



Infrastructure
Commission
for Scotland



Phase 1: Key findings report

A blueprint for Scotland

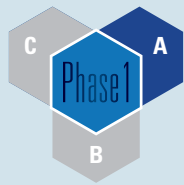
JANUARY 2020

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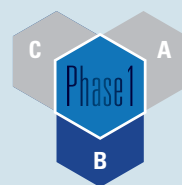


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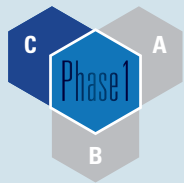
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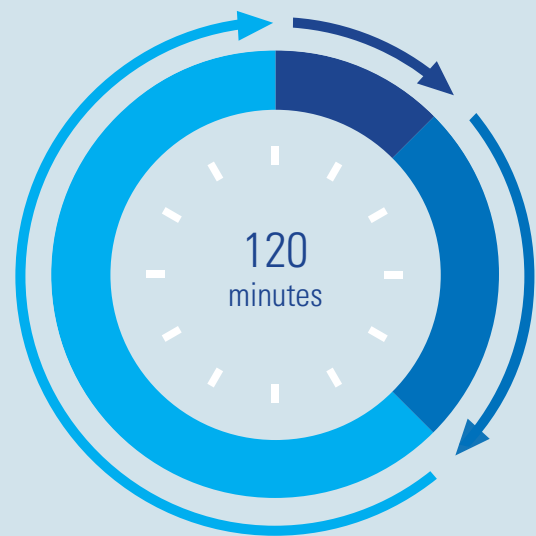
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- Executive Summary: 15 minutes
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Foreword

In early 2019 the Cabinet Secretary for Transport, Infrastructure and Connectivity invited us to undertake an 18-month commission to advise on a 30-year, long term strategy and its delivery for Scotland's infrastructure.

The Scottish Government's definition of infrastructure includes both economic and social infrastructure that covers transport, energy, telecoms, water, waste, flood defences, housing, education, health, justice and culture. During the work of the Commission it has also become evident to us that Scotland's natural assets should also be incorporated in this definition of infrastructure.

The commission has engaged widely and received input from over 200 organisations and 1000 individuals across Scotland. It also took evidence from similar organisations in the remainder of the UK and internationally. This engagement and evidence gathering has been fundamental to shaping and informing our work.

During the past 12 months it has become clear that net zero carbon and inclusive economic growth are two key policy areas which have a significant bearing on infrastructure. Focussing infrastructure decisions on these areas of policy will lead to very different outcomes compared with past investment, and the nature, purpose and focus of infrastructure investment over the 30 year horizon is likely to change fundamentally as we aim for an inclusive net zero carbon economy.

Most of the evidence in relation to the impact of infrastructure is focused on traditional GVA type outcomes which are not seen as the sole measures of success and opportunities of net zero carbon or inclusive economic growth. Given the urgency of the transition, this means we will have to take some infrastructure decisions according to agreed principles for which detailed empirical evidence may not yet be available as well as take immediate steps to develop that new evidence base. This Phase 1 report therefore provides an opportunity to set out an overall 30-year infrastructure vision to support and enable an inclusive net zero carbon economy and establish some short and longer-term actions to achieve this.

Much good work is already underway in Scottish Government, Local Government and the private sector. More can be done and faster if target dates are to be met. Whilst many of the recommendations are principally aimed at Scottish Government, it is important to recognise that the success or otherwise of achieving the desired outcomes will be incumbent on all those who plan, build, invest in, own, operate, regulate and use infrastructure as well.

The Infrastructure Commission for Scotland

Ian Russell (Chair), Iain Docherty, Ken Gillespie,
Benny Higgins, Mary Pitcaithly, Rachel Skinner,
Grahame Smith, Sara Thiam, John Trower, Jan Webb



Executive Summary

As we tackle the dual challenges of a climate emergency and the desire to create an inclusive growth economy, we urgently need to re-think what infrastructure we use and how we use it. This is not just a challenge for government, although political vision and determination is going to be essential. Crucially it is a call to all of us who plan, build, invest in, own, operate, regulate and, as importantly, use the infrastructure of Scotland.

Scotland has been at the forefront of infrastructure innovation since the first industrial revolution in the late 18th Century. However, we now stand on the brink of a fourth industrial revolution. Whilst the current challenges, opportunities and responsibilities may be very different, infrastructure innovation to drive and enable change remains at the centre of decision making as much now as it was then.

The Infrastructure Commission for Scotland was established in early 2019 to provide independent advice to Scottish Ministers on a 30-year vision (the “why and what”) of infrastructure for Scotland by the end of 2019, and to consider options for delivery (the “how”) by June 2020. The Commission was also asked to provide shorter term 5-year guidance to Ministers on both of these aspects. This Phase 1 Report focuses on the “why and what” of these challenges and seeks to build on the considerable infrastructure backbone that exists across Scotland as a result of billions of pounds worth of investment by both the public and private sectors.

The Commission’s remit covers a broad spectrum of infrastructure sectors including transport, energy, telecoms, water, waste, flood defences, housing, education, health, justice and culture. During the work of the Commission, it became evident that Scotland’s natural infrastructure should also be incorporated in this definition. This diversity of infrastructure sets the Commission apart from similar work undertaken in many other countries, where economic infrastructure has principally been a focus. However, given the desired combined outcomes of inclusive economic growth and net zero carbon that have framed our work, consideration of this diverse infrastructure base is both appropriate and essential. It ensures that a coherent understanding and a systems-wide approach to infrastructure investment and prioritisation can be developed. The need to assess all of this in the context of place,

and what is appropriate for a given geography, has also helped frame the work of the Commission.

We have engaged with over 1,000 members of the public in Scotland through face-to-face workshops or online surveys.

To establish an evidence-base to underpin the work of the Commission, we have engaged widely and deeply - and listened carefully. Earlier in the year we received almost 150 responses to our Initial Call for Evidence from experts and specialists across all infrastructure sectors. Respondents came from business and academia, all levels of local, regional and national government, private individuals, as well as public and private sector infrastructure operators and deliverers. This was followed by the Commission holding five regional forums across Scotland as well as nine specialist roundtables events. We have also sought the views and experience of international bodies such as the Organisation for Economic Co-operation & Development (OECD) and the World Bank, as well as infrastructure planners and practitioners from countries across the globe. As importantly, we have also engaged with over 1,000 members of the public in Scotland through either face-to-face workshops or an online survey, to understand better what they view as key infrastructure priorities for the future, as well as some of the trade-offs that may need to be considered.

Having placed an inclusive net zero carbon economy at the core of its thirty-year vision, the Commission does not underestimate the nature and scale of the challenges as well as the opportunities that this presents to Scotland. Whilst the journey to this vision has already started, the urgency and pace of change will need to increase, and the

Engagement highlights



Initial Call for Evidence

147

respondents



Regional Forums

139

individuals from
100 organisations
attended 5 regional
forums



Specialist Round Tables

93

individuals at
9 round tables



Public Engagement Research

73/1,000

73 members of the public at
4 face-to-face deliberative
workshops, 1,000 on-line user
surveys completed by Scottish
residents

scale of change required will affect almost every aspect of daily lives. It is also becoming clear that the vision of an inclusive net zero carbon economy, will sometimes require difficult choices to be made and trade-offs to be addressed. Therefore, if we are to be successful in capturing the opportunities whilst facing up to the challenges, it is not a matter of choosing change or no change; it is a matter of what, how and when future change will happen and the choices we make to get there. Informed, enhanced and inclusive engagement with users and citizens throughout that process of change will be critical to the outcomes.

These changes and choices clearly go far beyond infrastructure. However, infrastructure is and can continue to be a key enabler of and contributor to wider change. In relation to long term infrastructure investment and prioritisation, the ability to demonstrate the contribution these choices will make to achieving the desired inclusive net zero carbon economy outcomes will be essential. Building on the excellent start made through the National Performance Framework, "measures of success" for an inclusive net zero carbon economy from infrastructure investment urgently needs to be established. The work of the Commission has also highlighted the need, in both the public and private sectors, for a transition to a system-wide approach to infrastructure strategy, planning, delivery and operation across all infrastructure sectors supported by a coherent place-based approach to planning and decision making.

Our work has demonstrated that infrastructure investment can and does play a vital role in the economy, the delivery of effective public services in Scotland and the wellbeing of its citizens. However, it achieves this principally as an enabler that underpins all of our day to day lives and the world around us. The successful impact of this is a combination of when and how it is designed, how it is used, who uses it, where it is

used and when. To ensure we achieve the outcomes that are important to us as effectively and efficiently as possible, we must focus our infrastructure resources - be that financial, natural or human - on the infrastructure system that is best able to achieve and support those outcomes.

We have set out below a set of eight core areas of recommendation that we believe can help to achieve these desired outcomes. If you only have 15 minutes, the Foreword and Executive Summary provide a snapshot of the key context and the eight recommendations. If you have an extra half an hour, Part C provides an additional level of commentary on how those recommendations have been developed. Parts A and B contain a further level of detail that will require an additional hour or so of your time; Part A focused on the wider background and key drivers, whilst Part B is focused on the sectors that we have considered.

If we can all embrace and build on the recommendations set out in this report, we could go a long way towards turning an infrastructure vision for an inclusive net zero carbon economy into a reality. One that will support a sustainable, resilient and inclusive Scotland over the next 30 years.



Summary of Recommendations

↓ 01

Leadership

To provide leadership and demonstrate intent, the Scottish Government should prioritise all new infrastructure investment decisions based on their contribution to the delivery of an inclusive net zero carbon economy:

1. All Scottish Government funded projects included in its 2020 Infrastructure Investment Plan should be prioritised against available inclusive net zero carbon economy outcomes.
2. The Scottish Government should, by 2021, develop and publish a new infrastructure assessment framework and methodology that will enable system wide infrastructure investment decisions to be prioritised on the basis of their contribution to inclusive net zero carbon economy outcomes.
3. The Scottish Government should publish by 2023 a system wide Scottish Infrastructure Needs Assessment covering all infrastructure sectors defined by Scottish Government and we recommend the inclusion of natural infrastructure. The Assessment should be refreshed and updated at least every 5 years thereafter.
4. A fully updated Infrastructure Investment Plan should be developed by the Scottish Government for publication by 2025 using the new assessment framework and methodology and informed by the Infrastructure Needs Assessment.

↓ 02

Place

To achieve an inclusive net zero carbon economy, the Scottish Government should put “place” at the heart of coherent, infrastructure prioritisation and planning. To enable this to be achieved:

5. The Scottish Government should lead the development of a place based assessment of long term housing supply and demand across Scotland by 2021, supported by the development of a coherent strategy for the labour market and business opportunities arising from an inclusive net zero carbon economy.
6. To support the implementation of National Planning Framework 4 and the new system of development plans, a co-ordinated and appropriately resourced Infrastructure First approach to the planning system should be introduced by the Scottish Government by 2021. This should be undertaken with infrastructure providers, developers and other public bodies, to ensure the effective delivery of a Scotland wide, integrated and coherent outcome based approach to planning spatial land use; with implementation to be undertaken at the appropriate regional, local and community level.

↓ 03

Making the most of existing assets

Most of the underlying infrastructure that will be used in 30-years’ time already exists today. It is therefore essential that these assets are most effectively and efficiently utilised, maintained and enhanced to net zero carbon readiness.

7. By the end of 2020, the Scottish Government should require all public sector infrastructure asset owners to develop asset management strategies containing a presumption in favour of enhancing, re-purposing, or maintaining existing infrastructure over developing options for new infrastructure. New infrastructure should only be considered where the relevant authority has demonstrated this is the most appropriate response.
8. To support this, the Scottish Government should now prepare guidance for relevant authorities on a whole-life approach to infrastructure maintenance and prioritisation which includes both cost and build resources. It should also include guidance on assessing the wider net zero carbon and inclusive economic growth priorities that need to be established.
9. There should also be a presumption against like-for-like replacement of existing assets and the construction of new, single organisation/purpose assets in favour of shared facilities.
10. To support the creation of a vibrant circular economy for Scotland, by 2023 the Scottish Government should establish a route map for the implementation of a viable outcome focused system of resource use, reduction, collection, treatment and repurposing.
11. Drawing upon available evidence, including the 2nd Scottish Climate Change Adaptation Programme, by 2023, the Scottish Government should develop a clear implementation plan, to address critical natural and built infrastructure climate resilience and adaptation needs.

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Recommendations (continued)

↓04

Heat and Transport

Key priorities for Scotland in reaching net zero carbon over the next 30-years will be accelerating the decarbonisation of heat and transport.

Decarbonisation

12. By the end of 2020, and to augment legislation already being considered, the Scottish Government should set out proposals to substantially accelerate the development and implementation of incentives, support mechanisms and standards for energy efficient, net zero carbon buildings across Scotland. This should include 'whole building' solutions and systematic public engagement, customised to the needs of different groups, to ensure that all property owners engage with proposed changes and are committed to upgrading their property.
13. By 2022, the Scottish Government, local authorities, regulators and industry should work together to establish the viability, incentivisation mechanisms and a route map for the transition to net zero carbon that in combination addresses heating for domestic, commercial and public buildings as well as all surface-based transportation.

Transport

14. The Scottish Government should ensure that its new National Transport Strategy and Strategic Transport Projects Review 2, which are due to be published during 2020, fully reflect the need to deliver an inclusive net zero carbon economy and consider the infrastructure and the use of it as a holistic system. This should include:
 - > Aligning strategic investment decisions to address fully the requirement for demand management, a substantial increase in the proportion of journeys made by active travel, and opportunities for shared mobility as well as a much greater role for public transport.
 - > For such roads investment that is made as part of the above, a presumption in favour of investment to future proof existing road infrastructure and to make it safer, resilient and more reliable rather than increase road capacity.
15. Investment decision making based on the above framework will require a significant change to investment guidance. Therefore, by the end of 2021, the Scottish Government and Transport Scotland should develop a new investment appraisal and decision-making process, incorporating necessary changes to the current Scottish Transport Appraisal Guidance (STAG) and Investment Decision Making Guidance.
16. To enable a managed transition to an inclusive net zero carbon economy road infrastructure, the Scottish and UK Governments should immediately commit to work together to establish a charging/payment regime alternative to the existing fuel and road taxation based structure. The Scottish Government should also consider additional options that could provide a more stable long term investment regime for the management and maintenance of road infrastructure to meet the priorities identified in 14 above.

