CPF is a domestic policy and therefore the costs are not borne by installations outside the UK.

The CPF consists of two components paid for by energy generators in two different ways:

- The EU ETS allowance price;
- The CPS price which tops up the EU ETS allowance prices to the carbon floor price target.

HM Treasury confirms the target carbon price and CPS rates 3 years in advance at each budget and all revenue from the CPF is retained by the Treasury. The costs of the CPF are indirectly paid for by business and domestic energy consumers. The CPF was due to rise annually to 2020 to a price of £30/tCO2. At the 2014 Budget, the UK Government announced a cap of the CPS set at a maximum of £18/tCO2 from 2016 to 2020 which was extended to 2021 in the 2016 Budget to limit the competitive disadvantage on UK businesses.

In the 2018 Budget UK Government announced the CPS rate will remain at £18/tCO2 for 2020-21 because of recent significant rises in the price of EU ETS. From 2021-22, it will seek to reduce the CPS rate if the Total Carbon Price remains high.

Economic Action Plan

The Economic Action Plan (EAP) published in December 2017, sets out Welsh Government's approach to the economy and business. It has a clear strategic aim to raise levels of wealth and well-being across Wales, whilst reducing inequalities in both. Industry and business are now required to meet these requirements when receiving Welsh Government support. We will work with our key stakeholders to maximise the opportunities the new approach provides. See Policy 16.

Proposal 16 – Industrial Emission Reduction Support beyond 2020 for Carbon Intensive Businesses

The Environmental Protection Scheme (EPS) is a State Aid approved legal route which enables us to support industry in delivering a wide range of environmental improvements including carbon reduction. This expires at the end of 2020.

The EPS is a legal route establishing a set of rules within which aid can be delivered. Projects brought forward under EPS compete for funding against other investment projects, which equally deliver against economic and other priorities in Wales.

We will work with our stakeholders to consider the most appropriate mechanisms to incentivise industry to continue on the decarbonisation pathway beyond 2020. This will be informed by the consolidation of support under the Economic Futures Fund and will compliment UK wide funding schemes, available now or in the future, to decarbonise industry and increase energy efficiency.

Policy 57 - Energy Efficiency Scheme – UK Government

UK Government's Clean Growth Strategy sets out policies and proposals to accelerate the pace of clean growth. It includes the development of a package of measures to support businesses to improve energy productivity by at least 20% by 2030 including the establishment of an industrial energy efficiency scheme to help large companies reduce their energy use, supporting the use of industrial waste heat and working with the Carbon Capture Usage and Storage (CCUS) Council to consider options to deploy CCUS in the UK and maximise its industrial opportunity. See policy 60 and proposal 18 for more detail.

In the 2018 Budget, UK Government announced it would establish a 5 year Industrial Energy Transformation Fund (IETF) as part of the Industrial Strategy with up to £315[79] million of investment to support high energy using businesses transition to a low carbon future and increase energy efficiency. It will consult on the design of the IETF in 2019.

Proposal 17- Industry-Led Decarbonisation Group

We will establish a dedicated Industry-led Group in 2019 to consider the particular opportunities and challenges of decarbonising industrial sectors in Wales alongside ensuring a sustainable, competitive industry and business environment.

The Group, to include Welsh Government and academic representation, will build on the positive sectoral work already underway and consider the most appropriate ways Wales can maximise resource and energy efficiency and enable industry to invest in low carbon opportunities and deliver carbon reductions. The Group will include representatives of industrial sectors identified by the UKCCC as most challenged by decarbonisation.

The Group will also consider how policies and proposals across decarbonisation sectors including power, transport, waste and buildings can contribute to industrial and business emission reductions. The group will also consider how products manufactured in Wales can contribute to a circular economy and clean growth. The outcomes of the group will inform Welsh Government's wider decarbonisation targets and budgets and strengthen and enhance the authority of Welsh Government in its representations to UK Ministers to help ensure the scale and nature of the challenge in Wales is recognised and appropriately supported by UK Ministers.

A move to a regional approach through the EAP will enable the Welsh Government to work with industry and business to consider how to reduce carbon emissions in particular areas, focussing on the particular opportunities and skills development and innovation opportunities to meet these challenges. This will provide

79 https://www.gov.uk/government/publications/budget-2018-documents/budget-2018

a mechanism to further develop our engagement with industry around the challenges of decarbonisation post 2030, which will require more fundamental actions. Alongside this, we recognise the significant role that innovation will play in meeting the longer-term challenges.

Case Study 16 – Innovation and Industry

Innovation in the industrial sector will be crucial to meet our emission reduction targets and budgets in a way that will secure the most industrial and economic advantage for Wales from the global transition to a low carbon economy. Whilst the global shift to decarbonisation offers Wales opportunities to grow our economy it also highlights the challenges faced by industry and business.

The Reducing Industrial Carbon Emission (RICE) project[80] is an example of innovation meeting this challenge. Driven by a consortium of researchers and industrial partners in South and West Wales, funded by the European Regional

Development Fund, it focuses on delivering transformational change through the adoption of innovative processes to reduce Wales' CO2 emissions and decrease Welsh Heavy Industry's energy & raw material consumption. RICE will work with local supply chain companies to test how carbon dioxide produced from heavy industrial processes can be innovatively used to make high value products and industrially important chemicals.

Policy 58 – Onshore Petroleum Extraction

Consenting process

The combustion of fossil fuels is covered in the power chapter however there are also green house gas emissions associated with the activity to extract fossil fuels.

For fossil fuel extraction the extraction of coal and onshore oil and gas for the purposes of energy generation are now placed at the bottom of the **Planning Policy Wales'** energy hierarchy reflecting their position as the least preferred source of fuel for power generation. Planning policy relating to coal has been amended to restrict extraction and states that planning permission should not be granted. A Notification Direction has also been published requiring any

80 https://www.swansea.ac.uk/press-office/news-archive/2018/92meu-backedprogrammetohelpwelshindustryreducecarbonemissions.php

planning application for the development of petroleum or coal, which the local planning authority is minded to approve, be referred to Welsh Ministers.
The Wales Act 2017 transfers **Onshore Petroleum Licensing** functions under Part 1 of the Petroleum Act 1998 to the to the Welsh Ministers. These new functions commenced on 1st October 2018. The functions will include managing 14 existing petroleum licenses, the approvals associated with them and decisions on whether to issue new licenses which covers both conventional and unconventional petroleum extraction.

As a new area of responsibility for Welsh Government we commissioned evidence in 2017 to inform our future policy towards petroleum extraction and its administration in Wales. Following a thorough analysis, we do not believe that the evidence presents a compelling case that the benefits of petroleum extraction outweigh our commitment to sustainably manage our natural resources. Therefore, policy for petroleum extraction is to not undertake any new petroleum licensing in Wales or support fracking.

We consulted on the proposed future extraction policy in 2018. Existing licenses will be considered subject to our decarbonisation commitments and the application of Welsh Government planning and petroleum policies in accordance with the law.

Policy 59 – Industrial Heat Recovery

Industrial heat recovery has potential to realise significant energy and carbon savings by reusing the waste heat either within the industrial facility or by another end user including through a heat network. There are however commercial, technical and practical barriers to implementation.

In July 2018 UK Government announced an industrial Heat Recovery Support (IHRS) programme to further understand the challenges and barriers to adoption and to increase industrial confidence in deploying heat recovery technologies.

The IHRS Programme runs from 15 October 2018 to 31 March 2021. Up to £18m of funding is available to support the uptake of industrial heat recovery projects which is being allocated as grants through a competitive process. The Programme is open to projects in England and Wales. Working with UK Government, we will continue to promote this scheme to businesses in Wales.

Policy 60 – Carbon Capture Utilisation and Storage

The UKCCC assumes that CCUS could significantly reduce Welsh emissions by 2050 but the deployment of CCUS in its Welsh scenarios does not commence until the late 2030s and will be towards the end of the window of UK deployment. This reflects the greater practical difficulty and cost in the Welsh context relative to other parts of the UK.

UK Government's industry-led CCUS Council will need to work with Welsh Government when considering steps required to reduce the cost of deploying CCUS in the UK. In July 2018 the Group published its independent report setting out industry's view on how best to progress CCUS in the UK in order to enable the UK to have the option of deploying CCUS at scale during the 2030s, subject to costs coming down sufficiently.

In November 2018 UK Government published an action plan setting out how government can work with industry to find routes to deploying CCUS solutions.

Proposal 18 – Commission an independent economic and technical feasibility study on Carbon Capture Usage and Storage (CCUS)

Evidence on CCUS includes the CCUS Solutions Deployment Pathway Action Plan, Industrial CCUS Business Models and the UK Carbon Capture and Storage Research Centre (UKCCSRC) 2016 report 'Delivering Cost Effective CCS in the 2020s: an overview of possible developments in Wales and areas linked to Welsh CCS activities via shipping'[81]. These studies alongside the UKCCC advice[82] found that we will be unable to achieve the legislated emissions reduction of at least 80% by 2050 without a significant contribution from CCUS.

We need more detailed and Wales-specific information. We will work with industry to understand from them what any further study should most usefully focus on. The objective will be to better understand the options for delivering CCUS projects and the balance between capturing at source, transporting to depositories and offsetting strategies. In addition, we recognise that we need to explore the potential to collaborate cross-border between North Wales and North-West England. This programme of work will be commenced later in 2019.

Policy 61 – Food and Drink Action Plan – Towards Sustainable Growth

Welsh Government's Food and Drink Action Plan ''Towards Sustainable Growth (2014-2020)' was launched in 2014 to deliver an overall headline target to grow the value of the food and drinks sector in Wales by 30% to £7 billion by 2020. The Plan includes 48 actions grouped around 5 main themes to support the sector, including promoting low carbon productivity and a more efficient use of resources.

Projects applying for the Food Business Investment Scheme (FBIS) and Rural Business Investment Scheme are scored against their contribution to the aims of 'Towards Sustainable Growth', which include 'Continuing to develop a green image based on sustainable production methods'. Projects attempting to enter FBIS also need to comply with at least one of Welsh Government Rural Communities – RDP 2014-2020 focus areas, which include 'Promoting resource efficiency and

81 Delivering Cost Effective CCS in the 2020s: an overview of possible developments in Wales and areas linked to Welsh CCS activities via shipping (UKCCSRC 2016)

82 https://www.theccc.org.uk/wp-content/uploads/2017/12/CCC-Building-a-low-carbon-economy-in-Wales-Setting-Welsh-climate-targets.pdf

supporting the shift towards a low carbon and climate resilient economy'.

A successor Plan to 'Towards Sustainable Growth', which will in effect be an enabling plan for Food as a Foundation Sector under the Economic Action Plan, will be launched at the end of the year.

The successor Plan will establish a refreshed vision for the food sector, a stronger set of key performance indicators and targets, and a clear map of support for the sector. In return and in line with the EAP's Economic Contract and Calls to Action, businesses will have to make commitments in order to receive investment or in-kind support including focus on decarbonisation.

7. Well-being

The aim of the policies and proposals for the first carbon budget and subsequent carbon budgets will be to work together to reduce emissions from our industrial sector at a scale and rate that maximises their contribution to the well-being goals.

Supporting the transition to a low carbon industrial sector is crucial to Wales. In 2017, 146,000 people work directly in manufacturing alone in Wales[83] without accounting for those employed in supply chains and supporting services. Unilateral rapid decarbonisation of these industries would not only put jobs at risk but risk carbon leakage that would offshore production and the related emissions. The low carbon transition offers Wales a range of opportunities to maximise the well-being goals. For instance, waste heat produced by our heavy industries offers opportunities around industrial symbiosis, district heating networks for communities and future competitiveness in a global low carbon economy.

Decarbonisation of our industry could allow us to become a world leader in cutting edge and clean technologies and exporting these to the rest of the world. The UK's low carbon economy has the potential to deliver export sales of low carbon goods and services around the world. By 2030 annual exports could be worth up to £170 billion and could support up to 2 million 'green collar' jobs by 2030[84] contributing to growth significantly.

The EAP is Welsh Government's key policy to drive inclusive sustainable growth and future-proof the economy through our direct support for businesses. The Well-being Matrix Tool showed that the EAP had a strong positive direct benefits against a more equal Wales, a Wales of cohesive communities well-being goals.

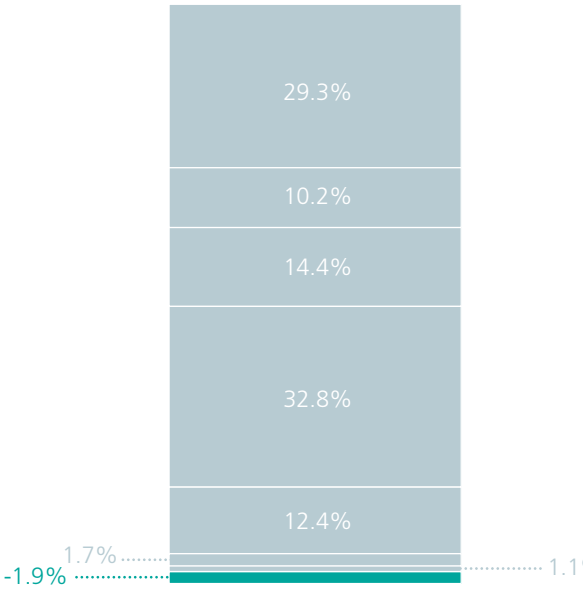
83 https://gov.wales/docs/statistics/2018/181031-workplace-employment-industry-2001-2017-en.pdf

84 https://www.gov.uk/government/news/world-first-carbon-net-zero-hub-of-heavy-industry-to-help-uk-seize-global-economic-opportunities-of-clean-growth

Land Use, Land Use Change & Forestry (LULUCF)

1. Ambition

The Land Use, Land Use Change and Forestry (LULUCF) sector is the only one, which has the current capability to remove emissions from the atmosphere. Locking up atmospheric carbon through plant photosynthesis is the only available and functioning mechanism we have to "clean up" past emissions. The UNFCCC and stakeholders have commented that negative emissions are essential to achievement of global climate change targets.



It is crucial that the sector in Wales should remain a net sink for carbon for Wales to meet its own climate change targets. To do this, the store of carbon in the biomass in the natural and built environment should increase and that the overall amount of the sink will need to increase significantly, in line with the recommendation of the UKCCC.

Therefore, we need to increase our woodland creation activity and ensure the management of our soils is sufficient to be compatible with our statutory obligation. Whilst the UKCCC recommendations are mainly focused around the role of trees we recognise there are wider opportunities for carbon storage through safeguarding and increasing carbon stores in soils and other biomass.

We also recognise that policies and proposals in this sector provide wider benefits for society. Our Natural Resources Policy introduced by Part 1 of the Environment Act is one of our corner stone policies for tackling GHG emissions and delivering multiple benefits, through nature based solutions, resource efficiency and taking a place based approach.

Therefore we need to increase both tree cover and restore and enhance our soils in a way that provide the wider benefits for human health, environment and business. Enhancing the resilience of our ecosystems

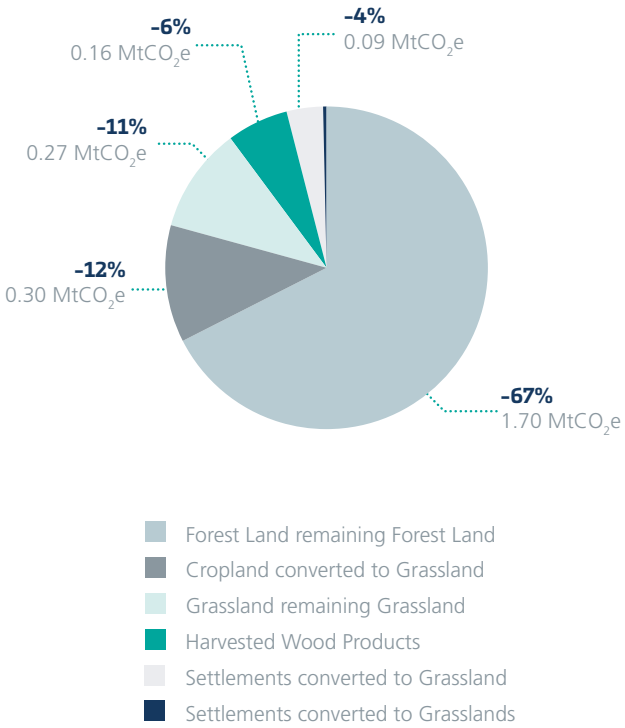
will help us to adapt to climate change. They also support wider benefits for society such as maintaining supply of food and renewable products, such as, timber and clean water to meet the needs of Welsh people, environment and business. The policies we develop in the short-term for post-Brexit support will be crucial to support the emissions reduction and removals as well as providing these wider benefits.

2. Where do LULUCF sector emissions come from

At -0.77 $MtCO_2e$, LULUCF provided a net reduction in Welsh emissions in 2016. The emissions reduction is largely due to the action of forest land removing carbon dioxide from the atmosphere. However, the sector comprises both sinks (activities that remove carbon dioxide from the atmosphere) and sources of emissions. In 2016, the largest sinks are existing forest land (67%), cropland conversion to grassland (12%) and existing grassland (11%). The largest emission sources in the sector arise from grassland conversion to cropland (30%), existing cropland (23%), grassland conversion to settlements (21%) and existing settlements (16%).

A key component of the LULUCF activity in Wales is through soil and peatland management. However, the UK GHG Inventory currently uses a relatively simple methodology for peatland emissions modelling. This takes account only of horticultural peat extraction or peat extraction for fuel production. There is only a very small amount of this in Wales. As such peatland is currently not well represented in our carbon budgets or within the current emission pathways advised by the UKCCC. We expect that a new methodology will be introduced during our first budget period, which will take account of a wider range of emissions from peatland. This will alter the overall LULUCF inventory for Wales and it makes it important that we consider peatland management within our policies and proposals for CB1.

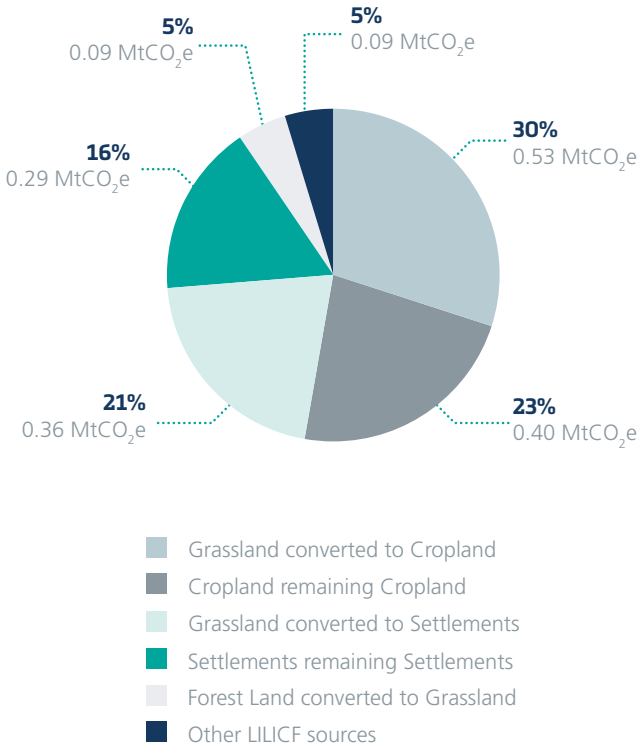
Figure 20: Graph showing LULUCF sector sinks in 2016[85]



Total sink (2016): -2.53 $MtCO_2e$

85 The emissions data is sourced from the Greenhouse Gas Inventories for England, Scotland, Wales & Northern Ireland: 1990-2016 and aligned to the UKCCC sectors as described in Annex 3.

Figure 21 – Graph showing LULUCF sector sources in 2016[86]



Total source (2016): 1.75 $MtCO_2e$

Table 7: how the biggest emissions in the land use and forestry sector contribute to the Welsh total

Source	% of total Welsh emissions
Grassland converted to cropland	1.1%
Cropland remaining cropland	0.8%
Grassland converted to settlements	0.8%

3. Progress to date

The LULUCF sector in Wales has remained a net sink of GHGs since 1990 with the size of the sink growing by 6% between the base year (1990) and 2016.

