A Net-Negative Nation: Hitting Scotland's Climate Targets

Pete Wood | November 2021

Our Scottish Future

Environmental Commission

Foreword by Robin Harper, former leader of the Scottish Green party

The nations of the UK are presently engaged in a competition between each other as to who can claim to be the best at combatting climate change – but we need competition like a hole in the head.

In the next few days, Glasgow is playing host to what could be the most important international conference ever to take place on this earth. We are witnessing, at last, an astonishing level of a will for international co-operation in the face of huge threats to our environment, and at last a will to adopt strategies that the richer nations are prepared to finance. We in the UK live on one island (with the exception of Northern Ireland). We have no excuse for not co-operating in every detail to challenge the dangers surrounding us.

The progress Scotland has made in decarbonising energy, with the assistance of a huge natural resource, generous amounts of investment from outside Scotland, and a combination of native and imported skills has placed us as a world leader in this respect. We must not allow this to lull us into the slightest feeling of self satisfaction – after all, Scotland has been handed the advantage of the biggest wind energy resource in Europe. We have already been criticised – quite rightly – for the absence of meaningful detail and lack of obvious strategies to achieve our other announced targets. We cannot pat our backs when we look at our recycling rate, our traffic problems, our pollution and environmental damage. We need to co-operate rather than compete; we need constructive dialogue; and in the face of the environmental emergency that looms, we should be abandoning the toxic binary politics of today in favour of constructive dialogue.

This report by Peter Wood will help to set us on the right road, opening up a wide range of areas for discussion and the development of common strategies to take us more safely forward.

Executive Summary

Scotland – and the UK – over a 20 year period has led the world in reducing carbon emissions, with the migration to renewable energy in particular reducing emissions by 40% since 2019

- Scotland's carbon emissions have declined from almost 85 Megatonnes of CO2 (MtCO2e) to 48 MtCO2e 1998-2019[1]
- On a per-head basis this has seen Scotland's carbon emissions halve from 16 effective tons to 8 – ahead of the UK average of 13 reducing to 7

However, the gains from decarbonising energy production that have supported 80% of the last decade's reduction cannot continue to sustain Scotland's momentum: focus needs to move to other areas such as transportation, business, agriculture, and home-heating, as well as making the best use of Scotland's land as a carbon sink.

- Of the 15 Mt pa reduction that Scotland made 2009-2019, 12Mt came from the energy supply sector – which the independent Climate Change Committee (CCC) defines as a 'mostly reserved' area of carbon. The success of renewable energy was based upon creating Britain-wide sources of funding and integrated regulation. This provided capital, diluted risk and provided a strong overarching framework that incubated the sector's rapid change. Scottish Government support through the planning system and public engagement, including via community energy, were core parts of the wider change.
- The energy supply sector in 2019 accounted for only 6 MtCO2e of the total 48 emitted
- Transport is now the largest sector for carbon emissions, (12), followed by Business (8), Agriculture (7), and Residential (6)

Despite significant devolved powers to make real gains in these areas carbon emissions have stagnated between 2016-2019 rather than reducing, missing the Scottish Government's own targets

- Between 2016 and 2019, Scotland's carbon emissions only declined by 0.76 MtCO2e (1.6%), having reduced by around 3-4% for each of the previous 17 years
- The overall slowdown happened as the impact of greening power generation diminished, due to potential decarbonisation being achieved. The decarbonisation of other sectors did not accelerate, leading to an overall stagnation.
- Critical factors not addressed include:
  - Transport Scotland spending £4 billion on building new roads, with vehicle miles increasing
  - Residential energy efficiency improvements stalling, with heat pump installation targets being missed
  - Emissions from waste rising since 2014
  - Stagnant emissions from agricultural soil and waste, with emissions from agricultural machinery increasing
  - Forestry removals of greenhouse gases reaching historic lows, with tree planting targets missed

The Scottish Government is setting eye-catching targets that are implausible to meet if current trends continue

- After flatlining for years, Scottish emissions increased in 2018 and missed their reduction target in 2019.
- Despite this, the updated 2019 Climate Change Plan set emissions reductions of 75% by 2030, almost 50% earlier than recommended by the independent CCC.

1 'Megatonnes of CO_2 Equivalent'. The 'equivalent' results from converting emissions of the seven greenhouse gases covered in the Kyoto protocol into their equivalent heating effect if calculated in Carbon Dioxide. For example, Methane has a somewhat stronger heating effect than Carbon Dioxide. Hydrofluorocarbons (HFCs), known for destroying the Ozone layer, have a heating effect many times that of the same mass of CO_2. For methodology on the calculations included in this executive summary see Part 3 and 4 of this report.

- Going against the advice of the Scottish Government advisory body, the 'Just Transition Commission', updates to the Plan did not detail policies for supporting the workforce, employers and communities' affected by change.

- Two years after setting the 2030 emissions target, the Chief Executive of the Committee has publicly stated: "So far I haven't seen a strategy from the Scottish Government that would deliver that."

Much of what could be done now to have an impact is either partially or fully devolved and could be acted upon today by both the UK and Scottish governments working together. Priorities include:

- Increasing ambition and creating a medium term joint plan for renewable energy, Carbon Capture and Storage, and accelerating the roll out of hydrogen. Combined with new investment in cross-border and international transmission capacity, the green energy formed in Scotland will lead the rest of the UK and Europe to achieve Net Zero.

- Reallocating the roadbuilding budget to reduce congestion by increasing rail, bus, cycling and walking, including creating jobs by fixing the roads maintenance backlog. To reduce emissions from aviation, including to Europe, the First Minister and the Prime Minister should immediately and publicly champion work on cross-border High Speed Rail.

- Encouraging business and behaviour change support to lock-in the emission reductions and financial savings from increased remote working and use of digital communications, including upgrading rural broadband, municipal wireless or 5g, and free adult education in digital skills.

- Accelerating energy efficiency renovations to existing properties through planning reforms, investment in vocational training, and financial support to boost consumer demand. In addition to ensuring that Net Zero benefits everyone directly, OECD expert analysis suggests that energy efficiency retrofits are one of the most cost-effective ways to create jobs during the Covid-recovery.

- Reducing agricultural emissions through public communications to increase demand for low-emission diets, alongside reduced meat and dairy consumption, whilst providing support for the agriculture industry to electrify machinery, change crop or livestock, and diversify the rural economy.

- Increases in tree planting, the restoration of degraded peatland, and timber production, boosting rural employment.

However, if Scotland and the UK really want to avert climate collapse, better co-operation around re-made institutions is required

- The first phase of combatting climate change – decarbonising power generation – was a natural thing for central government to lead on.

- The next steps require a scale of funding and expertise that only central government can provide, but a system change in how government works with business and society.

- Society will not support rapid decarbonisation if it destroys communities and intensifies inequality.