↓05

Regulation

To incentivise investment at the necessary pace and scale to meet future infrastructure requirements for Scotland, regulation will be a critical component to the delivery of a 30-year inclusive net zero carbon economy vision.

17. Building on the findings of the recent UK National Infrastructure Commission review of Energy and Telecoms regulation, the Scottish and UK Governments should immediately commit to work together to develop by 2021, an appropriately devolved regulatory and pricing framework that enables energy and telecoms infrastructure investment to be planned and delivered to meet the future needs of Scotland.
18. Building on the existing plans, and the commission's recommendation to incorporate natural infrastructure, the Scottish Government should by 2021 consider options for longer term implementation and regulatory coherence across water provision and flood management and resilience.

↓06

Digital & Technology

Ensure every citizen, organisation and business in Scotland has the ability to access digital public services, to undertake trade and commerce and to participate in future global economic markets regardless of geographic location.

19. In conjunction with the regulatory reforms highlighted in 17, the Scottish Government should provide the leadership required to ensure the delivery of a full fibre network for Scotland by 2027 to enable the transition to 5G across the whole of Scotland.
20. To ensure Scotland's place in the world and increase its international presence and connectivity resilience, the Scottish Government should prioritise support for an indigenous data centre market and investment in direct international fibre optic cables.
21. From 2020, the Scottish Government should consider the future data requirements and data potential for all new publicly funded infrastructure as well as the potential for the use of digital services associated with the assets.

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Recommendations
(continued)

↓07

The role of the public

Much greater participation of the public needs to be incorporated as an integral part of infrastructure investment decision-making:

22. By 2022, the capacity and capability requirements for an informed approach to public engagement and participation needs to be clearly established and implemented by the Scottish Government, to ensure that short and long term outcome trade offs are effectively debated, understood and taken into consideration.

↓08

Independent long-term advice

To enable government, regulators and industry to make the transition to a long-term, coherent, systems wide approach to place-based infrastructure strategy and planning.

23. By 2021, a body should be given the responsibility by the Scottish Government to provide independent, long term, evidence-based advice to Scottish Ministers on investment decisions for the social, economic and natural infrastructure needs and priorities required to deliver an inclusive net zero carbon economy.

Next steps

The Commission is 12 months into an 18-month programme of work and the recommendations set out in this report represent the findings of the first phase that has been focused on the “why and what” for infrastructure. As a result, a number of areas have yet to be considered by the Commission and will form the basis of the next phase of activity. The Phase 2 report will be aimed principally at the more downstream aspects of the work to date including the practical implications in relation to the “how” of infrastructure. This includes consideration of a Scottish National Infrastructure Company, as set out in our remit. The Commission will continue to engage widely for this phase of work as we move towards the conclusion of our work during 2020.

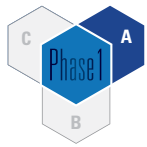


Phase 1

Infrastructure
Commission
for Scotland 

Part A

Context & Key Drivers



Part A:
Context & Key Drivers
(continued)

1. Introduction

Part A summarises both the evolving policy context of our work, and its interaction with the often complex and conflicting role of infrastructure in supporting policy priorities. It seeks also to demonstrate the interlinkages that mean that today's infrastructure decisions cannot be made in isolation. The Commission seeks to contribute to a better understanding of what needs to be done to maximise Scotland's success in meeting net zero carbon targets, and securing a socially-inclusive society and economy, over the next 30-years.

2. Remit and Scope

The Scottish Government gave the Commission a broad remit, reproduced at Appendix A. Uniquely, the Scottish Government definition of infrastructure captures both traditional economic infrastructure and assets often considered social infrastructure, with primarily social objectives:



UK Gov annual investment

2.6%
of GDP



OECD average
annual spend

3.6% GDP

Source:
<https://sp-bpr-en-prod-cdnep.azureedge.net/published/2019/1/15/Scottish-Government-infrastructure-investment/SB%2019-02.pdf>

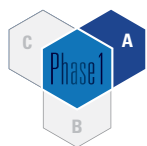
Infrastructure includes economic and social aspects, defined as: The physical and technical facilities, and fundamental systems necessary for the economy to function and to enable, sustain or enhance societal living conditions. These include the networks, connections and storage relating to enabling infrastructure of transport, energy, water, telecoms, digital and internet, to permit the ready movement of people, goods and services. They include the built environment of housing; public infrastructure such as education, health, justice and cultural facilities; safety enhancement such as waste management or flood prevention; and public services such as emergency services and resilience.

Following engagement with Stakeholders, we have incorporated natural infrastructure in our work, and are suggesting it be included in this definition

Whilst this scope was broadly welcomed by stakeholders, it was also suggested by a number of the initial call for evidence respondents that natural infrastructure should be included, and this has been taken up by the Commission. This combined definition is an explicit recognition of infrastructure's role beyond the economy and its support for social and environmental policy outcomes. This is further emphasised through the wide terms of reference for the Commission, including: traditional considerations such as international competitiveness; demographic and technological changes; infrastructure ownership and fair work; and newer objectives of inclusive economic growth (IEG) and low -now net zero- carbon economy (NZC)¹. To frame its work, the Commission made the early decision to focus on the role of infrastructure in achieving both of these objectives in tandem: an inclusive net zero carbon economy. This approach was tested throughout its stakeholder engagement and informed by desktop research.

¹ Where we state Net Zero Carbon (NZC) we are referring to the legislation and related actions to achieve net zero greenhouse gas emissions by 2045ix.





Part A: Context & Key Drivers (continued)

3. Approach

The Commission consulted widely, ensuring that all of Scotland had the opportunity to consider and inform the short and long-term vision for infrastructure. Alongside this we drew upon existing research and good practice, to understand the balance of opinion and evidence.

3.1 Stakeholder Engagement

We developed an engagement strategy which reflected this commitment. Further details of this strategy are included at Appendix B. The approaches, and segmentation, ensured engagement with a wide and varied range of stakeholders across civic Scotland. These included experts with a professional understanding of the infrastructure sectors, to individuals, and communities of interest affected by infrastructure decisions:-

- > As a first step, the Commission issued an Initial Call for Evidence in March 2019. The Call provided individuals, representative bodies, public bodies and organisations who use, plan, manage, maintain, finance and deliver infrastructure with the opportunity to contribute to Commission work by submitting written evidence. 147 responses were received; Appendix C provides a link to the Call for Evidence document issued by the Commission; Appendix D provides links to the individual submissions, where the respondents agreed these could be shared.
- > The Commission held a series of five Regional Forums in Aberdeen, Edinburgh, Glasgow, Inverness and Moffat. The forums were designed to capture regional distinctions, through dialogue with representatives from the public, private and third sectors. Appendix E provides a summary of the Forums, highlighting the key points and issues raised.
- > The analysis of the Call for Evidence and the responses from the Regional Forums were used to identify key sectors, emerging themes and gaps in evidence which the Commission investigated in more depth via nine Thematic Round Tables. These were attended by subject matter experts and enabled the Commission to interrogate further some headline issues raised in the Call for Evidence and Regional Forums. Appendix F provides a summary of main points from the Round Tables.
- > At key stages throughout this process, there were also a number of one-to-one and group meetings with representatives of specific sector interests. Appendix G details all stakeholder organisations the Commission

engaged with during Phase 1. This included engagement with Scottish Government policy leads and sectoral experts, and Appendix H contains a summary of the Scottish Government group meetings which had a similar form to the Thematic Round Tables.

- > Finally, a programme of social research was undertaken by Ipsos Mori, to understand the views and opinions of the wider public; as both users of Scotland's infrastructure and often also contributors to its funding, this included 4 deliberative workshops in Edinburgh, Glasgow, Moffat and Kinross and an online survey of over 1,000 people. Appendix I provides the report from this activity.

3.2 Desktop Research

In addition to capturing the views, opinions and priorities of stakeholders, desktop research was undertaken. The Commission undertook an internal review of research on the links between inclusive economic growth and infrastructure, which is included at Appendix J, following which the Fraser of Allander Institute was commissioned to undertake a deeper literature review. This is included as Appendix K.

Aventia Consulting was also commissioned to undertake a desktop review of literature on the relationship between net zero carbon (NZC) and infrastructure. This is included at Appendix L.

The key findings from these studies are highlighted below in Section 4.

The Commission also worked with the Scottish Government to understand the existing infrastructure asset base across Scotland. Appendix M provides the collated baseline and Part B of this main report provides commentary on individual sectors. All data is current to at least September 2019. In some instances, this has been updated subsequently.

Research and good practice were collated and analysed as identified in the Bibliography at Appendix N.

4. Key Policy Drivers

4.1 Introduction

The Scottish Government's policy has directed the Commission to the primary focus on infrastructure's role to achieve an inclusive net zero carbon economy. This supports the holistic goal of enhancing wellbeing over more narrowly defined measures of economic success such as GVA/GDP. The Scottish Government's 'Just Transition' process will be essential to achieve these objectives. Being clear on the role of infrastructure as a contributor to these

National Performance Framework

Our Purpose, Values and National Outcomes



Source:
https://nationalperformance.gov.scot/sites/default/files/documents/NPF_A2_Poster.pdf

goals is challenging, as the evidence is complex and conflicting. New forms of evidence are now needed to ensure that investment is fit for the purpose of an inclusive, net zero carbon economy.

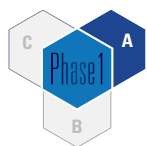
4.2 National Performance Framework

Scottish Government's National Performance Framework (NPF) sets an overall purpose and vision for Scotland. It includes 11 broad national outcomesⁱ that support the purpose and provides measures on how well Scotland is progressing towards them. Aligned with the UN Sustainable Development Goals it "...aims to reduce inequalities and gives equal importance to economic, environmental and social progress". The framework is represented as an integrated system, showing the interdependency of economic, environmental and social priorities. As such, success is currently equally measured across the 11-outcome areas, with no obvious weighting or prioritisation.

The NPF could be considered to encompass the breadth of measures essential for a wellbeing economy. Concepts of a wellbeing economy are not new; however, they are now gathering momentum

across the UK and beyond. The Office of National Statistics (ONS) has developed a number of datasetsⁱⁱ to measure well-being, since 2010, including their "beyond GDP" series. This year ONSⁱⁱⁱ acknowledged the limitations of GDP as a measure of welfare and living standards. They suggested instead that complementary measures of wellbeing are needed. Similarly, the UN Human Development Index^{iv} (HDI) takes a broader approach to understanding the development of a country and not only economic growth.

Infrastructure is not explicitly measured within the NPF, perhaps reflecting the understanding of it being either an enabling asset to achieve other priorities, e.g. schools provide the public environment to achieve educational outcomes; or an area which needs to be managed to minimise negative impacts e.g. within the Environment outcome it states "We promote high quality, sustainable planning, design and housing."^v One notable exception to this is blue-green or natural assets which are identified as outcomes in their own right, such as access to green and blue space; biodiversity; and clean seas. As indicated above, the Commission has included natural infrastructure within its scope of its work.



Part A: Context & Key Drivers (continued)

4.3 Programme for Government

The annual Programme for Government (PfG) lays out the key policy action plan and priorities for the coming year, including any legislative programme. The 2019-20 PfG^{vi} leads with addressing the climate emergency, while ensuring a just transition, through equitable share of opportunities as well as impacts. Through this prism, the programme explicitly identifies a range of infrastructure initiatives to support its economic, environmental and social priorities.

While seen to have a wider role within the PfG, infrastructure is most commonly framed to support the economy. Scotland's 2015 Economic Strategy states "Scotland's economic prosperity depends upon the strengths and talent of our people, our natural resources, our infrastructure and how we are governed."^{vii} In addition, the PfG^{vi} notes that "[investment commitments] are not possible without a strong economy that generates the jobs and wealth for us all to benefit from. We will continue our work to transform Scotland's infrastructure, support our innovators and expand our exports." A report by the Scottish Government's Office of the Chief Economic Advisor (OCEA)^{viii} in December 2018 identifies the ways in which infrastructure enables broader objectives, and in particular inclusive and sustainable growth. This report highlights the Scottish Government target to increase expenditure on infrastructure by 1% of current GDP by the end of 2025-26, in order to achieve the OECD average of 3.6%. The PfG notes this will take the annual infrastructure investment to £6.7 billion, from the 2019-20 figure of £5.2 billion. A number of benefits are indicated from this increase covering: market impacts; social and environmental impacts; demand and supply side economy impacts. It is also noted however that these impacts depend strongly on the degree of economic slack; the efficiency of the investment; the overarching system; and the method of financing. Trade-offs were also acknowledged as important: with a focus on economic growth also regarded as necessary to fund many of the social and environmental priorities.

4.4 Net Zero Carbon

Scotland has legislated for net-zero greenhouse gas emissions by 2045^{ix}. There are also ambitious interim targets which include achieving a 75% reduction of greenhouse gas emissions by 2030. This commitment puts Scotland as only one of six countries* that has legislated for NZC by 2050. While this has set the policy direction, there is a recognition that the magnitude and pace of implementation will need to change to achieve this target; and

First Minister quote from 2018-19 Programme for Government announcement:

"We will make it our mission to steadily increase annual infrastructure investment so it is £1.5 billion per year higher at the end of the next Parliament [2025-26] than in 2019-20.

This bold mission will increase Scottish Government capital investment by an additional 1% of current Scottish GDP and to achieve it we will need to continue to innovate in our models for investment and work across the public sector. On our current estimates that would mean around £7 billion of extra infrastructure investment by the end of the next Parliament."