In 2016, the first year of our budget period, Welsh LULUCF sector emissions decreased by 29% compared to 2015 driven largely by a change in the forest land sink.

86 The emissions data is sourced from the Greenhouse Gas Inventories for England, Scotland, Wales & Northern Ireland: 1990-2016 and aligned to the UKCCC sectors as described in Annex 3.

4. What are we aiming for?

2020 emissions target

Whilst there is considerable uncertainty in LULUCF sector reporting compared to other sectors, we along with the UKCCC believe the sector will provide a sink, together with the mitigation activities identified in the other sectors, which will enable us to deliver the overall NWEA budget and targets.

The LULUCF sector will continue to provide a sink from baseline levels in the year 2020.

LULUCF sector allocation for Carbon Budget 1

We intend that this sector should remain a sink. We aim to work with UKCCC to improve methodological approaches and quantify its contribution more fully.

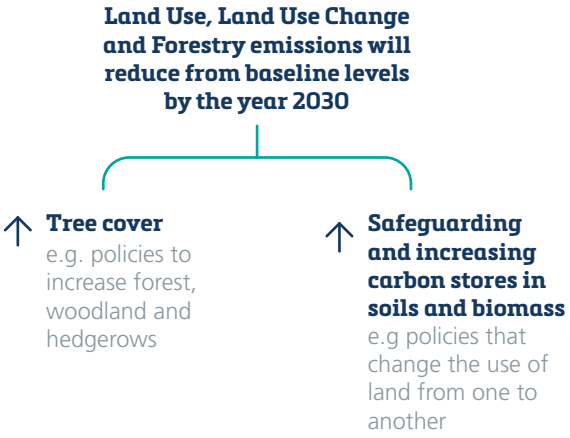
LULUCF sector pathway to 2030

We will significantly increase the LULUCF sink in Wales by the year 2030 by:

- increasing tree cover; and
- reducing carbon loss from peatlands and building carbon stores within biomass.

5. How we are going to get there?

Figure 22 – Policy Framework for LULUCF Aligning policy action to meeting targets, budgets and 2030 pathway



6. Policies and Proposals

The policy action in this area focuses on two broad areas of increasing tree cover and safeguarding and increasing carbon stores. We will take appropriate steps to ensure that our woodland creation activity is sufficient to be compatible with our statutory obligation to reduce carbon emissions by at least 80% in 2050. Woodland creation is also essential to enable increases in resilience in existing woodland, diversification of tree species and restoration of open habitats. Woodlands also support wider benefits for society, such as supporting natural flood management or absorbing pollutants from

the air, while at the same time maintaining supply of renewable products, including timber and wood fibre to meet the future needs of Welsh society.

In addition to increasing tree cover, we need to safeguard and enhance the carbon in our soils. Peat is found throughout Wales and modification and degradation can negatively impacted upon their ability to deliver a range of ecosystem services, most notably; their ability to absorb and store carbon.

The emission reductions required to meet CB1 and the 2020 target will be delivered by the following policies and proposals covering these areas.

We will increase tree cover through:

Policy 62 – Implementing our Natural Resources Policy

For woodland and foresty, the priority nature-based solution is increased canopy cover and well located woodland, for example close to towns and cities where it will have the greatest recreational and ecosystem service value. This recognises the role of decarbonisation and the wider benefits that well-located woodland has for our well-being and prosperity. Our trees and woodlands are vital in delivering our national priorities. Wales needs both large and small scale, diverse woodlands that include both conifer and broad-leaved species. We also need greater integration between woodland and other land uses and a removal of the historical, artificial distinction between farmland and woodland management. We must also recognise the fundamental importance of increasing the number of trees in our towns. New woodland will need to be created and trees established to provide greater connectivity and to address key challenges, in both rural and urban areas.

In taking forward action we will:

- encourage good forest design and sustainable management that makes a positive contribution to the character and quality of the landscape, improves the biodiversity value of the forests, and secures wider benefits, such as flood risk management;

- improve the climate resilience of the forest resource and its capacity to resist pests and diseases through more appropriate species and provenance choice, coupled with adaptive management approaches;
- work across government to support the higher value use of our timber resources, in particular in the construction of high quality housing; and
- carefully manage trees and woodland that have high environmental values, including ancient woodland sites, and ancient, veteran and heritage trees, which are an irreplaceable resource that provide a wide range of ecosystem services.

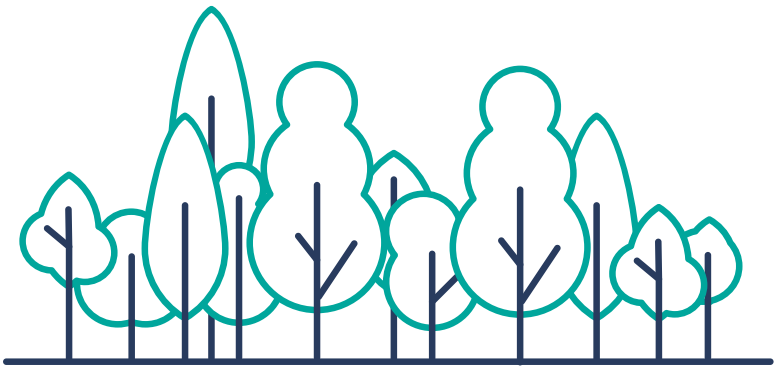
Natural Resources Wales (NRW) has a duty to implement the Natural Resources Policy in a local context through area statements, which must be published by 2020. Area statements will set out the local priorities for action including identifying areas of opportunity and constraint for woodland creation. They will set out the actions that NRW can take. NRW must also encourage others to take steps to implement an area statement.

Policy 63 – Woodland for Wales Strategy

Welsh woodlands and trees are vital to the delivery of the priorities as set out in our Natural Resources Policy, The Woodlands for Wales strategy is key component on delivering these priorities. In the past we adopted an aspiration of target of planting 100,000 ha of trees between 2010 and 2030. Planting rates in the first 7 years of that is period have only been a fraction of the required 5,000 ha per year. The recently published strategy provides a more realistic target updating in line with the UKCCC's advice up until the 2020's. This requires developing new approaches to incentivising and helping landowners overcome barriers to planting, both real and perceived.

Policy 64 – Felling licences

We will continue to replant trees in the right places. Within existing woodland, all felling is regulated by Natural Resources Wales. Felling of trees will continue to require a licence and licences will specify replanting with trees of the area of woodland that has been felled. Only in exceptional circumstances, to restore open habitat of high environmental value, will licences for clearfell be granted unconditionally. Where unconditional licences are granted, NRW will take account of the carbon emissions impact of their decision. Before issuing an unconditional licence for clearing of woodland, NRW will seek to negotiate with the applicant to secure planting of an alternative and equivalent area of new woodland to compensate for the loss of woodland that would occur if an unconditional licence were issued.



Policy 65 – Welsh Government woodland estate

We will increase the size of our own woodland estate. The Welsh Government Woodland Estate is managed by NRW. The Minister for the Environment set out Welsh Ministers priorities for the estate in the foreword to the report on the *Purpose and Role of the Welsh Government Woodland Estate* published in July 2018[87].

Proposal 19 – Increase tree planting

Increase tree planting to at least 2,000 hectares per year, aiming to increase this to 4,000 hectares as rapidly as possible, ensuring while doing so it will be well-located for greatest ecosystem service value.

We will take appropriate steps to ensure that our woodland creation activity is sufficient to be compatible with our statutory obligation to reduce carbon emissions by at least 80% by 2050. Woodland creation is also essential to enable increases in resilience in existing woodland, diversification of tree species and restoration of open habitats and can support wider benefits for society, such as supporting natural flood management or absorbing pollutants from the air, while at the same time maintaining supply of renewable products, including timber and wood fibre to meet the future needs of Welsh society.

In the summer of 2018 we published the *Brexit and our Land*, consultation on proposals for future land management in Wales. This outlined two future support schemes for land managers, an Economic Resilience scheme and a Public Goods scheme, which will provide support to deliver more public goods from the land. Woodland creation delivers significant public goods and our intention is to develop further proposals in light of the responses we have received to Brexit and our Land. These will set out both future payment mechanisms for woodland creation and, where appropriate to change our approach to the regulation of woodland creation. Proposals arising from the 'Brexit and our Land' consultation are subject to a further round of consultation in 2019 and their inclusion in the Plan is for information rather than representing a clear commitment at this point.

87 https://naturalresources.wales/about-us/what-we-do/welsh-government-woodland-estate/our-vision-for-the-welsh-government-woodland-estate/?lang=en

We will provide guidance to help NRW as regulator for woodland creation, and land managers who wish to create the new woodland that we need, to demonstrate that new woodland is established in accordance with the objective and principles of the Sustainable Management of Natural Resources.

Proposal 20 – Identifying preferred areas for tree planting

Identify preferred areas for tree planting, including for greatest ecosystem service value, and commercial woodlands and planting at medium and large scale. We have published a woodland creation opportunities map on our Lle web portal. This map shows the areas where we know that there are significant public benefits from planting trees. We use this map to help prioritise applications for funding for tree planting. The map provides guidance to those planning tree planting about the issues that may influence their decisions, and help them produce a design that complies with the UK Forestry Standard (UKFS) and is in accordance with the Objective and Principles of Sustainable Management of our Natural Resources Policy. However the regulatory process is the same for applications that will generate significant public benefits, as for those that will not. Applicants have told us that they face particular challenges in getting larger schemes approved, that landowners lack the confidence to develop proposals because they cannot tell whether their proposal will be approved even if it is in the green area on the map.

We need to give those who want to plant trees a transparent and predictable process for getting permission to do so and enable proposals that will provide significant public benefits to access support. Landowners who want to plant trees to improve the resilience of their businesses will also generate significant public benefits if they do so in the right areas, and their proposals are well designed and meet the right standards. The UKFS requires at least a quarter of all planting to be devoted mainly to public goods.

We intend to refine the woodland opportunities map so that it shows both the areas where public benefit is greatest, and is clearer about the kind of planting and the scale of planting that is appropriate in each. As we take forward the proposals which we set out in the Brexit and our Land consultation, we will look at further guidance and the regulatory process to ensure that in these areas, tree planting proposals have a timely, transparent, predictable and proportionate way to proceed.

We will reduce carbon loss from peatlands and build carbon stocks within biomass through:

Peatlands are defined by their deep organic soils. These soils are naturally waterlogged for most of the year and as plant material is deposited it builds up rather than breaking down as happens in other soils. The carbon within the plant material is locked into the peat rather than being released to the atmosphere as carbon dioxide. The total area of peat soil in Wales is approximately 91 400ha.

Drainage, land use change, inappropriate grazing, burning and air pollution have all damaged and degraded Welsh peatlands. Over 70% of Welsh peatlands were estimated to have been modified and in degraded condition. This has negatively impacted upon their ability to deliver a range of ecosystem services, most notably; their ability to absorb and store carbon. Peatlands in degraded condition are significant sources of GHG's rather than sinks.

The Glastir Monitoring and Evaluation Programme 2015 compared present-day emissions to natural 'reference' emissions and estimated that if all Welsh peatlands were returned to near-natural condition emissions reductions of approximately 300 kt CO2-eq yr-1 would be achieved.

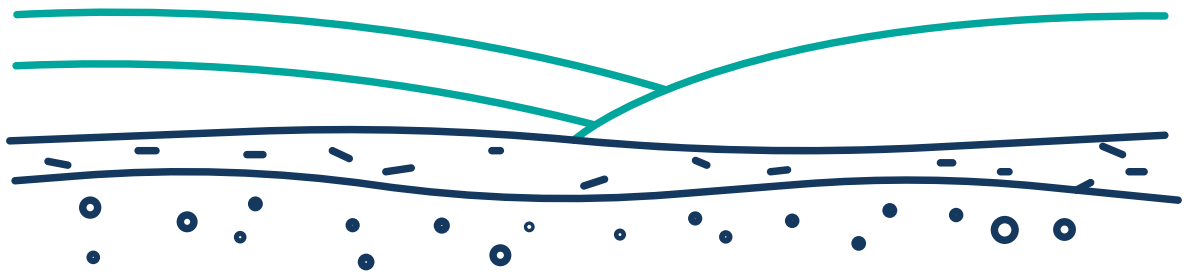
Policy 66 – Peatlands for the Future

Current Welsh Government policy is to use all available mechanisms to bring semi-natural peatlands into sustainable management by 2020. Semi-natural peatlands cover approximately 66,000ha and if restored emissions reductions of approximately 70 kt CO2-eq yr-1 would be achieved.

The most intensive emissions arising from peatlands in Wales are from those under grassland and arable land use (not semi-natural). Towards 2050 we need to continually look at what new opportunities can be brought into play to further enable all Welsh peatlands being brought into sustainable management securing a further 230 kt CO2-eq yr-1 of emission reductions.

Case Study 17 – Realising the Natural Capital of Welsh Peatlands

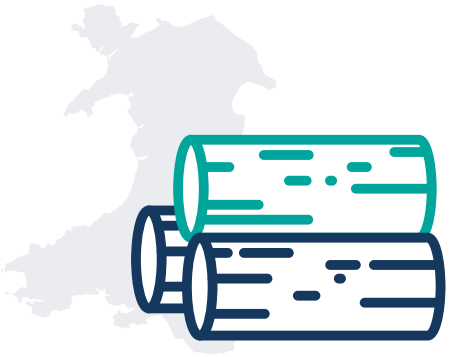
The collaborative *Realising the Natural Capital of Welsh Peatlands* project funded by Welsh Government's Sustainable Management Scheme has National Park Authorities, landowners, Non-Government Organisations, farmers and community organisations working together to bring Wales' peatlands into sustainable management. It consists of co-ordinated action across Wales is delivering multiple environmental benefits through collaboration with existing mechanisms together with capital works covering the current 'difficult to do' sectors of peatland restoration. The aim is longer term sustainable management supported through Payments for Ecosystem



Service (PES) including the adoption of the Peatland Code1. Other critical activities will lead to more co-ordinated and coherent approaches covering external funding, training, education, PES procurement, monitoring and research activities relevant to Welsh peatlands and the high carbon storage potential they hold.

Planning Policy for Wales

Planning Policy Wales provides for continued protection for Best and Most Versatile Agricultural Land and contains a preference wherever possible for settlement to expand onto existing previously developed land where it suitable for development in preference to greenfield sites.



7. Well-being

The aim of the policies and proposals for the first carbon budget and subsequent carbon budgets will be to work together to reduce emissions from our Land Use sector at a scale and rate that maximises their contribution to the well-being goals. The priorities set out in the Natural Resources Policy are they key ways that Wales' natural resources contribute across all the Well-being goals. Woodland provides society with a range of multiple benefits. Provided they are managed carefully and sustainably, they provide shelter for livestock, reduce noise pollution, slow down flood waters and improve air, soil and water quality. They are havens for biodiversity and provide a wealth of recreational opportunities and a means of improving our general health and well-being.

The timber and non-timber products from our woodlands are key renewable resources which contribute to prosperity for all. We need more of them, to aid the sustainability of our industries and to contribute to a more circular economy.

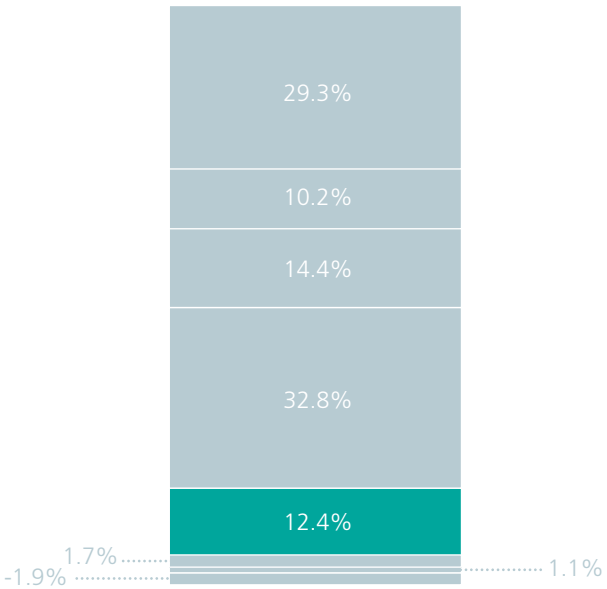
The Well-being Matrix Tool highlights the policy has a large impact on all the well-being goals but specifically high against a more equal, healthier and resilient Wales.

Agriculture

The agriculture sector covers soil, livestock, and waste and manure management. It also covers on farm fuel efficiency improvement.

1. Ambition

We need to develop a resilient and prosperous agriculture industry, which reduces its carbon emissions through a range of approaches, including the development of improved efficiency in livestock and crop production, nutrient management and increasing the sustainability of farm assets.



Future changes to agricultural support,offer the opportunity to better target public funding more effectively in support of societal outcomes. Our consultation 'Brexit and our Land' sets out the choices under consideration. The principle of 'public funding for public goods' underpins our proposed approach and offers farmers and land managers the opportunity to access new funding streams for the delivery of public goods, which includes decarbonisation through improving efficiencies and carbon sequestration.

Agriculture emissions are mainly derived from livestock (cattle and sheep predominantly), the use of fertiliser for growing and farm machinery. By taking a holistic view of the overall management of the farm business, in particular the business performance, land and animals, improvements can be made which together will contribute to tackling climate change within the agriculture sector.

We will work closely with the industry to help transition and deliver the positive outcomes we are seeking. The levy body organisations operating in Wales, Hybu Cig Cymru (HCC) and the Agriculture and Horticulture Development Board

(AHDB) have prepared a number of documents[88] to complement the work of Welsh Government in reducing the GHG emissions.

2. Where do Agriculture sector emissions come from

Agriculture accounted for 12% of Welsh GHG emissions in 2016. Agriculture emissions are dominated by methane (62%) and nitrous oxide (28%), with only 10% of sector emissions as carbon dioxide. This reflects the dominance of livestock enteric emissions (largely from sheep and cattle), which accounts for 54% of the sector's emissions in 2016.

Fertiliser use for agricultural soils is another significant source of emissions, comprising 21% of agriculture emissions.

