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# Scotland 2030: Picturing life in a low carbon Scotland

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## Part A: Constructing the Scotland 2030 narrative

### 1. Introduction

The Climate Change (Scotland) Act 2009 commits Scotland to reducing its greenhouse gas emissions by 42% (on 1990 levels) by 2020, with an 80% reduction by 2050. Meeting these targets calls for a transformational change across society. While infrastructural and technological changes will play an important role in this transition, the impact of these measures will depend on how people adapt – whether we accept significant infrastructural changes, adopt new technology, and how we use this technology. Infrastructural and technological measures alone will therefore not suffice – behaviour change is also a necessary component of our journey towards becoming a low carbon society. This behaviour change will include one-off actions like installing insulation in the home, smaller one-off changes like turning down thermostats, and the adoption of new routine behaviours like composting our food waste or walking instead of driving for short journeys. The transition will therefore require significant lifestyle changes for most people at an individual or household level, as well as a cultural-level shift in the way we think about and use energy and resources.

The Scottish Government's *Low Carbon Scotland: Meeting the Emissions Reduction Targets 2013-2027*, the second report on proposals and policies[1] (RPP2) sets out how Scotland can deliver its statutory annual targets for the period 2013-2027. The policies and proposals laid out in RPP2 outline the infrastructural, technological and behavioural changes to occur in the following sectors:

- Energy
- Transport
- Homes and communities
- Business, industry and public sector
- Waste and resource efficiency
- Rural land use

It can however be difficult to envision what these sectoral changes will mean for individuals and for households, and similarly how these sectoral changes, when taken altogether, will interact and affect our lives.

### 2. Project outline

To help to address this, the Scottish Government asked ClimateXChange researchers to develop an evidence-based narrative picturing life in 2030 which is meaningful at a household level, and grounded in the proposals and policies set out in RPP2. The purpose of this narrative, as set out in the project specification, is to communicate a positive vision of what the low carbon Scotland of 2030 might look like and what it might feel like to live in this low carbon society, using everyday examples.

[1] http://www.scotland.gov.uk/Topics/Environment/climatechange/scotlands-action/lowcarbon/meetingthetargets

There are two stages to ClimateXChange's contribution:

**Stage 1** – Producing a sectoral review of the projected outcomes of Scottish emissions reduction policies and proposals, to inform stage 2 work. The stage 1 report is available on the ClimateXChange website.

**Stage 2** – Translating these sectoral outcomes into a narrative that describes how our daily lives may or may not have changed in 2030. This stage draws on scientific literature on behaviour change to understand what these changes will mean in terms of the activities in which people will engage in 2030 and how people might interact with technology and physical infrastructure.

This report presents the narrative developed for stage 2.

The specific objectives for stage 2 of the project, as set out in the brief, are:

- to translate the ambitions set out in RPP2 and other relevant Scottish Government policy statements into narrative descriptions of a low carbon vision for Scotland in 2030 which are meaningful at a household level;
- to create a vision which is relevant to different communities and types of households;
- to develop a vision which includes mitigation and adaptation measures[2]; and
- to explore the feasibility of describing the wider social and economic benefits of low carbon living.

The intention is for this narrative to inform future work by the Scottish Government to raise awareness of what a low carbon future might mean for individuals and households, and highlight the actions that people can take to make this vision a reality.

## 3. Approach: An evidence-based narrative

As academic researchers, our intention is to add value to the development of a narrative for a low carbon Scotland in the following ways:

1) By using our understanding gained from research **evidence on how to communicate effectively** about the transition to a low carbon society. The evidence informing our approach is drawn largely from the fields of environmental education and environmental psychology.

2) By drawing on the available **evidence on why people change their behaviour (or don't) and how people respond to and interact with low carbon technologies,** as well as the challenges that we will face as a society in our journey towards a low carbon future, in order to build a realistic, evidence-based vision.

Our approach to constructing the narrative is based on the following underpinning principles for communicating the vision, developed in discussion with Scottish Government colleagues and drawn from relevant empirical and theoretical literature:

- **Bringing it home** – Reducing the psychological distance to our potential low carbon future by focusing on everyday lives and activities, speaking to the reader from the present of 2030, focusing in on local areas and grounding the vision in the Scottish context, and making the vision relevant to different types of people from different backgrounds.

[2] Whilst climate change adaptation measures are included in the scope of this project, the primary focus is on mitigation measures, to avoid duplicating ongoing work by Adaptation Scotland.

- **Communicating the win-wins** – Highlighting the co-benefits of reducing carbon emissions, particularly where these benefits resonate with shared values such as fairness/equity, health and wellbeing, community and resourcefulness.

- **Balancing the new with the familiar** – Creating excitement around the changes to come while also conveying comfort in the continuity of aspects of everyday lives that remain largely unchanged.

- **Normalising change** – Communicating the performance of key low carbon behaviours as being the norm for those living in the low carbon society of 2030, as well as highlighting the existing norms that can be built on to achieve our goal of a low carbon society.

- **Presenting a shared journey** – Building recognition that becoming a low carbon society will require actions on the part of individuals and institutions across society by highlighting the roles that different sectors of society will play in the transition, where appropriate.

- **Highlighting success stories** – Presenting examples of where positive transitions are successfully being made in the here and now, helping to ground the vision in the reality of the present and to reduce feelings of helplessness in the face of a global challenge like climate change.

The narrative presented here takes into account research investigating public engagement with climate change and responses to different ways of communicating about environmental sustainability (e.g. COIN, 2014; Ellis-Jones et al., 2014; Lorenzoni et al., 2007; TNS, 2011; Whitmarsh et al., 2013). It also draws on issues raised in participatory visioning and scenario-building exercises that have already been carried out on this topic in Scotland and the rest of the UK (e.g. ICARB, 2014; Ipsos MORI, 2011; Parkhill et al., 2013; Scottish Enterprise, 2011). There is also a wealth of evidence on the social dimensions of specific mitigation measures (e.g. on the uptake of home insulation and micro-renewable technologies, energy efficient heating practices) that has informed the content of the narrative. It was agreed that in-text referencing would not be appropriate in the narrative itself. In light of this decision, the key sources informing the narrative have instead been included in a bibliography at the end of the document. Other sources referred to in the accompanying text in Part A and C are noted in a separate reference list.

The 2030 narrative presented here is the result of a process of co-production between The James Hutton Institute, ClimateXChange and the Scottish Government. The objectives and scope of the project were initially set out in the project specification, with refinement and further development through face-to-face and telephone meetings between the Low Carbon Behaviours policy team and ClimateXChange researchers and secretariat. A workshop was held to further define the scope of the work and to gain policymakers' feedback on the proposed approach. Attendees included policymakers and analysts working in areas such as housing, energy, transport, and low carbon behaviours. The subsequent development of the narrative text was led by the researchers, with input and feedback from policymakers and analysts across the RPP2 policy areas. During the process, the Scottish Government policy team also held an event to update stakeholders on the development of the narrative, and to seek their views on how they might use resultant engagement tools in their own work with communities. As part of this event, the researchers presented an outline of the proposed approach to communicating the Scotland 2030 narrative.

## 4. Underlying assumptions and scope

An underlying assumption in the development of this narrative is that in 2030 Scotland will be meeting its emissions reduction target. It also assumes that we have achieved the outcomes and milestones that are set out

in RPP2 through the policy mechanisms that the Scottish Government has proposed and/or committed to. Whilst the specific changes discussed in the narrative are grounded in the policies and proposals set out in RPP2, it should be noted that this is not a vision of a society that is to be delivered solely by the Scottish Government, but a vision of what a low carbon Scotland might look like, given the trajectory that has been set out by the Scottish Government and the work that is already being done by multiple parties across the public, private and third sectors. The purpose of this report is therefore to inform the development of a process of conversation, not to critique particular policies. Given the policy directions that have already been set out, this narrative seeks to draw together the changes envisioned in different sectoral areas and consider these changes in a holistic way, to help people from all walks of life to begin to imagine what it might feel like to live in a Scotland in which the outcomes and milestones set out in RPP2 have been achieved.

Technological innovations in the coming years are likely to impact on the lifestyles and everyday activities of residents of Scotland 2030. Some of these technological changes will relate directly to the reduction of carbon emissions. However, as we cannot confidently predict what new technologies will be available and when, nor how householders will interact with them, this presents a challenge in developing the evidence-based narrative of life in the low carbon Scotland of 2030. We therefore focus our greatest attention on existing technologies for which we have evidence on people's perceptions and behaviours. Other technological solutions which were considered important to include from the policy perspective (e.g. energy storage technology and hydrogen fuel cell vehicles) have been included in the narrative. However, due to uncertainties as to the specific forms some of these solutions will take and the rate of their diffusion in society, these have necessarily been discussed in less detail than existing technologies.

Finally, it is outwith the scope of the narrative to detail the specific policies and proposals that will contribute to the societal changes discussed in this narrative. RPP2 comprehensively details these current policies and proposals, and an accessible synthesis is available in the stage 1 report. Due to the wide scope of the narrative and its foundation in policies spanning a range of sectors, it was not possible to include reference to all of the policy actions outlined in RPP2. In addition, it has not been possible to include in-depth discussions of all of the issues raised in the narrative due to the need to produce a short, accessible output conveying the overall picture of life in Scotland 2030. Readers seeking further information on specific issues are referred to the supporting bibliography.

## 5. Structure of the narrative

There are three key components of the narrative set out in this report:

*1) The core narrative -*

The core narrative text draws the outcomes and milestones laid out in RPP2 together under three domains of everyday experience:

- Home
- Work
- Leisure

Within each of these domains, some of the pathways towards achieving these outcomes and the challenges to be overcome are discussed. These issues are considered with reference to different geographical contexts:

- City/town centres
- Small town and suburban areas
- Rural, coastal and island areas

The core narrative speaks from the future Low Carbon Scotland 2030 in the present tense. In speaking from the future in this way we aim to help to reduce the psychological distance between readers in the present and the low carbon future of 2030 (Liberman & Trope, 2008; Spence et al., 2012).

*2) 'In focus' boxes -*

These sections of the text use vignettes to illustrate how we might experience everyday activities and routines in 2030. They highlight both how our way of life might change, and also the ways in which it may remain quite similar. These vignettes aim to be inclusive - telling stories of people at different stages of life, living (and working) in different circumstances and different geographic locations. Given the wide diversity of Scotland's population, the small number of vignettes presented here can only give a flavour of how *some* aspects of living in a low carbon society might be experienced by *some* people.

Environmental educators and cognitive scientists have argued that one of the best ways to learn is through direct experience. Where this is not feasible (like in this case when talking about the future), stories can act as an effective substitute for first-hand experience (De Young & Monroe, 1996). Stories can be more effective in helping people build an understanding of a subject than simple information-based approaches because story-telling takes advantage of the way people process information, helping the audience to link new ideas into their existing mental maps of the world (Kearney, 1994).