- Moving to a Net Zero economy is a chance to reboot how the country works, but doing so requires government, business and civil society to cooperate

- We therefore suggest three new institutions:
  - An Office for Climate Responsibility (OCR), to evaluate government policy and promises. With a network of offices across the country it will also offer local analysis and advice that helps business and civil society to decarbonise efficiently. It will produce a plan on how Scotland can become the first Net

Negative nation.

- A UK Agency for Climate Cooperation Acceleration (UK-ACCA), to coordinate strategic central government investment that reduces inequality and emissions, bringing society together around previously overlooked opportunities. This includes scaling up Scottish greenhouse gas removals, to become the first Net Negative Nation.
- A Climate Community Renaissance, so that building Net Zero means building happier, more secure communities. It would make investment available to repair community and natural heritage, increase access to ethical trade and investment, whilst an International Climate Action programme, including 'Attenborough Scholarships' would develop networks of exchanges between countries and nations.

A Beacon of Hope: Scotland and the UK's promise on climate change

The UK has been a world-leader in action to prevent climate change, and we are on track to meet Net Zero for greenhouse gas emissions by 2050.[2] Achieving climate neutrality by the middle of the century would mean we have successfully played our first part towards limiting global temperature changes at 2ºC or less, the current target of international agreements.[3] Perhaps even more importantly, doing so will practically demonstrate how an economically leading, democratic country can transition away from fossil fuels with the support of its people. In the process, we will have developed the technologies and processes that can be used by the rest of the world, both rich and poor, to successfully make their own journey to Net Zero. In this report, Our Scottish Future's proposals suggest how decarbonisation can improve fairness and equality: within Scotland, across the UK, and in our relationships with the rest of the world.

The target of 'Net Zero' comes from the need to prevent the planet warming to dangerous levels. This warming is being caused through the release of carbon dioxide (CO2) and other greenhouse gases into the atmosphere, primarily through burning fossil fuels such as oil, gas and coal. 'Net Zero' means that any greenhouse gas emissions are balanced by greenhouse gas removals. For example, growing trees means locking up CO2 in their branches, or developing 'Carbon Capture and Storage' technologies that allow greenhouse gases to be trapped in decommissioned oil wells, or turned into limestone. In total, it means that there are two steps to prevent dangerous climate change. First we need to reach Net Zero, so that no further emissions are being created. Then we need to remove historic greenhouse gases from the atmosphere: we need to go 'Net Negative'.

The starting point for Scotland's potential to combat climate change is to understand our past successes, both as part of the UK and as a nation with its own particular strengths.

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2 Committee on Climate Change (CCC), 2021, Independent Assessment: The UK's Net Zero Strategy, p2-3.

3 The UN Framework Convention on Climate Change underpins the Conference of the Parties (COP), of which Glasgow is the 26th meeting (COP26). For further information on the COP process and the science behind the 2oC target see: https://unfccc.int/

Part 1: A proud history

Firstly, it is widely underappreciated that the UK is already a world leader in climate action. The UK has achieved the largest greenhouse gas reduction in the G20[4] between 1990 and 2019, cutting emissions by 40%. It did so whilst growing the economy by over three quarters. As a part of the UK, Scotland achieved the greatest cuts of any nation in our union, getting to 45% below 1990 levels.[5] As will be set out subsequently, the greater reductions in Scotland have been achieved through working with the rest of the UK in cooperation, not competition.

The UK parliament in Westminster, under the Labour party in government, led the world in passing the first legally binding all-emissions Climate Change Act (2008). This built upon its innovation in creating the world's first multi-industry carbon trading system in 2002 and the Climate Change Levy's carbon tax in 2001, both of which informed the later development of the European Union's Emissions Trading Scheme[6]. The 2008 act set legally-binding emissions targets, creating the independent Committee on Climate Change (CCC) to monitor progress and issue evidence-based advice[7]. The Conservative's UK government target for Net Zero by 2050, and the SNP's Scottish Government target for Net Zero by 2045, are both based on their accepting the recommendations of the CCC[8]. Yet to date the majority of emission reductions achieved in the UK, and particularly in Scotland, have been achieved through following through on the energy market reforms that began in the early 2000s. Britain-wide cooperation, shared across multiple nations, parties and parliaments, has been the engine of our successful decarbonisation.

Looking internationally, the UK was selected to host COP26 because of its success in fighting climate change, but also in upholding international standards. The CCC goes beyond our obligations under the United Nations Framework Convention on Climate Change, and has been a source of advice to other countries developing processes for holding their governments to account. Glasgow was then chosen by the UK to host COP26, due to its commitment to sustainability and world-class facilities[9]. From bases in Scotland, international delegates and experts have been visiting locations across the UK that showcase the range of greenhouse gas reductions we have pioneered in our country.

Achieving global Net Zero is agreed to require global cooperation and support. In this context the UK recently doubled its commitment to 'International Climate Finance' for aid-recipient countries from 2021-2026[10]. Historically, the UK has been responsible for raising standards in international aid, including climate aid, and in 2013 the UK was the first G7 country to meet the UN target for 0.7% of GDP to be committed to overseas aid[11]. Until COVID-19 in 2020, the UK remained one of only seven countries meeting the target[12], and has committed to returning to it by 2024[13]. In the meantime we remain one of the largest global donors and unlike many others we are still notable for avoiding loans and instead issuing assistance as grants[14]. Similarly, whilst the increased International

4 The 20 economically largest countries

5 CCC, 2020, Reducing emissions in Scotland Progress Report to Parliament, p33.

6 Department for the Environment, Fisheries and Rural Affairs (Defra), 2006, Appraisal of Years 1-4 of the UK Emissions Trading Scheme

7 The CCC, whose publications are acknowledged as being non-political and free from government influence.

8 Now including international aviation and shipping, the UK has a comprehensive framework for emissions.

9 COP26, 2021, Glasgow, https://ukcop26.org/the-conference/

10 HM Government, 2020, United Kingdom Biennial Finance Communication to the United Nations Framework Convention on Climate Change

11 House of Commons Library, 2021, The 0.7 percent aid target Research Briefing

12 Organisation for Economic Co-operation and Development (OECD), 2021, Preliminary ODA levels in 2020 https://www.oecd.org/dac/financing-sustainable-development/development-finance-data/ODA-2020-detailed-summary.pdf

13 HM Government, 2021, Autumn Budget and Spending Review 2021, P7

14 See previous by OECD. also World Resources Institute, 2021, A breakdown of developed countries' public climate finance contributions towards the $100 billion goal, https://files.wri.org/d8/s3fs-public/2021-10/breakdown-developed-countries-public-climate-finance-contributions-towards-100-billion.pdf

Climate Finance is not wholly new and additional funding, it makes the UK the first major aid donor to announce a significant increase in climate finance over the next half-decade. Perhaps most importantly, whilst many other countries continue to fund greenhouse gas emitting aid projects in parallel to their dedicated International Climate Finance work, the UK is making its entire aid budget compliant with the requirements of the Paris international climate change agreement[15]. In short, though it can do more, the UK remains a world leader in the quality and quantity of its aid-giving. This is something we can be proud of, and which allows us to negotiate for other countries to increase their support towards that required for global net zero.