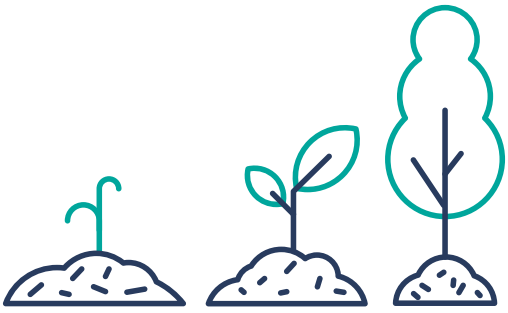
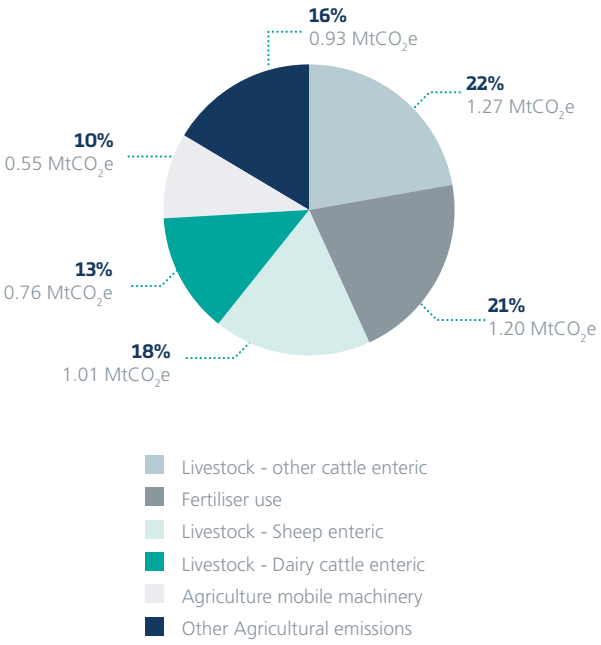


Figure 23 Graph: Agriculture sector emissions in 2016 [89]



3. Progress to date

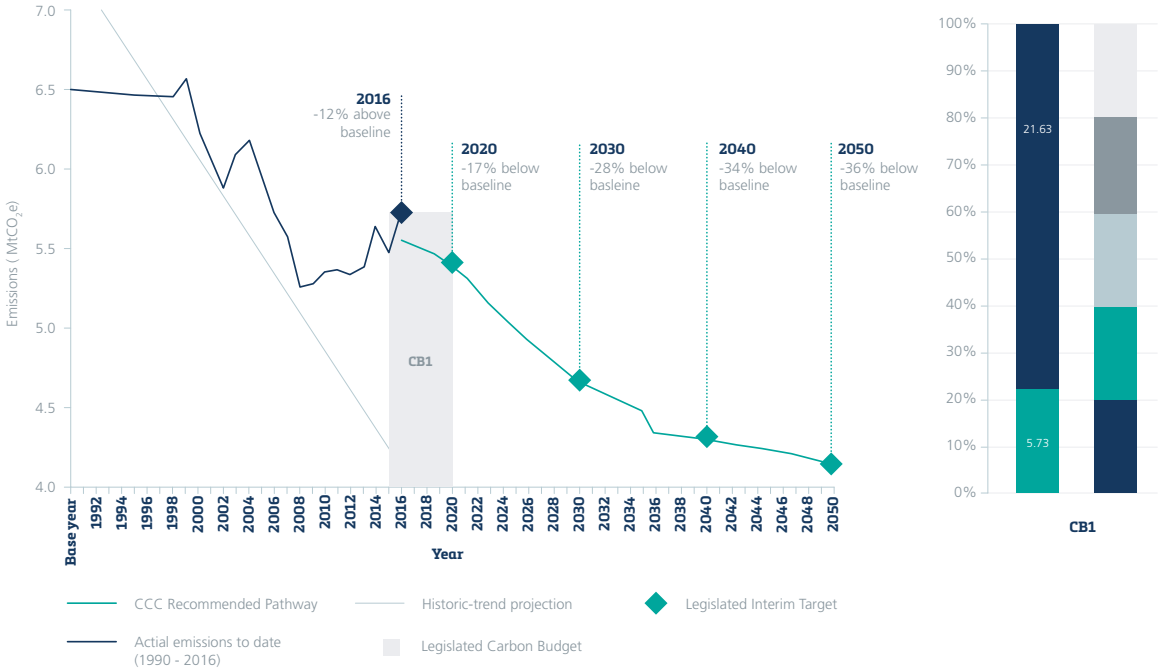
Total emissions from the Agriculture sector in Wales have declined by 12% between the base year (1990) and 2016, driven largely by a general decline in livestock numbers and nitrogen fertiliser use.

In 2016, the first year of our budget period, Welsh Agriculture sector emissions increased by 5% compared to 2015. This is largely a result of a 55% increase in the amount of nitrogen fertiliser directly applied to agricultural soils on grassland.

88 HCC - A Sustainable Future – The Welsh Red Meat Roadmap & Industry Action Plan, HCC - 20:20 Vision, HCC - Vision 2025 and AHDB - Dairy specific roadmap

89 The emissions data is sourced from the Greenhouse Gas Inventories for England, Scotland, Wales & Northern Ireland: 1990-2016 and aligned to the UKCCC sectors as described in Annex 3.

Figure 24: A graph to show historic emissions for the Agriculture Sector and UKCCC modelling to show emission reductions for the first carbon budget (CB1) and a possible route for a contribution to an 80% reduction in all Welsh emissions in 2050



4. What are we aiming for?

2020 emissions target

Emissions in 2020 will be 6% lower than in 2016. This will mean that Agriculture sector emissions are 17% lower than the baseline in the year 2020.

Agriculture sector allocation for Carbon Budget 1

The total budget for the Agriculture sector for CB1 is estimated to be 27.4 $MtCO_2e$[90]. The Agriculture Sector contributes 12.4% of the total Welsh budget for CB1.

In 2016 the sector emitted 5.7 $MtCO_2e$ using up 21% of the Agriculture Sectors contribution to CB1.

Agriculture sector pathway to 2030

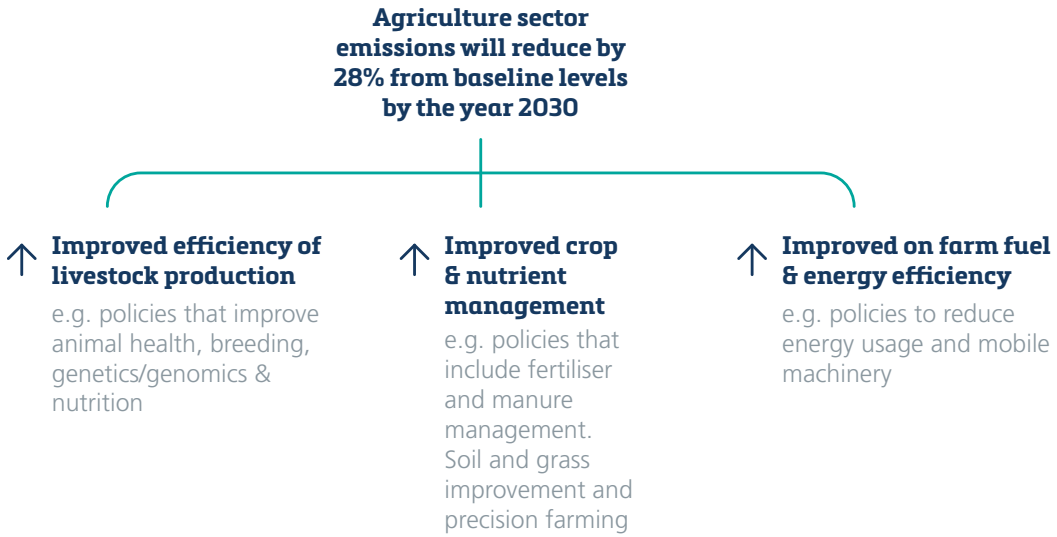
Agriculture sector emissions will reduce by 28% from baseline (1990) levels by the year 2030:

- through improved efficiency of livestock production;
- improved crop and nutrient management; and
- improved on farm fuel & energy efficiency.

90 Analysis based on 1990-2016 GHGI. All absolute figure referenced here will vary slightly as our understanding of GHG emissions in Wales improves.

5. How we are going to get there?

Figure 25: Policy Framework for Agriculture Aligning policy action to meeting targets, budgets and 2030 pathway



6. Policies & Proposals which contribute to our carbon budget

Support currently provided to the sector is primarily delivered through multiple schemes funded through Welsh Government Rural Communities – Rural Development Programme for Wales 2014-2020, which provide multiple benefits to the farm enterprise and also have a positive impact on climate change. The support delivered through Welsh Government and partner organisations is far reaching and cross-cutting. A summary of the actions under each scheme and how they link to the decarbonisation agenda is set out below.

The emission reductions required to meet CB1 and the 2020 target will be delivered by the following policies and proposals.

We will improve the efficiency of livestock production

Improving the efficiency of livestock production is about optimising production while reducing the impact on our natural resources. It does not mean increasing animal numbers and intensifying farming. It is essential we balance the need to produce food whilst ensuring a sustainable and profitable livestock industry. This will require a host of actions, which include investment, behavioural change and a greater understanding of climate change.

A number of our schemes aim to increase the efficiency of our livestock production through improving animal health and welfare, technology and innovation, collaboration, data sharing and funding which all help to improve product quality, reduce costs and improve emissions.

Policy 67 – Red Meat Development Programme 2018-2023

The £9.2m Red Meat Development Programme Genetic Improvement Project, aims to improve the efficiency of livestock production and reduce the emissions associated with that production. The project aims to achieve this through improved genetic performance including breeding, survival, longevity, fertility, feed efficiency and faster growth and finishing while also continuing to ensure a high quality product that meets market demands, maintains welfare standards and potentially reduces waste.

Raising healthy stock and ensuring optimum health and welfare standards increases profitability by reducing inputs, allowing farmers to market animals quicker and reduce costs through reduced antibiotic use. The Flock and Herd Health Project, part of the Red Meat Development Programme, and the recently approved £5.5m Dairy Improvement Programme (Herd Health Planning & Monitoring project) are both researching alternative disease control measures and sharing with industry the most successful mechanisms to prevent disease.

Policy 68 – Animal Health and Welfare Framework

Through our Animal Health and Welfare framework, we will continue to improve health in livestock. It is important to emphasise that adopting this approach is meant to reduce overall emissions, not enable an increase in livestock numbers. There is scope to improve the efficiency of animal production in Wales by increasing the amount of milk, meat or fibre produced by fewer animals, which will reduce their GHG impact. There are many ways efficiency of production can be improved through feeding, breeding, management and ensuring optimal health. Healthy animals help protect the productivity and production levels of farmers, reduce capital losses, minimise negative trade impacts as well as reducing pollution and carbon emissions.

Policy 69 – Farming Connect Programme

We will continue to offer advice, support, tools and demonstration projects focussing on cost effective emission reduction measures to help improve efficiency and productivity, whilst also helping farmers up-skill and develop appropriate skills for the future.

Farming Connect, a £28m programme, provides subsidised independent, tailored business support and technical advice through the Advisory Service. The Service provides advice on using recognised tools and techniques to achieve optimum results from livestock, incorporating Estimated Breeding Values, feed options, nutrient management, housing and wintering options. Improving efficiency of how we produce our livestock and helps to reduce the emission intensity.

Through the programmes' Demonstration Network, made up of 8 Innovation Sites, 12 Demonstration sites and up to 36 Focus Sites per year across Wales, Farming Connect runs a number of trials and projects to establish and demonstrate new technology and farming practices for industry focusing on improved livestock health and nutrient management. Outcomes from the above projects and trials are disseminated through Farming Connects communication channels; on farm open events, technical articles, case studies, social media and news articles as well as fact sheets produced by the Knowledge Exchange Hub in conjunction with IBERS, Aberystwyth University.

We are raising awareness with famers of emission reduction activities through various communication channels. In order to change behaviours and improve farming practices, it is essential that the knowledge obtained through research and evidence collection enhances business performance and supports farmers at all levels. Through Farming Connects Skills and Mentoring programme, eligible individuals registered with Farming Connect can access funding to complete short accredited training courses to further their understanding and personal training needs. Category 2, Technical advice, offers 80% funding on topics raising Environmental Awareness and Better Livestock Handling.

In addition to the face-to-face training on offer, a suite of E-learning modules are also available, covering a wide range of topics to help improve working practices and knowledge to develop farm business. Topics specifically supporting the livestock indicator are the Livestock Health and Welfare and Forages and Feeds categories.

Policy 70– Farm Business Grant

We will provide financial assistance to enable farmers to invest in equipment to help reduce emissions and improve efficiency in production. £40m has been made available under the Farm Business Grant (FBG) scheme, offering a maximum 40% contribution towards capital investments in equipment and machinery that have been pre-identified as offering clear and quantifiable benefits to farm enterprises.

Grants of between £3,000 and £12,000 are available to purchase equipment which support animal handling, feed management and the administration of antibiotics thus reducing inputs, improving animal health, overall efficiency of livestock and reducing the emissions intensity of livestock production. The overall outcomes mainly focus on the Red Meat and Dairy industries particularly focusing on reducing the time it takes to finish stock, or increasing milk yields by decreasing inputs and improving the profitability of the end product, without compromising quality. Advice and guidance offered can be applied across all sectors providing multiple benefits to the business whilst positively contributing to the reduction of the business carbon footprint.

In respect of our future plans, there are a number of areas where we will work to reduce emissions in agriculture.

Proposal 21 – We will work with the farming sector to help drive efficiency

We will work with the farming sector to help drive efficiency. We will do this through improving our evidence base, raising awareness and helping drive behaviour change.

We will look to develop our evidence base further around emission reduction from livestock production. We will look to improve our evidence base to inform the Welsh Inventory and future emission targets.

We will also increase awareness through further dissemination and engagement with the industry in order to change behaviour, ensuring farmers take responsibility for their carbon footprint and understand the wider impact of the agriculture industry.

Proposal 22 – Provide post-Brexit support in the form of a land management programme that contains a public goods element and an economic resilience element

Provide post-Brexit support in the form of a land management programme that contains a public goods element and an economic resilience element, replacing the Common Agricultural Policy with a framework that also links support to emissions reduction and removals.

Proposals arising from the 'Brexit and our Land' consultation are subject to a further round of consultation in 2019 and their inclusion in the Plan is for information rather than representing a clear commitment at this point.

We will improve soil and nutrient management through:

We will reduce our emissions by effective nutrient management, minimising the use of fertiliser, improving manure management and storage. These actions will also help to protect and enhance water and air quality. The policies and proposals detailed below help to support this.

Farming Connect Programme 2015 - 2019

We will improve soil and nutrient management through raising awareness, improving knowledge transfer, skills and training through our Farming Connect Programme.

Farming Connect's Demonstration Network delivers a number of on-farm projects and trials looking at improving land management practices and grazing systems which can help to reduce emissions. In particular, the Welsh Pasture project has developed a Master Grass and Master Soils programme providing farmers with practical skills and confidence to implement change on their own farms. These programmes have focused on helping farmers and land managers to select and establish appropriate grass species and varieties for rotational grazing, soil management and measuring and interpreting grass growth measurements.

The Grassland and Crop Management category offers subsidised support through the Advisory Service element of Farming Connect to help farmers reduce their emissions by making best use of resources through. The Service provides advice on the most appropriate grassland and crop regimes, the effective management of farmyard manure and how to best address soil and nutrient management. Developing tailored nutrient management plans and encouraging soil testing ensures nutrients are applied in a targeted manner, which reduces inefficiencies and wider water and air pollution.

Further initiatives to improve soil and nutrient management will be delivered through the Farming Connects Skills and Mentoring programme. We are providing skills training and advice on enhanced Grassland Management, Grazing Systems, and utilising Home-grown Crops and Forage. We are also supporting knowledge transfer through communication channels and on-farm events offer further information and support.

Further advice and knowledge transfer will continue to be made available for silage and slurry storage, ensuring farmers are equipped to meet the legal silage, slurry and agricultural fuel oil (SSAFO) regulations regarding the design (capacity), construction and maintenance of storage facilities for silage and slurry.

Policy – Farm Business Grant

We are providing finance towards capital investments in equipment and machinery that helps increase technical performance and delivering better crop management as well as soil, nutrient management and grassland improvements.

Policy 71 - Nitrate Vulnerable Zones

The Nitrate Pollution Prevention (Wales) Regulation 2013 are in place to protect water from agriculture pollution. The regulations designate areas of land which drain into polluted waters or waters at risk of pollution and which contribute

to nitrate pollution as Nitrate Vulnerable Zones (NVZs). The definition of such waters is as follows:

- Surface freshwaters, in particular those used or intended for the abstraction of drinking water, containing or that could contain (if no action is taken to reverse the trend) a concentration of more than 50 mg/l of nitrates.
- Groundwater containing or that could contain (if no action is taken to reverse the trend) more than 50 mg/l of nitrates.
- Freshwater bodies, estuaries, coastal waters and marine waters, found to be eutrophic or that could become eutrophic (if no action is taken to reverse the trend).

The 2013 Regulations contain measures, which apply to agricultural holdings within NVZs. The measures have been designed to address water pollution while preventing pollution swapping. Therefore, GHG emissions and ammonia emissions are also reduced within the NVZs. The measures focus on improved use of livestock manures. In particular, applications of livestock manures are restricted to specified crop limits. Controls are in place to ensure livestock manures can be stored until they can be applied when there is a nutrient requirement from the crop and when weather conditions are suitable.Currently, 2.4% of Wales is within an NVZ.

Proposal 23 – Regulations to reduce agricultural pollution.

Further regulations (which will apply to the whole of Wales) to address agricultural pollution will be made in 2019 and will apply to all agricultural holdings in Wales from 1 January 2020. The measures will include nutrient management planning; sustainable fertiliser applications linked to the requirement of the crop; protection of water from pollution related to when, where and how fertilisers are spread; and manure storage standards. The approach will be based upon the evidence supporting the measures which apply in the NVZs. Therefore, emissions will be reduced through improved storage of manures and improved land management practices, such as spreading manures at the most beneficial times.

Going forward we need to ensure emission reduction is considered in any regulatory reform proposals arising from the land management programme consultation.

Any proposals arising from the 'Brexit and our Land' consultation are subject to a further round of consultation in 2019 and their inclusion in the Plan is for information rather than representing a clear commitment at this point.

Policy – Sustainable Production Grant

£6m has been made available under the Sustainable Production Grant (SPG), offering a 40% grant contribution (between £12,000 and £50,000) towards capital investments in equipment and machinery which have been pre-identified

to specifically support famers address and safeguard nutrient management and improving water, soil and air quality by reducing the impacts of agriculture pollution.

Policy 72 – Glastir

Glastir our current five year whole farm sustainable land management scheme, offers payment for the delivery of specific environmental goods and services. The main aims of the scheme are to reduce the impacts of climate change within agriculture whilst improving water and air quality through the creation, management and restoration of woodland.

We will improve on farm fuel and energy efficiency.

We will reduce our emissions through increasing the efficiency of our farms by reducing energy and water use and improving efficiency in machinery.

Encouraging data capture and management through benchmarking of physical and financial data enables thorough and accurate business and nutrient management planning. This provides businesses with the opportunity to gain a greater understanding of the farms performance whilst also identifying areas for improvement and opportunities to reduce inputs.

Policy – Farming Connect Programme 2015-2019

We will aim to raise awareness and evidence through out Demonstration Network projects. All Farming Connect Demonstration sites receive an energy audit which identifies steps to reduce energy consumption. Results from these energy audits are communicated to the industry promoting best practice and evidencing the positive impacts of installing energy efficient lighting and equipment by reducing overall farm costs.

Policy – Farm Business Grant

As well as providing advice and evidence, we offer funding through the £40m grant made available under the Farm Business Grant (FBG) scheme towards capital investments in equipment and machinery. This support, sets at a maximum of 40% grant contribution, which looks to directly reduce on farm energy consumption.

Grants of between £3,000 and £12,000 are available to purchase energy efficient lighting and equipment which can directly reduce electricity usage whilst also providing capital investment towards equipment which enables farmers to utilise water resources already available to them through the installation of boreholes, providing a private water supply.

Additionally, the FBG scheme offers capital grant to farmers providing the opportunity to purchase equipment for the preparation of land for growing crops. Traditionally, this process can be time and labour intensive. Minimum tillage/cultivation machinery can not only reduce the resource required but also reduces machinery use by cutting down the process entirely, thus reducing fuel emissions from farm machinery.

Policy – Sustainable Production Grant

Reducing tractor use and reducing fuel emissions can also be achieved by ensuring compliance with the Silage, slurry and agricultural fuel oil (SSAFO) regulations. Meeting design (capacity), construction and maintenance of storage facilities for silage and slurry not only ensures compliance with legal obligations but also reduces the need to spread slurry as often, reducing tractor usage. Capital Grant available through the £6m Sustainable Production Grant (SPG) offers support to farmers helping them to meet the slurry storage requirements and improve farm design which can also include the collection of fresh water.

Waste – Wales Waste Strategy 'Towards Zero Waste'

The agriculture sector also links to the waste and power sector. Through the period of the carbon budget, we have been maximising our waste stream to reduce our reliance on producing electricity. For instance there is over 27 MW of anaerobic digestion (AD) capacity in Wales from 46 projects totalling around 27 MW of capacity in 2017[91]. Our forthcoming Waste Strategy will set out the next steps in terms of maximising the energy and broader wellbeing benefits of a more circular economy.

7. Well-being

The aim of the policies and proposals for the first carbon budget and subsequent carbon budgets will be to work together to reduce emissions from our agriculture sector at a scale and rate that maximises their contribution to the well-being goals. Wales' agriculture sector produces essential food for our society and large numbers of jobs depend on farming, either within the sector itself or within the wider food sector such as food processing and related retail and services together.

Our farmers are also the stewards of the natural environment, as they care for the natural resources of soil, water, air and biodiversity and provide essential carbon sinks and the supply of renewable resources for industry and energy. They also depend directly on these natural resources themselves.