*3) 'Doing it now' boxes -*

Through the use of case studies, these sections highlight actions that are already underway in 2014. Case studies, which can also be thought of as 'success stories', are a useful way to facilitate familiarity with the unknown and can help to empower and inspire people to take action themselves (Bardwell, 1991).

# Part B: The Scotland 2030 narrative

## 1. Introduction

Welcome to Scotland 2030! We have made some big changes over the last couple of decades that have helped us, individually and collectively, to reduce our impact on the environment, as well as making Scotland a cleaner, greener, healthier and fairer place to live. Renewable sources produce more electricity than we use, we have made significant progress towards decarbonising heat generation, and we are on our way to entirely replacing fossil fuels used in road transport with clean fuel sources. These are successes that we all can share in, because all areas of society – government and the public sector, businesses, communities and households – have played a part in making these changes happen. It wasn't always easy, especially when there were many other challenges to be faced in the short-term. However, by keeping an eye on our long term goals – of making the most of Scotland's natural resources, of building a fairer society where everyone can enjoy a decent standard of living, and of protecting and enhancing our landscapes and local environments for future generations – we've made significant progress by working together.

Here we will show you some of the ways in which Scotland as a whole, our local areas and communities, and our homes and workplaces have changed. But whilst some things (like the mix of energy sources we use) are quite different now, you may be surprised to see how many aspects of our way of life have remained relatively unchanged.

## 2. At home

### 2.1 Where does our energy come from?

The energy we use for heat and electricity now comes from a wider range of sources than it used to. By 2020, 30% of the amount of energy we consumed was generated from renewable sources. Energy generation has also become more localised; we now produce much more of our energy in our individual homes and communities than we did previously.

As a country, the amount of electricity we generate from renewable sources now exceeds the total amount we consume. To generate this electricity we make use of the full range of natural energy sources we have in Scotland – including wind (both on- and off-shore), hydropower, tidal and wave energy, and solar power. The electricity we use is produced both by large-scale commercial energy developers and by communities and individual households. One of the milestones on this journey was that by 2020, 500 MW of renewable generation capacity (enough to power over 250,000 homes[3]) was owned by local communities. It has also become more common for our homes to be heated using renewable energy sources such as heat pumps (which take heat energy from the air or the ground) and solar thermal panels. By 2020, 11% of our heat was supplied from renewable sources, and today more than 100,000 homes across Scotland are now heated using renewable heat technologies. It is particularly important that renewable heat is generated close to where it is used; this is because the further heat has to travel, the more energy is lost along the way. We are also much better now at capturing and using heat that used to simply be wasted. Heat recovered from waste water and industrial processes is now a valuable source of energy for heating our homes.

As well as producing more electricity and heat locally, we also have many ways to store energy locally too. Technological innovation in the past decade has increased our options for storing electricity and heat, and if progress continues at this rate, energy storage will only become more efficient in the future. These energy storage

[3] In 2012 the average UK home consumed 18,600 kWh of energy (source: DECC). Assuming a projected 12% reduction in household energy demand by 2020, 50 MW of energy could power the equivalent of 267,666 homes.

solutions mean that although the wind isn't always blowing and the sun isn't always shining, we have a more secure supply of energy from these renewable resources because we can store excess energy for use when it's needed during times of peak demand. Also, now that we are no longer so reliant on fossil fuels and instead are meeting our energy needs through a mix of different energy sources, we are less dependent on other countries for our energy, and we will be in a stronger position to adapt to diminishing supplies of fossil fuels, making us less vulnerable to future energy shortages and potential black outs.

### *City/town centres*

District heating networks have become more common in our towns and cities both in new developments and in retrofitted existing buildings. Many existing homes have been connected to new district heating networks as many communities move toward more local energy. By 2020, 40,000 homes were heated in this way. Heat networks use one or more central energy sources (e.g. a gas or biomass boiler, waste-to-energy plant, or waste heat recovered from industry), to heat a number of buildings more efficiently than having separate boilers in each property. Hot water produced by district heating systems is distributed through pipes, sometimes connecting hundreds or even thousands of properties in a heat network. Inside the home, heat is circulated through pipes and radiators in the same way as in traditional systems with individual boilers. Fifteen years ago, district heating systems were much less widespread in Scotland than in many other European countries. We are now beginning to catch up with our neighbours, thanks in part to local authorities and other public bodies leading the way in installing heat networks to serve social housing and public buildings, as well as to private developers putting heat networks in place when building new homes.

For the individual householder, getting their heat from a heat network means instant access to heat and hot water 24 hours a day. The heating of the home itself is still controlled by the householder through, for example, programmable timers and thermostatic radiator valves. What's more, the central energy source can be changed (e.g. moving from gas as a main energy source to recovered heat from industry) without requiring modifications to the properties it serves or to the pipe network. Another benefit of district heating systems is that they can save households money on their fuel bills compared to traditional boiler systems. Although in the early days of heat networks in Scotland they didn't automatically work out cheaper for every household, for many years we have had robust consumer protection that ensures that all households are supplied at a fair price. Heat network suppliers are independently regulated and have to meet certain standards, including benchmarking their prices against other forms of heating. This has given heat network users peace of mind because living in a home supplied by district heating means less flexibility to choose your own energy supplier.

***Doing it now: Districting heating***

The Commonwealth Games Athlete's Village in Glasgow's East End was designed to include a district heating network. A 28 km network of pipes connects the 704 homes in the Village, along with the Sir Chris Hoy Velodrome and a nearby care home, to a purpose built Energy Centre. This houses a Combined Heat and Power (CHP) plant, along with back-up gas boilers and a thermal store, generating power, heating and hot water. As well as helping to make Glasgow 2014 the 'greenest games ever', members of the public will be able to buy or rent a home in this low carbon development, which is planned to be extended to include an extra 750 homes in the future.

### *Suburbs and small towns*

Nowadays, as well as access to district heating becoming more widespread, many households are able to produce their own energy through 'micro-renewable' technologies. Whilst these technologies were not cheap to install, government support schemes have made these long-term investments possible for low and medium income households by helping to cover the upfront costs and spread repayments over time. Choosing to invest in micro-renewables has been a shrewd decision for the many households whose renewable systems have already paid for

themselves by reducing the amount of energy they have to buy in, as well as by generating income from selling the surplus.

Heat can be generated from solar thermal panels fitted on the roof or on a wall. These are used to provide hot water in the home, and can supply more than half of the hot water a household uses. Although these work all year round, homes that have them also have to have a boiler or immersion heater as a back-up for during the winter months when the system can't obtain enough energy from the sun to fully heat the water. To get the most efficiency from solar thermal technologies it is important that they are correctly fitted and used, making sure that the hot water thermostat is not turned up too high and that back-up heating is timed appropriately. Users have found that to benefit the most from solar thermal panels, the best time to use back-up heating is in the early evening, when the water in their hot water cylinder has already been heated as much as possible from the day's sun. To ensure there is still hot water available for the next morning, it is important that hot water cylinders are well insulated.

The most common way that people generate their own electricity in suburbs and small towns is through solar electric panels, also known as solar photovoltaic (PV) systems. Householders also generate income by selling on the electricity that they don't need. The amount of electricity that can be generated by PV systems depends on a number of factors e.g. the size of the system, the extent of shading (e.g. by trees or other buildings), and the direction the panels face (with south facing surfaces collecting the most sunlight).

### *Rural, coastal and island areas*

Many homes in rural areas now generate their own heat and electricity using solar thermal and PV systems (see 'suburbs & small towns'), heat pumps and small scale domestic wind turbines. This has meant that many in rural areas are no longer reliant on oil heating and instead have access to renewable heat all year round if they require it.

Some of the most common sources of renewable heat in rural, coastal and island areas are ground and air source heat pumps. These are systems that take heat from the air outside the home or from the ground to heat the water circulated in a central heating system. These have to be used differently from conventional gas or oil boilers because they deliver heat more slowly and at a lower temperature, meaning that they are best left on for longer periods of time to let heat build up more gradually. This has meant that heat pump users have had to change their expectations about how a heating system should perform. To get the most out of heat pumps, users will often leave the pump on continuously during the winter. If the rooms get too warm, it's best to turn down the radiator valves or adjust room thermostats as opening windows and doors makes the pump work harder and pushes costs up. Heat pumps can work best for homes that are occupied for much of the time during the day. They are therefore most suitable for households with occupants who are retired, house-bound or less mobile, working from home or carrying out caring responsibilities at home. Cost effectiveness is a major consideration for those thinking about having a heat pump installed. Heat pumps are most cost effective in areas that are not connected to the gas network (54% of rural properties in 2012)[4] because the amount that can be saved in fuel costs depends on the heat source that householders switch from. Those switching from bottled gas, oil and electric storage heating have saved the most money by installing a heat pump.

As well as these micro-renewables, our rural (and marine) environments are home to larger-scale renewable energy generation. This takes the form of both commercial renewable electricity generation (developments owned by private sector companies) and community owned developments. These developments help to fund community projects and initiatives through community benefit payments and community equity shares (in the case of commercial wind farms), as well as the reinvestment of the profits from community-owned renewables projects.

[4] Source: Scottish House Condition Survey 2012

***Doing it now:*** ***Gearrannan Blackhouse Village wind turbines***

The Gearrannan Blackhouse Village lies within the Outstanding Conservation Area at Gearrannan on the Isle of Lewis. The historic blackhouse homes of the village, which attract a large number of tourists, have been restored and protected by Urras na Gearrannan (the Garenin Trust). Today the blackhouses are used as self-catering cottages, and other facilities to support tourism, such as a restaurant and museum. In 2011, the trust erected four 6 kW wind turbines, to help solve the problem of their high heating bills. This was funded with the help of a grant from the Community and Renewable Energy Scheme and local authority funding from Comhairle nan Eilean Siar. During the first winter, the turbines exceeded expectations by producing 46,691 kWh of electricity. It is expected that, as well as saving the equivalent of over 22 tonnes of $CO_2$ annually, an extra £10,000 towards the running and heating of the village will be generated through Feed in Tariffs each year.

## 2.2 How have our homes changed?

One of the challenges Scotland has faced in tackling fuel poverty and becoming a low carbon society has been improving the energy efficiency of buildings. In 2030, although we have been building new energy efficient homes for many years, much of the housing stock is still made up of older buildings that were built before the introduction of building regulations that ensured energy efficiency. This has meant that we have had to give high priority to making changes to the fabric of existing buildings (known as retrofitting).