Part 2: Scotland's Targets and Plans for Net Zero

Since devolution was introduced at the turn of the millennium, leadership and responsibility on climate change has been split between the UK and Scottish governments. This means actions can be taken in four ways: firstly, across the entire UK, such as changes to the cost of fuel duty. Secondly, by the UK government in Scotland, such as supporting industrial clusters like Grangemouth, or licences for offshore wind-farms. Thirdly, across levels, such as Scottish planning frameworks for how renewable power is connected to Britain's National Grid. And fourthly, mostly devolved, such as the Scottish Government's control over road-building, public transport, agriculture, waste, and forestry.

In terms of timescale, the CCC advises that to meet interim targets of a 75% reduction in greenhouse gases by 2040, rigorous policies should be in place and appropriately funded by the end of the current UK parliament in 2024[16]. From analysing each nation's starting point, economy and natural resources, including its potential for Carbon Capture and Storage, the CCC expects Scotland to naturally move faster, reaching 75% reductions by 2035. However, in 2019 the Scottish Government set itself an accelerated, legally-binding, target to make these reductions five years earlier, by 2030. Despite these aspirations, it has subsequently emerged that Scotland's total emissions increased in 2018 and its emissions reductions targets were missed in 2019. Evaluating the Scottish Government targets two years later the Chief Executive of the Committee publicly stated: "So far I haven't seen a strategy from the Scottish Government that would deliver that."[17]

The CCC estimates that powers over 60% of emissions are partially or mostly devolved in Scotland, Northern Ireland and Wales, whilst some or all key powers are devolved for 11% of emissions.[18] As such, to achieve its targets the Scottish Government needs to be championing clear improvements to UK-wide policy and *already* be demonstrating rapid

15 HM Government, 2020, United Kingdom Biennial Finance Communication to the United Nations Framework Convention on Climate Change

16 CCC, 2020, The Sixth Carbon Budget

17 Chris Stark, in Radio Scotland, 2021, No Hot Air - Are we keeping our own promises to reduce CO2?, https://www.bbc.co.uk/programmes/p0b19f72

18 CCC, 2020, Letter: Lord Deben, Climate Change Committee to Roseanna Cunningham MSP, p21

reductions in Scottish emissions.

Even where the technology and knowledge exists, meeting the 75% target in only nine years' time means cutting emissions 50% faster than advised. This will create trade-offs in cost or equality. For example, requiring all new cars, vans and boilers to be electric from the early 2030s will allow the most spending to take place when existing vehicles and equipment come to the end of their working life; when it breaks naturally and is not worth repairing. This is why the CCC estimates that although spending on tackling climate change must scale up to £50 billion per year by 2050, it is expected to benefit the economy by improving efficiency and reducing fuel costs.[19]

Without careful support, bringing deadlines forwards by 50% will require equipment to be scrapped early, increasing economic shocks as businesses are forced to change at speed and industries are unable to access mature technological alternatives. Furthermore, the poorer members of our society are, by definition, those with less access to financial resources. They tend to live in less insulated accommodation, drive older motor vehicles, or be in more precarious employment. Because of this, the poor are the most likely to be hurt if there is no support provided through the transition.

When the Scottish Government released its updated Climate Change plan in December 2020 it refused to follow the requirements of the 2019 Climate Change (Scotland) Act, which requires ministers to develop 'policies for supporting the workforce, employers and communities' affected. The refusal goes directly against the Government's own advisory 'Just Transition Commission'[20].

Part 3: Scottish and UK Greenhouse Gas Reductions to Date

The internationally agreed practice for monitoring and taking action on greenhouse gas emissions is to analyse by economic sector. The UK further splits its data by nation. The following section summarises the state of greenhouse gas emissions in Scotland, then explains key trends in each sector[21].

Scotland has almost halved its carbon consumption from 16 tons CO2e/person in 1998 to 8.4 in 2019, in line with the rest of the UK figure of 12.8 to 6.8

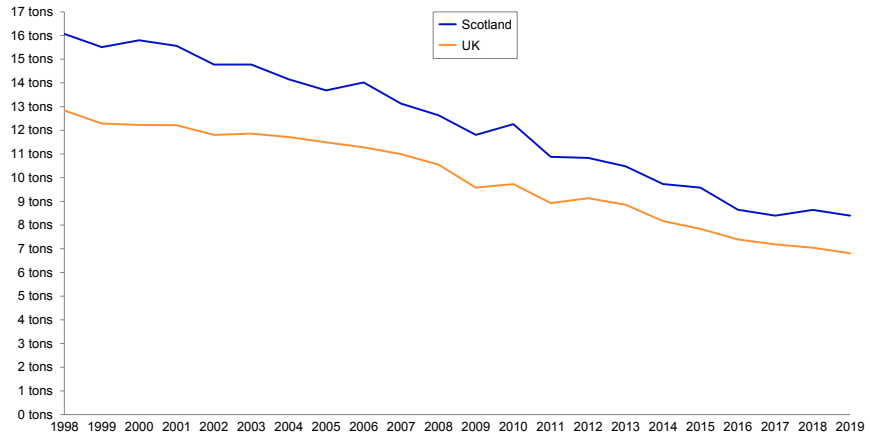

Figure 1: Total Carbon Emissions per Head (1998-2019)[22]

19 CCC, 2020, The Sixth Carbon Budget, p5

20 Scottish Government, 2020, Just Transition Commission Interim Report https://www.gov.scot/publications/transition-commission-interim-report/

21 Source: National Atmospheric Emissions Inventory (NAEI), 2020, Greenhouse Gas Inventories for England, Scotland, Wales & Northern Ireland: 1990-2019. Also CCC, 2020, Reducing emissions in Scotland Progress Report to Parliament. Note that where figures differ between different publications by the Scottish Government, the Climate Change Committee, and this report, discrepancies are explained by the inclusion or exclusion of International Aviation and Shipping. The NAEI data is reported to the UN according to a set methodology which excludes International Aviation and Shipping. The UK and Scottish carbon targets use the same data but report through an 'accounting' methodology that includes International Aviation and Shipping 'on the books' rather than 'off balance sheet'. The UK and Scottish Governments use the same data and methodology. Changes to the numerical figures are marginal and no claims or conclusions in this report would be altered by taking the other. Opening figures in the Executive Summary are an International Aviation and Shipping inclusive summary, taken from Scottish Government, 2021, Scottish Greenhouse Gas Emissions 2019. Analysis from this point on uses the more detailed NAEI data.

22 ONS, 2020, Population estimates for the UK, England and Wales, Scotland and Northern Ireland: mid-2019, https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationestimates/data-sets/populationestimatesforukenglandandwalesscotlandandnorthernireland

Both the UK and Scotland have reduced emissions at great speed. Although Scotland has reduced greenhouse gas emissions by a greater relative amount since 1990, the total emissions per person have remained higher.