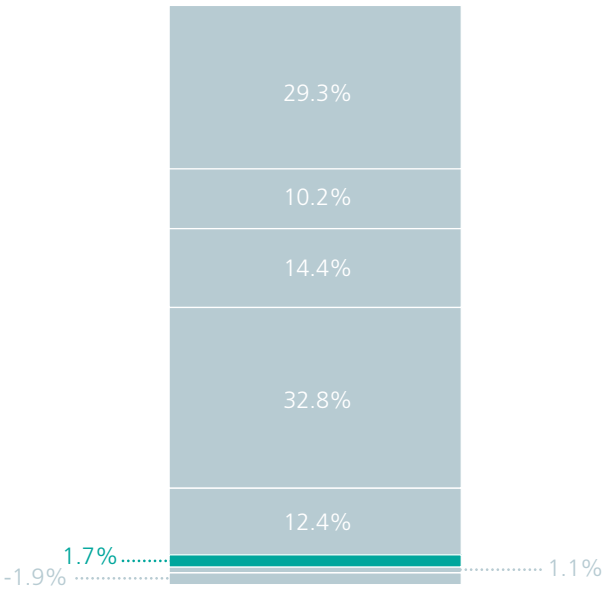
The Well-being Matrix Tool highlighted the SMS scheme has a positive direction against a prosperous, resilient and healthier Wales well-being goals.

91 https://gov.wales/docs/desh/publications/181113-energy-generation-in-wales-en.pdf

Waste Management

1. Ambition

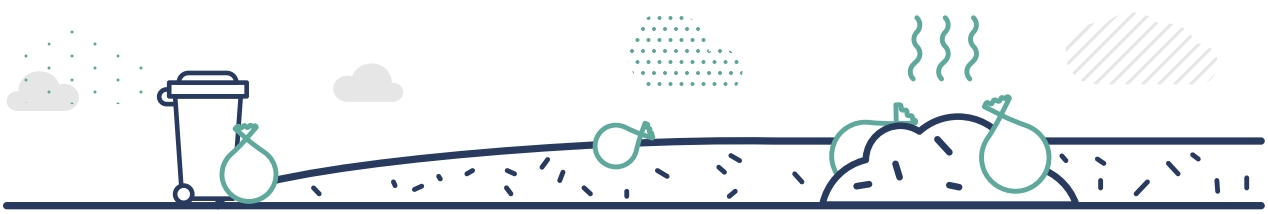
Wales is a global leader in waste management. After twenty years of sustained and collective effort following devolution, Wales is now a high recycling society, with high quality collection systems, a well-developed re-processing infrastructure and a worldwide reputation for achievement.



Over the last 20 years, we have moved from recycling around 5% of our municipal waste in the late 1990s to 63% in 2017-18. The amount sent to landfill is 11%. This transformation has been as a result of a clear strategy, supported by investment. Reducing waste to landfill and increasing recycling has had a positive impact on reducing carbon emissions.

Our ambitions are long-term and our drive to meet those ambitions will continue. Welsh Ministers have set the objective of, by 2050, having a more circular economy and being a zero waste, one planet resource use nation. We will aim to realise economic, social and environmental benefits whilst ensuring our approach to resource efficiency delivers our contribution to reducing carbon emissions.

By 2050 we will, as a minimum, reduce the impact of waste in Wales to within our environmental limits. We aim to phase out residual waste through enhanced actions on waste prevention and sustainable consumption and production and ensuring that all potential waste that is produced is reused or recycled.



We also have an ambition of 'zero landfill' by 2025, which means we will be aiming for no waste to being landfilled in Wales.

Our new waste strategy will be consulted upon in 2019. Within the strategy will be proposals for a number of policy initiatives that impact on our carbon budget including our plans to consult on halving food waste, new targets for municipal recycling and how we aim to maximise the innovation opportunities presented by moving towards a more circular economy.

2. Where do waste sector emissions come from?

At 1.26 $MtCO_2e$, waste accounted for 2.6% of Welsh emissions in 2016, down from 2.7% the previous year. Waste emissions are dominated by emissions of methane at 94% of the sector, followed by nitrous oxide (5%) and carbon dioxide (<1%). The dominant source of emissions is landfill, which makes up 77% of the sector's emissions. Wastewater treatment makes up the second most significant source, at 15% of the sector.

Figure 26: Graph to show waste sector emissions in 2016 ($MtCO_2e$)[92]

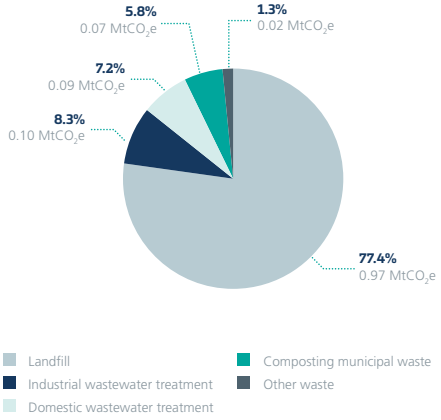


Table 8 Table: How the biggest emissions sources in the waste sector contribute to the Welsh total

Source	% of total Welsh emissions
Landfill	2.0%
Waste Water Treatment	0.4%

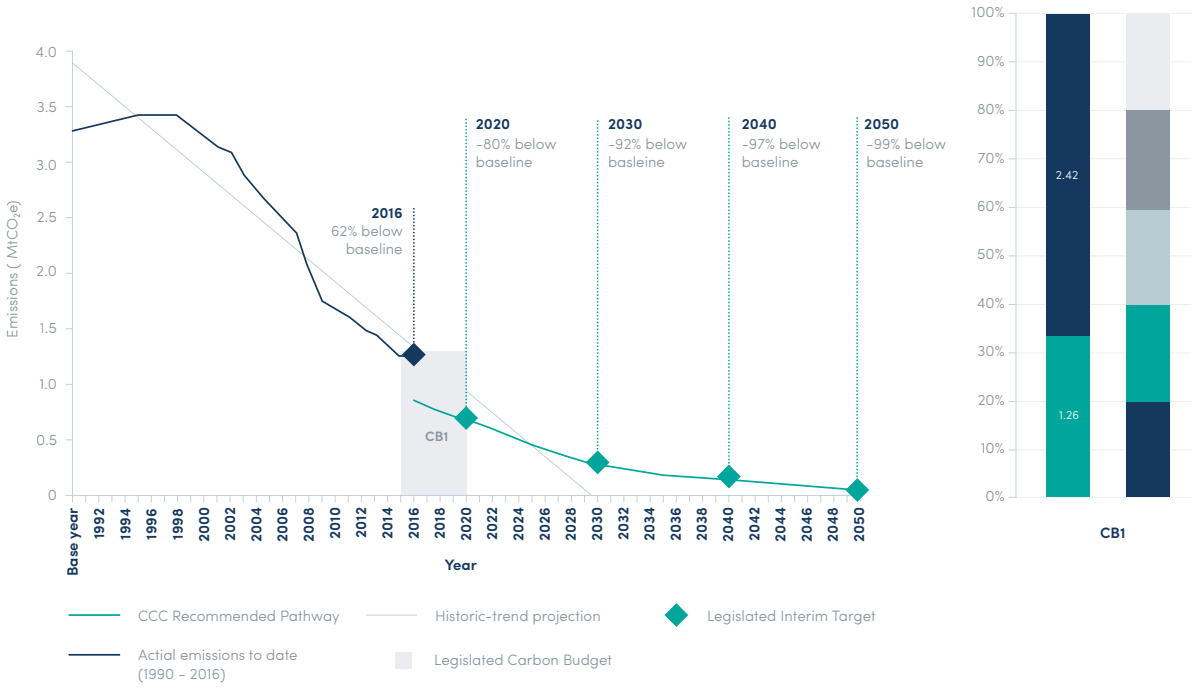
3. Progress to date

Total emissions from the Waste sector in Wales have declined by 62% between the base year (1990) and 2016, driven largely by the progressive introduction of methane capture and oxidation systems within landfill management.

In 2016, the first year of our budget period, Welsh waste sector emissions increased by 0.8% compared to 2015.

92 The emissions data is sourced from the Greenhouse Gas Inventories for England, Scotland, Wales & Northern Ireland: 1990-2016 and aligned to the UKCCC sectors as described in Annex 3.

Figure 27: A graph to show historic emissions for the Waste Sector and UKCCC modelling to show emission reductions for the first carbon budget (CB1) and a possible route for a contribution to an 80% reduction in all Welsh emissions in 2050



4. What are we aiming for?

2020 emissions target

Emissions in 2020 will be 48% lower than in 2016. This will mean that Waste sector emissions are 80% lower than the baseline in the year 2020.

Waste sector allocation for Carbon Budget 1

The total budget for the Waste sector for CB1 is estimated to be 3.7 $MtCO_2e$[93]. The Waste Sector contributes 1.7% of the total Welsh budget for CB1.

In 2016 the sector emitted 1.3 MtCO2e using up 34% of the Waste Sectors contribution to CB1.

Waste sector pathway to 2030

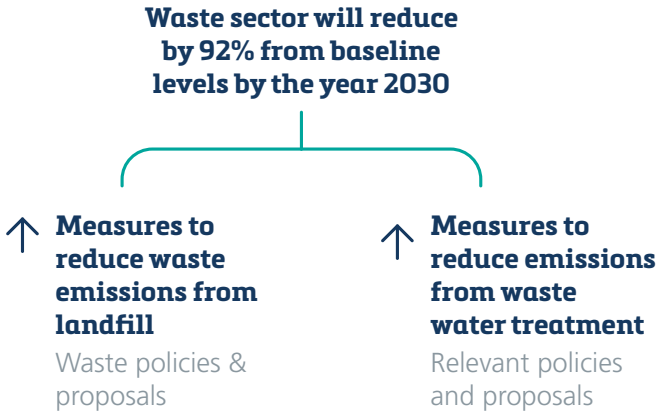
Waste sector emissions will reduce by 92% from baseline (1990) levels by the year 2030:

- through reducing waste emissions from landfill;
- Increasing measures to reduce emissions from water treatment.

93 Analysis based on 1990-2016 GHGI. All absolute figure referenced here will vary slightly as our understanding of GHG emissions in Wales improves.

5. How we are going to get there?

Figure 28: Policy Framework for Waste Aligning policy action to meeting targets, budgets and 2030 pathway



6. Policies & Proposals

The following policies and proposals focus on reducing GHGs from landfill, supporting the generation and recovery of energy from waste and through waste management and innovation, stimulating the move towards a more circular economy. We are also working with our partners to reduce emissions from waste water treatment.

We will increase measures to reduce emissions from landfill through:

Policy 73 – Reducing Greenhouse Gas Emissions from Landfill

We will continue to reduce emissions from landfill by reducing the amount of biodegradable waste being sent to landfill and increasing landfill gas capture to convert to energy generation.

We have developed a whole package of measures to support this approach including legislation, policy, delivery programmes and behaviour change campaigns. We have set statutory recycling targets for local authorities. The Landfill Allowances Scheme sets targets to reduce the landfilling of biodegradable municipal waste.

We are also supporting local authority contracts for the energy recovery of non-recyclable wastes.

As well as driving legislative and infrastructure improvements, we are also using behavioural change and consumer campaigns such as *Love Food Hate Waste* to help households make the most of the food they use and avoid food waste.

Wales' Waste Targets

Towards Zero Waste 2010 (Wales waste strategy) policies:

- 70% recycling of all wastes by 2025
- Statutory local authority recycling targets (70% by 2024/25) set in the Waste (Wales) Measure 2010 and the Landfill Allowances Scheme Wales Regulations are in place to reduce the landfilling of biodegradable municipal waste.

We have also legislated for the business and public sector to separate recyclable waste through the Environment (Wales) Act 2015. This will reduce the amount of waste going to landfill, enabling more to be recycled. We are planning to have regulations in place in 2019, and in effect by 2020.

We will consult on a new Waste Strategy in 2019 and within that will consult on plans to halve food waste by 2025 (on a 2007 baseline) and further increase municipal recycling rates to help us achieves our aim to become a Zero waste nation. As part of the Strategy, we will continue to invest and support Local Authorities through programmes such as our highly successful Collaborative Change Programme and behaviour change programmes. These are measures which will help to deliver the reduction of emissions.

Policy 74 – Generate Renewable Energy from Waste

We will continue to support the generation of renewable energy from the Anaerobic Digestion (AD) of food waste, energy recovery from waste wood in biomass power plants and the energy recovery of residual waste (the renewable element) and the utilisation of landfill gas. This reduces GHG emissions by reducing reliance on fossil fuels (also see power chapter). Our actions to support this activity include:

- our statutory recycling targets for local authorities (which incentivises food going to Anaerobic Digestion);
- municipal waste residual treatment procurement programme (with a requirement for high energy efficiency).

We also aim to put Environment Act provisions in place by 2020 for food waste to be kept separate and collected separately for recycling from business and public sector premises. In 2018, two energy from waste plants operated in Wales, providing a capacity of 35 MW for the power sector in Wales[94].

Case Study 18 – Energy from Waste

The largest and most recent energy from waste project to be commissioned was the 30 MWe Trident Park energy recovery facility in Cardiff, owned and operated by Viridor. Commissioned in 2015, Trident Park diverts 425,000 tonnes of municipal waste a year away from landfill, which equates to 95% of residual waste produced in South Wales.

Policy 75 – Transposing the Circular Economy Package

The EU recently set a new legislative framework to drive resource efficiency. We are already working on transposing the EU's Circular Economy Package[95] (CEP) into our own legislation. The Package includes waste management targets and waste packaging requirements to stimulate a transition towards a circular economy. We are already exceeding some of these targets in Wales.

94 https://gov.wales/docs/desh/publications/181113-energy-generation-in-wales-en.pdf

95 Transposition is required by 5 July 2020.

The changes will help prevent waste and, where this is not possible, increase recycling of municipal and packaging waste.

Case Study 19 – Public Health Wales – Circular Economy Innovation through Procurement

Public Health Wales (PHW) is a statutory body, established in 2009, which aims to improve public health and well-being and reduce health inequalities in Wales. As part of its mission, PHW aims for all of its activities to contribute towards its public health objectives, including procurement of goods and services.

In 2016 the organisation relocated from nine smaller satellite offices to a new larger 4,700m^2 open-plan office in Cardiff Bay. It decided to use this move as an opportunity to embed the core principles of 'sustainability' and 'maximising public value' in the new office. Public Health Wales decided to adopt a new mindset when procuring for the design and supply of office furniture, equipment and floorings, and sought suppliers who could reuse as much of the existing items as possible. This included repairing and refurbishing existing items where necessary and adding new elements as required by the design.

The winning bid was from a consortium which included a sustainable office design service, a furniture manufacturer and a community interest company with specific objectives to support low-income and long-term unemployed people in areas of high social deprivation. The consortium successfully developed new ways of working, met the ambitions of the tender and avoided waste and created additional greater public value by creating training and meaningful employment opportunities.

We will increase measures to reduce emissions from waste water through:

Proposal 24 – Exploring the opportunities provided by the water sector in reducing emissions

Research and development is crucial in tackling emissions from waste water treatment. We need to explore opportunities around the effective use of green gases (biomethane) generated from the wastewater treatment process – which in turn would help to decarbonise heat or transport networks. Water companies in Wales are already trialling innovative methods to reduce process emissions through anaerobic digestion and exploring tackling emissions from sludge and Combined Heat and Power exhausts to see what can be captured and used.

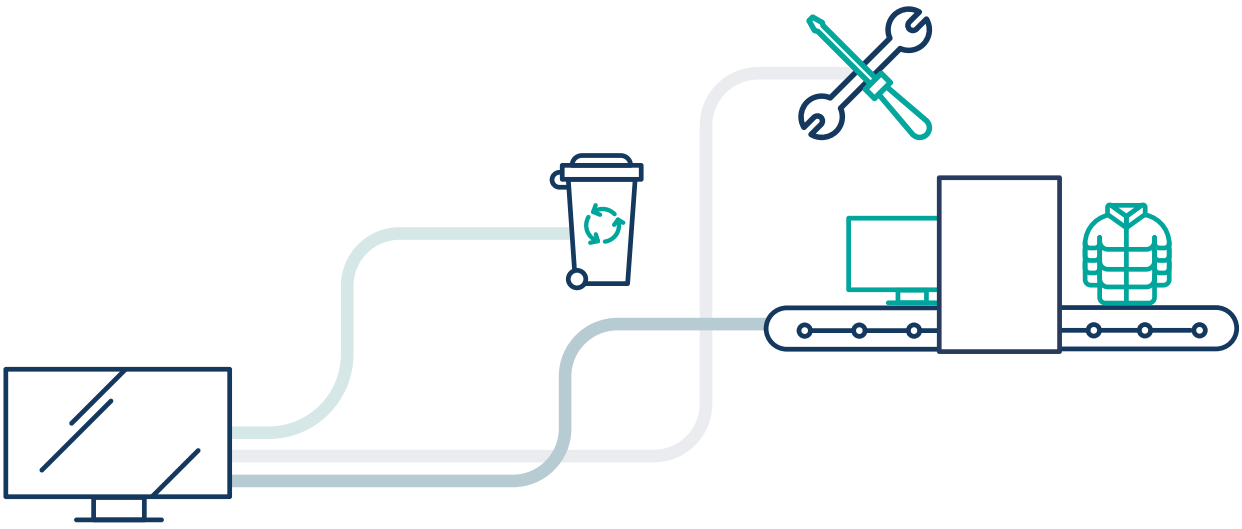
We need to work with the water companies on the wider opportunities around emission reduction (e.g. reducing emission from their fleets and energy usage) as well as opportunities provided by their land assets for renewable generation or further carbon sequestration.

We propose to bring key the water companies and other key stakeholders together to develop a routemap over the period of Carbon Budget 1 for decarbonising the water industry in Wales, with actions to be implemented in subsequent budgets.

7. Well-being

These policies and proposals aim to reduce emissions from the waste sector in way that provides multiple benefits that contribute to the well-being goals. Keeping products and resources in use for as long as possible through recycling, reuse, repair, remanufacturing reduces emissions and can help develop a circular economy. These include greater economic stability through increased resource security and new business and employment opportunities from an expanding industrial sector. Research suggests that if we stay on the current development path for the circular economy in Britain, then by 2030 the sector could require an extra 205,000 jobs;

The Well-being Matrix Tool identifies the strong link to a prosperous and globally responsible Wales.

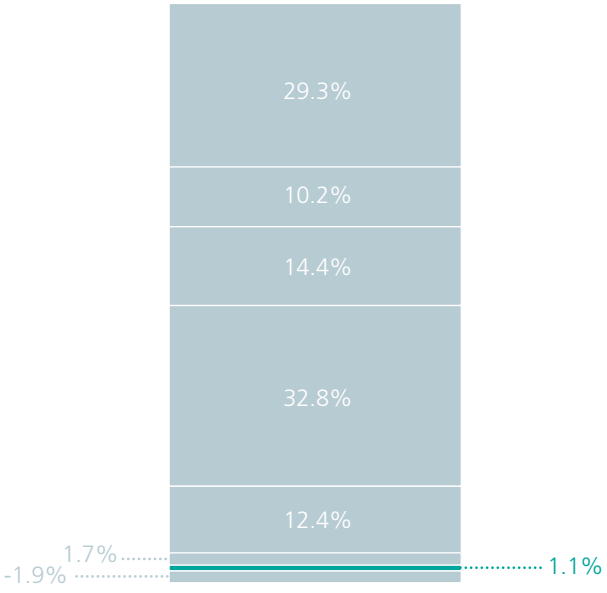


F-Gases Sector

This chapter covers Fluorinated gasses (F-gases) and includes GHG emissions of Hydroflurocarbons (HFCs), Perfluorocarbons (PFCs) Nitrogen trifluoride (NF3), and Sulfur hexafluoride(SF6). Emissions of these gases in Wales are dominated by emissions linked to refrigeration and air conditioning. F-gases arise in Business, Industrial and Building sectors.