Source:

(Scottish Parliament, 2018)¹ source: <https://sp-bpr-en-prod-cdnep.azureedge.net/published/2019/1/15/Scottish-Government-infrastructure-investment/SB%2019-02.pdf>

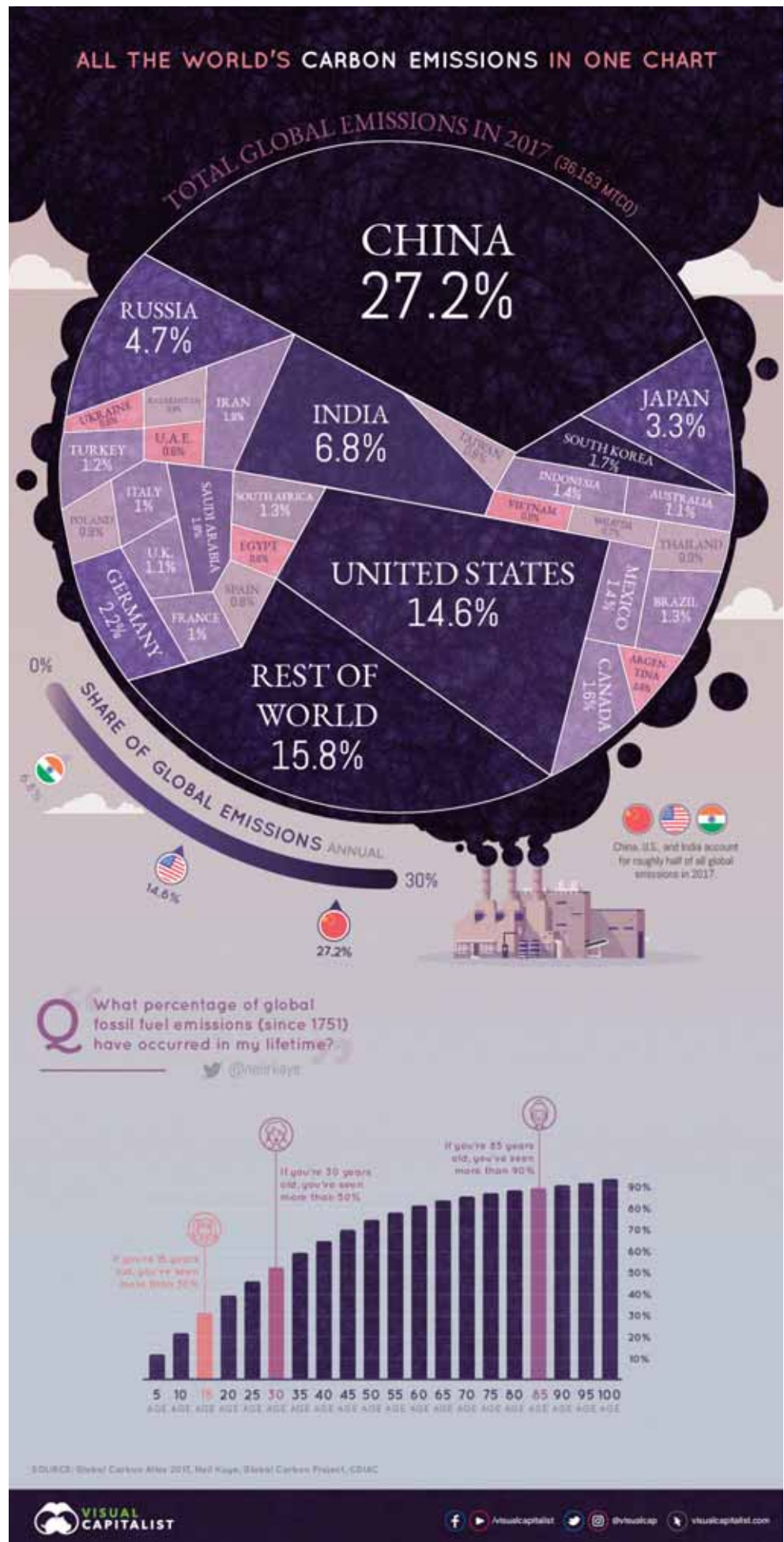
that progress is needed to address sectoral carbon reduction challenges, as well as structural and system barriers to change.

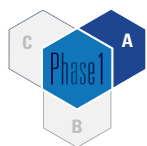
To provide a path to NZC, The Climate Change Plan 2018-32 (CCP) identifies key actions, currently for 2032 emission targets. The First Minister has committed to updating the CCP, to reflect the Climate Change Act, within six months of its Royal Assent. Much has already been achieved, with the recent Eighth Report^{xi} on progress, noting that in 2017 Scotland had reduced its emissions by 47% from the 1990 baseline. In addition, in 2017 Scotland generated 68% of its electricity requirements from renewables.



World's Carbon Emissions

Source:
www.visualcapitalist.com/all-the-worlds-carbon-emissions-in-one-chart/





Part A:
Context & Key Drivers
(continued)

Aventia Consulting undertook a desktop study into the relationship between infrastructure and carbon, considering both embodied and lifecycle/operational carbon. The full report is at Appendix L. Infrastructure was estimated to account for 53%^{xii} of total UK emissions in 2013, putting it front and centre in the requirement for decarbonisation. Without significant action this is set to grow to 90% by 2050 as other sectors decarbonise, and asset construction in particular takes a greater share of remaining emissions. The current 53% includes the more narrowly defined economic infrastructure used by the UK National Infrastructure Commission (NIC), therefore it is likely to be higher in Scotland, with its wider infrastructure definition. In terms of investment requirements and life expectancy, infrastructure is a long-term intergenerational asset. For example, it is estimated^{xiii} that of the current 2.5 million homes in Scotland, 80% will still be in use in 2050. Moreover, 75% of the current housing stock was built before 1982, with 20% being built before 1920, making these properties at least 100 years old. In addition, infrastructure is interdependent e.g. homes and schools need roads and utilities. It is anticipated that this interdependency will continue to grow as we move through the transition to low and zero carbon solutions, as is playing out now for energy and transport.

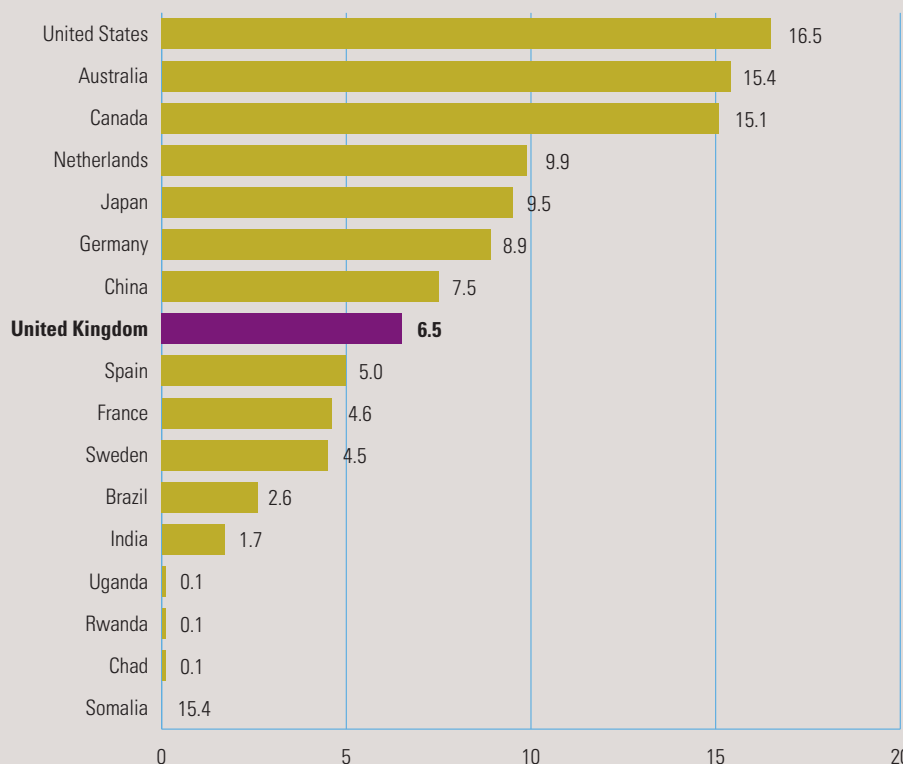
This means that no single area of infrastructure can be considered in isolation.

The scale of infrastructure's role in emissions makes decarbonisation of infrastructure a priority, however the interdependency and long-term nature of much of our infrastructure also makes decarbonisation complex and often challenging.

Aventia's review suggests that new appraisal and financing models need developed to work with the interdependence of infrastructure classes, including the interface between old and new assets, as well as the interactions between sectors and across the economy. Aventia note that Scotland is in a good position, primarily due to electricity decarbonisation and good progress on raising awareness of adaptation, building capacity and long-term decision-making to respond to climate change challenges. However, areas noted as requiring more progress are: transport, agriculture and heat for buildings.

Domestic transport is the most carbon-intensive sector; it is as carbon intensive now as it was in 1990. Total vehicle kilometres on Scotland's roads increased by 37% from 35bn in 1993 to 48bn in 2017, with the volume of traffic on major roads in Scotland more

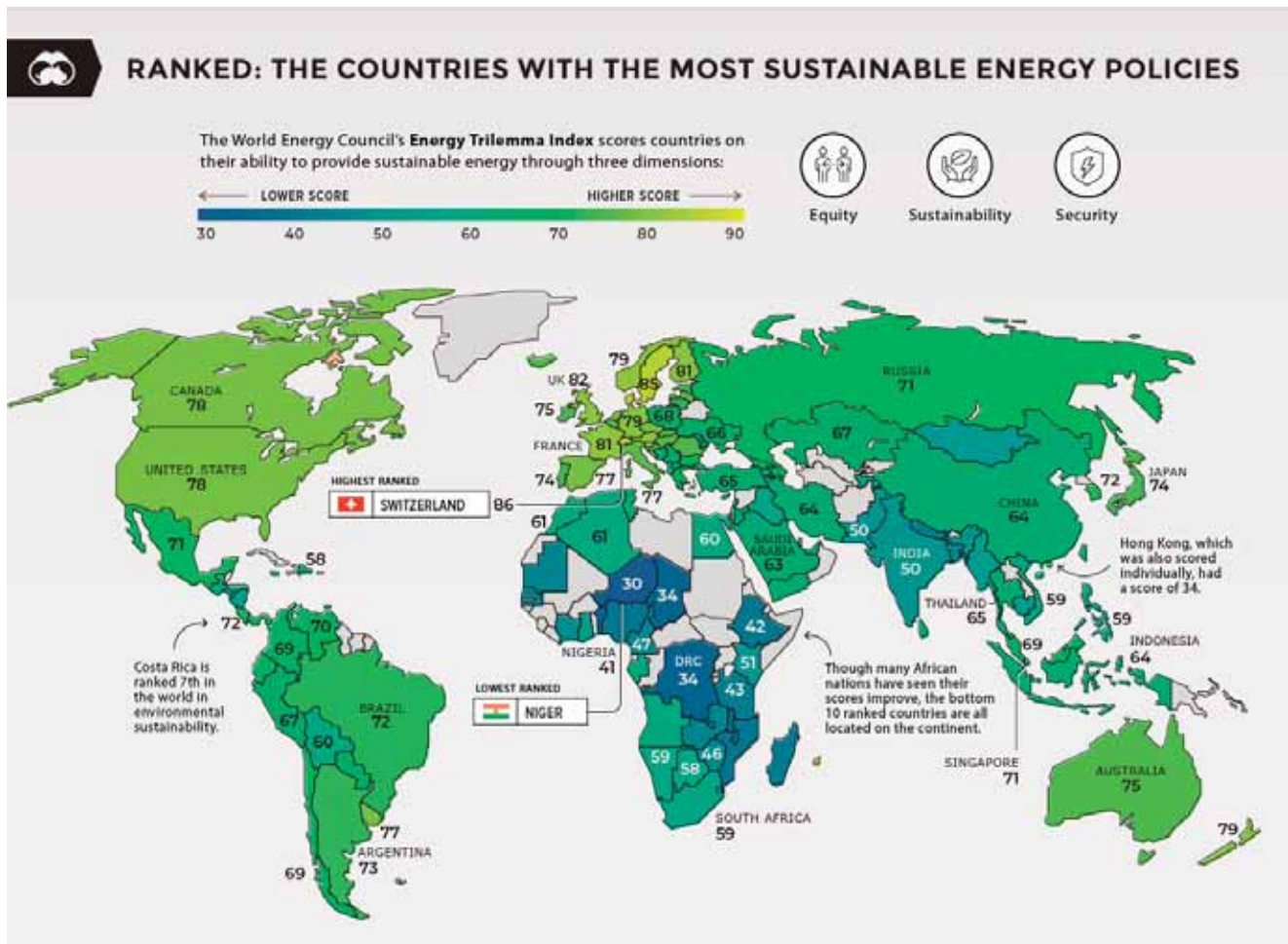
*CO2 emissions per capita
(Metric tonnes per capita)*



Source:

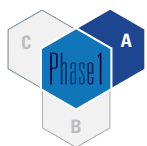
World Bank - EN.ATM.CO2E.PC

<https://www.economicshelp.org/blog/10296/economics/top-co2-polluters-highest-per-capita/>



than doubling since 1975. In the main, public transport use is moving in the wrong direction, with both bus travel and cycling decreasing as a proportion of trips made; with only train use increasing. In contrast, car and air travel are increasing. To illustrate, in 2017 journeys to work by car made up 63% of all journeys, while 10% were by bus and 5% by train. The rapid pace of change in transport and mobility is likely to bring significant developments in fleet electrification, connectivity, automation and shared mobility, to reduce the carbon impact of travel. These developments make transport planning for a NZC future extremely challenging. Part B goes into greater detail on some of these future scenarios, as well as the wider transport challenge. Overall, however, the message is clear: we need to use new and different scenario modelling techniques to better align strategy so that it delivers NZC. Within this there are key questions for policymakers about the roles of incentivisation, regulation, pricing and other tools to achieve the changes in behaviour that will be required to meet the NZC targets.

Turning to energy, Scotland has an integrated strategy underpinned by significant public investment, although as a reserved policy area, liaison with UK Government and regulators is clearly essential. This investment, alongside building standard changes, has been associated with increased energy efficiency, with energy consumption in 2015 down by 15.4% compared with the mid-2000s at 157 TWh. Despite this however, in 2016 heat was 54% of total final energy consumption, compared to 25% for transport. This is slightly skewed to industrial/commercial consumption at 59% versus 41% for domestic. These figures are higher than the rest of the UK. As with transport, there is change ahead and key decisions to be made around primarily electric or primarily hydrogen futures. The decarbonisation of heat is anticipated to rely on one or both of these developments, alongside district heating.



Part A:
Context & Key Drivers
(continued)



As a result of the scale of energy used for heat, housing and related space heating are the dominant building sector challenges. This is primarily an issue of retrofit, as building standards continue to have a key role in reducing new-build emissions that include targets to end gas-connection by 2024. Fuel poverty also continues to be a policy concern, with public programmes to remove poor efficiency of homes as a driver for fuel poverty. Aventia suggests that there is an economic stimulus argument to extend this support more widely.