Retrofitting to improve energy efficiency included taking actions like properly insulating lofts, walls and floors. In homes that still use gas boilers, it also included upgrading older systems to newer ones such as condensing boilers which produce more heat from the same level of energy input. By 2012 we had already made a great deal of progress – the vast majority of homes had installed double or triple glazing, almost 9 out of 10 lofts were insulated, and around two-thirds of homes with cavity walls had wall insulation[5]. By 2020, we had reached a significant milestone in our progress, with all lofts and cavity walls having had insulation installed, where cost effective and practical, and all gas-heated homes benefiting from efficient boilers and effective heating controls like room thermostats and thermostatic radiator valves. Wanting to further reduce energy bills and make homes more comfortable, people have installed insulated pipes, hot water cylinders and draught proofing. It is now quite uncommon to live in a draughty home.

As well as these retrofit measures to improve the efficiency with which we heat our homes, we also now light our homes more efficiently too. LED bulbs are the most common type of light bulb in use, with the old incandescent and halogen bulbs a thing of the past. The main differences between LED bulbs and the original compact fluorescent (CFL) energy saving light bulbs are that LEDs are even more energy efficient, they last much longer, and they don't take time to warm up. LED lighting has long been available in a variety of warmer and cooler tones. The cost of LED bulbs has come down significantly over the years, but even when they were first introduced and seemed very expensive they were still better value for money in the long run than either CFL or incandescent lighting.

Financial support schemes have helped many households to improve the energy efficiency of their home by installing insulation and upgrading heating systems. However, progress on energy efficient homes really began to accelerate when we started to think differently about how important energy efficiency is in our choices of where to live. The Scottish Government's proposals on minimum energy efficiency standards drove an increased awareness in the energy efficiency of properties, and nowadays one of the main things people look for when they are searching for a home to buy or rent is a good rating on the Energy Performance Certificate. For most people, the main motivation for choosing an energy efficient property is to have a warm and comfortable home that is affordable to heat. The lower running costs are an added benefit.

[5] Source: Scottish House Condition Survey 2012

The focus on improving energy efficiency, as well as the need to future-proof our homes against the changing climate, has encouraged people to think about the overall condition of their property. As energy efficiency measures became standard features of most homes, there was more motivation to address disrepair that prevented improvements from going ahead. Structural repairs are now prioritised. After all, a home that is in a good state of repair is less leaky and draughty, and will use less energy. Support schemes have helped meet the upfront costs of home improvement. Addressing energy efficiency alongside structural improvements has, for many people, been a case of taking care of two issues at once. For example, improving energy efficiency by installing underfloor insulation has prompted people to deal with damp, rot and infestations that could have led to greater problems further down the line. For people living in areas where flooding has become more frequent, adapting their homes to protect against flooding and to reduce the damage caused by floods is an important consideration in home improvements and maintenance. Although air and watertight homes are more energy efficient and resistant to flooding, we have learned that in a warming climate we also have to ensure that new and older homes alike have plenty of ventilation as some of those living in highly energy efficient homes have experienced overheating. This can be a particular problem during heatwaves, and can be quite dangerous for vulnerable groups such as older people.

### *City/town centres*

Many of the homes in urban areas are flats rather than houses. Social housing providers initially led the way in improving the energy efficiency of these types of properties, as they were required to provide a minimum standard of energy efficiency in the properties they let. However, improving the energy efficiency of flats and tenement buildings often required a co-ordinated effort between different owner-occupiers and private and social landlords. This is because property owners have a collective responsibility for the parts of the building (like walls, lofts, and communal stairwells) that their properties share. From 2009, climate change legislation required that most decisions to install insulation only required a majority (rather than unanimous) support by the different parties involved to go ahead. Over time, as the different parties in linked homes have become more aware of their rights and responsibilities around undertaking insulation work, and as the demand for energy efficient properties amongst buyers and renters has increased, the rate of uptake of insulation measures in flats and tenements has also grown.

### *Rural, coastal and island areas*

In 2012, over half of rural properties did not have access to the gas grid[6] and so were not able to benefit from the efficiency savings associated with upgrading old gas boilers to modern condensing boiler types. Many households in this position have benefitted from adopting technology such as heat pumps and solar thermal panels to generate their own heat.

Many of our rural homes were also built with solid walls, meaning that cavity wall insulation was not a possibility. Insulating solid walls is more expensive than filling cavity walls, so government support schemes to help households meet the costs of making improvements have been important for driving forward progress in improving the efficiency of solid walled homes. Solid wall insulation is installed on either the inside or outside of properties. At first some people had concerns about how external wall insulation would affect the look of their home; however as this type of insulation measure has become more common we have all had a chance to see for ourselves how external insulation can actually improve the appearance of certain types of properties, in addition to improving their energy efficiency. Other households whose homes have solid walls chose to install internal wall insulation instead. Most have found this easiest to do one room at a time when planning to redecorate anyway, as this reduces the hassle and costs involved in redecorating after installing internal insulation.

[6] Source: Scottish House Condition Survey 2012

## 2.3 How have we made our home lives more sustainable?

### Managing our energy use

In 2030, many aspects of our home lives have actually changed rather little over the years. One of the main changes we *have* seen is that we now manage our energy use on a day-to-day basis more efficiently. For most households, controlling the heating system no longer means having to fiddle with the controls in the boiler cupboard. Instead we can control our heating using apps on our mobile phones, tablets and PCs. This means that it is easy to programme timers and change the settings for your heating system both when at home and on the go. Wasting heat is now seen as irresponsible (as well as being expensive), so hardly anyone would consider leaving their gas heating on 24 hours a day in winter, or heating every room in the home if they aren't all being used. With greater control over the heating of our home, many of us have moved away from heating the whole home to what is known as zoned heating, where we can programme individual radiators and thermostats for each room to give us the right amount of heat, at the right time, in the places we need it. There's also the added benefit of being able to turn on the heating remotely – no more having to come home to a 'cold house' in winter, or worry about the pipes freezing up when you're on holiday!

Moving towards a low carbon way of living hasn't meant we've had to stop relying on electrical appliances like washing machines and vacuum cleaners for household chores, nor give up TVs, computers and other electronic devices. Instead we manage our electricity use by making simple changes in our actions and habits around the home. By 2020, all homes had been fitted with a smart meter (replacing the old style of electricity and gas meters that had to be read manually) with most people also having opted to have an in-home display fitted at the same time, free of charge. These in-home displays allow us to see how much energy we are using in real-time measured in cost (£), kilowatt hours (KWh) and carbon emissions ($kgCO_2e$). Engaging with these has helped many people to become more aware about their energy use, and it is much easier now for us to see what actions make a real difference in reducing our energy use. For example, seeing how much electricity a washing machine uses was a real wake up call for many people. People responded to their new in-home displays in a wide range of ways. Whilst some became really competitive with themselves in their efforts to keep pushing their daily usage down, others felt that seeing energy savings broken down into pennies per day just didn't provide enough of a motivation for them to bother changing their habits. Although initially most people found that measuring energy use in pounds and pence was the most useful for understanding consumption, as we became more aware of the energy used by our appliances we have become more comfortable with the language of kilowatt hours and $CO_2$, since these aren't subject to change over time like fuel prices. Needless to say, not everyone is interested in monitoring their household energy use, and some people who were initially engaged lost interest fairly quickly, especially if their in-home display wasn't fitted in a place where they were likely to notice it regularly. However, even just an initial period of learning about how much energy different appliances use was enough for some to start making changes.

Having an energy monitor installed also prompted households to start talking about their energy use in a way that they had never done before. In some cases where just one person in the household became enthusiastic about monitoring and managing energy use this was enough to encourage the others to change some of their behaviours - whether this was due to good habits rubbing off or to other family members giving into nagging is another story! One way or another, there are lots of simple energy-saving measures that have now just become the norm – like turning lights and appliances off when we're not using them, only filling the kettle with as much water as we need, and washing clothes at 30 degrees and then hanging them to dry outside or on a clothes horse instead of tumble drying.

### Products and appliances in the home

And then there are the really simple one-off actions that keep paying off in terms of energy savings, like turning down the setting on the fridge or choosing a more energy efficient model if buying a new appliance. These one-off actions are less of a hassle now because of the use of labels that tell us how much energy an appliance uses and

makes it quicker and easier to compare options. An appliance's energy efficiency rating is now one of the most important features we consider when making a purchase, because we recognise that it would be false economy to

***In focus: The morning routine***

Another morning begins with you being rudely awakened by your alarm. Slowly poking one foot out from under the covers you register the comfortable temperature of the room, despite the frosts that were forecast for the previous night. You've really felt the benefit of the extra insulation and triple glazing you installed over the last few years - it hasn't even been necessary to heat the bedrooms in the mornings so far this year. It never ceases to amaze you that body heat is enough to keep the room warm now, even with winter drawing in.

You hit the timer as you jump in the shower and it starts to count down your 4 minutes. You don't always use the timer, especially during summer when you tend to shower in the evening to make the most of the hot water generated by your solar thermal panels during the day. Either way, it's nice to be able to save that time in the morning.

Once you're dressed and presentable, and have made sure everyone else is up and about, you head downstairs to quickly prepare your lunch to take into work, using up some leftovers from the night before. Your partner puts on the kettle for coffee for you both, only filling it with as much water as is needed, and sits your son down to breakfast. The primary 7 class are learning about personal carbon accounting as part of their numeracy curriculum, and he's been quizzing you for the last week about what things used to be like in what he insists on calling the 'olden days' before people cared about their carbon footprint. You tell him about how when you were little there was only one kitchen bin that everything would go into and it would sometimes get smelly. He finds this hysterical. "Why did you not just empty the scraps into the outside food bin every day?" he says, carefully scraping the last morsels of his breakfast cereal into the food waste caddy as if to make a point. The conversation moves on to the subject of the class trip he is attending today. They're visiting the nearby factory so that the children can see where the heat used in the school comes from. The wee man's been getting excited because they've been told they'll get to see the robot that assembles the electronics for the solar energy systems produced there. He's now convinced that he wants to be an engineer when he grows up. Last week he wanted to be a chef.

By the time you wave him off as he joins the 'walking bus' to school, your partner has already left to catch the train and your teenage daughter has finally emerged. Bolting down the last of her toast, she barrels out the door without so much as a "good bye" and grabs her cycling helmet and shiny new refurbished bike from the shed before greeting the group of her friends who are perched on their own bikes waiting for her. On the short walk to your local remote working hub you glance up the hill at the community turbines and see that the blades are turning smoothly. They'll be producing lots of electricity today, so it's a shame that you couldn't make the most of it by doing some of the household chores that require lots of energy. At least the electricity that's not used will get stored for later, because the laundry and hoovering will just have to wait until tomorrow!

choose the cheapest option if it wastes energy and ends up costing us more in electricity as well. This changing demand from consumers, along with minimum energy efficiency standards imposed by government, has pushed manufacturers and retailers to work harder to improve the efficiency of their products even further and to provide them at competitive prices. This means that energy efficient appliances are now the norm, and there is an incentive for manufacturers to keep pushing standards up.