Green energy has been responsible for over half of Scotland's emissions reductions since 1998, and 80% of those over the last decade

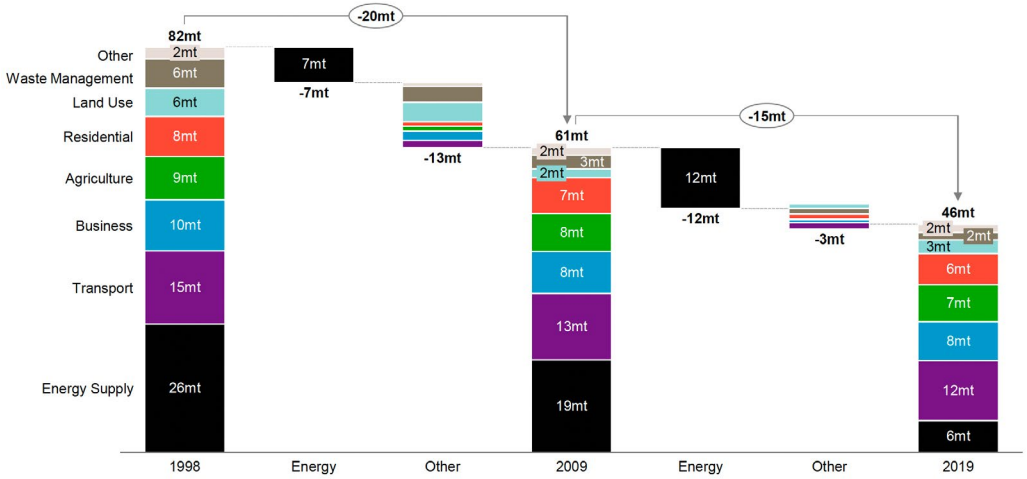

Figure 2: Whole-Economy Analysis of Greenhouse Gas Emissions, MtCO2e

The adjacent graph compares the greenhouse gas emissions produced in 1998, 2009 and 2019[23].

Between 1998 and 2009 there is a total reduction of 20 MtCO2e. Over a third of the total is from reduced emissions in Energy Supply.

Between 2009 and 2019 there is a total reduction of 15 MtCO2e. Decarbonisation of energy has accelerated to 12 MtCO2e, making 80 percent of the total reduction. The reduction from other sources is only 3 MtCO2e, so has slowed down.

By 2019 Energy Supply is close to entirely decarbonised, with only 6 MtCO2e emissions remaining. Reaching Net Zero by 2050 will require all emissions to reduce. Reaching 75% reductions by 2030 requires the reduction to accelerate rapidly, across all sectors.

Scotland's decarbonisation agenda has flatlined since 2016 – the pace of change now lags the rest of the UK rather than leading it

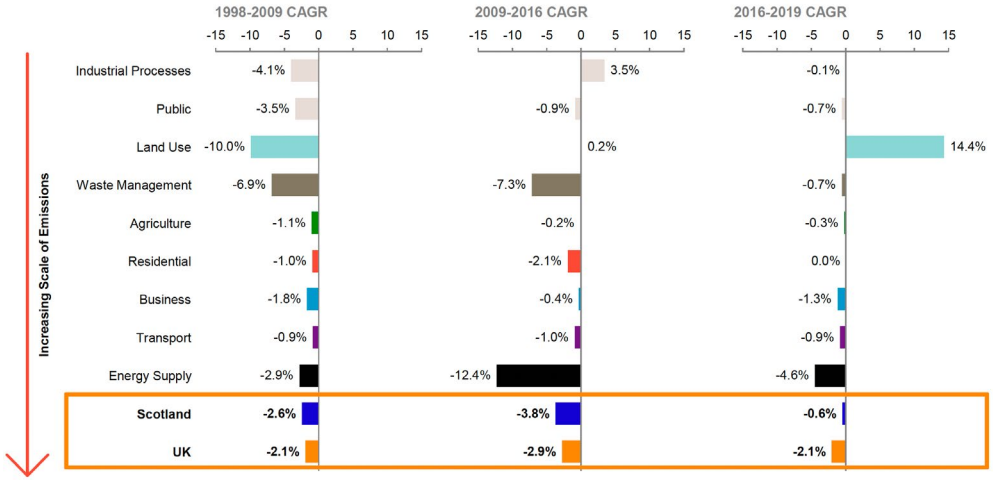

Figure 3: Carbon Emissions Growth (1998-2016). CAGR is 'Compound Annual Growth Rate', the relative change between the years analysed.

The first decade of the millennium Scotland saw large relative reductions in Land Use and Waste Management. Along with agriculture these are the areas of policy most devolved to the Scottish Parliament. During this period the total amount of emissions reduced from Energy Supply was large, but the relative reduction was much smaller.

23 Graph shows 'Megatonnes of CO2 Equivalent'. The 'equivalent' results from converting emissions of the seven greenhouse gases covered in the Kyoto protocol into their equivalent heating effect if calculated in Carbon Dioxide. For example, Methane has a somewhat stronger heating effect than Carbon Dioxide. Hydrofluorocarbons (HFCs), also known for destroying the Ozone layer, have a heating effect many times that of the equivalent amount of CO2.

'Land Use' includes the full category of Land Use, Land Use Change and Forestry.

From 2009-2016 the emissions from waste continue to be successfully reduced, but those from Land Use and Agriculture stagnate. The reduction in emissions from Energy Supply is now significant in both relative and absolute terms. The decarbonisation of Energy Supply is now powering the reduction in emissions across the UK, but particularly in Scotland.

Between 2016 and 2019 emissions reductions are minimal in all but Energy Supply, which has significantly slowed. Emissions from Land Use have increased in relative and absolute terms. Scotland is now reducing emissions slower than the UK average.

Transport becomes Scotland's biggest emitting sector in 2015, with Energy dropping below Business and Agriculture in 2016