There are also less obvious areas of emissions. For example it has been estimated that at a global level digital emissions are increasing fairly quickly and in 2018 were 3.7% of the annual total; and expected to rise to 4% by 2020. Contextualising this, the same source suggests that civil air transport accounted for was 2% and light vehicles 8% globally^{xlv}. The fact that the digital energy used is primarily within the devices themselves raises distinctive challenges for public policy.

The sectoral challenges are clear, however research suggests that actions for both NZC infrastructure and climate change are “piecemeal, unsystemic and of inadequate scale^{xliii} and the Committee for Climate Change has identified transport, heat, carbon capture and storage, housing, buildings, industry and afforestation^{xliv} as all having policy deficits. “Clear, stable and well-designed policies” are needed to reduce emissions further. While it is noted that Scotland has shown significant leadership – globally as well as nationally, the CCC concludes that more needs

to be done to ensure the appropriate governance and planning structures are in place. It is recognised however, that establishing this is not easy. In a recent report by the RSE on the challenges facing energy policy in Scotland, the authors summarised the “quadrilemma” of competing energy policies: addressing climate change; ensuring affordability; providing energy security; and developing energy policy which is acceptable to the public, economically sustainable and just^{xv}. This further emphasises the interlinked policy areas of inclusive economic growth and net zero carbon. The Scottish Government established the Just Transition Commission^{xvi} to guide and manage this relationship, ensuring that the opportunities of NZC are maximised, but equally to mitigate against any negative impacts. Their interim report is due to be published in early 2020.

4.5 Inclusive Economic Growth

IEG Concept

The concept of achieving Net Zero Carbon by a specific date in order to meet emissions and climate change obligations is extremely challenging, yet also clearly defined. In contrast, the concept of Inclusive Economic Growth is less definite given its complexity and implications across all aspects of the economy and society. IEG can therefore be expected to evolve over the period in which decarbonisation must be achieved.

The Scottish definition of IEG is:

Growth that combines increased prosperity with equity, that creates opportunities for all, and distributes dividends of increased prosperity fairly

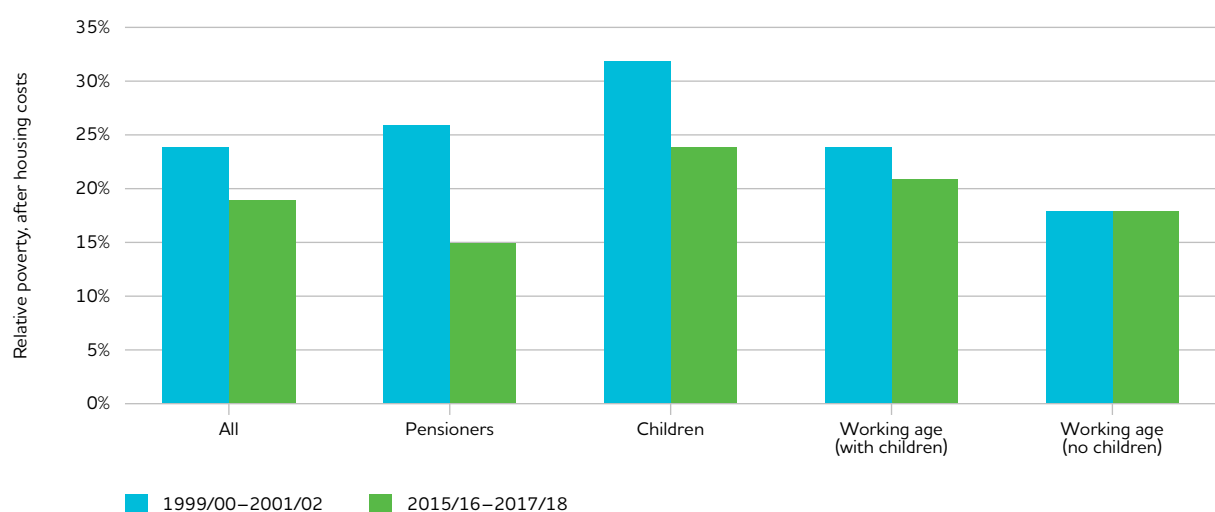
This definition could be interpreted as being interested in both pre-investment appraisal and post-investment review to influence inclusion i.e. creating opportunities through growth policies, but also with a redistributive element. The earliest reference to IEG was in Scotland's 2015 Economic Strategy. The strategy summarised the approach through the two pillars of increasing competitiveness and tackling inequality. While no definition of IEG was provided in this document, aspects covered included fair work, access to the labour market and equity, including spatial equity. This is useful in identifying measures that help contextualise IEG, including poverty, advancing equality of opportunity, employment, and fair work. There are also spatial considerations of inclusion be that local, regional or national; urban, semi urban or rural.

The interlinked challenges of poverty, employment and fair work

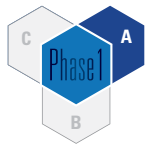
are also highlighted by the Joseph Rowntree Foundation (JRF) in their recently published Poverty in Scotland^{xvii} report. They encourage the Scottish Government to use all the tools at their disposal to ensure those on low earnings have sufficient financial gain from their work, while acknowledging that the reserved matter of employment law reduces some of the levers available to the Scottish Government in addressing poverty.

The Commission asked researchers at the University of Strathclyde's The Fraser of Allander Institute (FAI) to review the evidence about the links between infrastructure and both traditional economic growth and IEG. Their literature review is at Appendix K. Their work shows that while theory supports a range of roles for infrastructure, the ex-post evaluation evidence is weak or unavailable. The recurring inability of analyses to clearly isolate the role of infrastructure from wider service and other system influences is a particularly important challenge. Possibly due to the emerging nature of the concept of IEG, FAI were also unable to find any study that demonstrated the link between IEG and infrastructure, including any evaluation by the Scottish Government. The available evidence in this area was seen to relate to developing nations and specifically inequalities and infrastructure.

The largest falls in poverty levels seen in the past 20 years have been among pensioners and children, but children remain the highest-risk group



Source: JRF analysis of the Households Below Average Income (HBAI) dataset. These figures may differ marginally from those that the Scottish Government publishes due to differences in the end-user licence data that is provided for public use through the UK Data Archive.



Part A:
Context & Key Drivers
(continued)

The challenges in conclusively linking economic growth and infrastructure included issues of causation and attribution. For example, the often-assumed role of infrastructure in stimulating economic growth is just as likely to be due to richer countries ability to invest more in higher quality infrastructure and public services. This means that it cannot be concluded that it is infrastructure investment alone that has achieved growth. Instead infrastructure is more appropriately seen as one part of a wider interconnected system, including the services that make use of it and the range of economic and social activities that the overall provision of infrastructure makes possible. In addition, the long-term nature of infrastructure can make short-term impacts and benefits difficult to identify.

FAI reviewed a number of individual sectors, to assess the evidence on the correlation between infrastructure and growth. Transport evidence was mixed and the FAI noted that economic displacement is a strong consideration for transport investment which could be the basis for a conscious policy to re-align regional development. In terms of digital, a 2012 OECD study related a 10% increase in

digital activity, to a 0.2-1.6% GDP growth. In terms of housing, it is noted there is an accepted link between housing and economic benefit where it is of the right standard and type. So again, it depends on context and efficiency of investment.

As a result of the weaknesses in available research, the review focused on the theory.

Theoretically, the ways in which infrastructure can support IEG are more indirect. They may include improving the supply side of an economy, better environmental outcomes, and correcting market failures, especially as these tend to impact the most disadvantaged in our communities.

The FAI summarise that sectorally housing, energy and transport infrastructure may have the strongest role to play in inequalities and IEG. The links to housing and energy, are due to their costs, while transport is key for providing access to employment. Overall however, the evidence establishes the need for a system-wide approach if the structural inequalities that exist in society are to be tackled. Many causes of poverty and exclusion in the UK have a limited connection to infrastructure provision directly: as the JRF



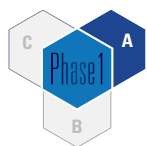


notes, unemployment and low paid jobs, low levels of skills, an ineffective benefit system, discrimination and relationship breakdown all play a large part.

Finally, there is also the possibility of significant trade-offs between pro-growth and pro-inequality infrastructure measures, at least in the short-run. Understanding and managing trade-offs was a persistent theme among stakeholders and in the FAI review. Given the limited extent of current evidence, important work remains to be done to fully establish how infrastructure investment should best be directed to support IEG priorities, within a wider well-functioning system.

This complex picture aligns with our stakeholder views. There was a strong commitment and agreement to prioritising IEG. However, it was recognised that implementing actual policy towards IEG outcomes would be challenging. While the Scottish Government's Scottish Centre for Regional Inclusive Growth^{xlviii} (SCRIG) has made significant progress in developing indicators^{xlviv} and measures for IEG, there was a desire expressed for more guidance, including better understanding of trade-offs and the application of available tools. This included the relationship between IEG and infrastructure.

Key issues summarised in this section are incorporated into a number of recommendations at Part C, most specifically those relating to Leadership, Place, and Heat and Transport.



Part A:
Context & Key Drivers
(continued)

5. Future Proofing

5.1 Introduction

In a world facing a climate emergency, global economic and technological disruption, future-proofing our infrastructure is a key requirement. Infrastructure is a long-term asset, with 80%^{xviii} of our current systems likely to still be in use in 2050, which makes the optimal management of those existing assets essential. Resilience to shocks was raised by our stakeholders as a key concern, with opinions that we must do things differently to manage these threats. Scotland has already made a firm commitment to achieving NZC in an ambitious, fixed time frame, and has established the Just Transition Commission to begin the task of planning to deliver the ambitious agenda in practice. However, stakeholders were clear in their responses to the Commission that there was a need to improve the alignment of policy measures to ensure clear actions are implemented.

5.2 Resilience & Adaptability

Infrastructure resilience and adaptability was a key area that many stakeholders raised in our consultation sessions. Comments ranged from specifics around climate resilience and how flood management is being co-ordinated to the wider issue of the extent to which infrastructure design and investment is planned to be resilient in the first place. Resilient and adaptable infrastructure systems are required to meet a diverse range of needs, including the ability to respond quickly to low probability high impact events, and have sufficient redundancy in the system to manage and mitigate the impact of disruption whilst it is happening. There are inevitable vulnerabilities across our infrastructure stock, and establishing a detailed understanding of these and their impacts is an important first step in developing a genuinely system-wide approach to infrastructure management that can achieve real resilience and adaptability.

“Infrastructure can facilitate business growth by improving productivity through enhanced digital connectivity; connecting employers to new markets, suppliers and partners; or increasing their access to talent and labour”

SCDI

Scottish Government’s 2nd Scottish Climate Change Adaptation Programme^{xvi} identifies 7 key outcomes, including infrastructure resilience. In addition, there is a statutory UK-wide requirement for the Committee on Climate Change to prepare Climate Change Risk Assessments^{xvii} every 5-years, again including the risks to infrastructure. A clear step in this process is to take action where straightforward interventions are evident to improve resilience, such as increasing prevention measures and providing back up support for key potential points of failure to minimise potential system breakdown. Indeed, ensuring a system-wide approach is critical if we are to move beyond asset specific risk management approaches to identifying the key interdependencies that underpin genuinely resilient design and planning of infrastructure.

5.3 Business Impact & Opportunity

While the challenges of identifying the impacts of infrastructure on the economy and IEG have already been detailed, theory suggests a range of business benefits. This includes providing international connectivity and access to markets and services, which are some of the drivers identified by the Scottish Government within the Commission’s remit. For business, appropriate and resilient infrastructure means ensuring our goods can get to market and people can get to work. This objective requires ongoing investment in existing infrastructure as a minimum. That this investment also needs to reflect NZC targets and the impact of climate change is an essential consideration which should be central to the decision-making process.

The FAI report on realising Scotland’s potential in 2050^{xix} identified the important role of international trade, whereby exporting firms are more productive, innovative and competitive over time; and countries with a stronger export base are often more resilient. For example, businesses that export account for 60% of UK annual productivity growth and are, on average, 70% more productive than businesses that do not export. Despite the noted benefits however, Scottish exports are low. Including UK exports, Scotland has a ratio of exports to GDP of c53%, the percentage of international exports is only 20% which is less than half of the EU average of 45% and also lower than the OECD average of 28%.

To contextualise some of the challenges, it is useful to reflect on the components of competitiveness and the UK’s standing internationally. The World Economic Forum defines competitiveness as “the set of institutions, policies and factors that determine the level of productivity of a country”^{xx}. Reflecting this broad definition, their Global Competitiveness Index covers 98% of the world’s



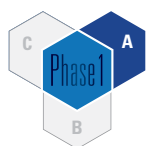
“Strengthening the resilience of our transport network and minimising the level of disruption during extreme weather is vital to all businesses, particularly those that rely on the ability to move people and goods across Scotland and further afield”

CBI Scotland



economies, allowing for an international comparator of the UK’s position. While this does not explicitly include Scotland, the UK ranking is a helpful indicator of some of the strengths and weaknesses in Scotland. Within this context, the UK Strengths are noted as: macroeconomic stability (maximum score), infrastructure (11th), and financial system development (7th). Areas for improvement are: the employability of graduates (11th), digital skills among the workforce (29th), ICT adoption (31st) and training and reskilling opportunities (29th). Notably, the infrastructure measure only covers the limited sectors of transport, electricity and telecoms. Within this group, some components of ICT adoption (a measure of ICT diffusion through broadband and mobile-telephony subscriptions and use) are highlighted as specific areas for development. Within this category, the UK is ranked 79th for fibre internet subscriptions and 70th for mobile-cellular subscriptions. However, the breadth of the Index signals that infrastructure’s role for competitiveness is only part of a much wider system.

Closer to home, a David Hume Institute review^{xxi} shows that Scotland’s productivity in 2018 was only behind London and the South East, however for Scotland to move into the top quartile of the OECD table, it would need to increase its productivity by approximately 20%. Challenges noted included: little employment growth in productive industries, low business investment and R&D spend, lower exports than the EU and OECD averages and from a narrower base. Insufficient use of the well-educated workforce, seen in low levels of management quality and small low-productivity firms, is also a cause for concern, as are declining survey scores for Scottish school education and reducing working age population. In the context of infrastructure, business investment weaknesses include a lack of investment in machinery, equipment and capital stock, with Scottish workers operating with less of these assets than their most productive OECD counterparts.