1. Ambition

'F-gases' are a family of man-made gases used in a range of industrial applications. Because they do not damage the atmospheric ozone layer, they are often used as substitutes for ozone-depleting substances (ODS). However, F-gases are powerful GHGs, with a global warming effect up to 23 000 times greater than carbon dioxide (CO2). F-gas emissions in Wales have more than doubled since the base year following international trends of increasing F-gas emissions.



In Wales, the EU Ozone Depleting Substances Regulation (1005/2009) restricts the use of chemicals, which damage the ozone layer. It implements the Montreal Protocol, an international treaty that aims to phase out ODS and restricts use to very specific circumstances. The Kigali amendment brings HFCs under scope of the Protocol, which has now been ratified by the UK and EU. The EU F-gas Regulation (EU) No 517/2014 goes further than the Montreal Protocol, requiring a faster rate of phasedown and extending controls to a larger number of F-gases.

This is the primary framework that is expected to significantly reduce F-gas emissions across the UK. We assume Welsh F-gases change in line with the UK scenarios.

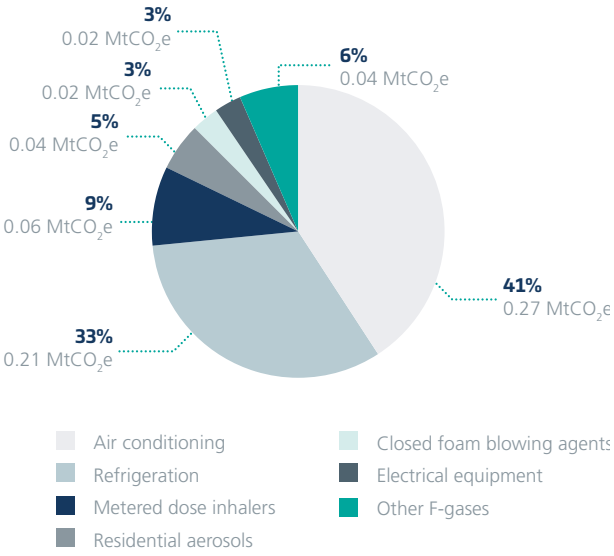
In a 'no deal' scenario, Wales would maintain the same high standards. Phase-down, licensing and associated requirements will continue to apply in relation to the UK after EU exit. This will ensure the UK can continue to maintain controls on ODS and F-gases to meet climate change goals and fulfil legal obligations under the Montreal Protocol.

2. Where do F-gas sector emissions come from?

Wales emitted around 0.65 $MtCO_2e$ of F-gases in 2016 which is equivalent to 1.3 % of total Welsh emissions for 2016. Of these F-gases, 94% of emissions were emissions of HFC's. They are used in refrigeration, air-conditioning, insulation foams, electrical equipment, aerosol sprays, medical inhalers, solvents

and fire extinguishers. Emissions occur through leakage during the manufacture, operation and disposal of products.

Figure 29: Graph: F-gas sector emissions in 2016



3. Progress to date

Total emissions from the F-Gas sector in Wales have increased by 103% between the base year (1990) and 2016.

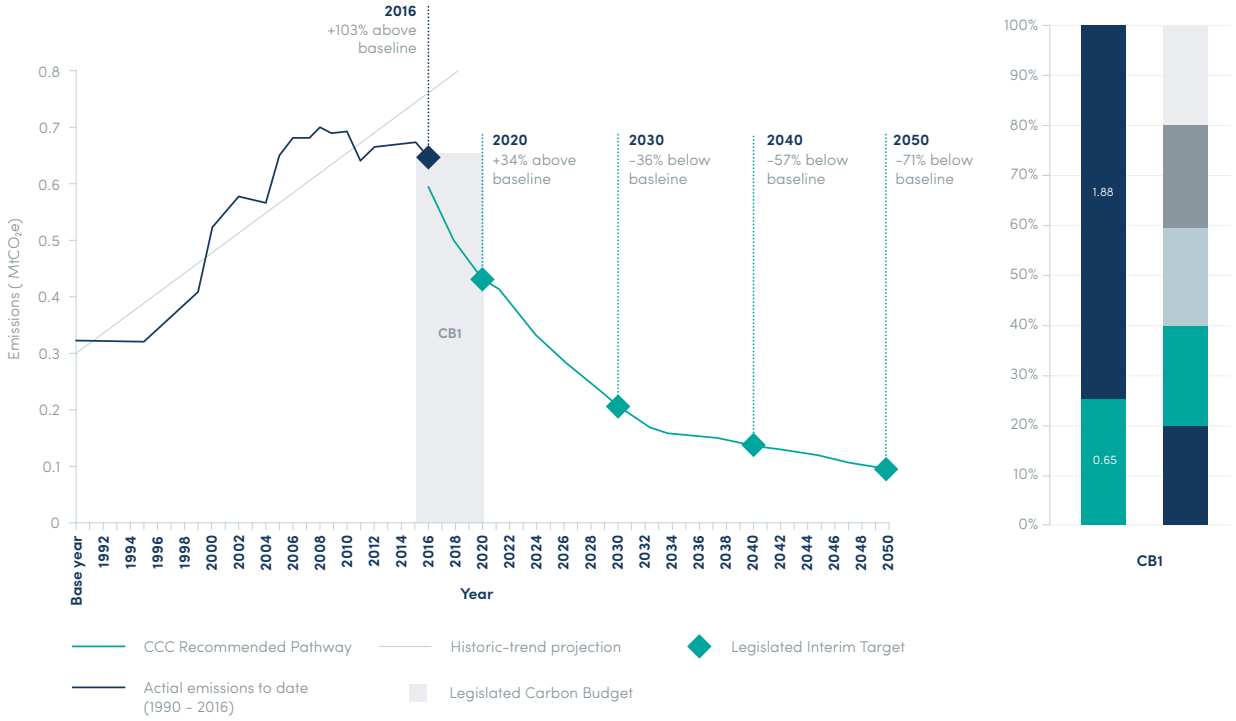
Without the policy framework in place it is likely that F-gas emissions would increase further. This is due to increasing use of products and appliances using F-gases, such as in refrigeration and air conditioning equipment or foams used for energy efficiency measures. However, EU regulations will significantly reduce F-gas emissions across the UK. We assume that Welsh F-gases change in line with these UK scenarios.

In 2016, the first year of our budget period, Welsh waste sector emissions decreased by 3.5% compared to 2015.

Table 9 How the biggest emissions sources of F-gases to the atmosphere contribute to total Welsh GHG emissions

Source	% of total Welsh GHG emissions in 2016
Air conditioning	0.55%
Refrigeration	0.44%

Figure 30: A graph to show historic emissions for the F-gas Sector and UKCCC modelling to show emission reductions for the first carbon budget (CB1) and a possible route for a contribution to an 80% reduction in all Welsh emissions in 2050



4. What are we aiming for?

2020 emissions target

Emissions in 2020 will be 34% lower than in 2016. This will mean that F-gas sector emissions are reduced to a level 34% above the baseline in the year 2020.

F-Gas sector allocation for Carbon Budget 1

The total budget for the F-gas sector for CB1 is estimated to be 2.5 $MtCO_2e$[96]. The F-gas Sector contributes 1.1% of the total Welsh budget for CB1.

In 2016 the sector emitted 0.65 MtCO2e using up 26% of the F-gas Sectors contribution to CB1.

F-Gas sector pathway to 2030

F-gas sector emissions will reduce by 36% from baseline (1990) levels by the year 2030:

› Through demand reduction For existing equipment, there is a ban on using the most carbon-intensive HFCs (with a Global Warming Potential above 2,500) for the maintenance and servicing of existing refrigeration equipment from 2020.

96 Analysis based on 1990-2016 GHGI. All absolute figure referenced here will vary slightly as our understanding of GHG emissions in Wales improves.

5. How we are going to get there?

Figure 31: Policy Framework for F-gas Aligning policy action to meeting targets, budgets and 2030 pathway

F-gas emissions will reduce by 36% against base year levels by 2030

↓ **F-gas**

e.g demand reduction policies

6. Policies & Proposals

We will decrease F-gas emissions through:

Policy 76 – implementing the 2015 EU F-gas regulation

The 2015 EU F-gas Regulation introduced a series of measures, including a quota system, a series of bans and further leakage checks, which are expected to bring emissions down significantly by the early 2030s:

- It reduces the quantities of HFCs that producers and importers are allowed to place on the EU market.
- For new equipment, the regulation introduced a series of bans on the use of F-gases covering cross-cutting areas.
- There is some strengthening of existing obligations related to leak checking and repairs, F-gases recovery and technician training.
- It has been estimated by the UKCCC that if these policies are continued post EU exit, they will save around 0.5 $MtCO_2e$ by 2030.

Part 4 – Methodological Approach

Introduction

This section describes the methodological approach for:

- how we will achieve our overall emission reductions, including how we are accounting for the policies,
- how we will monitor those policies; and
- how we have developed this Plan, guided by the principles of the Well-being of Future Generations Act 2015.

Meeting the Targets and Budgets

Under Section 39 of the Environment (Wales) Act 2016 Welsh Ministers must prepare and publish a Plan (report) for each budgetary period setting out their proposals and policies for meeting the carbon budget. The Plan sets out how we will ensure Wales lives within the allocated budget for the period 2016-2020 and meets the 2020 interim target.

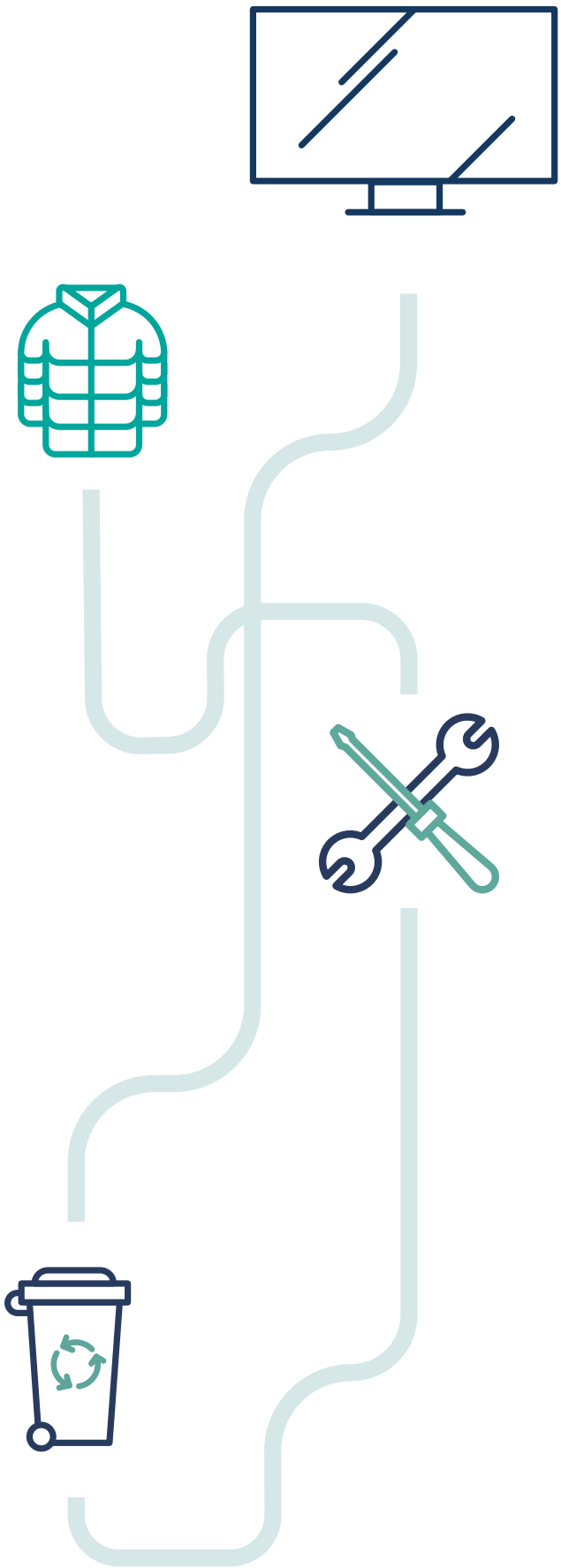
Following our own analysis, including an internal cross-sector review, we have adopted the UKCCC's recommended 80% pathway and the specific sectoral contributions this implies for Carbon Budget 1 (CB1) only. The UKCCC's analysis suggests that we will meet the first budget predominantly through existing actions and provides an assessment of how this effort is currently distributed across our sectors. This is a logical approach given that there is limited time to implement new policy and for that to have a significant effect on emissions within the current budget period. However, the advice highlights the need to start developing further policies to achieve our next budget and in recognition of this, the Plan identifies longer-term policy proposals that will be needed to deliver future budgets and targets.

Achieving these sectoral contributions will ensure that Wales delivers the overall emission reductions required to meet CB1 and the 2020 interim target, as well as remaining on track to deliver our longer- term commitments. The Sector Pathways Chapters in **Part 3** outline the agreed sectoral contributions over the first budget period and details the policies and proposals that will ensure these contributions are delivered.

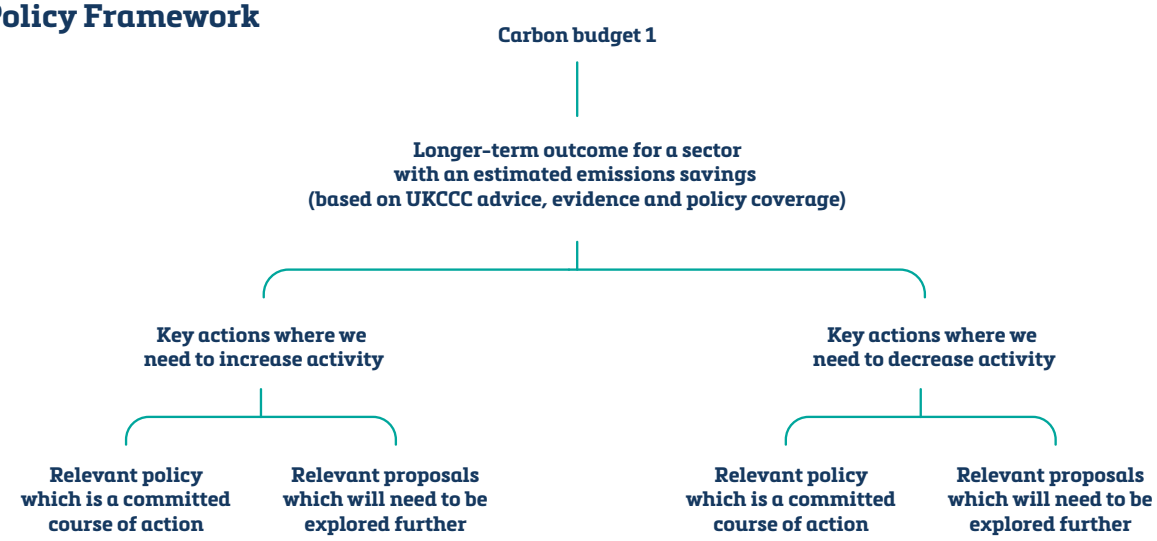
These include actions from across all Ministerial portfolios within Welsh Government, as well as UK and EU policies and wider societal contributions that will be required to deliver our targets. These policies and proposals also take into account the recommendations made by the UKCCC in their advice and responses to our consultation 'Achieving our low-carbon pathway to 2030' to the first carbon budget period. Alongside this Plan we have published a summary of responses and have outlined in Annex 5 where we have developed the ideas for action further.

The policies and proposals are set out in Part 2 and Part 3 of the Plan. Part 2 primarily sets out the cross cutting and facilitative policies and proposals to decarbonise, whilst maximising the benefits of emission reduction. These are mainly indirect emission reduction actions but are no less important.

Part 3 of the Plan details each sector's emissions pathway and provides the Policy Framework that will deliver these reductions, consisting of a Policy Outcome, key actions and Policies and Proposals. These policies and proposals reflect more direct emission reduction actions. The Policy Framework is explained below.



Policy Framework



A **Policy Outcome** provides an emissions saving underpinned by a number of measures. The emission savings have been quantified from the UKCCC's evidence and other sources of evidence, for further information see Annex 3, which we have accepted for this budget period. The supporting measures are constructed from a policy or combination of related policies.

Policy outcomes are not bound by the delivery timeframe of the existing budget (2016-2020) and recognise the longer term need to decarbonise our economy.

To support the policy outcomes, we have identified the main actions we need to take to achieve these outcomes. This will normally involve the increase of particular activities (e.g. active travel), or the decrease others (e.g. reduce energy demand).

We have shown how we will take action through our policies and proposals. A policy is a committed course of action to which a policy outcome can be attributed with a reasonable level of confidence. 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. Many policy proposals will continue to be developed into detailed policies to deliver future carbon budgets. Where a policy proposal contributes to a future Plan, the rate to which the outcome contributes towards the budget delivery for that period will be quantified. As we go through our carbon budget cycles, the long-term emissions savings of the outcomes stated here may change, as new evidence emerges and

further work is undertaken to quantify the impacts of our policy proposals.

The policies and proposals in this Plan are mainly focused around:

- direct emission reduction activities;
- actions to develop our evidence base to make future decisions;
- knowledge transfer to share learning;
- Funding mechanisms; and
- the role and establishment of advisory bodies and collaborative groups.

Monitoring and Reporting

The Environment (Wales) Act 2016 requires Welsh Ministers to prepare and lay a statement after each budgetary period setting out whether Wales has met the budget and relevant interim targets.

The statement must explain what the Welsh Ministers consider to be the reasons why the carbon budget and interim target have, or have not, been met. In particular, it must include the Welsh Ministers' assessment of the extent to which their proposals and policies for meeting the carbon budget for the period have been carried out, and have contributed to the carbon budget for the period being met (or not being met).

This report must be laid before the end of the second year after the budgetary period, allowing time for the emissions data to be compiled from the GHG Inventory, which requires 18 months from the close of year. For further information on our GHG Inventory please see Annex 4.

To meet the requirements of this report, a Monitoring, Reporting and Verification (MRV) system will be developed to track the progress of the Plan. This will provide an insight into how the policies and proposals set out in the Plan have contributed to meeting the targets and budgets. It is proposed that the suite of quantitative performance indicators will be structured in three 'tiers' that seek to track progress from the national level down to the policy level. The three tiers include:

- Tier 1: Emissions estimates which are consistent with the Environment Act target definition for each sector;
- Tier 2: More specific activity data, or emission factors, that provide information on the underlying drivers of GHG in Wales. Data will generally come directly from the database compiling the GHG inventory for Wales; and
- Tier 3: Policy-tier indicators will monitor the policies and proposals which Welsh Government is actively doing or aiming to do to reduce GHG emissions. This will also include the monitoring of UK policy delivery where it contributes to the delivery of Welsh targets.

In addition, further performance indicators will be explored to track progress on the realisation of the wider well-being benefits identified in the Plan and to track wider contextual factors that influence Welsh emissions such as population and economic factors (i.e. GVA). Adopting an integrated MRV system for tracking GHG emission reduction targets, based on both an inventory and suite of indicators, would provide additional granularity and

insight into individual policies and actions implemented to achieve these. Indicators enable the progress of individual policies to be tracked in more detail. Crucially they also enable both *implementation* (i.e. has a policy been initiated) and *effectiveness* (i.e. to what extent it is achieving its original aims) to be tracked. Such information can be used to establish a detailed feedback mechanism between evidence compilers and policy makers, allowing policies to be adapted or even terminated if not effective or to establish if lack of impact is due to them not being effectively rolled out.

It is also important to understand policy effectiveness given a large proportion of our emissions are outside of our control. The National Assembly's Climate Change, Environment and Rural Affairs Committee highlighted the importance of specificity in looking at the effectiveness of devolved and non-devolved policy interventions.

How we developed this Plan guided by the Ways of Working and Well-being Goals

The Well-being of Future Generations (Wales) Act ensures we consider the social, cultural, economic and environmental impacts of our decisions, both now and for the long-term. As a result of our responsibilities in line with the Act, we also need to ensure that our decisions and actions are undertaken under the 'sustainable development principle'. In developing this Plan, we have considered how to achieve our long-term target by looking at what actions we need to take, ensuring we collaborate and involve stakeholders to integrate decarbonisation within the way we work as a government, to limit further effects of climate change and avoid unintended consequences.