In fact, although we do still buy some of our own appliances and devices, it is actually quite common now for people to lease rather than buy white goods and other home appliances. In this way, instead of buying a *product* we buy a *service* from the manufacturers, who retain ownership of the appliances and are responsible for repairing

and reusing components such that as a customer we are provided with a "like new" appliance throughout the lease period. As well as reducing waste and encouraging manufacturers to make more durable products, it makes things an awful lot easier for the householder if the washing machine does break down, and avoids any unexpected costs of having to replace faulty appliances. For less frequently used equipment, like lawnmowers and power tools for example, there's also more of a culture now of sharing resources rather than each household owning one of everything. For example, you might own a lawnmower that you lend to your neighbours, and when it comes to needing a leaf blower you borrow theirs. This sharing doesn't even have to be with people you already know, as internet sites and apps that allow people to offer up their items for others to rent for a short time have grown in popularity.

### Food, consumption and waste

There has been a marked change in our actions around food consumption (see '*In focus: The weekly shop*') and household waste. We create less waste in our homes than we used to and we deal with the waste we do create in different ways, like by reusing and recycling. This contributed to Scotland reducing the total amount of waste we create by 15% between 2011 and 2025, with only 5% of all the waste generated by Scotland's households, industry and public sector now being disposed of in landfills. Some of the main ways that householders have reduced their waste are: wasting less food, choosing products with less packaging, taking their own bags with them when shopping, repairing and reusing items in the home, choosing items that will last longer, and leasing rather than buying certain items (see section 2.3 'managing our energy use').

At the same time, we try to ensure that the waste that we can't avoid creating is disposed of in responsible ways. This includes passing on items that are still in useable condition to others, recycling packaging and electrical goods that can't be passed on, and by recycling or composting our food waste. By 2025, we had reached a major milestone of 70% of all household waste being recycled, composted or reused. This progress has been the result of Government and business providing the infrastructure to enable this change and a gradual cultural change where as a society we realised that we did not want to have a wasteful 'throw away' culture; that 'being canny' is something to be valued. Our thrifty grandparents and great-grandparents would approve – by reviving some of the values that they grew up with we've taken a huge step forward.

***In focus:*** **A top-up shop at the supermarket**

You did your big monthly online shop more than a week ago now, and you're running low on some fresh ingredients for the meals you've got planned for the next couple of days, as well as a few everyday essentials. So, armed with a couple of reusable carrier bags, you decide to take a walk down to your local supermarket. Once there you bypass the small section of fruit and vegetables that have been imported or grown here out of season using extra heating and lighting, and instead head straight to the main section of local seasonal low-carbon produce. On your way past the 'reduced to clear' section you stop and choose a couple of items that still have a day left until their use by date – they'll go nicely with what you've got planned for tonight's meal. Consulting your list as you go, you make your way around the rest of the shop, gathering all the other things you need. You scan the barcodes and check to see where different products and their ingredients have come from, as well as getting more information on their nutritional content, ethical and animal welfare standards, and even recipe ideas. This can be quite handy when buying something new. Because you cook most of your meals from scratch you don't tend to buy too much highly-processed food that comes with lots of packaging, but you do still try to make sure that you minimise packaging and that you can recycle what's left.

At the checkout, you find yourself absentmindedly reading the cover of the in-store magazine that declares 'We've cut down our energy, and we're passing the savings on to YOU!' next to pictures of refrigerators and vehicles covered in the supermarket branding. Once through the other side you're quite pleased to see that the carbon cost of your shopping that flashes up alongside the total price is lower than last time, and you haven't spent any more money than you planned. Since becoming more thoughtful about planning meals in advance and doing smaller top-up shops instead of a big weekly one you've found that you no longer end up buying more than you can use, which means you're saving money as well as cutting down on waste.

This shift has been supported by systems that make it easy not to be wasteful. For example, every kitchen now has a food waste recycling caddy for scraps and vegetable peelings etc., with regular kerbside collections for food waste bins. There are also kerbside collection services that pick up broken electrical and electronic equipment that needs to be recycled, and it is easier than ever to arrange collections of electrical equipment still in working order and other items like furniture or bicycles that can be distributed to charities and other organisations to be reused or reconditioned and resold. Not only does this shift to a waste-not culture mean that items that still have life left in them can be enjoyed by others and help to generate income for good causes, it also means that we no longer have problems with unsightly fly-tipping and littering in our local communities, countryside and coastlines.

### Getting around

For the most part the types of changes we have made in leading more sustainable home lives have been similar regardless of whether we live in city/town centres, small towns and suburbs, or rural, coastal or island areas. There are, however, differences when it comes to travelling around our local areas.

#### *City/town centres*

In all areas in Scotland, but especially in towns and cities, the most common modes of transport people use for short journeys are walking and cycling. Many people choose to walk or cycle because it's an easy (and inexpensive) way to stay fit and healthy, as well as being more environmentally-friendly. Cycling in particular has become much more popular in the last fifteen years – now at least 10% of everyday journeys made in Scotland every year are by bike. Part of the reason for this is that there are more cycle routes available and, as more people have switched from using the car, there are now fewer cars in our city centres. This means that cycling is not only a healthy option but also a safe, quick and convenient one. Cycle hire schemes make cycling in the city centre easier as bikes can be picked up and dropped off at any of the many cycle ranks stationed across the city.

For longer journeys, and for those individuals who are less able to walk or cycle, public transport is the best option. Travelling by bus is even more environmentally friendly now in 2030 as around half of all buses use low carbon fuels such as hydrogen. In addition to buses, Glasgow's underground system and Edinburgh's trams also offer convenient low carbon travel options for getting around Scotland's urban areas, with the rail network providing important links between city centres and their nearby towns. There has also been an increase in the use of electric bicycles particularly in the more hilly areas. Most people living in city and town centres find that it is no longer necessary for them to own a car, because everyday amenities (like shops and leisure facilities) and public services (like doctors' surgeries) can be easily reached on foot, by bicycle, or by public transport. However, there are times when access to a car is still needed, perhaps to travel longer distances to visit friends and family who aren't on a public transport route, or to pick up large bulky purchases that cannot be delivered. For this reason, car clubs are popular. These allow people to book a local car and pick it up in their neighbourhood, meaning that members have easy access to a car when they need it but can avoid the costs and hassle of maintaining a car. Many car clubs use ultra-low emission vehicles (ULEVs) such as battery electric cars and hydrogen fuel cell electric cars. Since there is now a well-developed infrastructure for charging electric vehicles in Scotland's cities, this is an ideal way for people to make those necessary journeys without creating harmful emissions that contribute to air pollution and climate change.

These changes mean that Scotland's cities are now cleaner and healthier places to live and work. Since more people are choosing low carbon travel and we have now halved the number of fossil-fuelled cars in urban areas, we no longer have hotspots of air pollution in our town centres. Also, since we have switched to using more electric cars (which are quieter than petrol and diesel ones) our city centres have become more liveable; for example being able to hear birdsong instead of cars makes them really quite pleasant places to be.

***Doing it now: H2 Aberdeen Hydrogen Bus project***

Private and public sector organisations in Aberdeen are working together to make the city a global leader in low carbon public transport by investing in hydrogen infrastructure. The project's demonstration fleet of 10 hydrogen fuel cell buses hit the streets of Aberdeen in 2014. The green hydrogen fuel for these buses is being created by using electricity generated from renewable sources to split water, releasing the hydrogen and oxygen that together make up water molecules. The hydrogen produced is transferred to buses at a new hydrogen refuelling station. The buses' hydrogen fuel cells then reverse this process using chemical reactions to convert the hydrogen (along with oxygen) back into electricity which in turn powers the bus. With the only waste product of this process being water vapour, hydrogen fuelled vehicles like these create no harmful exhaust emissions. Another added benefit is that they can act as an energy storage solution; surplus renewable electricity can be used to produce hydrogen which can be stored for later use.

### *Suburbs and small towns*

As in Scotland's town and city centres, people living in the suburbs and small towns tend to rely on walking and cycling to get from A to B for short journeys. These places are also well connected, so it is easy to travel around the local area using low carbon public transport. This reduction in our dependency on cars is also reflected in the built environment. It is now more common to see streets designed for people - not cars - creating safer and more pleasant places for walking, cycling, and for children to play outdoors in the street again. Achieving this has required high standards in planning and design to ensure that streets are designed to meet the needs of pedestrians of all ages and abilities first and foremost, and by introducing traffic calming measures like lower speed limits and speed bumps in existing streets. Some people remain reluctant to switch from using the car for short journeys, and sometimes Scotland's weather can make the idea of walking or cycling much less appealing. Yet more people are now making the effort because they can *feel* the benefits of doing so, in terms of their physical health and also in the positive effect that being active can have on their moods and stress levels.

Car ownership is still fairly common in these areas, but changes in the car industry have meant that these cars now create much lower carbon emissions. Some people make use of peer-to-peer car clubs, where neighbours offer use of their cars to others. Many people now own their own battery electric vehicles, which are fuelled by a battery charged by plugging in to mains electricity. Plug-in hybrid electric vehicles are also popular; these give owners more flexibility as they have both a conventional combustion engine and a battery. They also have a longer range than battery electric vehicles, allowing the motorist to drive further without having to recharge. There has also been much progress in developing affordable hydrogen fuel cell vehicles. These are powered by 'green hydrogen' produced using water and renewable electricity. Like plug-in hybrids, these allow users to drive longer distances than battery electric vehicles. They also have the added benefit of being quick to refuel at a service station. Due to this transition towards low carbon fuels, Scotland is now on target to have almost completely decarbonised road transport by 2050. Considering that, in 2012, more than two-thirds of our carbon emissions associated with transport came from road traffic alone, this is making a very important contribution to reducing our greenhouse gas emissions from transport.

Initially, most people were a bit reluctant to change from the conventional cars they were used to, especially when battery electric cars were more expensive and were limited in terms of their range (the distance they could cover on a single charge). However, as the technology developed to allow longer ranges and faster charging times, and hydrogen fuelled vehicles became available with driving ranges comparable to petrol or diesel vehicles, these technologies came to be seen as more desirable. People started to become used to seeing their friends and neighbours using them, and more people had a chance to try them out for themselves (e.g. by driving a work's ultra-low emission vehicle (ULEV), a car club or hire ULEV, or on a trial period from car dealerships). Over time, they stopped being a novelty. The development of the electric vehicle charging infrastructure, beginning in Scotland's urban areas, and the creation of a network of hydrogen refuelling stations across the country also

played an important part in setting the scene for these changes. As we became used to seeing cars plugged in at work or elsewhere or being refuelled with hydrogen at service stations it started to be much easier to see how owning an ULEV could work for us.