Part A:
Context & Key Drivers
(continued)

Exports



The top 3 sectors make up 40% of all exports in 2017

The UK, followed by Europe remain Scotland's largest trade partners

Businesses that export account for 60% of UK annual productivity growth and are, on average, 70% more productive than businesses that do not export

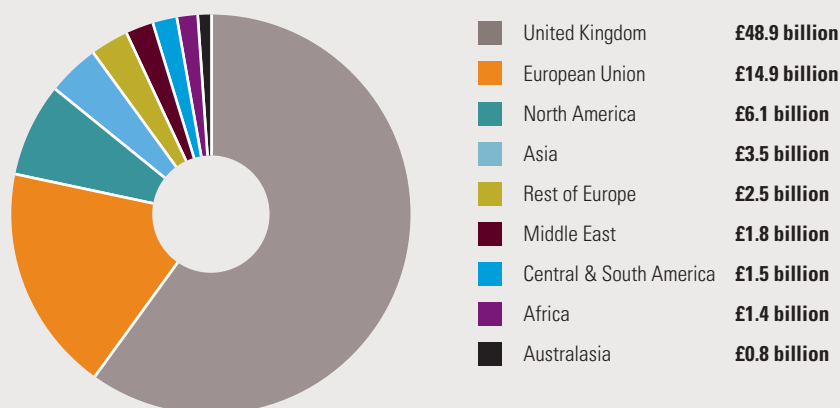


In 2017, Scotland showed an increase in international exports (excluding oil & gas) to

£32.4 billion

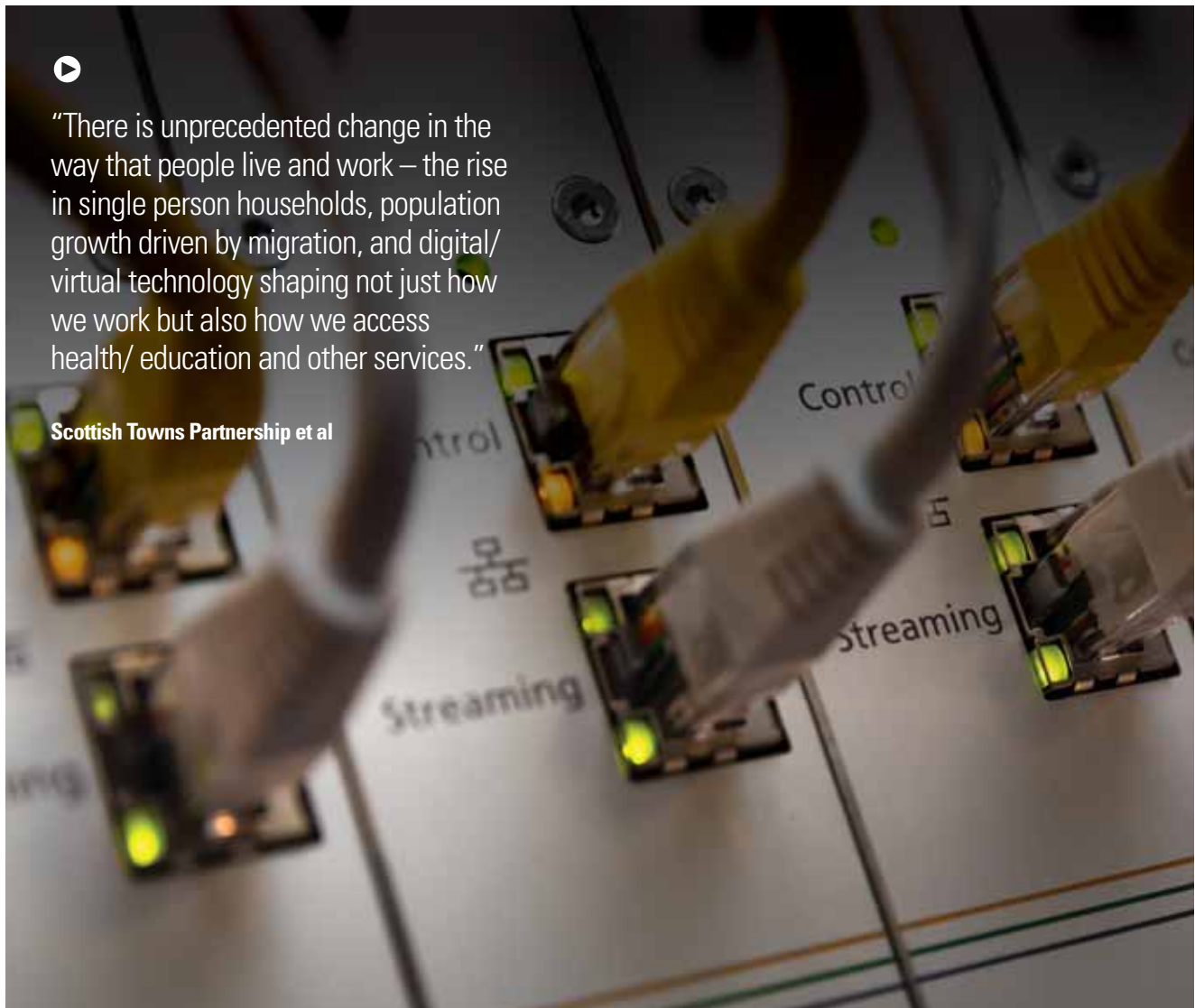
(an increase of £1.9 billion (6.3%))

Scotland's export partners by value



Top three exporting sectors





“There is unprecedented change in the way that people live and work – the rise in single person households, population growth driven by migration, and digital/virtual technology shaping not just how we work but also how we access health/ education and other services.”

Scottish Towns Partnership et al

5.4 Technology & Data

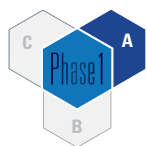
Future proofing for technological and data changes is also essential. As seen above, technology and ICT adoption are key components of competitiveness and ensuring both climate and economic resilience for these assets is essential. Stakeholders identified some key weaknesses in the fixed and mobile internet and data communications infrastructure, including subsea cabling and data centres. Perhaps unsurprisingly therefore the the UK’s adoption of ICT and in particular fibre internet is low. Yet, there are concerns around technology inequality affecting the most disadvantaged within our society. As with housing, it is important that investment in digital also improves access for those currently excluded, such as disabled people and those in our most deprived communities. While, as previously noted, digital technology is an increasing area of energy consumption, primarily within the charging for battery-supported devices, but also in areas such as data centres that have large energy needs.

The UK Industrial Strategy^{xxii} explains that the “fourth [industrial] revolution is characterised by a fusion of technologies that is blurring the lines between the physical, digital and biological worlds”. It is expected to disrupt every sector, creating both opportunities and challenges. Scottish Enterprise in its 2019-22

strategy, *Building Scotland’s Future Today*, also identify the opportunities and challenges of this revolution. Opportunities include low carbon innovation, taking advantage of Scotland’s rich natural environment, and existing strengths in data analysis and insight.

Scotland’s digital strategy, *Realising Scotland’s Full Potential in a Digital World*^{xxiii} notes that digital has the same importance of other utilities such as gas, electricity and water. It details an action plan which includes, amongst others, developing the resilience of the digital infrastructure. Part of that resilience will require better subsea connectivity as well as the expansion of the data centre sector within Scotland.

There are however concerns around the unequal impacts of the fourth industrial revolution. Reflecting this, in 2018 Scottish Government and the Scottish Trade Union Congress jointly produced a report on how changing technology may impact on the Scottish labour market^{xxiv}. While setting out in some detail the global debate and projections and how this may affect Scotland, this study notes there is little agreement on how technology will continue to develop and impact on our economy. Indeed, there is little evidence to date of significant technological disruption in Scotland, nor is there likely to be in the medium-term.



Part A: Context & Key Drivers (continued)

Irrespective of whether we will see significant disruption in the short to medium term, technology will have an increasing role in our society. There are some clearer weaknesses in our digital infrastructure, such as the provision of full fibre and mobile coverage, as well as issues of resilience around international connectivity, but there are economic opportunities, in areas of data and delivery of effective public services. Ensuring Scotland embraces and exploits the opportunities fairly must remain a key focus.

5.5 Accessibility & Mobility

The Scottish Government estimates that 32% of adults (and 10% of children) have long-term conditions that are limiting. The number of people with disabilities is growing as populations age and chronic health conditions increase globally^{xxv}. Infrastructure is critical to social functioning with impacts on earnings, wellbeing and education. Accessible infrastructure provides a barrier free environment, independence, convenience and safety for disabled people.

Disabled people's rights to independent living are enshrined in the UN Convention on the Rights of Persons with Disabilities. In Scotland 0.7% of local authority housing and 1.5% of housing managed by Registered Social Landlords is accessible for wheelchair users^{xxvi}. The demand for wheelchair-accessible housing is expected to increase significantly: a projected 80% increase in the population of wheelchair users by 2024, with an increase in unmet needs from 17,226 to 31,007 households^{xxvii}.

The Equality and Human Rights Commission noted in their 2018 report^{xxviii} that 'there was strong evidence to the inquiry that housing that meets disabled people's requirements will save on health and social care costs in the future, as well as considerably

lowering the cost of adaptations when they are needed. The Commission also noted that disabled people who were inappropriately housed were 4 times less likely to be in work.

At the Commission's thematic round table on accessibility and mobility, participants identified key infrastructure concerns in using public transport, housing, streetscapes and poor access to information and services. Despite the excellent work of the Access Panel Network^{xxix} across Scotland to address access issues in the built environment, as well as improving social inclusion for disabled people; the impression was that often disabled people and their representative organisations were not being involved in co-design. In addition, resources for both Access Panel Networks and public bodies was limited. The principle view expressed was that to enable disabled people to fully contribute to society requires accessible infrastructure being in place from 'door-to-door' and will require Scotland to look at working closely with disabled people to design built environments which works for them and society as a whole.

Key issues summarised in this section are incorporated into a number of recommendations at Part C, most specifically those relating to Leadership, Place, Making the most of existing assets, Heat and Transport and Digital & Technology.

6 Infrastructure Planning & Regulation Framework

6.1 Introduction

Scotland's planning landscape is comprehensive, incorporating guidance and decision-making at a national, regional and local spatial level. The successful delivery of policy priorities such as IEG and NZC require appropriate planning and regulation systems.



The 2019 NIC report, Strategic Investment and Public Confidence, notes some key regulatory changes to support the challenges of NZC, weather changes and increased digitalisation

Stakeholders were concerned that these systems do not currently address these dual priorities sufficiently, although it was recognised that change is underway, reflecting the changing policy emphasis. In addition, another consistent message from stakeholders was the desire to see these frameworks evolve to facilitate what is often termed an Infrastructure First approach.

6.2 National Planning Approach

National Planning Framework 4 (NPF4)^{xxx} is the long-term spatial plan for Scotland, which is currently in development and will supersede the current NPF3. This will include establishing where infrastructure is needed to support sustainable and inclusive growth. This next iteration to NPF4 is expected to see an evolution of priorities. This includes a longer-term timeframe and regional spatial strategies to reflect the evolution of decision making across spatial scales. NPF4 is also likely to incorporate the latest policy position for NZC and IEG more fully.

Research by Ironside Farrar^{xxxi}, on behalf of the Scottish Government, reviewed the role and use of Scottish Planning Policy, and how it could be developed in light of the Planning (Scotland) Act 2019 and thereby influence NPF4. Recommendations included a greater emphasis on placemaking at the forefront of development, and that NPF4 should be more directive in ensuring principles are implemented. This includes mitigating for conflicting priorities, such as housing targets, which are at times seen to undermine place principles. More broadly, an Infrastructure First approach should be encouraged, which facilitates longer term strategic planning and addresses future transportation, health, education and community facility requirements. The Infrastructure First principle also allows for improved infrastructure planning at a national and regional level, through greater co-ordination and involvement of all stakeholder in the planning process. This includes developing greater clarity of the infrastructure needs of an area, to reduce barriers to investment and development.

As well as the national spatial plan, all planning authorities have a duty to prepare local development plans, joining up land use and infrastructure, and improving place outcomes, supported by public engagement. The NPF4 is expected to be drafted for consultation in September 2020, with final version before Parliament in 2021.

6.3 Regulatory Framework

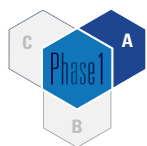
Just as NPF4 needs to further develop an Infrastructure First approach and a greater embedding of inclusive net zero carbon

“The emergence of new lifestyles with mobility, property and technology being provided as universal services rather than through individual acquisition needs to be part of our longer-term planning. Infrastructure planning needs to respond to the needs of an agile workforce contributing in different ways and in different places.”

Scottish Cities

economy priorities, the utilities regulatory regime for Scotland also needs to evolve. The need for a regulatory regime that is focused on future long-term investment requirements as well as appropriate oversight of standards of delivery was highlighted by a number of stakeholders, and reinforced during the roundtable engagement process. The views expressed were also reflected in the recently published report^{xxxii} by the UK National Infrastructure Commission (NIC) on the regulatory system for utilities infrastructure that incorporated water, energy and telecoms. Water regulation is a devolved matter while energy and telecoms regulation are reserved, therefore the recommendations of the NIC work are mainly relevant to energy and telecoms. The report identified some key regulatory changes to facilitate the three challenges that they highlighted in their 2018 National Infrastructure Assessment: NZC, weather changes and increased digitalisation. The assessment concludes that reform of the current regulatory system is necessary to address these challenges, and recommendations were based on (a) facilitating strategic investment and (b) building consumer confidence. Recommendations to facilitate strategic investment include: long-term investment planning; taking direction for strategic planning from devolved nations; updating regulation to include NZC obligations as well as the need for a long-term approach to resilience; and facilitating greater competition in delivery of infrastructure markets. Recommendations to build public confidence include: a better balance of risk and reward between consumers and investors; preventing price discrimination for the consumer; greater government guidance on priorities in terms of distributional impacts; and improved co-ordination of regulators. Both of these recommendation areas are relevant to addressing future requirements and outcomes aligned to IEG and NZC.