Climate change is one of the biggest global challenges and requires us to work differently and come up with different solutions. We have adopted the Ways of Working under the sustainable development principle to guide and shape our action. A number of examples are provided below:

Long Term	The Environment Act establishes a clear long term pathway for Wales to reduce emission by at least 80% in 2050. Whilst this first Plan focuses on the short term (carbon budget 2016-2020), it also lays the foundations for future action and continues to develop the policies now that will take us through to the 2020s and beyond. The consultation *Achieving Our low Carbon Pathway to 2030* is one example of our long term thinking. It was our first step in developing future policy proposals that will deliver our emission targets and meet the needs of future generations. Setting longer term targets for renewable energy and the public sector sets a direction of travel, providing certainty and clarity to enable us collectively to maximise the well-being goals for our future generations.
Prevention	We need to understand the impact of our policies to limit unintended consequences. This will include the development of our wider evidence base such an emissions modelling tool and further refinement of our integrated well-being assessment matrix tool. This will allow us to develop future policies and proposals in a way that maximise the goals and limit unintended consequences. We propose to establish a climate justice advisory group to ensure our transition avoids unintended consequences. The group will be represented from a range of sectors, from heavy industry to the citizen, and will advise Welsh government on its decarbonisation policies, considering how they can deliver fair work and tackle inequalities as the industrial landscape evolves towards a low carbon economy.
Integration	To drive low carbon solutions we need to integrate decarbonisation into our government processes and the way we develop and implement policy. As a result of this, decarbonisation now features as the sixth priority in the national strategy: Prosperity for All, which requires the government to collectively work towards delivering our national strategy. To ensure we are making good policy decisions, decarbonisation is also a key consideration of how we develop and implement policy, from our impact assessment process to how we fund our capital infrastructure. It is also an integral part of our cross cutting policies and processes for innovation, skills and business.

Collaboration

To make effective change requires us to work differently. We have changed the way we work across government and with key partners from across different sectors to help shape our policy delivery, from the establishment of our accounting framework to generating Ideas for Action that will enable us to meet our carbon budgets and targets.

To drive action, we have developed an extensive collaboration programme working at all levels. This included:

- The *Ministerial Task and Finish Group*, which is a new Ministerial group established in recognition of the cross cutting and strategic decisions needed.
- A cross government *Programme Board* to oversee implementation of the Act. The Board is supported by a series of cross government Working Groups to drive action across government.
- Collaborating with key external stakeholders across sectors to develop the carbon budgeting framework, the public leaders event and ideas for action in our consultation.

We have now started to develop our systems thinking recognising the need to work with our stakeholders across boundaries in a joined up and integrated way. Many of the policies and proposals reflected within this Plan have been designed to ensure close and effective collaboration with partners over the remainder of the budget period, for instance the establishment of a joint industry/government working group.

Feedback from our consultation also suggested we need to continue to support cross-sector external collaboration with key experts and organisations. To assist this we will work with our stakeholders to identify how we can encourage more cross sector collaboration including public and private sector. We will do this through holding a regular Climate Change Conference together to discuss progress and develop future ideas.

Involvement

We recognised we needed to involve people across different sectors bringing different stakeholders together to stimulate ideas and discuss how we shoulf to meet the challenge. In doing so, we worked closely with the Future Generations Office to help guide action on the involvement principle of this Plan in particular around young people.

We have changed our communications methods, introducing new communications materials to provide regular updates through social media, our newsletters and Written Statements.

We have also involved people through individual meetings as well as events, actively seeking views from the broadest range of stakeholders from across all emission sectors throughout the development of this Plan. This included our consultation period and the wider events that we held since 2016 which were cross-sectoral in nature.

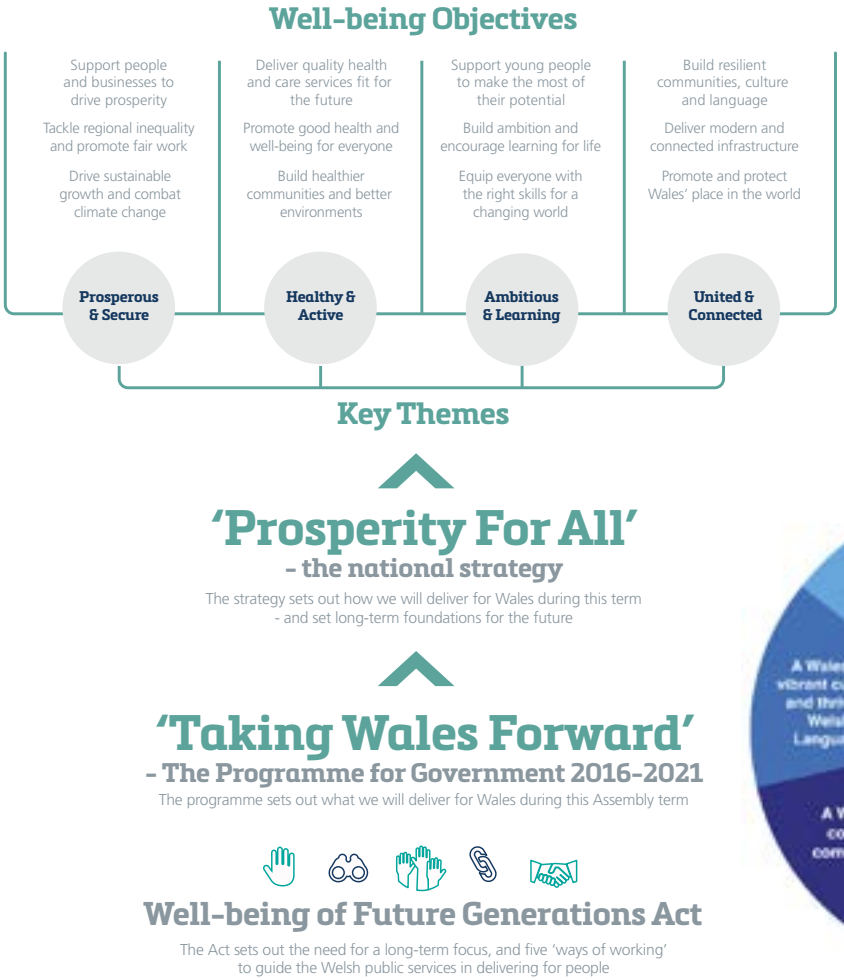
Future generations have been at the forefront of our thinking in the development of this Plan and we have involved them through a competition and a young person's video competition and consultation.

We have continued this approach by designing the policies and proposals in this Plan with the aim of involving society in the transition. We will do this by:

- collaborating with key partners and the Centre for Climate Change and Social Transformations and other key partners to explore how we use the media, arts and educators to communicate about the transition to a new energy system and the impacts of climate change;
- building an evidence base to identify where we can maximise the impact of behavioural and social science;
- collaborating with key partners through the climate just advisory group to understand the impacts of measures on people; and
- empowering communities and young people to act as advocates and early adopters of the low carbon transition.

Maximising our Contribution to the Well Being Goals and Objectives

The Well-being of Future Generations Act requires us, alongside other Welsh public bodies, to carry out sustainable development by setting and publishing objectives and taking reasonable steps to exercise their functions to meet them. These objectives must show how public bodies achieve the seven well-being goals to ensure we are all working to the same purpose for the future generations of Wales. The goals are to create a prosperous Wales, a resilient Wales, a healthier Wales, a Wales of cohesive communities, a Wales of vibrant culture and Welsh language, and a globally responsible Wales. In order to ensure we maximise our contribution to all the well-being goals, twelve well-being objectives were set within our national strategy Prosperity for All, which are mapped across the goals.



As the Plan is a an accumulation of 76 policies and 24 proposals, we can only make assumption on a high level basis, as there are a number of variables we have to consider covering different sectors and time periods. This is different to one policy, where it is easier to show and accurately measure the impact.

However, we recognise we have a responsibility to show how collective action is maximising our well-being objectives and goals. We are doing this through the way we develop our policies and looking at the collective contribution of the Plan.

How we developed the Plan to maximise the goals.

Although the Plan is predominantly based on existing policies, we recognise we have to develop proposals further into policies, in a way that maximises our contribution to the well-being goals. To this end, we have developed a well-being policy development tool, which helps us explore the social, cultural, economic and environmental impacts of potential decarbonisation interventions.

The tool asks a series of questions to assess what changes are expected as a result of a particular policy. These changes were created by considering the Well-being goals and our well-being objectives and relate to a broad range of areas, including number of jobs, air quality, and community cohesion.

The tool provides a list of expected impacts, which can be positive or negative. The tool can help prompt where policies can be strengthened in relation to one or more of the well-being goals and improve decision making. Examples of well-being impacts in the tool include GHG emissions, energy bills, crop yields and mental health.

We intend to develop the tool further, including improving its usability for future Plans to enable us to look at the cumulative effect of individual policies and their collective contribution to the well-being goals. We have included examples of how individual policies and proposals have been through the tool and deliver multiple benefits in the sector emission pathways chapters in Part 3.

How the Plan maximises our contribution to the goals

Although not formally required, as part of the development of the Plan we decided to commission a SA to provide an independent assessment of the Plan as a whole and to help demonstrate that the Well-being goals and Objectives formed an integral part of the plan-making process. A Sustainability Appraisal is a systematic process that aims to promote sustainable development by assessing the extent to which an emerging plan or project will help to achieve relevant objectives.

Instead of following the traditional SA process, we wanted to ensure that our wider well-being requirements were taken in to account. Our SA includes the principles and approach of the traditional SA and Strategic Environment Assessment (SEA) process, whilst incorporating our wider objectives such as the Well-Being of Future Generations Act, Welsh Government's well-being objectives and requirements for IAs. Further details on the

methodology can be found in *Prosperity for All: A low carbon Wales Sustainability Appraisal (SA)*.

The SA highlighted there were no significant negative effects identified and therefore no recommendations arising from the SA. Many of the effects identified were predicted to be minor positive impacts and some were found to have negligible or neutral effects. Major positive effects were indicated through the overarching approaches in Prosperity for All: A low carbon Wales. Whilst all the factors are inter-related and cross-cutting, particular issues for energy generation and transport are identified.

The SA made some suggestions for Prosperity for All: A low carbon Wales that could help enhance well-being and sustainable development or contribute to the next round of plan-making and SA,

We will take the findings from the SA in to account in the development of the next phase of the programme, which starts in April 2019.

Overall Summary SA of Implementing Prosperity for All: A low carbon Wales (2016-20)

	WELL-BEING GOALS									
	PROGRAMME FOR GOVERNMENT KEY THEMES									
	PROSPEROUS AND SECURE		HEALTHY AND ACTIVE		AMBITIOUS AND LEARNING		UNITED AND CONNECTED			
Prosperity for All: A low carbon Wales	SA OBJECTIVES 2016-20									
	1 Encourage Prosperity	2 Support Employment for all	3 Combat Climate Change	4 Health and Wellbeing	5 Healthier Communities	6 Better Environments	7 Skills and Learning	8 Resilient Communities	9 Connected Infrastructure	10 Wales' place in World
Vision	++	+	++	+	++	++	0	++	+	+?
Leadership, Integration, Collaboration and Involvement	++	+	++	+	+	+	+	+	0	0
Power	+	+?	+	+	+?	+	0	+	+	+?
Industry	+	+?	+	+	0	+	0	+	+	+?
Buildings	0	0	+	++	+	+	0	0	0	0
Transport	+	0	0	+	+	+	0	0	0	0
Waste	+	0	+	+	+	+	0	0	0	0
Land Use and Forestry	0?	+?	+	+	+	+	+	0	+	0
Agriculture	+	+	+	+	+?	+	+	0	0	0
Methodological approach	+	+	++	+	+	+	+	+	+	+

Categories of Significance of Effects		
Symbol	Meaning	Sustainability Effect
++	Major Positive	Proposal or policy encouraged as would resolve existing sustainability problem
+	Minor Positive	No sustainability constraints and proposal or policy acceptable
0	Neutral	Neutral effect
?	Uncertain	Uncertain or unknown effects
-	Minor Negative	Potential sustainability issues; mitigation and/or negotiation possible
--	Major Negative	Problematical and improbable because of known sustainability issues; mitigation likely to be difficult and/or expensive

Part 5 – Next Steps

This Plan is the next step of a low carbon journey for Wales

Over the next year, we will continue to work on decarbonising Wales, involving and collaborating with others and implementing the policies outlined in the Plan.

Advice on our long term targets

In May 2019, we will be receiving, further advice from our advisory body the UKCCC on our long-term targets in light of the Paris Agreement, ensuring they reflect our commitment to being a globally responsible Wales. We will consider this advice and its implications for our statutory framework and report back to the Assembly before setting the third carbon budget next year. We will also consider the other sources of evidence described in the Environment (Wales) Act 2016.

Autumn Conference

In the Autumn 2019, we will hold our first conference bringing people together to look at how we collectively decarbonise.

Monitoring and Reporting

We are committed to further developing our MRV system so we can monitor the performance of our Plan and adjust the actions as required during the relevant budget period. This will be a critical process where future Plans are developed and published early in the carbon budget period. This will enable us to effectively monitor the progress of our Plan and intervene early to introduce any necessary corrective action before the end of the budget period.

Future Plans

We will be publishing our next Plan in 2021. Our policies and proposals will evolve as we build our evidence and learn lessons about what does and does not work, and as we adapt to trends in the economy, society, technology and innovation.

Methodology

For future Plans, we will develop and refine our methodology for setting out how we will meet our carbon budgets. In the development of this Plan, our pathway to meeting the first budget was largely constructed on the basis of existing policies and proposals, given that there is little time to develop and implement significant new policies within the current budget period. This approach and the pathway for the first budget period was informed directly by the UKCCC advice and their assessment of how the current suite of policies delivering in Wales could meet the first carbon budget. However, for future Plans we will need to develop a more comprehensive approach that will allow us to test the impact of new emerging policies and proposals. To support this work we have developed a 2050 pathways tool for Wales. This tool will allow us to explore and test the impact of differing levels of action, and different distributions of actions across our sectors, on our future emissions pathways. Using

this tool the specific level of our proposed policy outcomes can be adjusted until a pathway is created that provides sufficient confidence that they will deliver upon the legislated carbon budget.

With future pathway modelling in place to complement our statutory advice from the UKCCC, the form of future Plans may take on a updated form, especially with regard to sector classification. In order to simplify our sectoral approach, we may wish to move from the current UKCCC sector definition (Annex 2) to a classification that more closely aligns with our own pathway modelling and the internationally agreed inventory reporting classification.

Over the current and future budget periods the internationally agreed emissions inventory reporting process will continue to evolve and improve, as we increase our scientific understanding of emissions. Wales will continue to engage with this process and ensure that the Devolved Administration-GHG inventory provides the best possible representation of GHG emissions in Wales. These updates may change our reporting of Welsh emissions and may result in revisions to the understanding of Welsh emissions upon which the Plans were initially developed. These updates are in most cases expected to be small and can be managed within the existing flexibility mechanisms built into our accounting approach. However, for sectors where our current emissions reporting is more uncertain such as LULUCF, and to a lesser extent Agriculture, improvements to the inventory reporting methodologies may have a more significant impact on reported Welsh emissions. Depending on the nature of any future changes, these improvements may be more challenging to integrate with our published emission reduction Plans and performance reporting, and in the extreme may provide grounds for revisions to our statutory targets and budgets. The Environment (Wales) Act provides for such amendments where it can be demonstrated that there has been a significant development in scientific knowledge about climate change, or where an amendment has been recommended by the UKCCC.

We will also continually look at how we show the ways of working and maximising the well-being goals and will continue to work with the Well-being of Future Generations office.

Where indicated, the policies and proposals contained within the Plan will be consulted on separately, where such consultation has not already taken place. Views received in response to both this Plan and the detailed policy proposals which will follow it will be considered as we update key elements of the Plan before setting our second carbon budget.

Working with Partners on the International Stage

We will continue to work with other States and Regions on the international stage, sharing our collective learning to contribute to the challenge of global climate change.

Annexes

Annex 1 – Wales Accounting Framework

What are we accounting for in Wales?

In terms of our accounting framework, we will account for all emissions in Wales, with no complicated reporting processes, as we believe it is the most transparent way.

The Environment (Wales) Act requires that for the year 2050, Wales achieves at least an 80% reduction in the Net Welsh Emissions Account (NWEA) compared to 1990 levels. It adopts the recommendations of our statutory advisors the UKCCC and accounts for emissions as described:

- In line with international carbon reporting practices. We account for emissions and removals of the basket of 7 greenhouse gasses including Carbon Dioxide, Methane, Nitrous Oxide and the four F-gases (HFC's, PFC's, SF6 and NF3);
- It is calculated by taking all emissions produced in Wales, minus emissions removed from the atmosphere by trees and peatlands (carbon sinks); and
- Emissions accounted for as Welsh emissions within the NWEA represent all direct emissions that are released to the atmosphere from activities occurring within the territorial boundary of Wales (with the exception of those emitted from International Aviation and International Shipping which are also included but largely released to the atmosphere outside of our national border).

The Act begins by assuming Wales will include all emissions generated within Wales within its targets and budgets and therefore we will take action to reduce emissions in all areas. However, the Act allows Welsh Ministers to vary the coverage and approach to certain emissions. Wales' emissions are split between emissions from the traded and non-traded sectors. The traded sector relates to the largest emitters that currently fall within the European Union Emissions Trading Scheme (ETS). Nearly 60% of our emissions come from the traded sector, which includes large sites that use, or produce our energy and products like steel. The ETS aims to gradually reduce emission through a 'cap and trade' approach over time.

The UK Government have decided to remove these emissions from their accounting framework and deal with them in a different way. However in Wales we will be including all emissions as it is the most transparent approach.

We will include the Welsh share of International Aviation and Shipping emissions in to our Net Welsh Emissions Account. All flights, which operate within Welsh borders and domestic shipping, are automatically included within the NWEA. However, 1% of our emissions in 2016 come from international flights and shipping. The method for calculating different countries' fair share of emissions from planes and ships travelling between countries is being considered at an international level. Therefore we considered whether it was best to wait for the outcome of these discussions or to find another

way to calculate Wales' fair share and include the emissions. In line with the recommendation from the UKCCC we decided it was the most transparent to include all emissions generated in Wales and we would calculate our fair share based on the amount of fuel taken from Wales to support international flights and shipping.

We will only use offset schemes towards our targets and budgets that are considered robust and recognised by international reporting guidelines. Whilst our focus is on our domestic action, the Act allows the use of offsets to contribute to our targets and budgets to account specifically for significant unforeseen increases in emissions such as cold winters, significant changes in our emissions inventory or increase in industrial activity. This means Wales could contribute to emission reduction schemes in other countries and claim the emission reductions to count towards our own targets. The effect is Wales is restricting global emissions in to the atmosphere but from different locations. However before utilising any offset mechanisms we would seek advice from the UKCCC.

We have set an offset limit of 10% for the first carbon budget. The Act required us to set a limit on the maximum amount of carbon offsets that can be used to meet the first carbon budget and 2020 interim target. In developing a limit we took into consideration a range of factors including:

- The Greenhouse Gas Inventory (GHGI) – The GHGI provides the information on emissions produced in Wales. However, the GHGI has inherent uncertainties. As our understanding of emission and technologies increases, the GHGI is updated. For Wales these uncertainties are estimated to be +/- 3%, and therefore we need to allow flexibility to account for methodological emissions changes of this order within our targets and budgets; and
- Emission from our largest (EU-ETS) sites – We chose to include direct emissions from our biggest (EU-ETS) emitters, therefore Wales could potentially miss targets regardless of whether we delivered sufficient emission reductions across the rest of our society. Therefore, we looked at past emissions from these sites and identified the largest relevant historical change in emissions from these sites. We calculated what would happen if these increases occurred for every year of the first carbon budget.

How did we set our interim targets and carbon budgets?

We have set an ambitious pathway for Wales. Once we knew what emissions we were going to include in our targets, and therefore where we could take action, we could then consider the scale and rate at which we could deliver emission reductions and set targets and budgets.