Switching to ULEVs has also opened up new opportunities for managing the balance between the supply and demand for renewable energy. By charging battery electric vehicles at times of the day when overall energy consumption is lower (like at night) rather than during times of peak demand (like early evening), this helps to avoid spikes in electricity consumption that result in fossil-fuelled power stations being switched on to meet demand and increases the likelihood that the energy used for charging comes from a renewable source. Mass charging electric vehicles at off-peak times also acts as a method of storing excess electricity produced from intermittent renewable sources like wind, ensuring that the renewable energy produced is put to good use.

### *Rural, coastal and island areas*

In rural areas, owning a private car is still a necessity rather than a luxury for many people. For many living in these areas, battery electric cars have become an attractive option, particularly for those who do not need to drive long distances on a daily basis, and can therefore rely on the mains electricity at home for charging their electric vehicle. They can also use the network of charging points that has spread across the country from cities and the primary road network to more rural areas. For those who regularly drive long distances in rural Scotland a plug-in hybrid electric vehicle that has both a battery and a conventional engine, or a hydrogen fuel cell electric vehicle is now the preferred choice. Whilst not all cars have been replaced by low carbon models like battery electric and hydrogen vehicles, the remaining conventional petrol and diesel cars on the road create much less pollution now than they used to, due to increased emissions standards for new vehicles placed upon manufacturers and greater demand for fuel efficiency from consumers. By 2020, EU requirements had reduced the average emissions for new cars to 95 $gCO_2e/km$ (around the same as a new SMART car in 2014), representing a reduction of almost half on the 2000 average of 181 $gCO_2e/km$[7] (which equated to around the same level of emissions as a 2014 model Land Rover[8]).

As with road transport, our maritime transport systems have also become more sustainable. Scotland's island communities are served by lower carbon ferries that integrate with public transport services both on the islands and the mainland. Improvements to the ferry fleet have resulted in more fuel efficient vessels. More recently we have started to see more ferries being powered by hybrid diesel-electric engines.

Enhanced digital connectivity of rural and island areas, through improvements to broadband infrastructure, has also meant that some journeys can now be avoided altogether. For example, access to high speed internet and a greater digital provision of services means that more people are able to choose to work remotely to avoid long commutes (see section 3.2), to access education and training through college and university e-learning courses, and to access digital health and social care services. This enhanced connectivity benefits people of all ages, by helping to increase access to employment and training opportunities as well as public services in rural areas.

[7] Source: Society of Motor Manufacturers and Traders (SMMT) New Car $CO_2$ Report 2014

[8] Source: *http://carfueldata.dft.gov.uk/*

# 3. At work

Becoming a low carbon society has not only meant changes in our home lives but also in our working lives. We recognise that whether we work in the public or private sector, in large businesses or in small and medium sized enterprises (SMEs), the choices we make at work - as employees, managers, employers and entrepreneurs - have consequences for Scotland's environment. In addition, the patterns of *where* we work have changed for lots of people; many more are now living and working in their communities rather than having to travel long distances to get to work.

## 3.1 How do we do business now?

Here in 2030 we are on target to reduce the direct emissions from business, industry and the public sector to almost zero by 2050. This has been achieved partly through large scale infrastructural changes happening across society and partly by changes in the way that we do business. The ways in which organisations have cut their carbon emissions are extremely varied, since there are so many differences between industries (and between businesses within the same industry) in terms of the energy and resource inputs used, the processes performed, and the goods or services delivered. By 2030 changes in business, industry and the public sector mean that:

- The energy used by organisations now comes from cleaner sources, due to the transformation of Scotland's electricity and heat generation infrastructure (see section 2.1).

- Business, industry and the public sector now consume less energy. By 2020 a 12% reduction in energy demand had been achieved, through e.g. increasing the energy efficiency of industrial processes and of non-domestic buildings. Workplaces also waste less energy too, with excess heat generated by industry being recovered and sold on for heating other workplaces and homes through heat networks. Waste heat is now a valuable commodity to businesses (see also section 2.1).

- Products are designed and manufactured to maximise their longevity and to enable them to be repaired and upgraded easily. Many products are designed for eventual disassembly and 'remanufacturing'; creating an 'as new' product from existing parts. This growth in remanufacturing goes hand-in-hand with the move towards leasing products as a service rather than buying them (see section 2.3). In moving towards this more 'circular economy' we have cut down waste by extending the life of products and materials.

- Carbon emissions from transport in business and industry have been cut through adopting low carbon fleet vehicles, transporting more goods by rail and water instead of by road and introducing low carbon business travel policies.

Public bodies, like local authorities and hospitals, have helped to lead the way in the transition to low carbon business models by implementing plans detailing how the organisation will reduce its carbon emissions (i.e. carbon management plans) and ensuring that the supplies they purchase and the IT equipment they lease are sustainable (i.e. sustainable procurement).

Within the private sector there is now a widespread recognition that going green can be good for the 'bottom line'. As well as the potential cost savings that can be achieved through greater efficiency in energy and resource use, there are also competitive advantages that can come from building a reputation as an environmentally and socially responsible organisation. The transition to a low carbon society has also opened up new opportunities for

business, stimulating a growth in employment opportunities in industries such as renewable energy, remanufacturing, the building trades, and their supply chains.

***Doing it now: Circular economy in Scotland****

The 'circular economy' concept, which is a response to the need to reduce waste and create more resilient resource supply chains, will partly be enabled by radical changes to how the things we use are designed and made. In particular, there will be much greater emphasis on modular design, which will make it easier for materials, parts and components to be recovered and repurposed at the end of their 'first life'. In Scotland, Zero Waste Scotland has developed a Resource Efficient House on the site of the old Ravenscraig steel works using modular, off-site construction methods and techniques which will enable parts of the structure to be easily re-used when the building is taken down. By drastically reducing the amount of waste generated in house-building, the techniques used to construct the Resource Efficient House offer opportunities for the construction industry to reduce its costs as well as its environmental impact.

Developing a circular economy also includes consideration of how products can be 'remanufactured' i.e. stripped back and refurbished so they are as good as a new product. This is currently something which happens in sectors like the automotive industry. In Scotland, Mackies Transmissions runs a specialised facility for repairing, rebuilding and reconditioning automatic and manual gear boxes. Remanufacturing these parts by reusing and reworking the original components produces gearboxes that meet or exceed their original condition whilst using less energy and creating less waste than parts made from new components.

*Case studies provided by Zero Waste Scotland

### 3.2 How have our working lives changed?

Many of the changes that have occurred in the public sector and business world have been a result of improvements in infrastructure, technology, and changing business models. However, the organisations that have been most successful in becoming more sustainable have also recognised that good environmental performance doesn't just come from strategy and decision-making by senior management, but also needs commitment from workers on the ground. Enabling and promoting sustainable behaviours amongst the workforce is therefore an important part of the action that organisations routinely take in lowering their carbon emissions. It is this that has arguably had the most impact on our working lives. At work, we now tend to see environmental responsibility as being part of our job.

This has meant developing new habits around energy use, waste, and travel. Office workers, for example, now use much less paper as most avoid printing unless it is absolutely necessary. In the workplaces that still lack automated temperature control and motion-sensor activated lighting, it is up to individuals to make sure that they turn off lights if they're last to leave the room, and that radiators are turned off in in unoccupied rooms. Relaxed company dress codes now mean that it's easier to dress for the weather, so in winter people are more likely to put on a jumper than turn up the radiator in the office.

Turning off computers at the end of the day, using power saving settings on PCs and laptops and recycling at work have long been the norm in our workplaces. Simple energy and waste behaviours like these can make a real difference when added up across the whole workforce of an organisation. The most substantial impacts of changing behaviours at work have, however, come from reducing the need for travel and choosing sustainable transport options for commuting and business travel.

The most significant shift in this regard has been the increasing popularity of flexible working arrangements. Although not possible in all types of work, more people than ever before are now working flexibly. This can mean working from home or from a local remote working hub, either some or all of the time. It can also include

adapting working times to avoid travelling during peak times, to allow people to work around public transport timetables, and to accommodate other responsibilities such as picking children up from school.

***In focus: Green trades***

Today's job is local, so you don't have far to go in the electric van to get to the client's home. It's an old stone built cottage a couple of miles from the village. A bonny looking house, you think, but it must cost a lot to run. It's no wonder that the owner has decided to get this work done to insulate it better. After having an energy audit done, the client applied for financial support towards the improvements that were needed and once that was secured that's where you came in. These houses aren't the cheapest or easiest to retrofit, due to the solid stone walls. After a lot of consideration, the owner decided to get internal solid wall insulation installed. She really wasn't sure about it at first; the upheaval it would cause was a worry, as was the idea of losing space in the house due to the thickness of the insulation boards. However, she plans to sell the property in a few years' time, and after seeing her neighbours up the hill try - and fail - to sell their house over the last couple of years, she knew that improving the energy efficiency would make it a lot easier to sell when the time comes. Folk just don't want to buy a cold and draughty old house in the country nowadays.

This is the second job you've done in the house. The owner decided to get the insulation installed on a room by room basis, so a couple of months ago you did the kitchen and now that she's got that room redecorated and back functioning properly it's time to move on to the living room. It's been an easy job to fit in - since the client is able to work from home she's been very flexible on the dates. She greets you and your apprentice familiarly at the door - it's a small community so you've known her for a while. She insists you come and see what she's done with the kitchen since you were last here. Since redecorating was going to need to be done after the insulation was installed she decided to take the opportunity to give the room a complete facelift, and she's thrilled with the result. Brimming with pride, she shows off a large wooden dresser that she got second hand and did up herself. She also tells you of the success in recycling much of what had been removed during the redecoration process.

After these pleasantries the owner excuses herself to go and work in her home office and the two of you get to work unloading the materials out of the van and making a start on the job. Since starting out in the trade 20 years ago these kinds of energy efficiency retrofits have gone from being the odd job to becoming a mainstay of your income. It was a steep learning curve at the start, to be fair. It meant undertaking training and developing new skills to make sure that you were delivering the highest quality workmanship to get the maximum energy efficiency savings for the client. You also had to learn a lot about renewable technologies so as to be able to explain to people how they could get the most out of the new heating systems that were being installed. Of course for folk who are newer to the profession, knowing the science is a necessary part of their initial training - it's just what's expected of the trade nowadays, and rightly so you think to yourself. Change in the industry was always going to happen, you're just glad that the changing nature of the work has meant you've been able to grow the business so much over the years, creating new jobs and training up new apprentices for a long and secure career in the trade.