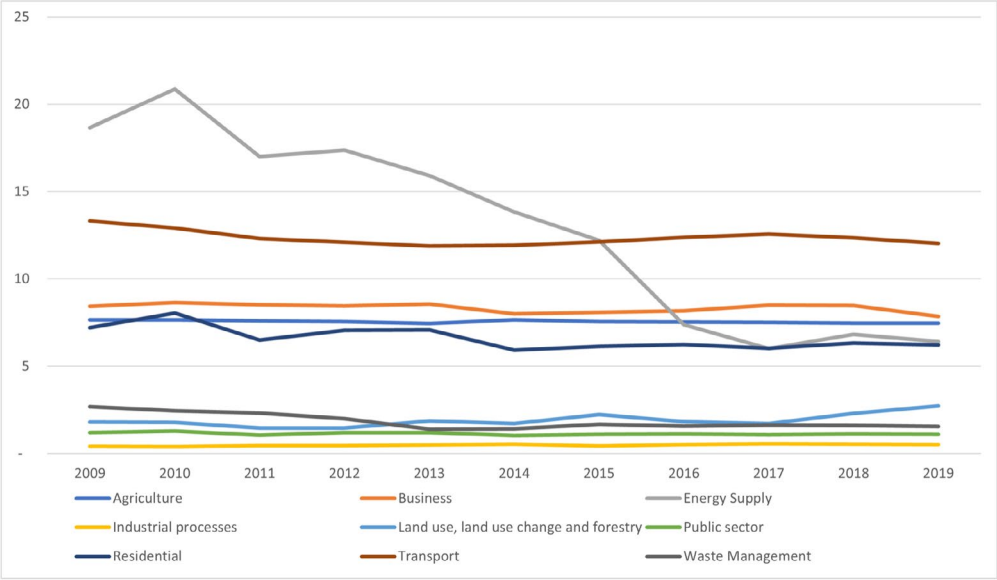

Figure 4: Scotland Greenhouse Gas emissions per year, MtCO2e

Energy Supply emissions are on track to drop below residential emissions in 2020. The increasing emissions from Land Use are notably increased in absolute terms. The data shows that progress in reducing emissions in most sectors has stagnated over the last ten years. Between 2016 and 2019, the figures have flatlined. This puts the Scottish Government's target to slash carbon emissions by 75% by 2030 into stark relief. Bluntly, if the figures for 2016-19 are repeated over the coming three years, then the legally-enshrined target set by the Scottish Parliament becomes a practical impossibility.

Part 4: Detailed Breakdown of Sector Trends, Causes and Solutions

Energy Supply: Mostly Reserved

The core success of Scotland's greenhouse gas reductions has been the almost total shift of electricity production away from coal, oil and gas, and into renewable and nuclear power. Through a coordinated system of UK-wide market interventions, this has taken only 20 years[24]. Cross Britain carbon pricing led to coal-fired power stations becoming outcompeted on cost, whilst Contracts-for-Difference have reduced the risk of investing in low-carbon projects. The Scottish Government's planning reforms have supported community-owned energy generation, ensuring that a wide range of people are able to benefit from action to prevent climate change.

The success of energy decarbonisation demonstrates that fundamental transformations can be achieved in less than a generation. It took funding raised from consumers across Britain and invested in Scotland to access its abundant natural resources. This investment could only happen by taking advantage of the Britain-wide power system. The National Grid allows renewable electricity to be exported from Scotland at times of surplus, then imported at times of low wind. This reduced the risk and the cost of becoming a global pioneer in renewable energy.

The next stage in the story is to massively increase the amount of electricity generated from renewables, creating the power that will be needed to electrify the rest of society: charging our vehicles, heating and lighting our buildings, whilst allowing industry to replace oil and gas, including through the generation of hydrogen. This transition will require large numbers of workers to be retrained to work in renewables, and to ensure that the new jobs created are good jobs. It will also require significant levels of public understanding, meaning that increased support for community-owned energy is vital if we are to scale up at the speed required.

But all of this will require co-operation. Firstly – it is no good making all this energy in Scotland if it cannot export to the rest of the UK: more cross-border transmission capacity is required. It is also by no means a just transition if the equipment that creates green energy shifts energy jobs from the places where that energy is created. We need a cross-UK supply chain for green turbines at a minimum.

Business and Industry: Mostly Reserved

Emissions from business have risen in Scotland since 2014, so leading to almost no overall change over the last ten years. Emissions from industrial processes have been rising since 2010, and although the overall amounts are small they have increased by almost a third. Emissions from paper, chemicals, refining, food, drink and the leakage of fuels have been significantly reduced.

COVID-19 has forced almost all businesses to radically re-organise their operations and estates. Many activities moved online need to be evaluated for their potential to be made permanent. In the case of transport this can lead to significant greenhouse gas savings in both frequent local commuting and longer-distance business travel, particularly flying. However, this must be balanced against new or shifted emissions, such as more inefficient heating and lighting through working-from-home in residential buildings, or making less frequent but significantly longer commutes.

For many businesses the next step is to electrify those processes currently powered by fossil fuels. The scale is comparable to successful efforts to decarbonise the energy supply by moving to renewable power generation. Much of this process is about infrastructure; building new connections to the national grid. Businesses using oil and gas powered equipment will need to replace them with electric versions as the assets become obsolete. New forms of energy storage will become mainstream, such as next-generation batteries replacing portable diesel generators.

A small but significant part of the industrial transition is comparable to

24 Power generation carbon emissions peak in the year 2000. Interventions include Renewable Obligation Certificates in 2002, Feed-in Tariffs in 2010, and Electricity Market Reform in 2012

the closure of large coal-fired power stations. Large industrial clusters and businesses with unique needs, such as the Grangemouth industrial cluster and the highest temperature furnaces, will need to switch to hydrogen rather than electricity.

Whether moving to electricity or hydrogen, the shift will require coordinated support from the UK and Scottish governments, working in partnership to ensure that new infrastructure and facilities are built. The UK government – as the recent budget has shown – will need to provide real incentive to invest – and over time commit to real disincentives to carry on with carbon emitting processes. A particular responsibility of the Scottish Government will be to provide the right business support, planning framework and education system, including adult education, to support the transition. Aligning on a plan with critical industries across these islands – rather than popgun support on a momentary basis – will be critical.

Aviation: Mostly Reserved

Emissions from international air travel from and to Scotland have been increasing since 2013, after reducing dramatically in the run up to 2010. This increase has eaten away the reduction in emissions from improved fleet efficiency and from flights between UK airports. A particular area of growth has been flights between EU destinations, rather than further overseas.

The Scottish government has significant power to reduce demand for flying. Tax on air passengers leaving Scottish airports was devolved in 2016, but the powers have not yet been taken up by the Scottish Government. Investment in communications infrastructure such as next-generation broadband, along with support for behaviour change, should be encouraging physical travel, online communication and service provision. Furthermore, journey times on electrified high-speed trains must be competitive with short-haul flights, with longer European journeys competitive via high-speed night train. The Scottish Government is key to championing consumer demand for such journeys, and for developing the planning and infrastructure for their Scottish segments.

For the remaining long distance in-person air travel and freight, Scotland would expect to be a significant source of biofuel, electricity, or Carbon Capture and Storage to remove equivalent emissions from the air.

Surface Transport: Partially Devolved

On-the-ground transport, combining Scottish road and rail, started to fall in 2007 and reached a minimum in 2013, but have subsequently risen again. Although fuel efficiency in cars has increased, the benefits have been eaten away by the greater number of miles driven and through increased journeys by vans and lorries. In the same period, bus use has reduced, and although walking, cycling and train travel has increased, commuter car use has increased faster. Electric vehicle uptake has been lower than the rest of the UK, although there are signs this has accelerated over the last year.

Significant focus and spending by the Scottish government has been on building new roads. From 1990-2017 Scotland's motorway network doubled in length[25]. Despite the Scottish Government's target to reduce emissions faster than independently recommended, it is planning £7billion of spending on major road-building. This would double the £4billion spent over the last ten years, or almost triple the amount to £12billion if past overspending is repeated[26]. This is in comparison to only £1.3 billion for decarbonising transport and investing in sustainable travel[27].