Key issues summarised in this section are incorporated into a number of recommendations at Part C, most specifically those relating to Leadership, Place, Heat and Transport and Regulation.



Part A:
Context & Key Drivers
(continued)

7 Decision-Making & Prioritisation

7.1 Decision-making

Scottish Government approach

For infrastructure investment the Infrastructure Investment Plan^{xxxiii} (IIP) is the key Scottish Government publication that sets out priority investments and longer term requirements. Refreshed at periodic intervals, the current plan was published in 2015 and a new plan is anticipated in 2020. The 2015 plan identified a number of guiding principles which focused on sustainability and low carbon; competitiveness and inequality; employment; and public services. It is anticipated that these guiding principles will evolve, to more fully reflect the inclusive net zero carbon economy priorities.

The implementation of the IIP is scrutinised by the Infrastructure Investment Board (IIB)^{xxxiv}. The IIB “aims to strengthen strategic direction, prioritisation and oversight to ensure coherent advice and successful delivery of an effective, fiscally sustainable programme which maximises Ministers’ ambition for infrastructure investment^{xxxv}” Within their remit, the IIB highlight the important aligning of the IIP across government’s reporting framework and annual timeline:

- > Infrastructure Investment Plan Annual Progress Report (April)
- > Medium Term Financial Strategy – Within four weeks of UK Spring Statement (May/June)
- > National Performance Framework and Scotland Performs published (June)
- > Major Projects Reports to Parliament, (October/March)
- > Programme for Government (September)
- > Scottish draft Budget (November/ December)
- > Scottish Futures Trust Corporate Plan, Business Plan and Annual Reports
- > Scottish National Investment Bank Implementation Plan and consultation exercises

The Commission remit did not include a consideration of the funding and financing of infrastructure, or include a funding envelope. As noted in the earlier OCEA paper, these are key components in ensuring that infrastructure investment is an efficient use of public money and therefore require careful consideration. It is worth noting that infrastructure investment is made by: the Scottish Government and its agencies, local authority-led investment, in areas such as housing; private sector-



The 2019-20 Budget defines the baseline

£5,195.8m

and sets out the ambition to increase annual infrastructure investment to

£6,750.8m

in 2025-26



Since 2007

£11.1bn

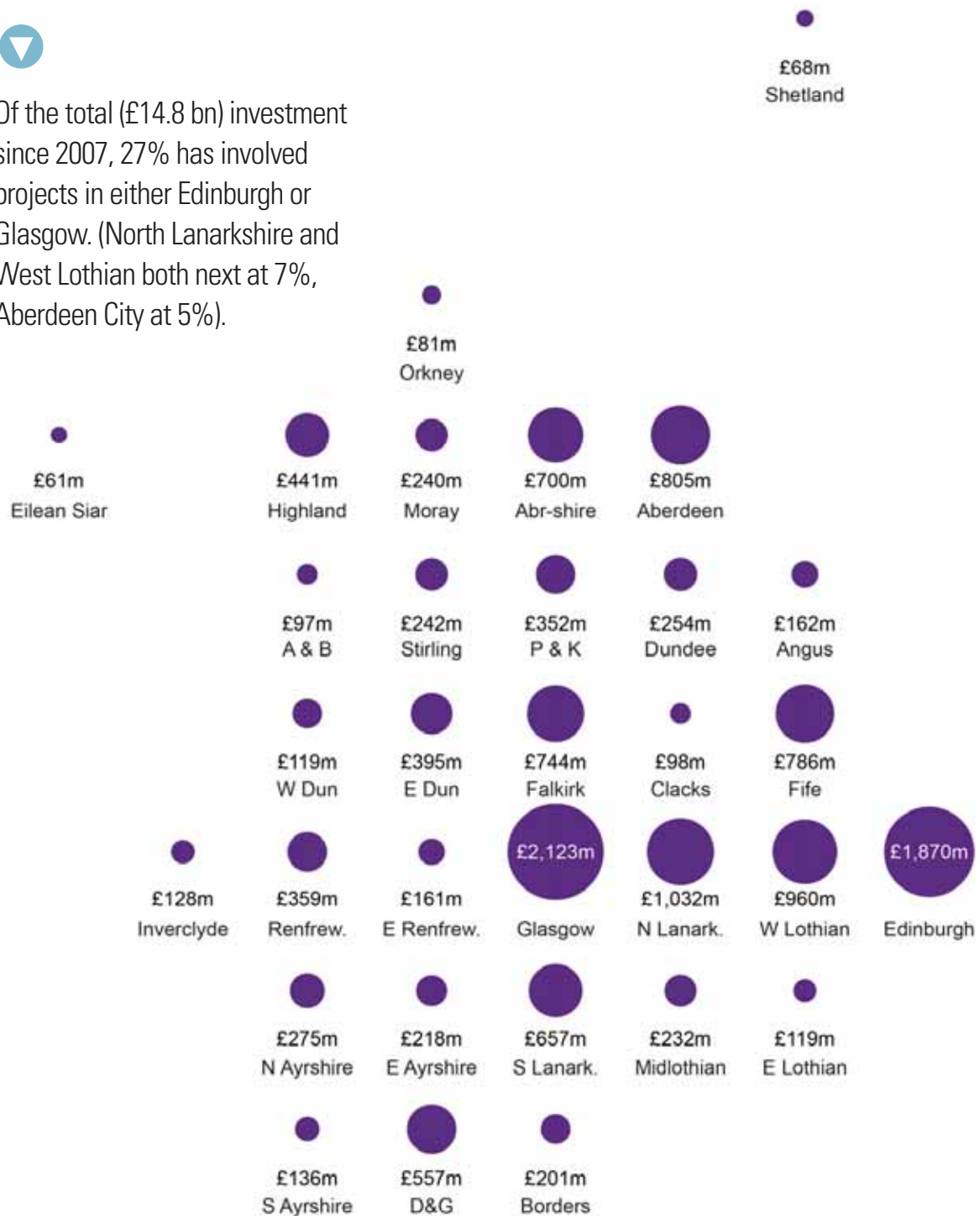
of Scottish Government led infrastructure projects have been completed with £3.7bn of capital projects currently under construction.

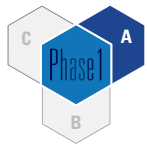
Around half of the pipeline projects are schools (34), schools account for less than 1/5 of the total capital value of projects.

In value terms 50% of the total pipeline is accounted for by road and rail projects



Of the total (£14.8 bn) investment since 2007, 27% has involved projects in either Edinburgh or Glasgow. (North Lanarkshire and West Lothian both next at 7%, Aberdeen City at 5%).





Part A: Context & Key Drivers (continued)

“A long-term approach to infrastructure policy making will help deliver sustainable investment, provide a clear long term outlook to potential investors, encourage industry to plan resources to deliver work and help reduce industry cyclicity.”

Ayrshire Councils

led investment, in areas such as digital infrastructure; and investment by Scottish Water, the cost of which is met by user charges. This is important in reflecting that decisions on investment are made not only by different stakeholders, but also at different spatial levels. The interaction in prioritising investment is therefore important to consider.

Place

The spatial levels for decision-making are clearly important and can be seen to have developed in recent years. Scottish Government policy has a focus on place-making, supported by a number of tools, such as the Place Principle^{xxxvi} and Place Standard^{xxxvii}. Effective integration of these standards within the decision-making process was highlighted by stakeholders; alongside managing the interaction of spatial decision-making more generally.

The Place Principle defines place as:

... where people, location and resources combine to create a sense of identity and purpose, and is at the heart of addressing the needs and realising the full potential of communities. Places are shaped by the way resources, services and assets are directed and used by the people who live in and invest in them

One size does not fit all. The Principle promotes a more joined-up and collaborative approach to services, land and buildings within a place; while the Place Standard is a tool designed to support assessment of places and what is needed. Assessment areas are again broad, including public transport, work and the economy, influence and sense of control, and feeling safe.

Place can also be considered at different spatial scales. While there is no statutory requirement to use the Place Principle and

Place Standard, the Scottish Government has legislated to embed local involvement in decision-making. This is both via Community Planning Partnerships^{xxxviii} as well as democratic structures such as Community Council schemes^{xxxix}. Local authorities are central to both of these frameworks with a range of resources and mechanisms at their disposal, including their role as the local planning authority. Spatial decision-making is further demonstrated through regionalisation developments. Following the establishment of City Regional Deals^{xl}, an increased regional focus has brought together groups of authorities and their partners to understand and plan regional priorities. These Regional Economic Partnerships are in their infancy for many, they are following a different strategic planning approach, that encompasses not only issues previously covered by strategic development plans but also wider economic, social and environmental shared priorities. Reflecting this increased focus on the region, the Planning (Scotland) Act 2019 has introduced a requirement for all authorities to develop regional spatial strategies.

Beyond this, there is a growing recognition of place in the work of national agencies, including Transport Scotland and Scottish Enterprise, that infrastructure investments significantly impact on the quality of places and need to reflect the priorities of local people.

Place therefore is an increasingly referenced policy area, with implications and decision-making structures at different interlinked spatial levels. Making better use of available tools for place-making, while establishing appropriate co-ordination of investments at different spatial levels were both consistent stakeholder themes. Understanding trade-offs and the best-fit of priorities across areas needs to be part of this decision-making.

“It is important to acknowledge that the creation of high quality places where people wish to live, requires upfront investment in ‘hard’ infrastructure such as transport, utilities, and educational facilities as well as ‘soft’ infrastructure such as recreational open space, blue and green networks as well as cultural facilities.”

Homes for Scotland



Scotland's population has risen since 2000 and is projected to rise to 5.69m by 2041



Views of the Wider Public

Place highlights the importance of local influence of decision-making, to develop well-designed communities. The final area of research was undertaken by Ipsos Mori on behalf of the Commission. This sought to understand the opinion of the public, who are both users of infrastructure and often also contributors to its funding through taxation or user-charges.

Focusing on future priorities, users and participants prioritised infrastructure which impacted on their day-to day lives and their communities. A sense of fairness was often raised as a priority, with public infrastructure seen as having an universal level of importance, with the biggest impact on the greatest number of people. As such, healthcare facilities, education facilities, housing (in particular social housing) and emergency services were all seen to be important. Unsurprisingly therefore, thematic investment considerations highlighted a prioritisation of public services.

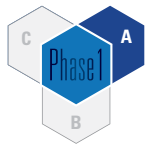
This research also confirmed public interest in making better use of our existing infrastructure assets. For example, conversations around existing assets emphasised the need for efficiency and

effective resource use, but also the negative impact of empty buildings on places.

Young participants gave a greater emphasis on support for solutions that will enable a zero-carbon future, although it was notable that this thread was not linked to support for the circular economy, perhaps suggesting a disconnect between the commitment to NZC and practice.

Reflecting the reality of budget decision-making, trade-offs were discussed. Public service provision tended to be prioritised over convenience, with increased travel acceptable, should the provision be of a higher quality than that available locally. Affordability of transport was considered more important than environmental considerations. Housing and access trade-offs were more mixed, with no clarity on the preference of affordability versus convenience of location.

Appendix I provides the full output from this research which took the form of 4 deliberative workshops, with 73 participants and an online survey, completed by 1,004 people. The deliberative engagement methodology is seen to be an informative and powerful approach, particularly when developing a long-term



Part A: Context & Key Drivers (continued)

view, with multiple potential trade-offs. More work is needed to engage our communities in what infrastructure within Scotland should comprise and where acceptable trade-offs may lie.

7.2 Prioritisation and Appraisal

Within this framework of prioritising infrastructure investment to drive an inclusive net zero carbon economy, a clear framework for investment decision-making and implementation is essential. In their report for the Commission, the FAI noted the need to improve the quality of data being fed into appraisal, to support investment decision-making. In parallel, the need to understand trade-offs, to manage the potentially competing priorities identified within the NPF has been highlighted. Developing a clearer route-map is essential.

HM Treasury's Green Book^{xi} continues to be the main public sector tool to appraise investment proposals. This system has continued to develop over time, with the most recent iteration seeking to provide greater clarity on how to effectively encompass carbon outcomes. Scottish sectoral appraisal systems based on the Green Book, include the Scottish Transport Appraisal Guidance (STAG) and the NHS Scottish Capital Investment Manual (SCIM).

The policy direction of travel within the context of the NPF, balances a diverse group of priorities. How potential trade-offs and conflicts across these policy areas are managed and subsequently prioritised is unclear. In addition, the extent to which our existing appraisal models sufficiently capture the pressing priorities of NZC and IEG was challenged by stakeholders. Aventia and others, for example, noted that the "hard-coding" of assumptions such as the primacy of drive-time as the key measure of accessibility appear to undermine STAG's flexibility to policy shifts.

On balance, to move towards NZC and IEG outcomes, what is needed, is a set of appraisal tools that are focused on these outcomes, in balance with other existing appraisal factors. This will in turn require better and different data, together with a greater element of cross-sectoral decision-making.

"...a greater focus on the measurement of wider economic benefit produced by projects... will allow far better prioritisation of investment to take place and better transparency of decision making."

NHS Lothian

"Economic outcomes and value for money alone can no longer be taken as the primary measure for decision making by the public sector. There is an opportunity for the Commission to instil a broader approach to infrastructure investment decision-making that incorporates social and environmental values alongside economic and financial criteria."

Scottish Towns Partnership

Understanding trade-offs and prioritising investment are the realities of policy and budgetary challenges. The Institution of Civil Engineers most recent publication^{xliii} on improving infrastructure decision-making, noted the importance of a clear framework, as well as considering affordability and undertaking ruthless prioritisation to allocate limited funds to those projects that bring the greatest development benefits over the long term.

A strategic approach is supported by international evidence. Australia^{xliii}, the International Monetary Fund^{xliiv} and National Audit Office^{xliv} amongst others, suggest that establishing an improved strategic approach to infrastructure decision-making is essential. They recommend that enhancements should focus on key areas such as: lead roles for a neutral assessor rather than a project promoter; real and active engagement of future users, customers and /or tax payers; careful consideration of investment priorities; requirements to publish evidence and assumptions; and proper evaluation of the projects post-opening to allow the actual outcomes to feedback into future decisions.

International evidence also tells us that best practice investment decision-making requires a clearly established framework that operates across sectors and portfolios, to enable these principles to be met.