***Doing it now: Flexible working at Aberdeenshire Council***

Aberdeenshire Council's Worksmart programme, launched in 2010, introduced flexible working options to staff. Teams participating in Worksmart have the opportunity to work from home more often and to work from any of the council's offices. Feedback from Worksmart participants indicates that almost 50% have experienced an improvement in their work-life balance as a result of switching to Worksmart. The Worksmart initiative has been rolled out in conjunction with the WorkSPACE office space rationalisation programme. WorkSPACE aims to reduce the number of desks to worker to a ratio of 7:10 with a view to reducing the number of offices the council runs and therefore generating significant savings in running costs.

Most organisations now operate business travel policies that either eliminate the need to travel altogether or promote the use of sustainable modes of transport where travel is unavoidable. Greater access to effective and reliable technology for video-conferencing and tele-conferencing means that it is often possible (and less time-consuming) to attend meetings remotely. As remote meetings have become the norm rather than the exception, this has cut down business travel significantly. When travel is necessary, workers are often required to choose the greenest travel option available; whether this is walking or cycling, taking public transport or using one of the organisation's low carbon fleet cars. Many organisations will now refuse to pay travel expenses for domestic flights unless the journey is absolutely necessary and there are no other alternatives. For some workers, such as delivery drivers and travelling sales reps, travelling several hours a day is still part of the job. For many of these, electric fleet vehicles have replaced conventional company cars and vans. Those who still drive vehicles with a petrol or diesel engine are usually trained in fuel-efficient driving techniques and are often monitored to make sure that they are putting these skills into practice on the job.

### *City/town centre*

Part of our progress towards more energy efficient workplaces has been achieved through changes to the physical environment of non-domestic buildings like offices, shops, restaurants and hotels. This has included improvements to the fabric of existing buildings (e.g. by insulating them more effectively, introducing low energy lighting, altering shop entrances and introducing automated doors to avoid heat loss in the winter) which have helped to make them more efficient to heat and light as well as helping to make older buildings warmer and less draughty during winter. However, those who have experienced the greatest effects have been those working in new green buildings and existing buildings that have been significantly reconfigured to reduce their environmental impact. These places have been designed not just to maximise energy efficiency but also to provide more functional and comfortable places to work, especially given the changing climate. The design of a typical modern building aims to maximise natural ventilation and natural light penetration, so these buildings have lots of open spaces and many of the interior walls are made of glass to let in the daylight. Greater exposure to daylight and natural ventilation benefits our health and quality of life in several ways: we tend to get sick less often, we feel more energised and productive during the day, and we sleep better at night. Many of these new buildings also bring nature into the workplace to help regulate temperature and air quality and to contribute to a pleasant working environment, either by incorporating indoor plants, green walls and/or green roofs into the design.

### *Suburbs and small towns*

For many of those living in the suburbs and in small towns who have the option to work flexibly, remote working hubs can offer the opportunity to work closer to home instead of travelling to an office in the town or city centre. These hubs are kitted out with high quality IT facilities and high speed internet connections, offering users the benefits of office working without having to spend significant amounts of time and money commuting. Because these are located close to where lots of people live, they are readily accessible by bike and on foot. Some of these hubs also have childcare facilities on-site. However, as more people now work flexibly from alternative locations including at home, the nature of the traditional organisational base has also shifted. It is not unusual now for organisations to have downsized their central offices, as it's neither cost- nor energy-efficient to run large offices that have desk space that's under-used because individuals are working remotely more often. This means that it's becoming less common for employees to have their own allocated desk space.

For the significant proportion of people who are still based at a particular location to do their work, travel in one form or another is a necessity. Whilst walking and cycling are the norm amongst those who live reasonably close to their workplace, others rely on public transport and private vehicles. Most large workplaces have good public transport links, and many people prefer to take the bus or train (or both) rather than drive to work because they can use the time they spend travelling to do other things – like catching up on emails or social media, reading, watching TV or films, or simply enjoying the view from the window. For some people, their time on public transport is extremely valuable as it's the only 'me time' they get during their busy day. Many of those who still

***In focus: A working day in the city centre***

It's shaping up to be a good day. Using real time travel information streamed instantaneously to your phone you are able to catch the train in perfect time. On boarding the train you manage to find a seat, pull out your tablet, stick your headphones in and get back into the film you started streaming on yesterday's journey. Fresh from its annual upgrade, you're delighted with the new features and sharper image quality you're getting from your trusty refurbished tablet. Once at the station you swipe your pre-pay travel card on the way out and put it back in your wallet, deciding that since the weather's good you'll walk the rest of the way today instead of using your card to get on the bus.

On the way you drop by a coffee shop and hand over your reusable cup for the barista to fill. While you wait you glance over a large sign telling customers about the sustainably sourced coffee beans that the shop uses, and what happens to their used coffee grounds. Back on the street again, cyclists whizz past, and beyond the cycle lane the electric cars and buses trundle along quietly. Turning onto the street you work on, you remember how unhappy the owner of your shop was when the street was pedestrianised. She thought it would be bad for business but as it turns out the shop's gone from strength to strength. It does mean that someone has to be in very early to take the deliveries, since the electric vans are only allowed access at certain times, but thankfully you seldom have to work that shift.

Once you get in and you and your supervisor have opened up the shop, he starts telling you about the new line of merchandise that was delivered that morning. Since customers often want to know where the clothes you sell come from and how eco-friendly they are, you've got to stay on top of these things. Although having said that it's easy enough for the customer to scan the label code with their phone to find out these details. One of the most popular lines just now is a range of jeans made from recycled fibres. Maybe it's the brand label on them that makes them so desirable, but they've certainly been selling! On top of this, the shop has just taken on a new member of staff so that it can branch out into remanufacturing clothes. You're pleased with what they did with your old coat – the new cuffs and lapels have brought it right up to date.

After a busy morning it's time for your lunch break. You decide to make the most of the sun by heading up to the roof garden of the nearby shopping centre. Sitting there and breathing in the fresh air, you forget all about the customers and the endless to-do list at work as you are distracted by the butterflies around the wildflower area and the other people coming and going. On the way back into the shopping centre you stop to dispose of your drinks can at a reverse vending machine, choosing to donate your reward points to one of the selected charities instead of collecting them to go towards money off a purchase in the centre. Stepping back into the busy shop you think how lovely it would've been to sit in the garden all afternoon. Shrugging off the thought, you get back to work.

use private vehicles to commute to work are now car-sharing instead of driving on their own. Car-sharing works for many people as it's a good way of reducing fuel, parking and maintenance costs for those that need to drive to work. Many large workplaces like hospitals and factories are signed up to formal car-share schemes that match up people who need to travel at similar times. For others working in smaller businesses these arrangements tend to come about more informally. With more people walking, cycling, taking public transport and car-sharing for commuting, this is helping to alleviate congestion on the roads during peak times, reducing journey to work times for road users, and has helped to reduce air pollution in and around towns.

### *Rural, coastal and island areas*

For many people (and not just those living in rural areas) flexible working has had an enormous effect on their daily routine, especially those who choose to work from home either some or all of the time. Workers, their families, and their employers can all benefit from flexible working, as these workers are often more satisfied with their work-life balance and may be more productive. Flexible working policies have also helped businesses to reduce the disruption caused by the increasingly frequent extreme weather events that can prevent people from travelling. The increase in remote working has been facilitated by improvements to the broadband network, with

high speed internet connections now available across Scotland's rural areas. Choosing to work at home for some of the week has helped many people reduce the amount of time and money they spend on commuting, as well as lowering their environmental impact. However, whilst flexible working is popular amongst employees, some people are less keen to work from home because they feel that it can blur the boundary between work and home, leading to longer hours and sometimes having trouble 'switching off' from work at the end of the day.

It's clear that working from home more can significantly reduce commuting travel. However, not everyone agrees that working from home is more environmentally friendly. Some argue that it's possible the environmental benefits of reducing travel might be outweighed by the environmental costs of increasing the energy used in heating and powering homes during the day (which may be greater per employee than that used in running a workplace). This issue is becoming even more complicated as we progress towards decarbonising the transport and heat sectors, as the question of whether there is a net benefit of home working will depend on both the transport mode that would be used if a person did commute to work and the energy sources that are used to heat the home and the workplace.

At the same time, many people in rural areas continue to work in sectors where flexible working is usually not possible. Agriculture, forestry and fishing, along with tourism and hospitality, for example, are still major employment sectors in Scotland's rural, coastal and island areas.

Those working in farming have also seen changes in their work life in the move towards becoming a low carbon society as a result of changing agricultural practices. Increased onshore renewable energy generation has introduced different activities on farms, with some generating income by investing in community renewables projects on their land whilst continuing to use the land for livestock grazing, and others installing micro-renewable technologies to generate their own energy and gain income from selling on the excess. Farmers and farming communities can also derive other financial benefits from commercial and community wind farms (see 'Rural, coastal and island areas' in section 2.1) Most farms have modified their practices around fertiliser use, optimising their use by adjusting amounts and timing of inputs and have increased their use of nitrogen fixing crops such as clover. Livestock management practices have also been modified to increase efficiency, reducing both the costs and carbon footprint of livestock rearing. Many farm businesses are also saving energy and money by monitoring their electricity and fuel use and using this information to make efficiency savings. Locking carbon into soils and vegetation has also become part of farming life, with more farms planting new woodland and introducing measures to protect against soil erosion and damage to peatland and moorland. These measures can also help to protect their land and downstream areas against flooding. Natural flood management practices like restoring bogs and wetlands, planting woodland in appropriate sites, and creating buffer strips between rivers and farmland have played a central part in adapting our landscapes to the pressures of a wetter climate. Whilst the more variable and extreme weather that we have now has presented challenges to farm productivity, the changing climate is also bringing about new opportunities. As we are starting to see longer and warmer growing seasons, potential crop yields are increasing and crop species that weren't formerly suitable for growing in Scotland have become viable options.

***Doing it now: Cream o' Galloway's low carbon rural business***

The Cream o' Galloway family dairy company, based at Rainton Farm in Dumfries & Galloway, follows principles of 'lean production' to minimise waste and maximise resource efficiency and the quality of their produce. The farm has reduced the carbon footprint of the ice cream and cheese they produce by generating more of their feed, fuel and fertiliser inputs on the farm itself. The electricity and hot water used on the site are generated by a community wind turbine and an anaerobic digester. This digester not only produces energy from farm waste; the organic matter that remains at the end of the process is mixed with slurry from the farm and used as fertiliser too. As well as producing their award winning food, Cream o' Galloway also operates a visitor centre offering activities for all the family, from adventure play and pedal karting to bicycle hire and farm and food tours. The visitor centre café serves up dishes using produce from the farm itself (including organic beef, home grown salad and vegetables, as well as their cheese and ice-cream) as well as other local, organic and ethically sourced ingredients like local wild venison and local artisan breads. These efforts to farm more sustainably and diversify their business by becoming a green tourist attraction, along with other measures like setting aside 10% of the farm for woodland planting, managing the land to promote habitat for wildlife, and innovative solutions to promote animal welfare have earned the business numerous awards for the quality of their produce, tourist attractions, and their environmental credentials.