Overall, transport needs to see decarbonisation at the speed previously

25 Transport Scotland, 2020, Carbon Account for Transport No. 12: 2020 Edition, https://www.transport.gov.scot/media/48199/sct07209535161.pdf

26 Transform Scotland, p22

27 Scottish Government, 2021, A National Mission with Local Impact: Infrastructure Investment Plan 2021–2022 to 2025–2026, p7-8, https://www.gov.scot/publications/national-mission-local-impact-infrastructure-investment-plan-scotland-2021-22-2025-26

achieved in the energy supply. Cutting road building would release funds for railways, buses and cars to be electrified, with lorries electrified or converted to hydrogen. It could also go towards the estimated £2billion maintenance backlog on Scotland's existing roads[28]. The UK government should work with the Scottish Government and English leaders to plan High Speed rail to Edinburgh and Glasgow. However, the most efficient and lowest-cost reductions can only be achieved through cooperation, with people choosing to support and travel by public transport, cycling or walking.

Residential: Partially Devolved

Emissions from residential buildings fell until 2014, after which they have slightly risen. Higher regulatory standards and greater consumer interest has seen a greater uptake of insulation, double glazing, residential solar panels, low-energy lighting and electric-powered cooking or heating appliances. However, the greatest movement has been from Energy Performance Certificate bands E and D, and into C and D. Less than 5% of Scottish homes have reached band B, whilst in 2018 almost 40% remained at band D. In particular, heat pump uptake has fallen behind the necessary target.

The challenge for reducing greenhouse gas emissions from residential sources is to find rounded solutions. For example, replacing a gas boiler with a heat pump, but without improving the home's insulation, can lead to higher costs for the consumer. Insulating and fitting a heat pump will lead to greater savings, unless the home cannot physically be effectively insulated or is off the electricity grid. In this case a hydrogen boiler may be better.

In new build or off-grid properties progress is linked to planning reforms, particularly as Scotland has a large proportion of properties not connected to the gas network[29]. The tenements of Scotland's great cities also pose a particular problem. Shared or district heating systems can offer cost and efficiency benefits over making stand-alone improvements to individual flats, but mainstreaming their installation requires additional forms of coordination and government support.

Solutions for residential decarbonisation rest upon boosting awareness of the benefits, including significant consumer savings in reduced energy bills. These need to be combined with greater minimum regulatory requirements, especially in rented accommodation. It would be facilitated by targeted government support to boost the number people trained and able to carry out retrofits of existing properties. Expert analysis suggests that installing insulation is one of the most cost-effective ways to reduce unemployment across all parts of the country, and that it effectively utilises government pooling of resources to bypass the barriers experienced by individuals and firms[30]. To maximise public engagement, support for community-owned energy production could be linked to the promotion and installation of energy efficiency in the homes of customers.

Waste Management: Mostly Devolved

Emissions from waste have been rising in Scotland since 2014, after previously falling for a decade and a half. The success had been achieved through reductions in the amount of waste created, reductions in the amount of biodegradable waste sent to landfill, and increased recycling.

Although only a small part of greenhouse gas emissions, waste management is an area wholly controlled by the Scottish government. This means it has the particular ability, and responsibility, to find innovations in technology, planning and behaviour change that reduce waste. Some solutions are likely to be operational, such as more convenient waste collection from residential and commercial premises, particularly to divert biodegradable material from landfill. Others are

28 Transform Scotland, p37

29 CCC, 2020, The Sixth Carbon Budget, p26

30 Organisation for Economic Co-operation and Development, 2020, Building back better: A sustainable, resilient recovery after COVID-19, https://oecd.org/coronavirus/policy-responses/building-back-better-a-sustainable-resilient-recovery-after-covid-19-52b869f5/

likely to involve the planning system and capital investment, such as replacing garden or on-street bins with communal underground facilities accessed by roadside chute. Reducing carbon emissions from waste management is particularly reliant upon ensuring that local authorities have sufficient funding available, and that the general public is willing to actively participate in changing their behaviours.

Agriculture: Mostly Devolved

Greenhouse gas emissions from agriculture have stagnated in both the UK and Scotland. This is a missed opportunity for both, but the neglect is more problematic in Scotland as farming comprises a much higher percentage of emissions and the economy. Emissions from livestock in Scotland have reduced by 6% since 2008, but emissions from soils and waste (including manure) have remained stable. The lack of progress in agricultural soil management can be put alongside peat restoration and wetland conservation as an issue of concern in rural areas, whilst the lack of progress in agricultural waste mirrors the lack of progress on waste in the wider economy. Most concerningly, between 2008-19 the emissions from machinery have increased by 17%.

Recognising that the areas of least progress are the ones in which powers are most devolved, these problems can and should be addressed through reforms at Holyrood. This could consider the better integration of agricultural machinery decarbonisation into support for the decarbonisation of business and industrial processes. Attempts to improve the treatment of agricultural waste could be combined with the need to improve treatment of general waste. Progress in agricultural soil management could be wrapped into research and development on a wider programme of land restoration and conservation. Surrounding all these production-focused measures, a change in consumer behaviour and business procurement is needed to close the loop. Some reduction in meat and dairy is needed, alongside a fuller supply chain and demand for low-emissions food, with higher soil and waste management standards.

Land Use, Land Use Change and Forestry (LULUCF): Mostly Devolved

Comprising emissions from land itself, such as from forestry, peat and grasslands, emissions in Scotland have increased by 87% since a 2012 minimum. The increase is caused by a reduction in the amount of greenhouse gases being taken out of the atmosphere by forest planting and rewilding of cropland to grassland[31]. Whilst there has been some decrease in the level of emissions from cropland and grassland, the reduction in Scotland has fallen behind the UK average and has been outpaced by the lessening of removals[32]. Continued improvements in land management, combined with a return to previous highs of forest and grassland planting, are required to reverse the greenhouse gas increases of the last decade. Whilst the Scottish government has now set new targets for planting that are in line with those recommended by the Committee for Climate Change, during 2012-17 it missed its own targets.

Emissions from peat degraded through wetland drainage have been a relatively constant source of emissions since 1990. In contrast, undamaged or restored peat wetlands remove carbon from the atmosphere. Increasing the restoration and conservation of Scottish wetlands would initially achieve a significant reduction in carbon emissions, then an increase in carbon removals. The CCC recommends that Scotland restore a minimum of 18,000 hectares of peatland per year from the mid-2020s to 2045, which the Scottish Government has now committed to doing. Developing new restoration practices in collaboration with conservationists and land managers on the island of Ireland would further reduce greenhouse gases in the UK and Europe.

Greater restoration or planting of forests, grassland and wetland would revolutionise the rural economy, boosting employment in forestry and timber, tourism, and in creating the fuel for biomass carbon capture and storage. Despite this, the current Scottish Government plans are for only

31 The peak in these greenhouse gas removals lasted from 1998-2009

32 Gross emissions decrease, net emissions increase

£250m over the next 10 year[33], in comparison to the £7-12 billion on road building. Ending this rural neglect means putting the rural economy in its rightful place, as the engine room of a carbon net negative Scotland.