The Act required us to set interim targets for 2020, 2030 and 2040 and the first two carbon budgets (2016-2020 and 2021 – 2025) by the end of 2018. We wanted to ensure the targets and budgets were ambitious enough so we could deliver our 80% target but also need to be careful they were not too ambitious and potentially have negative effects. For example, placing too heavy restriction on industries and business could mean they may leave Wales. This would not only have a negative impact on our economy and supporting communities but also could result in the emissions being emitted somewhere else, possibly in a place where there are less stringent restrictions on emissions.

To fully analyse our options we considered a range of evidence as set out in the Environment Act including:

- Independent advice – We commissioned advice from our statutory advisors, the UK Committee on Climate Change (UKCCC). The UKCCC are our independent advisory body consisting of a range expertise, who also provide advice to the UK and Scottish Government and Northern Ireland Executive on climate change matters;
- Past emissions in Wales – we analysed our historic emission data utilising the GHG Inventory to identify trends and patterns;
- Emission modelling – We commissioned Cardiff University to develop the Wales 2050 Calculator. The calculator allowed us to start analysing different pathways for Wales based on different mixes of effort across society;
- The Well-being of Future Generations Act – we commissioned the development of a Well-Being Assessment, which provides the economic, social, environmental and cultural impact and opportunities of alternative pathways. We also considered the UK's international commitments under the Paris Agreement which includes limiting global warming to 2 degrees and working towards 1.5 degrees; and
- Cost – we looked at the range of potential costs including the UKCCC costs estimates for delivering their recommended pathway and we also developed our own methodology.

Annex 2 – Sector definitions

The sectors described in Part 3 are matched to specific emission activities (IPCC Categories) within the Welsh Greenhouse Gas Inventory, as follows:

UKCCC sector	NC Format	IPCC category
Power	Energy Supply Business	Public_Electricity&Heat_Production (1A1ai) Electricity generators at Welsh businesses -Public_ Electricity&Heat_Production (1A1ai_)
Residential buildings	Residential	Residential_stationary (1A4bi) Residential:Off-road (1A4bii) Non-energy_products_from_fuels_and_solvent_ use: Paraffin_wax_use (2D2) Metered_dose_inhalers (2F4a) Aerosols:Other (2F4b) Composting_municipal_solid_waste (5B1a) Non-biogenic:Other (5C2.2b) Non-biogenic:Other_Accidental fires (vehicles) (5C2.2b)
(Non-residential buildings)	Public	Commercial/Institutional buildings(1A4ai)
	Business	Commercial/Institutional buildings (1A4ai)
Industry	Industrial Process	All
	Business	all except Commercial / Institutional buildings (1A4a) and Business Generators -Public_ Electricity&Heat_Production (1A1ai_)
	Energy Supply	all except Public_Electricity&Heat_Production (1A1ai)
Transport	Transport	All but Domestic_aviation (1A3a), Domestic_ navigation (1A3d) and Fishing (1A4ciii)

Agriculture	Agriculture	All
Land use, land use change, and forestry	Land use change	All
Waste	Waste management	All
International Aviation and Shipping	Exports	Aviation_Bunkers Marine_Bunkers
	Transport	Domestic_aviation (1A3a) Domestic_navigation (1A3d) Fishing (1A4ciii)
F-gases	All F-gases, independent of sector	

Annex 3 – Constructing emissions pathways

The Plan is required to show how future budgets and targets will be met in Wales. This requires an approach to project future emission trends in Wales and assess the future impact of our policies and proposals on Welsh emissions.

Accurately projecting future emission pathways and the impact of specific policies and proposals upon this pathway is challenging and highly uncertain. There are a wide variety of approaches to constructing emissions projections including a wide variety of optimised energy system models (UK TIMES[96]), top-down high level models (UK/Wales 2050 calculator[97]) and sector specific emissions models. For our first carbon budget we have been guided by expert advice from our statutory advisors who have drawn on a broad range of modelling tools to construct their scenarios for Wales.

The UKCCC, building on their experience of UK scenario modelling[98], constructed a range of scenarios to understand the decarbonisation pathways available in order to meet the 2050 target in Wales. These scenarios take account of the current context in terms of Welsh emissions, trends and policies, as well as the specific challenges and opportunities to reduce emissions in Wales, which differ significantly from the UK as a whole.

The Wales 80% scenario contains reductions across all sectors between 2015 and 2050. The scenario for each sector is based on detailed analysis, combining assumptions about new technology and investments (e.g. new vehicle purchases, heating system replacements, energy efficiency installations, power plant investments) and how consumers behave (e.g. how vehicles are driven, how buildings are heated). The scenarios are informed by an assessment of the costs and barriers of different options (both technologies and behaviours), by the need to reduce emissions on the path to 2050 and by call for evidence undertaken in Wales by UKCCC to provide advice to Welsh Government on targets and budgets.

The UKCCC sector scenarios are based on the latest emissions data available at the time when their advice was published (1990-2015)[99]. This has now been superseded by the 1990-2016 inventory data that was published on 12 June 2018[100]. As described above, this latest data provides an update to the entire time-

96 UKTIMES is a technology-rich model that performs a least-cost optimisation in order to meet energy service demands while meeting specified emissions targets

97 http://2050-calculator-tool.decc.gov.uk/. A Wales specific 2050 pathways model is also under development by Welsh Government.

98 https://www.theccc.org.uk/publication/the-fifth-carbon-budget-the-next-step-towards-a-low-carbon-economy/

99 Greenhouse Gas Inventories for England, Scotland, Wales & Northern Ireland: 1990-2016

100 Greenhouse Gas Inventories for England, Scotland, Wales & Northern Ireland: 1990-2016

series, providing an improved estimate of emissions in the base-year right through to the addition of new data for the year 2016. To account for this within the Plan we have updated the UKCCC's original advice to reflect the latest (1990-2016) emission information[101]. We have done this by applying the percentage reductions implied in the original UKCCC advice to the new GHGI baseline published for 1990-2016. This is an important process to ensure that the recommended scenarios continue to deliver the interim targets and carbon budgets, which are based on a percentage reduction from the 1990 baseline, rather than fixed absolute emissions targets.

101 The only exception to this is for the LULUCF sector. For this sector the UKCCC took into account the 2016 inventory methodology changes at the time of publishing their advice, so no further update is required.

Annex 4 – The Greenhouse Gas Inventory

Where do we get our data from?

The Welsh GHGI[102] provides the basis for our assessment of GHG emissions on a territorial basis for Wales. It is produced in consistency with the international reporting guidelines issued by the United Nations Framework Convention on Climate Change and the UK GHG inventory reporting protocol. From the close of year it takes approximately 18 months to compile the Welsh Greenhouse gas inventory meaning at present the latest inventory data for Wales is for the year 2016.

Accounting for uncertainty in the Welsh Greenhouse Gas Inventory

The UK and the associated DA GHGI is one of the most comprehensive and detailed inventories in the world, but it does have inherent uncertainties. The GHGI does not provide a direct measure of atmospheric emissions in Wales. Rather, it provides a modelled estimate of emissions based upon a wide range of data sources detailing activities (i.e. total passenger car miles driven in Wales) and their associated emissions factors (i.e. GHG emissions per mile driven). Ultimately the accuracy of the emissions estimates are driven by the quality and quantity of the underlying data and the modelling approach. In addition, the natural variability in processes (e.g. emissions from farming practices under different climatic conditions and across soil types, carbon content of fuels, and performance of industrial production plant and abatement plant) that are being "modelled" introduces a degree of uncertainty.

102 http://naei.beis.gov.uk/reports/reports?report_id=958

For Wales, our emissions are dominated by carbon dioxide emissions from well-documented emission sources such as heavy industry (power generation, oil refining and iron and steel production). As such, the Welsh inventory is estimated to have a relatively low overall uncertainty of +/_ 3 per cent. However, when emissions are assigned to individual sectors these uncertainties can be larger. This is especially the case for more uncertain categories where we understand less about the distribution and intensity of the estimates such as nitrous oxide from agricultural soils (~+/-35%[103]) and carbon dioxide from Land Use, Land Use Change and Forestry.

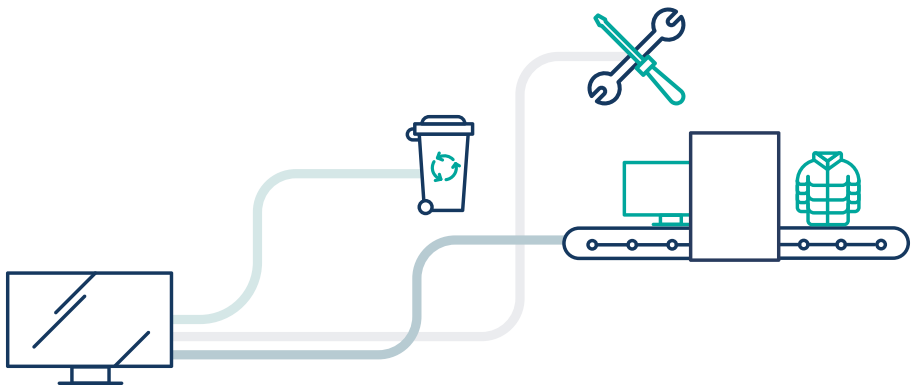
Whilst the Welsh inventory has a relatively low overall uncertainty there is a constant drive to improve our understanding of GHG emissions. The nature of emission inventories is such that ongoing improvements to data collection or estimation techniques will inevitably lead to some revisions of historical data and our understanding of the trends especially in sectors with greater uncertainty.

As a result of these improvements, along with any changes in international reporting guidelines or changes arising from recommendations following the expert review by the UN of the UK GHGI, each year when a new inventory is published it updates the estimates for every year back to 1990. These revisions can lead to changes in the historical estimates of emissions.

103 Note that the agriculture inventory methodology has been updated in the 1990-2016 cycle, but the uncertainty analysis has not been updated to reflect this improvement, either at UK or at DA level. Further work is ongoing to assess the uncertainty parameters and distributions for the new agriculture inventory data and methods.

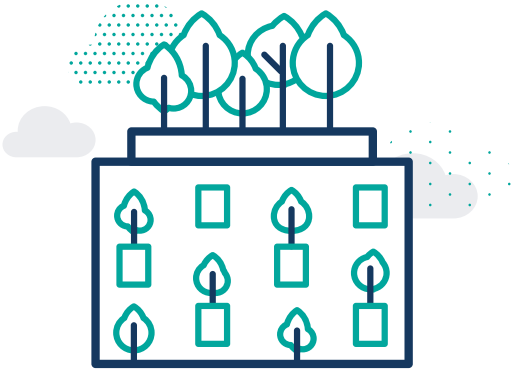
Annex 5 – Link between Ideas for Action and A Low Carbon Wales

Potential action to 2030	Relevant policies and proposals in A Low Carbon Wales (2016-20)
Collaborate with business to further decarbonise their activities whilst at the same time improve their competitiveness and productivity to take advantage of the opportunities arising from the transition to a low-carbon economy	**Policy 16: Economic Action Plan (EAP).** **Policy 43: Providing advice and support through Business Wales.**
Work with Regional Skills Partnerships (RSP) to anticipate future skills needs, focusing on priority growth sectors identified within regions	**Policy 3: Commission RSPs to review current skills gaps and shortages across regional priority sectors that support the decarbonisation agenda**
Review all current skills and work-based learning programmes to explore whether they can respond more flexibly to emerging requirements such as those represented by decarbonisation, working closely with employers	**Policy 3: Commission RSPs to review current skills gaps and shortages across regional priority sectors that support the decarbonisation agenda.**
Conduct a gap analysis of options where innovation can support the decarbonisation agenda and maximise the opportunities	**Policy 4: Establish Task and Finish Group to explore innovation and decarbonisation.**



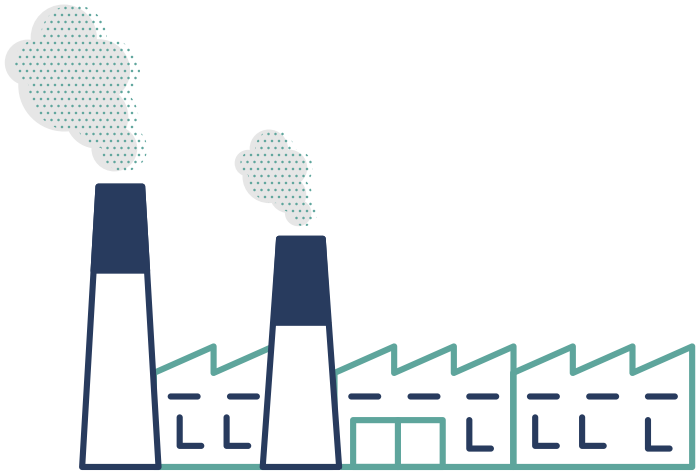
Collaborate with organisations across all levels of society and involve citizens in achieving our low-carbon pathway	**Policy 12: Work with key partners to expand and refocus education around decarbonisation.** **Policy 12: Establish a on the transition to a low carbon society.** **Policy 15: Provide funding to enable action on climate change in school and communities.** **Proposal 1: Design a public communications campaign to encourage people to use their cars less.** **Proposal 14: Hold a Climate Change Conference to collaborate with and involve all sectors and levels of society.**
Provide fruit, shade and fuel trees for the entire Mount Elgon region, Uganda by 2030	**Policy 17: Provide fruit, shade and fuel trees for the entire Mount Elgon region, Uganda by 2030.**
Power	
Support the development of regional and local energy planning to address the supply, distribution, and use of energy	**Policy 10 Energy Systems Planning: Policy 11- Welsh Government Energy Service and Smart Living**
Support innovation and commercialisation of new products, processes and services in the energy system	**Policy 27: Removing barriers to consenting for storage by removing batteries as part of the Development of National Significance process.** **Policy 32: Develop routes to market for renewable technologies.** **Policy 35: Energy innovation.** **Policy 36: Market regulation and investment.** **Proposal 7: Explore potential for investment and new approaches to energy.**

Develop and implement Wales's policy position around the extraction and combustion of fossil fuels in power generation	**Policy 29: Develop a policy on combustion of fuels for power.** **Policy 58: Onshore Petroleum Extraction.**
Accelerate the deployment of renewable generation whilst encouraging local ownership	**Proposal 7: Exploring potential for investment and new approaches to energy.** **Policy 11: Welsh Government Energy Service** **Policy 31: Delivery of our renewable energy targets.** **Policy 33: Increasing local ownership of energy generation**
Transport	
Develop a charging network that encourages early take-up of electric vehicles (EVs) and explore the merits of other measures, including access to bus lanes and free municipal parking	**Policy 50: Increase the proportion of vehicles which are electric and ultra low emission.** **Policy 51: Plan for and invest in EV charging infrastructure.**
Reduce the carbon footprint of taxis and buses to zero within 10 years to achieve the aim in the Economic Action Plan	**Policy 52: Aim to reduce the carbon footprint of buses to zero by 2028.** **Policy 53: Aim to reduce the carbon footprint of taxis and private hire vehicles to zero by 2028.** **Proposal 14: Piloting activity to promote the use of zero and ultra low emission road vehicles.**
Double the percentage of adults making cycling journeys at least once a week and increase the percentage of people making walking journeys at least once a week by 25% from the 2016 baseline	**Policy 49: Use planning policy to promote sustainable travel and reduce the need to travel.** **Proposal 12: Working to achieve modal shift from car dependency to sustainable forms of transport**
Explore the relationship between speed limits and greenhouse gas emissions, with a view to considering environmental factors in speed limit reviews	**Policy 56: Reduce transport emissions.**



Buildings	
Set higher energy efficiency standards for new builds through reviewing Building Regulations Part L (Conservation of Fuel and Power)	**Proposal 39: Setting higher energy efficiency standards for new builds through reviewing Building Regulations Part L (Conservation of Fuel and Power).**
Develop a long-term residential retrofit programme based on evidence	**Proposal 8: Improving our evidence base around the residential retrofit programme.**
Establish the baseline of energy use and associated emissions from business sector buildings	**Policy 1 – To continue to develop our evidence base around decarbonisation (including the social, cultural, economic and environmental) to inform the levels of future carbon budgets and the policy intervention required to meet them.**
Deliver buildings that are more sustainable by using innovative construction techniques to reduce and meet the energy demand within buildings and increase the use of sustainable materials, such as timber	**Policy 40: Driving innovation through the Innovative Housing Programme.** **Policy 41: Funding more efficient buildings through our sustainable buildings funding policy.** **Proposal 9: Developing innovative construction techniques to reduce and meet the energy demand within buildings and increasing the use of sustainable materials.**
Scope out the challenges and opportunities around low-carbon heat	**Proposal 10: Scoping out the challenges and opportunities around low carbon heat.** **Proposal 11: Increasing the use of waste heat and low carbon heat.**

Agriculture	
Provide post-Brexit support in the form of a land management programme that contains a public goods scheme and an economic resilience scheme, replacing the Common Agricultural Policy (CAP) with a framework that also links support to emissions reduction and removals	**Proposal 22: Provide post-Brexit support in the form of a land management programme that contains a public goods element and an economic resilience element.**
Ensure that emissions reduction is considered in any regulatory reform proposals arising from the land management programme consultation	**Proposal 23: Regulations to reduce agricultural pollution.**
Land use and forestry	
Revise our regulatory and support regimes to increase tree planting to at least 2,000 hectares per year, aiming to increase this to 4,000 hectares	**Proposal 19: Increase tree planting.**
Identify preferred areas for tree planting, including commercial woodlands and planting at medium and large scale	**Proposal 20: Identifying preferred areas for tree planting.**
Ensure that all peatlands supporting semi natural habitats are under active management by 2030 by supporting, enabling and co-ordinating the restoration and sustainable management of peatland, as well as utilising and maximising associated funding opportunities	**Policy 66: Peatlands for the Future.**



Industry	
Commission an independent economic and technical feasibility study on carbon capture use and storage (CCUS)	**Policy 60: Carbon Capture Utilisation and Storage.** **Proposal 18: Commission an independent economic and technical feasibility study on Carbon Capture Use and Storage (CCUS).**
Consider the further development of our Environment Protection Scheme (EPS) beyond 2020 to support the most carbon-intensive industries	**Policy 57: Energy Efficiency Scheme (UK Government).** **Proposal 16 - Industrial emission reduction support beyond 2020 for carbon intensive businesses.**
Consider waste heat recovery and use as part of the approach to heat policy	**Policy 59: Industrial heat recovery.**
Establish an industry-led working group on decarbonisation	**Proposal 17: Industry-led Decarbonisation Group.**

Public sector	
Support the public sector to baseline, monitor and report progress towards carbon neutrality	**Policy 20: Support the public sector to baseline, monitor and report progress towards carbon neutrality.**
Public sector buildings are supplied with renewable electricity by 2020 and, where practicably possible, are supplied with low-carbon heat by 2030	**Policy 23: Continue to drive low-carbon schools through 21st Century Schools.** **Proposal 5: Public Sector buildings should be supplied with renewable electricity by 2020, or as soon as contractually able and, where practicably possible, are supplied with low carbon heat by 2030.**
All new cars and light goods vehicles in the public sector fleet are ultra low emission by 2025 and where practicably possible, all heavy goods are ultra low emission by 2030	**Proposal 4: All new cars and light goods vehicles in the Public Sector fleet are ultra low emission by 2025 and where practicably possible, all heavy goods are ultra low emission by 2030.**
Waste	
Create new opportunities for resource efficient manufacturing through embedding resource efficiency within our programme of innovation support to SMEs and using public sector procurement to stimulate the market	**Policy 9: Maximising the innovation opportunities presented by moving towards a more circular economy.** **Policy 75: Transposing the Circular Economy Package.**