## 4. At leisure

In many ways, the things we do for leisure in our spare time look much the same as they did in 2015. We still visit new places, visit our friends and family, and go out to dinner or to the pub, to the cinema and on shopping trips. The environmental impact of making these journeys has been reduced though, because of the changes in our culture around how we travel – with more people using public transport and low carbon vehicles, including car club vehicles (see section 2.3 'getting around'). Behind the scenes changes in the sources of energy and the efficiency of energy and resource use by establishments like pubs and restaurants, cinemas, swimming pools and other leisure facilities also mean that although all these activities use energy, they have reduced their carbon emissions without affecting our enjoyment of the experience.

***Doing it now: Renewable energy generation for community leisure facilities***

'Ullaspool' is a community owned and run swimming pool in the village of Ullapool. Solar thermal panels help to heat the water for the swimming pool and showers, reducing the load on the oil boiler and saving an estimated 6,700 litres of oil every year, equivalent to 17,500 kg$CO_2$e.

There are also lots of opportunities to take part in leisure activities in our communities, many of which require little to no energy input at all. Community-based activities, like walking groups and volunteering in social and nature-based initiatives have increased in popularity. Over time, more communities have come together through low carbon projects; these have helped bring together people of all ages and backgrounds and contributed towards building the sense of community in the local areas. The resurgence in allotment keeping and community gardening that was seen in Scotland earlier in the century has only grown in strength, as more people of all ages want to be able to grow healthy, seasonal fruit and vegetables to use in their home cooking as well as enjoy the social aspects of meeting and chatting to others in their community. For most people, leisure time is an opportunity to get outdoors. Greenspace like parks, public gardens, recreation grounds and local nature reserves, as well as community gardens and allotments, remain a highly valued part of our local areas. These greenspaces contribute to our satisfaction with our neighbourhoods, provide places for children to play and for everyone to get outdoors and be active, or just to spend time enjoying nature alone or with friends and family. They also provide important habitat for wildlife, helping to support urban biodiversity. Greenspaces have also played an important part in society's adaptation to a changing climate. As we've seen our summers getting hotter and drier and winters getting warmer and wetter, we are having to adapt our built environment to reduce the risks that extreme weather events like heatwaves and storms pose to health and livelihoods. Greenspaces are helping to reduce the risks to people by providing surfaces that allow rainwater to drain away into the ground, cooling the air (which gets warmer in big cities than in rural areas), and providing shade in hot, sunny conditions.

Walking remains the most popular recreational activity amongst adults in Scotland, and there are now more people walking for pleasure on a regular basis than ever before. Recognising the significant opportunities to improve physical and mental health, reduce healthcare costs, and bring about other social benefits, many sectors have been involved in promoting this culture of walking. For example, GPs and other healthcare professionals now commonly prescribe walks in nature to benefit patients' physical and mental health, workplaces encourage staff to walk more on a daily basis, and schools and other organisations working with young people promote outdoor learning, skills like map-reading, and awareness about responsible outdoor access. Having good access to high quality natural environments, both close to home and further afield, has also helped to promote walking. As well as making the most of our easy access to greenspaces and paths networks in and around settlements, many more of us are now getting out into Scotland's countryside for outdoor recreation. Scotland's National and Regional parks, Country parks, National and Local Nature Reserves, as well as other places of high natural and/or cultural heritage value are a major draw for locals, visitors and tourists alike as these offer fantastic opportunities to enjoy and learn about Scotland's landscapes, wildlife and history. Thanks to the popularity of lift-sharing and membership to car clubs and walking groups, it's now easier for city-dwellers and households that do not own a

car to get out into the countryside for recreation. Working in partnership, local authorities, public bodies, land managers and charitable organisations have all helped to reduce other barriers to walking and outdoor recreation, for example by enhancing the quality and extent of paths networks, promoting access for people with disabilities, improving signage and interpretation and resolving conflicts between recreational use and other land use objectives.

Scotland's increasingly outdoor culture can also be seen in our choices of where to take holidays and short breaks. More people are now choosing to holiday closer to home, making the most of the variety of recreational and cultural opportunities that Scotland and the rest of the UK have to offer, and discovering parts of the country that they had never visited before. Scotland's tourism industry is reaping the rewards of the trend, and urban and rural tourism and hospitality businesses are thriving. The green credentials of these businesses contributes to their success, as there has been a growing demand for green tourism services from both domestic and international visitors. The tourism industry itself is even more diverse now too, since the growth in popularity of online marketplaces for renting out spare bedrooms and home swapping has meant that many households have become involved in small scale tourism.

### *City/town centres*

Our urban areas are vibrant centres of recreational and cultural opportunities. Now that we have halved the number of petrol and diesel cars in our urban centres, these places are cleaner and more pedestrian friendly too. With fewer cars in the town centre and more pedestrianised streets, many civic spaces have been reinvigorated and are now more widely used. New mixed use low carbon developments built on brownfield sites have further increased the recreational opportunities in urban areas, offering a mix of retail and leisure facilities alongside offices and/or housing.

This urban regeneration has also included redevelopment of derelict sites that were previously an eyesore. Other vacant plots of land in cities and towns have been given a new lease of life by converting these 'stalled spaces' into greenspaces for use by the local community and the wider public. Many towns have become 'edible towns', using all sorts of spaces for growing healthy food that anyone can help themselves to.

***Doing it now: Stalled spaces***

Glasgow City Council's Stalled Spaces initiative is helping to temporarily turn vacant land into usable greenspaces for communities. These projects, each designed to promote health and wellbeing, have included new growing spaces, arts projects, event spaces and green gyms.

### *Suburbs and small towns*

Investment in existing public parks to capitalise on their contribution to sustainable built environments has led to a new generation of 'climate change parks'. These actions have included incorporating more trees, woodlands and wetlands which help to store carbon, provide sustainable drainage, purify the air, and help people to keep cool in heatwaves. They also help create diverse habitats for wildlife, creating interesting environments where people can enjoy seeing, hearing, and learning about wildlife. The investment in these parks has also funded projects to improve facilities and promote access by sustainable transport modes. These efforts to make local environments greener have increased the scope for enjoying and engaging with the outdoors. This promotes better health and wellbeing, a sense of local ownership and identity for those who use them. However, whilst there are also more opportunities for people to come into contact with nature on an everyday basis, there are also new threats to our ecosystems as the warming climate promotes the spread invasive non-native species and new pests and diseases (some of which also pose a threat to human health). This has encouraged many people to start to learn more about the nature around them, with many engaging in 'citizen science' to help to monitor the health of our natural environments.

### *Rural, coastal and island areas*

Rural Scotland remains a great place for active outdoor recreational pursuits like walking, cycling, climbing and water sports. Our mountains, forests, heathlands and coastlines are a major draw to rural, coastal and island areas for residents, visitors from elsewhere in Scotland, and for tourists.

Great efforts have gone into increasing the amount of carbon that is captured and locked-in to vegetation and soils by protecting, extending and restoring 'carbon sinks' like forests and peatland. By the time we had reached 2015 we were planting 10,000 hectares (equivalent to around 14,000 football pitches) of new woodlands each year, with much of this being in rural areas. The overall aim is to restore a quarter of Scotland's land to woodland cover. As well as capturing carbon and creating more rural forestry jobs, as these new forests are growing up they are providing greater opportunities for woodland recreation, greater landscape diversity and habitat for wildlife.

Peatland restoration projects have been undertaken in rural areas in an effort to restore damaged and degraded habitats to a healthy and resilient state. In addition to locking-in large amounts of carbon, peatlands are a uniquely important ecosystem as they are home to some of Scotland's rarest species and to internationally important breeding bird populations. They also form some of Scotland's most iconic landscapes, like the moorlands of the North Highlands and Western and Northern Isles, so protecting and restoring peatlands is not only an investment in the environment but also in Scotland's cultural heritage.

***In focus: A visit to the community garden***

The sun is shining, so it's been a good day to visit the community garden in the village. This has become a really important place for you, especially since you've been on your own. Since you started coming here you've got to know many more people in your area, including some of the younger people in the area as well as the older folks like yourself. One of the best things about coming to the community garden is seeing the change in some of the youngsters; how their confidence has grown as a result of learning new skills. Today you've been helping to man the shop (which sells fresh produce from the garden), doing some weeding in your area of one of the raised beds, and enjoyed the banter over a cup of tea in the new picnic area of the garden. You feel quite tired from being on the go all afternoon, but pleased that you've been active and been able to get out and enjoy the fresh air and company.

You'd taken the bus in to the village earlier on but will lift-share back with a friend from the community garden as you've got a bag full of vegetables to carry and he's driving out past your way anyway. Once you're settled into the passenger seat of his new longer-range battery electric car, he drills you for ideas for what to do with the kale he's brought home. You promise to email him your special recipe for kale soup, passed down from your grannie. He suggests that you should do a cooking demonstration at the community centre, using food from the garden. It's nice to see young people taking an interest in the traditional foods again, and you like the idea of being able to pass these old recipes down to the younger generations.

You arrive home to the reassuring hum of your air source heat pump. What a difference it has made. When next door got theirs you weren't sure about these contraptions at all, but getting to see how to use it and hearing how pleased they were with it encouraged you to look into it more. Granted, it was a bit of a hassle to get it installed, since bigger radiators had to be fitted and you had to give up your airing cupboard. You do feel like it was worth the inconvenience though because now it's always a comfortable temperature in the house. You think about how you used to worry in winter – not knowing how you'd stretch your pension to cover the heating costs, worrying about what would happen if you were snowed in and couldn't get the bottled gas delivered…. With a contented sigh you settle in for the night and get ready for your weekly video chat with your grandchildren.

Scotland's beaches and marine environments have also benefited from our transition to becoming a low carbon society. Our strong commitment to waste reduction and disposal means that you rarely find litter in coastal and marine environments. For example, plastic bags used to pose a real threat to marine wildlife and were an eyesore when they washed up on beaches, but since the introduction of charging for single-use carrier bags the number of discarded plastic bags has dropped substantially. This makes for healthier marine life and cleaner beaches, supporting our enjoyment of Scotland's coastlines.