The UK Government should also fund the planting of trees in Scotland, so that UK funds are spent across the nation in partnership, to maximise the potential for Scotland to lead the country into Net Zero.

Carbon Capture and Storage for Net Negative: Partially Devolved

There are two main ways to take carbon dioxide out of the air. The first involves growing biomass, in the form of trees or other organic material, before combusting it in power stations to make electricity. Before the gases are released into the atmosphere a series of chemical systems are used to remove the greenhouse gases. The second involves operating similar systems but using energy from renewable sources, such as wind turbines, to remove greenhouse gases directly from the open air. The extracted gases can then be stored, either through being turned into solid high-carbon materials similar to limestone, or pumped into underground storage facilities and decommissioned oil wells. In either case, the end result means removing greenhouse gases from the atmosphere.

Scotland has particular ability to do both sides of the process. Its large amounts of rural land are ideal for the growing of biomass. The rock formations that previously held North Sea oil and gas fields are ideal for storing the extracted gases. Converting the decommissioned fields and on-shore facilities to Carbon Capture and Storage means retaining and finding new uses for the valuable skills that have been developed in Scottish oil and gas industry. Internationally leading the development of Carbon Capture and Storage would allow a return to the economic successes of the North Sea oil boom, where Scottish skilled workers became known across the world, employed in setting up a new industry. With support, funding and retraining they could do the same again, this time decommissioning oil fields and establishing Carbon Capture and Storage.

33 CCC, 2020, Reducing emissions in Scotland Progress Report to Parliament, p73

In the short term, Carbon Capture and Storage is an essential part of the toolkit whereby Scotland reaches Net Zero by 2045, and the UK reaches Net Zero by 2050. In the longer term, Scotland leading the world by becoming the first Net Negative nation will be essential if we are to limit and then reverse global greenhouse emissions, to prevent dangerous climate change.

The previous section has set out how Scotland has led the world in reducing greenhouse gas emissions. The last decade has seen progress stagnate, and in some cases even reverse, across the UK and Scotland. The Committee on Climate Change, along with other expert advisory bodies such as the Just Transition Commission, have suggested a range of policies to close the gap between targets and reality. The final part of this report suggests a series of institutional reforms to ensure delivery.

Part 5: System Change, not Climate Change

The great success story of greenhouse gas reductions in Scotland, and the wider UK, is the decarbonisation of the power system. This initially combined local skilled expertise and buy-in, abundant natural resources and new forms of government coordination. However, the ability to access this great untapped energy was built upon a foundation of shared risk and pooled funding from across Britain. Acting alone, each one of the UK's nations would have moved slower and at greater cost, including Scotland.

To reach Net Zero as fast as possible we propose the establishment of three key institutional reforms. These will set the conditions within which all other policies will be delivered. In so doing, they each have checks and balances to ensure that delivery is fast, efficient and equal. Yet the size of the challenge in removing greenhouse gas emissions from every part of our society in less than 30 years, means that these institutions cannot be another set of small arms-length agencies. They will need to distribute a volume of public funding that is large enough to alter the balance between different arms of the UK and Scottish governments, and to restore equality between the UK's nations and regions. They will need to impartially support the private sector and civil society to decarbonise their own activities at speed, and to bring together cooperation that can make this happen. They will also guide us in developing outward-looking, international cooperation with the rest of the world, so that Scotland achieves net zero in a way that learns from the best overseas ideas, and can be replicated by those who wish to follow us.

Office of Climate Responsibility

The first institution would be the 'Office for Climate Responsibility' or 'OCR'. The Office would ensure that climate change is considered at the heart of all government, private sector and civil society decisions, at every level. Its first responsibility would be to act as a regulator and ombudsman, ensuring that all government activity is compliant with the CCC's net zero timescales. It would be sufficiently staffed to produce authoritative reviews at a rapid speed, for example it would be able to review the climate implications of the Chancellor's budget on the same timescale as the Office for Budgetary Responsibility reviews its financial implications. Each part of the UK would be evaluated according to the same rules, so that we can tell when ideas are working well or working badly. Each devolved national administration or metro mayor, including future metro mayors or regional hubs in Scotland, Wales and Northern Ireland, would then be funded to build a unit with extra expertise in their local economic specialisms. Each local authority without a mayor would be given funding to procure services from the UK-wide network of local OCR units.

With a decentralised, physical presence at each level of devolution, the OCR would provide the checks and balances to ensure that a labour market in climate Quality Assurance and Quality Enhancement skills is being developed across the UK. To support local economic growth and civil society resilience outwith government, the local units would be expected to develop capacity to provide similar services, at not-for-profit rates, to private business and civil society organisations. Local elected leaders would be able to steer the development these external services, so allowing for innovation between operational models and local needs. Indicative examples include the different services and commissioning models operated by the Cabinet Office's Policy Lab, the spin-off Behavioural Insights Team (or 'Nudge unit'), and the Advisory, Conciliation and Arbitration Service (Acas), including its training and dispute-prevention services.

In Scotland, the OCR could:

- Establish a unit for the Highlands and Islands, based in Inverness, and a unit for the Lowlands based in Dundee or Clydeside.

- Coordinate the exchange of good practice from across the UK, the OBR would advise on restructuring the Major Projects Agency to focusing on reducing emissions from residential and business properties, transport, waste, agriculture and peatland.

- Potential priority projects would be to advise the Scottish government on how to end new road-building, and to reduce

congestion by increasing use of rail and bus, walking and cycling, including fixing the roads maintenance backlog.

- The UK OCR would develop proposals for an Emissions Trading System that allows Scotland to offer Bioenergy Carbon Capture and Storage (BECCS) or Direct Air Capture to other countries. Through international agreements Scotland could scale up and sell negative emissions credits to richer nations falling behind their climate change targets, whilst donating credits to lower income countries. Overall, making greenhouse gas removals cost effective would buy the time needed for the world to wean itself off fossil fuels, whilst paying for the restoration of Scotland's own rural economy and natural heritage.

UK Agency for Climate Cooperation Acceleration

The second institution would be the UK Agency for Climate Cooperation Acceleration (UK-ACCA) , acting as a projects clearing house and funding distributor for strategic decarbonisation actions. UK-ACCA's remit would be to identify and fund strategic projects that accelerate decarbonisation, finding the optimum between speed, cost and equality. Its focus would be on actions that require different parts of the UK to work in coordination. Guided by the successful decarbonisation of British power generation, it would seek to replicate this in to expand the electricity and hydrogen generation network, and to decarbonise UK-wide travel..