Annex 6 – List of policies and proposals

List of Case Studies

Annex 7 – List of policies and proposals by portfolio

Key: Main Portfolio Associated portfolio

Action	Policy or Proposal	Environment, Energy and Rural Affairs	Economy and Transport	Housing and Local Government	Finance	Education	Health and Social Services	International Relations and the Welsh Language	UK/EU
To continue to develop our evidence base around our decarbonisation	Policy								
We will continue to align the carbon and financial budget cycle incrementally.	Policy								
Welsh Government to commission RSPs to review current skills gaps and shortages across regional priority sectors that support the decarbonisation agenda. This would form an element of their funding contract from April 2019	Policy								
Establishment of a Task and Finish Group to scope out innovation need	Policy								
Planning Policy Wales	Policy								
National Development Framework	Policy								
Wales Marine Plan	Policy								
We will take an integrated approach to tackling emissions through the policies set out in the Clean Air Plan,the Low Carbon Delivery Plan and other associated strategic cross-government plans.	Policy								
Maximising the innovation opportunities presented by moving towards a more a circular economy.	Policy								
Energy Systems Planning	Policy								

Key: Main Portfolio Associated portfolio

Action	Policy or Proposal	Environment, Energy and Rural Affairs	Economy and Transport	Housing and Local Government	Finance	Education	Health and Social Services	International Relations and the Welsh Language	UK/EU
Welsh Government Energy Service and Smart Living	Policy								
Work with key partners to expand and refocus education around decarbonisation and promote co-benefits to health and well being for current and future generations	Policy								
Work with partners to help understand how to transform individual lifestyles and systems of governance for a sustainable, low-carbon future	Policy								
The Establishment of a climate just advisory group in 2019	Proposal								
We will host an Annual Decarbonisation Conference to discuss progress and generate new ideas	Policy								
Provide funding to enable action on climate change in school and communities	Policy								
Economic Action Plan	Policy								
Provide fruit, shade and fuel trees for the entire Mount Elgon region, Uganda by 2030	Policy								
Ensure our new International Strategy is founded on sustainability with a decarbonisation as a key part, working with other like-minded States and Regions and through our engagement with international networks and organisations.	Policy								

Key: Main Portfolio Associated portfolio

Action	Policy or Proposal	Environment, Energy and Rural Affairs	Economy and Transport	Housing and Local Government	Finance	Education	Health and Social Services	International Relations and the Welsh Language	UK/EU
Design a public communications campaign to encourage people to use their cars less.	Proposal								
Welsh Government to consult on options for successor Carbon Reduction Commitment Scheme in Summer 2019	Policy								
Support the public sector to baseline, monitor and report progress towards carbon neutrality	Policy								
Provide continued support to identify, develop and invest in district heat systems	Policy								
Value Wales to promote and encourage carbon reduction through procurement	Policy								
Development of a Decarbonisation Dashboard to baseline emissions	Proposal								
All new cars and light goods vehicles in the Public Sector fleet are ultra low emission by 2025 and where practicably possible, all heavy goods are ultra low emission by 2030	Proposal								
Public Sector buildings should be supplied with renewable electricity by 2020, or as soon as contractually able and, where practicably possible, are supplied with low-carbon heat by 2030.	Proposal								
Continue to reducing emissions in the health sector	Policy								
Continue to drive low carbon schools through 21st Century Schools	Policy								

Key: Main Portfolio Associated portfolio

Action	Policy or Proposal	Environment, Energy and Rural Affairs	Economy and Transport	Housing and Local Government	Finance	Education	Health and Social Services	International Relations and the Welsh Language	UK/EU
Continue to promote and market tourism in Wales in a sustainable way	Policy								
Commission research to gain a better understanding of Welsh public sector investment profiles to stimulate discussion about future investment strategies.	Proposal								
Energy Consenting, Planning and Permitting	Policy								
Remove barriers to consenting for storage	Policy								
Phase out of Unabated Coal	Policy								
Develop a Policy on Combustion of Fuels for Power	Policy								
EU Emissions Trading Scheme	Policy								
Delivery of Renewable Energy Targets	Policy								
Wales Waste Strategy 'Towards Zero Waste'	Policy								
Developing Routes to Market for Renewable Technologies	Policy								
Increased local ownership of energy generation	Policy								
Maximise Welsh benefit from major infrastructure projects in Wales	Policy								
Energy Innovation	Policy								
Market regulation and investment	Policy								
Explore potential for investment and new approaches to energy	Proposal								
Funding and Delivery of our Warm Homes Programme	Policy								

Key: Main Portfolio Associated portfolio

Action	Policy or Proposal	Environment, Energy and Rural Affairs	Economy and Transport	Housing and Local Government	Finance	Education	Health and Social Services	International Relations and the Welsh Language	UK/EU
Raising standards through our Welsh Housing Quality Standards	Policy								
Improving our Evidence-base around residential retrofit programme	Proposal								
Setting higher energy efficiency standards for new builds through reviewing Building Regulations Part L (Conservation of Fuel and Power	Policy								
Driving innovation through our Innovative Housing Programme	Policy								
Funding more efficient buildings through our Sustainable buildings funding policy	Policy								
Reducing emissions from listed buildings and scheduled monuments	Policy								
Developing Innovative construction techniques to reduce and meet the energy demand within buildings and increasing the use of sustainable materials	Proposal								
Providing advice and support through Business Wales	Policy								
Scope out the challenges and opportunities around low-carbon heat	Proposal								
Increase the use of Waste Heat and low carbon heat	Proposal								
Piloting Smart Flexible and Digitalised System to reduce demand	Policy								
Incentivising energy efficiency of homes through our Help to Buy Wales	Policy								

Key: Main Portfolio Associated portfolio

Action	Policy or Proposal	Environment, Energy and Rural Affairs	Economy and Transport	Housing and Local Government	Finance	Education	Health and Social Services	International Relations and the Welsh Language	UK/EU
Working to achieve a modal shift from car dependency to sustainable forms of transport	Proposal								
Increasing Active Travel	Policy								
Significantly increasing modal share of active travel for short journeys	Proposal								
Increasing travel by rail through investment	Policy								
Increasing travel by bus	Policy								
Using planning policy to promote sustainable travel and reduce the need to travel	Policy								
Increasing the proportion of vehicles which are electric and ultra low emission	Proposal								
Plan for and invest in EV charging infrastructure	Policy								
Aiming to reduce the carbon footprint of buses to zero by 2028	Policy								
Aim to reduce the carbon footprint of Taxis and Private Hire Vehicles to zero by 2028	Policy								
Piloting activity to promote the use of zero and ultra low emission road vehicles	Policy								
Promote the decarbonisation of private sector fleets in Wales	Proposal								
Reduce Transport Emission	Policy								
EU Emissions Trading Scheme	Policy								
Carbon price Floor	Policy								

Key: Main Portfolio Associated portfolio

Action	Policy or Proposal	Environment, Energy and Rural Affairs	Economy and Transport	Housing and Local Government	Finance	Education	Health and Social Services	International Relations and the Welsh Language	UK/EU
Climate Change Levy & Climate Change Agreements	Policy								
Industrial Emission Reduction Support beyond 2020 for Carbon Intensive Businesses	Proposal								
Energy Efficiency Scheme – UK Government	Policy								
Industry Led Decarbonisation Group	Proposal								
Onshore Petroleum Extraction	Policy								
Industrial Heat Recovery	Policy								
Carbon Capture Utilisation and Storage	Policy								
Commission an independent economic and technical feasibility study on carbon capture use and storage (CCUS)	Proposal								
Food and Drink Action Plan – Towards Sustainable Growth	Policy								
Implementing Natural Resources Policy	Policy								
Woodland Strategy for Wales	Policy								
Felling licences	Policy								
Welsh Government woodland estate	Policy								
Increase tree planting to at least 2,000 hectares per year, aiming to increase this to 4,000 hectares	Proposal								
Identify preferred areas for tree planting	Proposal								
Peatlands for the Future	Policy								

Key: Main Portfolio Associated portfolio

Action	Policy or Proposal	Environment, Energy and Rural Affairs	Economy and Transport	Housing and Local Government	Finance	Education	Health and Social Services	International Relations and the Welsh Language	UK/EU
Red Meat Development Programme	Policy								
Animal Health and Welfare Framework	Policy								
Farming Connect Programme	Policy								
Farm Business Grant	Policy								
We will work with the farming sector to help drive efficiency	Proposal								
Provide post-Brexit support in the form of a land management programme that contains a public goods element and an economic resilience element	Proposal								
Regulations to reduce agricultural pollution	Proposal								
Nitrate Vulnerable Zone	Policy								
Reduce Greenhouse gas emissions from landfill	Policy								
Generate Renewable Energy from waste	Policy								
Transposing the Circular Economy Package	Policy								
Exploring the opportunities provided by the water sector in reducing emissions	Proposal								
Implementing the 2015 EU F-gas regulation	Policy								

Acronyms and Glossary of terms

Acronyms

AD	Anaerobic Digestion
AHDB	Agriculture and Horticulture Development Board
BEIS	UK Government Department for Business, Energy and Industrial Strategy
BREEAM	Building Research Establishment Environmental Assessment Method
CAP	Common Agricultural Policy
CB1	Carbon Budget One (first carbon budget)
CB2	Carbon Budget Two
CCA	Climate Change Agreement
CCL	Climate Change Levy
CCS	Carbon Capture and Storage
CCUS	Carbon Capture Usage and Storage
CHP	Combined Heat and Power
CO_2	Carbon Dioxide
COP	Conference of the Parties
COP24	Conference of the Parties in Katowice, Poland
CPF	Carbon Price Floor
CPS	Carbon Price Support
CRC	Carbon Reduction Commitment Energy Efficiency Scheme
DAG	Advisory Group on the Decarbonisation of Homes in Wales
DNS	Developments of National Significance
EAP	Economic Action Plan
EPC	Energy Performance Certificate
EPS	Environmental Protection Scheme
ERDF	European Regional Development Fund
ESC	Energy Systems Catapult

EU	European Union
EU ETS	European Union Emissions Trading System
EV	Electric Vehicle - (Included but not shortened)
FBIS	Food Business Investment Scheme
F-gases	Fluorinated gases
FLEXIS	Flexible Integrated Energy Systems research programme
FREEDOM	Flexible Residential Energy Efficiency Demand Optimisation and Management
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GHGI	Greenhouse Gas Inventory
GW	Giga Watt
GWh	Gigawatt Hours
HCC	Hybu Cig Cymru
HESG	Home Energy Services Gateway
HFCs	Hydroflurocarbons
IAs	Impact Assessments
IETF	Industrial Energy Transformation Fund
IHP	Innovative Housing Programme
IHRS	Industrial Heat Recovery Support
IPCC	Intergovernmental Panel on Climate Change
IWA	Institute of Welsh Affairs
JTA	Joint Transport Authorities
kW	Kilowatt
LULUCF	Land Use, Land Use Change and Forestry
MRV	Monitoring, Reporting and Verification
$MtCO_2e$	Million tonnes of Carbon Dioxide Equivalent

MW	Megawatt
NDCs	Nationally Determined Contributions
NDF	National Development Framework
NF_3	Nitrogen trifluoride
NICW	National Infrastructure Commission for Wales
NRW	Natural Resources Wales
NWEA	Net Welsh Emissions Account
NWEAB – RSP	North Wales Economic Ambition Board – Regional Skills Partnership North Wales
ODS	Ozone-depleting substances
OFGEM	Office of Gas and Electricity Markets
PES	Payment for Ecosystem Services
PFCs	Perfluorocarbons
PHW	Public Health Wales
PPW	Planning Policy Wales
PV	Photovoltaic
R&D	Research and Development
RHI	Renewable Heat Incentive
RICE	Reducing Industrial Carbon Emissions
RSL	Registered Social Landlords
RSPs	Regional Skills Partnerships
SA	Sustainability Appraisal
SAP	Standard Assessment Procedure
SF_6	Sulfur hexafluoride
SME	Small and Medium Enterprises
SPECIFIC	Sustainable Product Engineering Centre for Innovative Functional Industrial Coatings
SPG	Sustainable Production Grant

SRA	Sustainable Risk Assessment
SSAFO	Silage, Slurry and Agricultural Fuel Oil
TWh	Terawatt hour
UKCCC	UK Committee on Climate Change
UKCCSRC	UK Carbon Capture and Storage Research Centre
UKFS	UK Forestry Standard
ULEV	Ultra Low Emission Vehicle
UN	United Nations
UNFCCC	United Nations Framework Convention on Climate Change
WHCS	Welsh Housing Condition Survey
WHQS	Welsh Housing Quality Standard
WIIP	Wales Infrastructure Investment Plan
WNMP	Welsh National Marine Plan
WRAP	Waste and Resources Action Programme

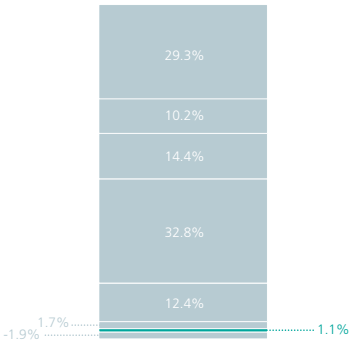
Glossary of terms

Anaerobic Digestion	The break down biodegradable material in the absence of oxygen.
Decarbonisation	The process of reduction or removal of greenhouse gas emissions from our activities, to create a low carbon economy.
Carbon Capture and Storage	The process of trapping carbon dioxide produced by burning fossil fuels or other chemical or biological process and storing it in such a way that it is unable to affect the atmosphere.
Carbon leakage	Occurs when industry relocates to countries with less stringent environmental regulation, resulting only in displacement of emissions rather than a reduction, at no benefit to the environment.

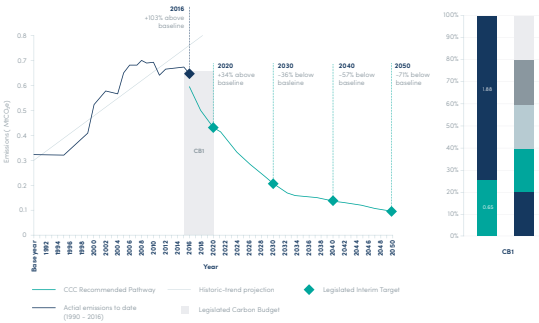
Carbon sequestration	The removal and storage of carbon from the atmosphere in carbon sinks (such as oceans, forests or soils).
Circular Economy	A circular economy aims to maintain the value of products, materials and resources for as long as possible by returning them into the production cycle at the end of their use, while minimising the generation of waste.
Consumption emissions	Emissions of greenhouse gasses whether in Wales, or elsewhere, that may reasonably be attributed to the consumption and use of goods and services in Wales.
Contracts for Difference	A Contract for Difference is a form of subsidy support for UK renewable electricity and low carbon generation.
Decarbonisation Pathway	A modelled route showing how emission reductions are distributed over time, and across sectors, to deliver the target of at least an 80% reduction in the year 2050.
Fossil fuels	A fuel derived from geological deposits of plant and animal remains, such as coal, oil, or natural gas.
Paris Agreement	The UNFCCC's Paris Agreement sets a global ambition for tackling climate change. The current pledge under the Paris Agreement to limit the global average temperature rise to less than 2° Celsius requires governments around the world to take action to decarbonise their economies, while striving to keep the temperature rise to 1.5° Celsius.
Smart energy	Smart energy can be considered as an approach using the internet to coordinate different intelligent devices and sensors across the energy system. Smart energy systems are now beginning to expand into integrating and interlinking with transport and heat systems. Smart technology allows homes, businesses and communities to use energy and other resources more efficiently. It offers the

	potential to generate, store and use energy in ways not previously available, in order to provide comfort and mobility and improve our health. It could enable local energy trading and other community sharing opportunities.
UK Greenhouse Gas Inventory	The UK Greenhouse Gas Inventory (UK GHGI) reports annually on estimated UK emissions of the seven direct greenhouse gases under the Kyoto Protocol. (http://naei.beis.gov.uk/)
DA Greenhouse Gas Inventory	The DA Greenhouse Gas Inventory (DA GHGI) provides an annual report on estimated greenhouse gas emissions for Wales, England, Scotland and Northern Ireland.

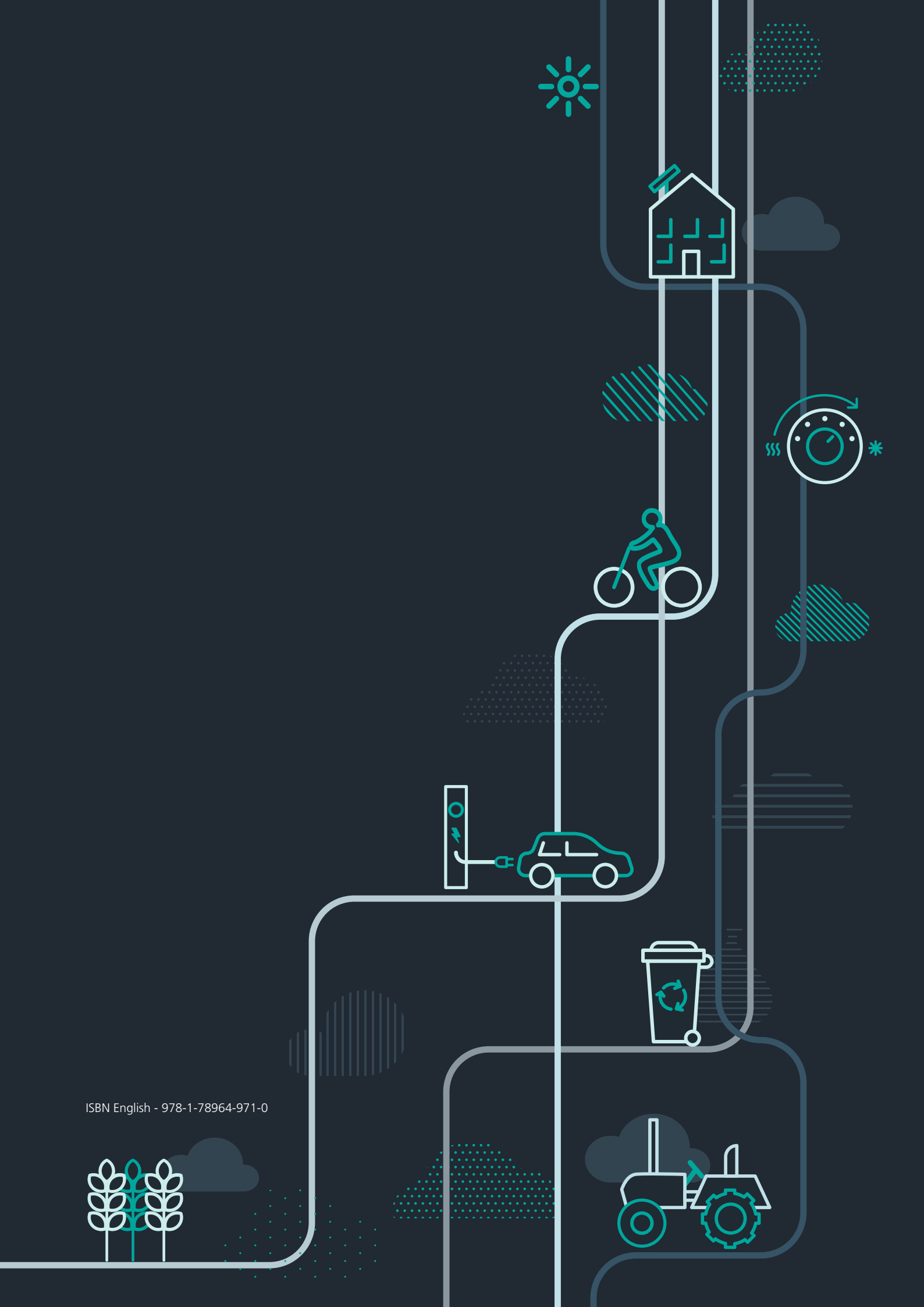
Description of sector graphs



This diagram shows the percentage share of the first carbon budget that is allocated to each sector. This shows the relative significance of each sector in terms of total greenhouse gas emissions over the first carbon budget.



This diagram (left graph) shows the historic emissions for the sector and the UKCCC's recommended pathway for the sector (updated to reflect the latest 1990-2016 GHGI as described in Annex 3). The left hand bar chart shows the sector emissions in year one (2016) of the first carbon budget. The right hand bar chart shows the first carbon budget for the sector split equally across the five year budget period. There is no fixed annual budget for the sector and the distribution of sector emissions over the 5 year budget is not required to be equal, therefore this bar graph provides a general illustration of progress only.



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