Key issues summarised in this section are incorporated into a number of recommendations at Part C, most specifically those relating to Leadership, Place, and The role of the public.

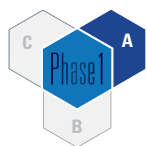
8 Summary

Scotland is a developed economy with a strong infrastructure base. As part of the UK, our economic infrastructure is ranked 11th out of 141 countries. However thinking of infrastructure in isolation does not help us to understand its role, current impact and wider benefits. Instead Scotland's policy direction of travel can be understood within the concept of an inclusive net zero carbon economy where infrastructure is one component of a wider and strongly interdependent system, equally concerned with social, economic and environmental outcomes to measure our success. This perhaps seems intuitive, however it does not immediately help decision-making, as very few of the appraisal techniques fully reflect these goals.

Our systems and structures have a number of areas that need attention to achieve an inclusive net zero carbon economy. Part of this, as highlighted by the FAI and others, is better evidence and data, within a more comprehensive and integrated decision-making system. Another part is immediate and clear action to address the role of infrastructure in carbon emissions. Taking all stakeholders on this journey is essential, whether it be those with specialist knowledge of infrastructure, or users and participants.

Part A has primarily sought to contextualise infrastructure and has only touched on the individual sectoral challenges where this illuminates an issue. This focused sectoral view is now picked up in Part B.



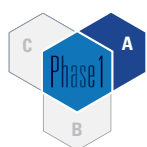


Part A:
Context & Key Drivers
(continued)

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Part A:
Context & Key Drivers
(continued)

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Phase 1

B

Infrastructure
Commission
for Scotland 

Part B

Sector Summaries



Part B: Sector Summaries (continued)

1. Introduction

The purpose of Part B is to provide a brief commentary on each of the sectors set out in the Scottish Government's definition of infrastructure with the addition of natural infrastructure that the Commission has added to its scope as a result of feedback received during its engagement process. Some background on key aspects of the elements of the infrastructure within each sector is followed by a discussion on potential challenges to be faced over the next 30-years as we move to an inclusive net zero carbon economy. It also indicates which of the Infrastructure Commission for Scotland's conclusions and recommendations, as set out in Part C, are directly relevant to the various sectors.

This is not intended to be, nor should be considered as, a detailed Infrastructure Needs Assessment – indeed the need for a system wide Scottish Infrastructure Needs Assessment by 2023 forms the basis of the Commission's third recommendation. Instead it provides some contextual background to the Commission's consideration of Scotland's infrastructure system and networks and its subsequent conclusions.

It draws on information:

- > Contained in Appendix M, Infrastructure Baseline Reports, which sets out key aspects of the current infrastructure for each of the sectors being considered;
- > Provided in response to the Initial Call for Evidence, the Regional Forums and various Round Tables;
- > Set out in the Fraser of Allander Institute Report on Inclusive Economic Growth (Appendix K); the Aventura Consulting Report on Net Zero Carbon (Appendix L); and the Ipsos MORI Report on Public Engagement (Appendix I).

In addition, it also draws on the findings and conclusions set out in Part A: Context and Key Drivers which provides a detailed overview of the relevance, impact and importance that key policy aspects have on Scotland's infrastructure and its future needs.

Part B draws on the findings of Part A to consider:

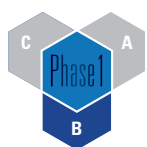
- > Energy
- > Digital
- > Transport
- > Housing
- > Natural Infrastructure
 - Natural Capital
 - Water & Wastewater
 - Flood Management
- > Waste
- > Public Service Infrastructure
 - Education
 - Health
 - Police & Fire and Rescue Services
 - Justice



Sector Summary

Energy





Part B:
Sector Summaries
(continued)

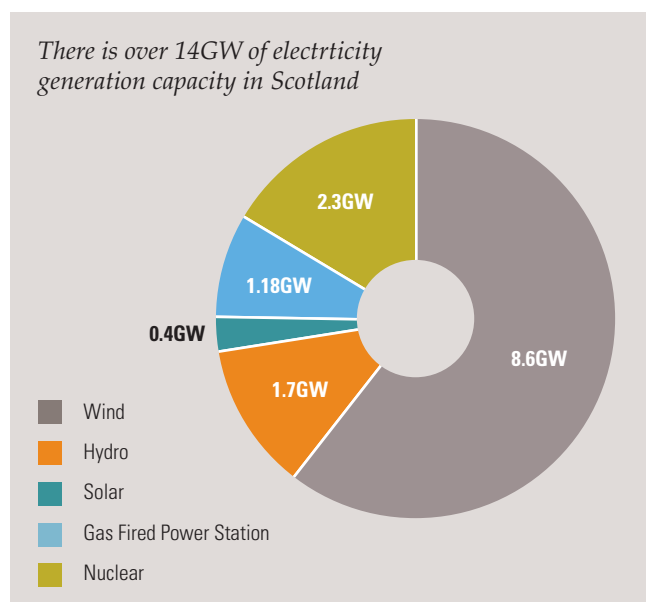
Energy

2.1 Background

A safe and secure supply of energy is critical in sustaining Scotland's economy and wellbeing – we need energy to heat and power our homes, for transport and to enable business to function. As a result, our energy system has evolved into a complex mix of infrastructure groups managed and operated by a wide range of owners and suppliers. The key groups that comprise Scotland's energy infrastructure are currently:

- > **Electricity Generation** – from renewable sources (primarily wind, solar and hydro) and non-renewable (gas and nuclear).
- > **Energy Networks** – transporting electricity and gas from its source to point of demand within Scotland and to facilitate its import and export to the rest of the United Kingdom.
- > **Oil and Gas Infrastructure** – including oil rigs and pipelines transporting oil and gas from the North Sea to onshore sites for refining, processing and distributing.
- > **Heat Systems** – incorporating both the production of heat and its distribution to the point of use through a small but growing number of district and communal heating schemes.
- > **Energy Efficiency** – designated as a national infrastructure priority in Scotland covering the end use applications which represent the final demand for energy, along with building insulation in the domestic and non-domestic sectors.

It is, however, likely that these categories will be extended as new, innovative infrastructure will be required to ensure the necessary progress is made towards meeting the Scottish Government's commitment to NZC emissions - this may include, for example, infrastructure for **Hydrogen Production** and **Carbon Capture Use and Storage**.



2.2 Where our energy comes fromⁱ

Each of these groups play a key part in meeting Scotland's overall energy demand. In the case of electricity, Scotland has the capacity to generate over 14GW, with the majority of this (some 75%) from renewable sources - wind, hydro and solar. The remainder is provided by Peterhead Gas Fired Power Station (the last major fossil fuel generator in Scotland) and Hunterston and Torness Nuclear Power Stations. However, Hunterston is expected to close by 2023 and Torness by 2030, due to the expiry of operating licences issued by the Office for Nuclear Regulation (ONR).

Turning to Oil and Gas, this sector continues to be an important component of the Scottish economy, worth around £12 billion per annum and representing over 7% of total Scottish GDP. In addition, the sector is also a major employer, supporting around 110,000 jobs. The volume of oil and gas produced in Scotland in 2018 represented about 82% of the UK's total production. Of this, around two thirds is of crude oil and natural gas liquids, while the remainder is natural gas production. It is also a major source of tax revenues and has provided over £330 billion in revenues (at 2019 prices) to the UK Government from production taxation alone. This is expected to continue for the foreseeable future – it is estimated that since oil and gas production began in the North Sea in the late 1960s, around two thirds of the available resource has been extracted.

2.3 How our energy is distributedⁱⁱ

The distribution networks for both electricity and gas represent a major infrastructure asset in Scotland. For example, the networks comprise some 114,000 kilometres of electricity cable, 98,000 electricity transformers and 27,000 kilometres of gas pipeline. Both networks are broken down into transmission and distribution. The role of transmission is the bulk transfer of energy across the country. These networks are designed to allow flexibility in the direction in which the energy travels to reflect a variety of production, generation and demand scenarios. The purpose of distribution is the delivery of energy from the transmission network to the end user.

In the case of electricity, Scotland's transmission and distribution networks are owned and managed by Scottish and Southern Electricity Networks (in the north) and Scottish Power Electricity Networks (in the south). However, while these assets are owned by Scottish and Southern and Scottish Power, they also form part of the National Grid System which ensures the day to day security of supply for the electricity system across the whole of Great Britain. The National Grid System will adjust which power stations are operating in response to demand and ensuring there is adequate back-up across Great Britain to cover important contingencies.

The National Transmission System for gas consists of a network of high-pressure pipelines connecting the major natural gas terminals,

Oil and Gas sector contributes around £12 billion to the Scottish economy and supports around 110,000 jobs

It is estimated that around two thirds of the available oil and gas resource has been extracted from the North Sea.

interconnectors and Liquefied Natural Gas terminals across Great Britain with major industrial gas consumers and the distribution system to local users. Within Scotland, a number of major pipelines connect the St Fergus Gas Terminal in Aberdeenshire with the central belt and supply gas directly to Peterhead Power Station and to Grangemouth Oil Refinery. The transmission network also links Scotland to England, providing a National Grid System, thus enabling supplies to be balanced across the entire system each day.

There are eight Gas Distribution Networks across Great Britain which deliver gas locally to domestic and commercial consumers. In Scotland, distribution is the responsibility of Scottish Gas Networks (SGN). In addition to the Scottish network, SGN also own and operate five “islanded” networks – small standalone networks not connected to the national gas grid – in rural parts of Scotland. These are at Campbeltown, Oban, Stornoway, Wick and Thurso. Four of these “island networks” are supplied with Liquefied Natural Gas delivered by road tanker; the fifth, in Stornoway, requires Liquefied Petroleum Gas.

2.4 How our energy is used

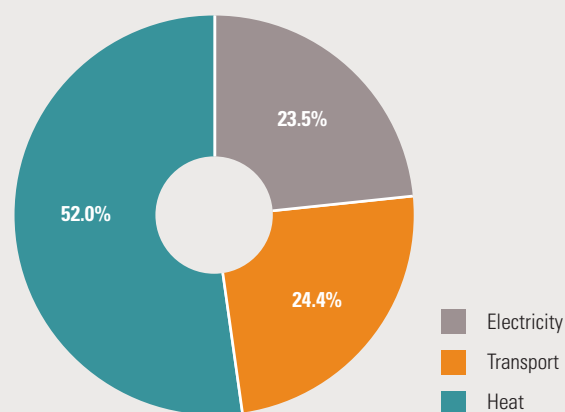
In broad terms, around 50% of the total energy consumed in Scotland is used to provide heating to homes and businesses, with the majority of this supplied by natural gasⁱⁱⁱ. At a domestic level, Scotland has become very reliant on gas as the primary heating fuel for our homes – 80% of Scotland’s 2.5 million dwellings use gas^{iv}. The remainder rely on electricity, oil or other fuel sources^v. However, almost 20% of Scottish domestic consumers live in an off-gas grid area, which means they have no access to mains gas – The Orkney and Shetland Isles are entirely off the gas grid as is most of the Western Isles; the highest proportion of off-grid properties on mainland Scotland are found in the Highlands and Argyll and Bute^{vi}.

In addition, there is a small but growing capacity of renewable heat generation from biomass, waste, heat pumps and solar thermal. At present, around 30,000 homes are connected to district or communal networks, with work progressing to reach the ambition of connecting 40,000 homes during 2020^{vii}.

Transport accounts for 25% of the total energy demand, comprising mostly of petrol and diesel for road transport^{viii}. At present, there are around 3 million licensed road vehicles registered in Scotland, of which 51% are fuelled by petrol and 48% by diesel. As discussed below, Ultra Low Emission Vehicles (ULEV, both fully electric and plug-in hybrid vehicles) account for around 1%. However, the numbers of new ULEVs being registered in Scotland is growing, with the rate of growth higher than in the rest of the United Kingdom^{ix}.

Electricity for domestic and industrial power requirements (for example lighting, domestic appliances, industrial processes) accounts for the remaining 24% of Scotland’s total energy demand, with around 80% of this being generated from zero or low carbon sources^x.

Energy consumption by sector in Scotland



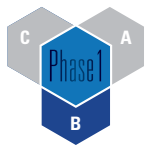
Around 20% of Scotland’s total; energy consumption is from renewable sources, comprising:

- > Renewable heat: 3.1%
- > Renewable transport: 0.7%
- > Renewable electricity: 16.2%

2.5 Scottish Energy Strategy

In 2017, the Scottish Government published its Energy Strategy^{xi}, which sets out a vision for the future energy system in Scotland. It recognises that a diverse, well-balanced energy supply portfolio or ‘energy mix’ will remain essential as we continue to decarbonise our heat, transport and electricity systems – providing the basis for secure and affordable heat, mobility and power in future decades. Among other things, it develops two scenarios for 2050 – an electric future and a hydrogen future – to illustrate the potential impact of and the changes required to deliver each option. The aim of the strategy is to help inform and guide decision making over the next 30-years.

In support of this, the Government has also prioritised the need for Scotland to become more energy efficient through improving the energy performance of Scotland’s buildings by making homes, retail and offices premises and public buildings, such as schools and hospitals more comfortable and easier to heat. These measures are designed to contribute towards reducing greenhouse gas emissions. In addition, through the new Fuel Poverty (Targets, Definition and Strategy) (Scotland) Act 2019, the Government has put in place a statutory process to set targets to eradicate fuel poverty.



Energy

2.6 Challenges

For the purpose of this report, the following section focusses primarily on issues around decarbonisation of heating and transport. Given the specific complexities that relate to the oil and gas sector, these will require separate consideration and have not been covered in any detail here.

Decarbonisation

The Scottish Government has set a target date for net-zero emissions of all greenhouse gases by 2045 and interim targets for 2030^{xii}. If this target is to be met, it is likely that Scotland will need to build on the good progress made to date in decarbonising electricity production and to significantly scale up the decarbonisation of heat and transport. However, given Scotland's current dependency on natural gas to heat our homes and petrol and diesel to fuel our vehicles, the scale of this challenge is immense – yet, there is no simple, quick fix or obvious single solution.