A reboot for the country, UK-ACCA would ensure that investment in decarbonising the economy is also an investment in rebalancing how opportunity and equality are spread across the country. As a time limited emergency body, it would be funded outside of normal borrowing limits, whether through fiscal policy, quantitative easing, or capital expenditure classed outside of structural expenditure accounting. Building upon to the CCC's estimated costs of basic decarbonisation, UK-ACCA would have additional funds to ensure the transition reduces geographical inequalities between the UK's regions and nations. This makes climate sense because poorer areas and struggling industries are often more polluting, more reliant on older machinery and equipment. UK-ACCA work would be steered by three-tests: 'each person, each pound, each place'. It must reduce carbon emissions per person, increase GDP whilst still reducing carbon emissions, and reduce inequality between the UK's regions and nations.

To ensure that UK-ACCA can draw on UK-wide finance but push investment out to the places that have previously been overlooked, the governing board would be composed of delegates from the Scottish and Welsh Parliaments, and the English metro mayors. They would act as a high-profile single point of contact, responsible for bringing their local business and civil society figures together to apply for funds, and ensuring that funds are distributed evenly. . Consensual arrangements for Stormont would be established subsequently. The rate of carbon reduction would be set to align with the CCC net zero pathway, whilst the rate of reduction in geographical inequality would be set and justified by the UK Chancellor, just as the Chancellor sets the target rate of inflation that the Bank of England must seek to meet. The OCR would then advise on the level of funding required to meet the three tests.

Drawing on their expertise as the European co-chair of the 'Under2' climate coalition of state, national and mayoral governments, we would recommend the First Minster of Scotland as the inaugural Provost or Chair of UK-ACCA.

In Scotland, inaugural projects could be:

- To accelerate construction of the next generation of renewable energy, so that it can provide electricity across Britain, and via under-sea interconnectors, to the island of Ireland and our European neighbours. Capacity and capability could be increased through significant investment in research and development, including a UK training college for renewable power in the North East of Scotland.

- To reduce emissions from short haul aviation. The board of UK-ACCA could be tasked with agreeing a network of improvements to the train network, with funds provided collectively from a UK pot. The First Minister would coordinate work alongside the English

Mayors to fix bottlenecks and upgrade rail lines across the UK, from Inverness and Aberdeenshire to the Channel Tunnel, allowing Scotland's integration into the European night train network.

- To increase tree and grassland planting rates. This would revolutionise rural employment and put Scotland's natural resources to work, allowing Scotland to become a global pioneer in Bioenergy Carbon Capture and Storage (BECCS). With access to UK funding and risk-sharing, Scotland could rapidly reach Net Zero and then start bringing down emissions entirely, to become the world's first net negative nation.

Global Communities

The third pillar would be a Climate Community Renaissance to ensure that the national effort to reach net zero is embedded not just in government, but in communities too. The green revolution cannot just be something that happens to people, it must happen with them; indeed, we should approach it as a way to build happier, more sustainable, and more secure communities. Efforts to push 'behaviour change' should not be seen as a way to prevent people from doing what they prefer, but to help people and communities lead more fulfilling and enriching lives.

The Covid pandemic has demonstrated just how quickly behaviour can change when we are forced too. In a few short weeks the UK changed behaviours that were expected to take decades; remote working and online shopping, increased walking and cycling, along with many changes in diet. Coming out of lockdown, a great number of people have changed career, moved home, or continued with the new habits and purchasing decisions they have picked up. In the Clap for Carers, the informal networks of mutual aid, and in small acts of kindness between neighbours, we saw how many people want to have a positive impact. The changes of COVID, and the changes that will be required by decarbonisation, also create a great opportunity for government to improve how it keeps people engaged in a grassroots movement to build a better world.

We are therefore calling for the Governments of the UK to work together on a series of initiatives which seek to mobilise action across the country. Targeted funding would both motivate delivery within the UK but also to ensure that the knowledge and expertise built up within the UK is mobilised to help the cause of carbon reduction around the world. Specific projects could include:

- A new UK Green Community Fund, aimed specifically at areas of high deprivation, offering financial support for those communities to reduce carbon emissions whilst gaining new skills in growing industries.

- Restoring our social heritage by supporting civil society's recovery from COVID, such as supporting community halls and churches to cut their bills by fitting solar panels, or for conservation societies to work with trade unions to make green improvements to older houses and buildings.

- The creation of "Green twins" – where towns and villages across the UK are encouraged to link up to help one other restore their local environment.

- An International Climate Action (ICA) programme would be established to help spread the UK's expertise and technological advances across the world, particularly to economically developing nations, and to facilitate networks of exchanges at national, state, city and county levels.

- The creation of a Green "Peace Corps", building on the National Citizens Service programme, giving 16-20 year olds across the UK the opportunity to volunteer in projects involving reforestation, residential energy efficiency, and peatland restoration.

- A new online portal to help consumers and small entrepreneurs make more ethical trade and investment opportunities – so people and businesses can get easy access to information and training on how to develop supply chains that avoid child labour, support community ownership or promote environmental restoration.

- The creation of hundreds of ‘Attenborough Scholarships’, sponsoring people from all ages and walks of life to share their experience overseas, or to come to the UK to share and learn new expertise.

Priority Recommendations for Carbon Reductions

Sector		Devolution Status
Energy Supply	Increase the supply of renewable energy to meet the electricity and hydrogen needs of a decarbonised society. Reinforce the National Grid and build hydrogen distribution infrastructure.	Mostly reserved
Business and Industry	Ensure the replacement of equipment is in line with required emission reductions. Maximise uptake of low-carbon replacements in advance of final bans. Support to lock-in emission reductions from remote working and increased use of digital communications. Ensure strategic decarbonisation of industrial clusters e.g. hydrogen system in Grangemouth.	Mostly reserved
Aviation	Reduce demand for flying through behaviour change and infrastructure investment, such as supporting use of digital communications. Increase Air Passenger Duty at a UK level, complete take up of devolved powers and increase Air Departure Tax in Scotland. Increase the speed of intercity train travel within Scotland, champion upgrades to routes starting or ending in Scotland.	Mostly reserved
Surface Transport	Reduce transport congestion and reduce emissions from non-electric powered vehicles by increasing rail, bus, cycling and walking, including fixing the roads maintenance backlog.	Partially Reserved
Residential	Accelerate energy efficiency renovations of existing properties. Support establishment of shared or district heating systems. Connect off-grid properties to National Grid or local renewable energy generation and storage.	Partially Reserved
Waste Management	Reduce the volume of biodegradable material ending in landfill and increase recycling rates through supply-chain regulation and behaviour change.	Mostly Devolved
Agriculture	Accelerate electrification of machinery. Improve management of waste to reduce emissions. Behaviour change to increase demand for low-emission diets.	Mostly Devolved
Land Use, Land Use Change and Forestry	Increase forest and grassland planting. Increase peatland restoration. Increase harvesting of timber.	Mostly Devolved
Carbon Capture and Storage for Net Negative	Enact stable long-term support to mature and scale up Carbon Capture and Storage technology. Develop long term funding streams for operation of Carbon Capture and Storage. Ensure biomass supply is increased to meet demand.	Partially Devolved

About the Author

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