Whilst Scotland's rural, coastal and marine environments have benefited in a number of ways from the move towards more sustainable living, there has also been much public debate over the years about the impact of expanding our renewable energy generation capabilities. Some of our landscapes have changed as a result of on-shore and off-shore windfarms. Nevertheless, our landscapes are still essential to our cultural heritage and tourist economy; and still culturally renowned. In 2030, Scotland's wild lands - the remote landscapes that show few signs of human influence – remain central to our cultural identity. These areas of wild land character have been safeguarded because they are such an important part of what Scotland is. This has meant accepting more renewable energy developments elsewhere, in landscapes that are less iconic on a national level, yet equally important to those who inhabit them. Strong public participation in the planning system has helped to ensure that everyone's views are taken into account in these decisions, and many communities are themselves choosing to explore the possibilities of generating their own energy. Whilst some people still feel that wind turbines mar their enjoyment of our natural landscapes, many others feel that these have become an important symbol of Scotland's sustainability that can be read in our landscape.

## 5. Conclusion: Low Carbon Scotland 2030 and beyond

Much of our transition to low carbon living has been grounded in steady improvements to our infrastructure and technology. Scotland's energy, transport and waste infrastructure, as well as our homes and built environment, are all undergoing a transformation to enable us to meet our targets for reducing our carbon emissions. At the same time, our 'green infrastructure' – the network of high quality green environments that envelope and permeate our towns and cities - is playing a central role in our efforts to adapt to the changing climate. Although a number of these structural changes have not had a direct impact on the day-to-day experience of the majority of people, we ourselves have not remained unchanged in this transition. To become a low carbon society, a cultural shift in our attitudes, values and our everyday routines has also been necessary. Over time, our awareness and our sense of responsibility have grown, and actions that at one time seemed inconvenient or challenging are now just the way we do things here. In many ways the changing infrastructure has helped facilitate positive changes in the way we act. Yet we have also had to adapt to new technology, like electric vehicles and home renewable energy systems, by modifying our habits and routines. In some cases we have been unable to fully capitalise on the potential of new technologies until these have evolved to fit more closely with our way of life.

Looking back from 2030, we can see that our journey towards becoming a low carbon society has not always been a straightforward one and it's a journey that's still in progress. There's still more that we need do to live our lives in a way that doesn't harm the environment for people living here in Scotland and for those living in other parts of the world that are suffering much more than we are from the effects of the changing climate. Yet from this standpoint we can also see how far we've come. The changes that we've made have not only helped to protect the environments where we live, work and spend our leisure time, and the global environment that sustains us all, but have also helped us to become a fairer, healthier and more resilient society. Although we haven't always agreed on the best way to get us here, we know that we are now in a good position to respond to the challenges that are yet to come.

# Part C: Researcher reflections on the Scotland 2030 narrative

## 1. Introduction

The Low Carbon Scotland 2030 narrative is the result of a process of co-production[9] between CXC researchers and policy colleagues in the Scottish Government.

The purpose of this project was not the (co-)production of research *per se*, but rather the translation of policy and social science into a single cohesive narrative that would provide a basis for developing tools to help citizens engage in discussion and debate about Scotland's transition to a low carbon society.

This work differed from our conventional research activities in two key ways. Firstly, the communication of policy aspirations was to be intertwined with the communication of social science in meeting the objectives of the brief. Secondly, given the wide scope of the narrative, a diversity of policy actors with remits including energy generation, transport, waste, housing and food policy were involved in the process of developing the narrative, with different policymakers and government analysts engaging in different stages of the work. This concluding section of the report presents a brief reflection on the co-production of the narrative and the challenges we faced in envisioning the Low Carbon Scotland of 2030.

## 2. Balancing credibility, saliency and legitimacy in co-producing the narrative

Cash et al's (2003: 8086) analysis of knowledge systems at the nexus between science and policy proposes that 'scientific information is likely to be effective in influencing the evolution of social responses to public issues to the extent that the information is perceived by relevant stakeholders to be not only *credible*, but also *salient* and *legitimate'*. Moreover, it is suggested that those working at the boundary between knowledge and action face trade-offs in balancing these attributes, as the enhancement of any one attribute is likely to constrain perceptions of the others. This framework offers a useful lens through which the development of the Low Carbon Scotland 2030 narrative can be retrospectively analysed.

Literature on the science-policy interface distinguishes between three broad types of knowledge: scientific (or expert) knowledge; bureaucratic knowledge (i.e. knowledge about political and administrative processes as held by policy-makers and officials); and stakeholder (lay, practical, or non-scientific) knowledge (Edelenbos et al., 2011). The present narrative is founded upon scientific and bureaucratic knowledge, although the Scottish Government seeks to incorporate stakeholder knowledge into the design of future engagement tools emerging from this project. Although providing useful tools for civic engagement in the low carbon transition, visions developed through open, participatory scenario building exercises may sometimes be seen to lack *saliency* in that they may be divorced from current policy trajectories, and may be viewed by some as 'wish lists' combining the desires of diverse actors into visions which may not be internally consistent or feasible when taken as a whole. The present narrative's grounding in existing policy therefore provides a high level of *saliency*. It is necessary to recognise, however, that in comparison to visions constructed through participatory processes that include a wider range of stakeholders, the *legitimacy* of the Scotland 2030 narrative may be perceived by some to be constrained at the expense of this saliency. Nonetheless, the co-production of the narrative arguably lends a greater level of

[9] Co-production or 'joint knowledge production' (Hegger et al 2012) can be conceived as a 'collective endeavour of academic and non-academic actors' (Pohl et al 2010; 269) in which 'scientists, policymakers and sometimes other societal actors cooperate in the exchange, production and application of knowledge' (Hegger et al 2012:53). This interactive model of working at the science-policy interface has been advocated as a way to deliver 'socially robust knowledge' (Pohl et al 2010), and is purported to help overcome well documented challenges of connecting science and policy stemming from divergences in, for example, the perspectives, interests, expectations, and process cycles of the actors involved (Hegger et al 2012).

legitimacy (as well as *credibility*) than if the narrative had been developed solely by the Scottish Government as a communication piece. By incorporating scientific input on pro-environmental behaviour and behavioural change, the resultant narrative has gone beyond communication of policy and begun to reflect on the complexities and practicalities associated with transitioning to the type of low carbon society envisioned in policy. Similarly, the development of a structure and framing for the narrative that is grounded on theory and empirical scientific evidence about how to effectively communicate about climate change provides a final narrative that may facilitate subsequent discussion and dialogue.

Other tensions in the balancing of the attributes of saliency, legitimacy and credibility relate to the role of researchers in a project such as this in which the boundary between science and policy is blurred. The policy communication aspect of the project represented a significant departure from conventional research activities of academics. This is an aspect which challenged us as researchers and required us to engage in what scholars of Science and Technology Studies have described as 'boundary work' (Gieryn 1983) involving negotiation and demarcation of the boundaries of science as a practice. One traditional view of the role of the scientist is as the 'unattached intellectual' working autonomously to construct knowledge, provide information, and to critically examine policy, considering alternative courses of action (Lövbrand, 2011). From a less rigid perspective, in a co-production context researchers may seek to perform the role of a 'critical friend' to policymakers (Blackstock et al 2014). However, Lövbrand (2011) points out that in co-production 'researchers who wish to be useful to policy practitioners may have to refrain from considering alternative lines of action and instead operate within existing policy goals and agendas', meaning that due to considerations such as the timing of science inputs in relation to cycles of policy development, effective engagement between science and policy may require the researcher to 'abdicate his [sic] privilege of exploring policy-possibilities' (Lövbrand, 2011: 234).

The focus on communicating the targets and milestones that the Scottish Government has already committed to in RRP2 demanded such an 'abdication' as described by Lövbrand. It also required the researchers to examine their own attitudes towards their role as academics working at the boundary of science and policy. It is recognised that there are tensions inherent in the narrative's dual purpose of communicating policy trajectories and outcomes in a non-critical manner (albeit in ways that draw upon academic literature on effective communication), and highlighting evidence that may be seen to challenge the assumption that current policies will achieve their intended outcomes. Another tension relates to the 'closing down' (Stirling, 2008) of certain issues, which although of relevance from a behavioural perspective, are not addressed directly in Scottish Government policies and proposals. These are some aspects upon which the *credibility* of the narrative, if viewed solely as a research output, may be questioned.

## 3. The challenge of envisioning the future

One final challenge which we wish to reflect on relates to the treatment of uncertainties surrounding technological innovations and future practices. An observation from some readers may be that the narrative presented is somewhat underwhelming in that it does not always convey a strong sense of being situated in a society of the future. As a result, the document may at times read like a narrative on an alternate present rather than a society of the future. We see this as a result of three factors.

Firstly, some of the most fundamental shifts envisioned in policy will occur 'behind the scenes' of the everyday life of householders, relating more to structural changes (e.g. in our energy production infrastructure and closed-loop production models) than everyday practices. As highlighted in the narrative, many of the behavioural changes described at the household level are far from innovative and can be done (or are already being done) at present, though may be more effectively facilitated by wider structural changes and evolving social norms.

Secondly, the evidence base we have drawn on - of which field trials and qualitative research form a significant part – is contextually grounded in the present and recent past. Our projections of future practices are therefore something of a 'venture into the wild', as these can only extrapolate from the current evidence on pro-environmental behaviour and experiences with low carbon technologies such as electric vehicles and micro-

renewables. With technological innovation, user experience may be transformed in ways that we cannot confidently predict.

Finally, also relating to technology, in developing the narrative we were aware that future technological innovations (and not just those relating to low carbon technologies) will likely impact significantly on everyday behaviour. We were, however, reluctant to postulate what form such innovations will take, or the extent to which current cutting-edge technologies will permeate society by 2030, for fear of stepping into the realm of speculation. Although doing so may have been conducive to creating an engaging narrative, we felt that it would impact negatively on the credibility of the work. Academics working in Futures Studies may be well-placed to make claims about such developments, however as researchers working primarily in the field of environmental psychology and conservation behaviour, our focus was on how existing technology influences behaviour.

## 4. Concluding remarks

In making explicit the challenges in balancing credibility, salience and legitimacy in the co-production of the 2030 narrative, we aim to communicate with transparency the context in which the narrative was developed, and make explicit some of the tensions that may underlie efforts to co-produce communications on sustainable living, especially when considering future visions of society. Co-production of knowledge by academic researchers and policymakers is still a relatively new practice, and parties across the science-policy interface are still in a process of learning how to negotiate the complexity of such collaborations successfully. Boundary organisations such as ClimateXChange - which have a specific intermediary role in exchanges across the science-policy boundary and are accountable both in the scientific and political arenas - are instrumental in mediating the tensions that can arise in co-production (Cash et al. 2003), as well as providing a forum in which co-production (and consequent social learning about the process) can take place.

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