The decarbonisation of heat and transport will present some major challenges

Heating

Reducing heat demand is a key priority for the Government, as borne out by its raft of measures such as improving the energy efficiency of buildings and eliminating fuel poverty. Non-electrical heat consumption has steadily declined since the 2005-07 baseline, dropping by 17.3% in the domestic sector and by 19.5% in the industrial and commercial sector. It is thought this decline may be a result of improved energy efficiency and rising temperatures. However, further reductions in domestic and non-domestic heat demand will be required to achieve net zero carbon targets. This becomes more challenging in spite of the progress made since 2005/07 as year on year fluctuations exists – for example, compared to 2015, heat demand has increased in 2016 in both domestic and non-domestic sectors by 0.2% and 2% respectively^{xiii}.

At a domestic level, the Scottish Government's Programme for Government for 2019/20^{xiv} sets out plans requiring new homes consented from 2024 to use renewable or low carbon heating systems. While this is an important step, it only begins to scratch at the surface of the problem. The current rate of new house completions is around 20,000 homes per year^{xv}, yet we have around 2 million existing homes dependent on gas heating which will require converting to an alternative heating system^{xvi}.

Given the Government's net-zero target date of 2045 and assuming a programme to install alternative heating systems in existing properties

could commence by 2025, meeting the net-zero target would require a conversion rate of around 100,000 homes per year. In addition to the domestic sector, a similar challenge faces non-domestic properties – there are around 255,000 premises subject to non-domestic rates^{xvii}, many of which may also require a change to their current heating system. Consequently, the scale of the challenge ahead is significant.

At this stage, there are many issues that need to be better understood. For example, decisions are still required on what type or types of heating system should be used to replace gas, at scale. However, and putting the question of carbon emissions to one side, modern gas central heating systems are simple to operate and easy to regulate; persuading consumers to change from the familiar and effective to something new and, in the case of hydrogen, potentially unproven will not be easy. While a range of potential options are often mooted, such as the implementation of district heating systems, air or ground source heat pumps, solar PV systems, hydrogen, there is no obvious choice or choices at this stage to replace gas. Each comes with its own advantages and disadvantages and, in a number of cases, unknowns – for example:

- > what works well in an urban environment may be less effective in a rural one;
- > a reliance on a more electric focussed solution could build on low carbon renewable generation, but could place significant pressure on the electricity network's ability and capacity to generate, store and deliver the energy necessary to meet peak demands;
- > replacing natural gas with hydrogen offers the potential for the existing gas pipeline network to be used; but there are significant technical challenges around boiler compatibility (existing boilers will continue to operate efficiently and safely on a blend of methane and hydrogen up to a maximum ratio of 80:20^{xviii}). Increasing the ratio of hydrogen beyond this would require a hydrogen boiler;
- > Production of hydrogen heating would necessitate the introduction of extensive and effective carbon capture and storage systems.

In addition, replacing existing systems will not come without a degree of cost and disruption to households, the level of which is likely to have an influence on the public's readiness to accept and embrace change. It is also unlikely that any disruption will be limited to individual households and property owners – depending on the system or systems being adopted, significant road works may be required across Scotland

Scottish Government's Heat Policy Statement:

Natural gas is currently the primary heating fuel for around 2 million homes in Scotland.

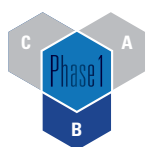


Case Study

Scottish Gas Networks Hydrogen 100 East Neuk Project

- > A pilot project in Fife to demonstrate how an integrated hydrogen energy system might work and how it could function at a much larger scale.
- > It is intended that the project will help to develop the whole systems thinking and business case of using renewable sources to create hydrogen.
- > Among other things, it will examine the technical and commercial feasibility of construction a new, dedicated network of providing 100% hydrogen to 300 homes and businesses.
- > This will include research to allow the developments of the safety case that will ensure the reliable and safe operation of the network.



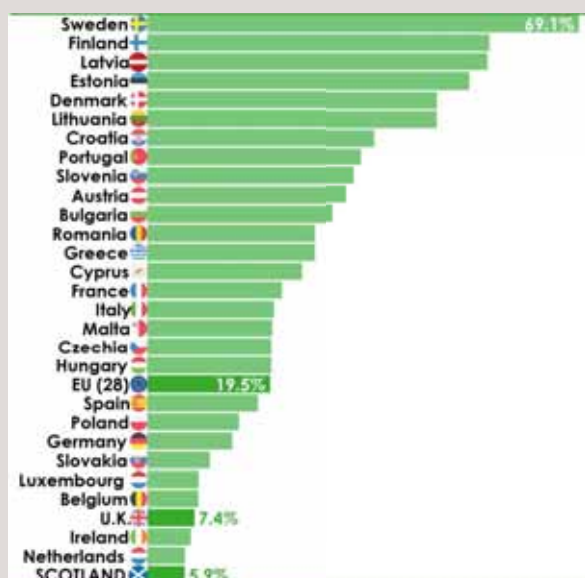


Part B:
Sector Summaries
(continued)

Energy

In contrasts to renewable energy where Scotland performs strongly relative to Europe, it is the lowest of all countries for renewable heat

*Renewable heat as a percentage of gross consumption for EU countries
2017*



Source: Annual Compendium of Scottish Energy Statistics 2019 – May 2019 update

to install the necessary infrastructure. Disregarding the question of cost – whatever is done will likely be more expensive than current gas central heating systems – the UK Energy Catapult has identified three key consumer challenges to be overcome if public acceptance of low carbon heating systems is to gain traction^{xvii}:

- i) Their effectiveness needs to be improved;
- ii) They need to be easy to control; and
- iii) They need to be easy to install.

In addition to the above list, it will be essential that whatever new heating option or options emerge, they do not result in an unintended consequence of further increasing fuel poverty. The application of the new Fuel Poverty (Targets, Definition and Strategy) (Scotland) Act 2019 should contribute towards mitigating against such adverse effects. Therefore, going forward, it will be imperative that any decisions of future heating options are taken in light of and with full regard to the implications and requirements of the 2019 Act. This may require infrastructure decisions regarding the supply of heat to be accompanied by remedial social policy measures to mitigate against potential unintended consequences, such as an increase in heating costs.

At this stage, the viability of a number of alternative heating systems at the scale and level required still need to be proven in a Scottish context, although in many cases are well-established in other countries. For example, earlier this year the Scottish Government sought evidence on the technologies and the actions necessary to support the decarbonisation of the heat supply of buildings that currently do not use mains gas as their primary heating fuel; and Scottish Gas Networks are assessing 3 sites in Fife, Aberdeen and Argyll to construct a demonstration hydrogen network to power 300 homes^{xx}.

Transport

2015 Scottish Government data estimated that emissions from road transport account for more than 30% of the total greenhouse gas emissions in Scotland^{xxi} – with other major contributors being agriculture, (25% share), business and industrial processes (21%) and residential and energy supply (15% each). Consequently, to meet the 2045 net-zero carbon target, major changes will be required by the transport sector in order to reduce its contribution of greenhouse gas emissions. The UK National Infrastructure Commission concludes that in light of current market trends, electric vehicles will drive the market for low emission light vehicles (cars and vans) in the short to medium term rather than alternatives such as hydrogen.

In the case of other road vehicles, such as buses and heavy goods vehicles, there appears to be a number of possible alternative approaches available, though at this stage there is still a degree of uncertainty around which is likely to emerge as the most effective solution. The solutions being considered are still at an early stage of

developments and not yet scalable to meet the demands of operators.

There is no reason suggest that the trend in Scotland will not follow a similar pattern. Indeed, the demand for electric vehicles in Scotland is ahead of the rest of the UK and continues to increase rapidly – the number of registrations in Scotland for new battery electric and plug-in hybrid vehicles grew by over 50% over the past year - although, in absolute terms, the numbers of such vehicles on Scotland's roads are still only 1% of the overall total^{xxii}. However, the uptake of vehicles is expected to increase as prices fall, with cost parity between electric and conventional vehicles expected by the mid-2020s.

Although the purchase cost will be a significant driver in the market, other barriers are:

- Availability of battery charging points;
- The battery re-charging time; and
- Battery range - distance travelled between charging.

Assuming the technical issues around battery re-charging time and battery range will be resolved by the manufacturers, further uptake of electric vehicles will likely then be dependent on the availability of an adequate and appropriate national network of charging points. While some progress has been made, there are already 1,000 public charge points installed across Scotland with a further 800 planned. Considerably more will be required to meet likely demand^{xxiii}.

Potential issues range from the availability of on street charging points within densely populated urban areas, on the one hand, to ensuring adequate coverage in rural areas on the other. In addition, it is estimated

that the full take up of electric vehicles would increase electricity demand by around 25%, if the existing fleet is replaced on a like-for-like basis, although it is expected that demand management and shared mobility will play a role in reducing this.

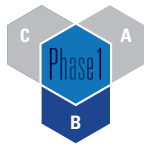
Nevertheless, even when cost parity between conventional and electric vehicles is reached and the other barriers and technical issues have been addressed, it is likely that electric vehicles will continue to remain unaffordable and out of reach to large sections of Scotland's population for many years to come. As a result, the Government will wish to consider what measures could be taken to make electric vehicles more accessible to all motorists.

Therefore, it is clear that decarbonising both Heat and Transport raises a series of complex and related issues, the resolution of which will lead to major and significant changes to the way we currently live. Moreover, the scale of the task to implement the changes required is immense and has no comparable precedent. Successful delivery will be dependent on our ability to develop a coherent, system wide approach with a clear understanding of the implications and consequences of the route taken. Work that has already started in this area provides a good foundation – but it is only that. Without a more detailed delivery plan that builds on this foundation, our ability to decarbonise heat and transport effectively by 2050 is likely to be compromised.

Consequently, it is concluded that a key priority for Scotland in reaching net zero carbon over the next 30 years will be a coherent plan for the decarbonisation across heat and transport that not only addresses the associated technical aspects but does so in an inclusive and fair way.



There are already 1,000 public charge points installed across Scotland with a further 800 planned



Part B:
Sector Summaries
(continued)

Energy

The uptake of Ultra-Low Emission Vehicles (ULEVs) in Scotland

Although ULEVs currently make up less than 1% of all vehicles registered in Scotland, growth in registrations has been rapid.

There was a fivefold increase in ULEV registrations between 2015 and 2018 – from 2,200 vehicles to nearly 11,000

However, it is estimated that a 100% uptake of electric vehicles could increase total electricity demand by more than 25% by 2050

Electricity Generation and Grid

Progressing with the decarbonisation of the heat and transports sectors are expected to present some significant challenges. An increased take-up of electric vehicles and the decarbonisation of heat is expected to result in a considerable increase in total electricity demand for example, the UK National Infrastructure Commission suggests that a 100% take up of electric vehicles across the UK could increase the total electricity demand by more than 25% by 2050^{xxiv}.

Consequently, it will be important to ensure that ahead of this expected increased demand, the necessary grid capacity is available in order to meet consumer needs. This may well require anticipatory investments to enable the electricity generation and supply networks to be upgraded and it will be important to prevent any unintended consequences of existing regulatory requirements hindering the delivery of Scotland's net zero carbon target.

Key issues summarised here are incorporated into a number of recommendations at Part C, most specifically those relating to Leadership, Heat and Transport, Digital and Technology and Independent Long Term Advice.



A 100% uptake in electric vehicles across the UK could increase electricity demand by more than 25% by 2050



Sector Summary

Digital



Part B:
Sector Summaries
(continued)

Digital

3.1 Background

The digitisation of Scotland has been both rapid and extensive. For example, twenty years ago, only around 40% of Scottish households had access to an internet connection but by 2017, this had more than doubled to 85%^{xxv}. Today, internet usage in Scotland is considered an everyday, essential activity, whereas in 2000 it was only accessible to a minority of the population.

Digital usage in the private sector has also developed with pace. Applications such as cloud computing, data analytics and the Internet of Things are now common place and have helped to drive new and efficient ways of working as well as the developments of new types of services. In the public sector, progress was initially slow, however, following the publication of the Scottish Government's Digital Strategy in 2011, there have been some significant developments, for example, Revenue Scotland's on-line platform is now used for 98% of all tax returns, mygov.scot has been launched as a portal and first point of access for all public services, and the establishment of the Scottish Wide Area Network (SWAN), a single shared network and common ICT infrastructure across Scotland's public sector. So far more than 6,000 sites have been connected, including schools, hospitals, GP surgeries, pharmacists and local council offices, who all benefit from reduced costs, improved service and the ability to share data across organisations, fostering co-operative working.

3.2 Current Digital Connectivity in Scotland

Legislative competence for the telecommunications sector is a reserved matter and the Scottish Government has no devolved powers over its regulation, although following the recommendations of the 2014 Smith Commission (on the further devolution of powers to the Scottish Parliament) the Scottish Government has appointed a Director to the Ofcom Board, to represent Scotland-related interests. The Scottish Government has recognised for some time the importance of ensuring that Scotland is able to keep pace with technological developments to allow it to prosper and compete in an increasingly connected world.

As a result of interventions by the Scottish Government, the availability of fixed and mobile services in Scotland has improved over the last few years. For example, the Digital Superfast Broadband Programme meeting its target to provide access to fibre broadband to 95% of Scottish premises by 2017^{xxvi}, or the Scottish Government's Reaching 100% Programme (R100) to provide all premises with access to superfast broadband at speeds of at least 30Mbps. In addition, the 4G Mobile Infill programme, also funded by Scottish Government is addressing specific 4G mobile not spots^{xxvii}.

However, in 2018, Audit Scotland reported that about half of Scotland's geography was unable to access basic mobile coverage from all operators and 60% of the country is not yet covered by a 4G signal from all operators. Also, at that time, around a third of dwellings in rural Scotland were unable to access superfast broadband services^{xxviii}. However, the situation has continued to improve, for example, 4G mobile coverage from at least one operator now reaches 78% of Scotland's landmass.

The Scottish Government's current Digital Strategy sets out its plans for ensuring that "we put digital at the heart of everything we do". The strategy recognises the complexity and scale of what this will entail and has been designed for the whole of Scotland.

3.3 Future Digital Connectivity in Scotland

However, while progress in delivering superfast broadband continues, a step change is expected with the arrival of 5G, which will take Scotland's digital connectivity to the next level. 5G is expected to lead to the ability to download and upload data at significantly higher speeds than at present, create greater capacity in the system to allow more connected devices and a lower level of latency which leads to an instant response with imperceptible levels of delay or lag. The benefits of 5G to Scotland are predicted to add some £17 billion to our economy by 2034 and lead to the creation of around 160,000 new jobs^{xxix}. According to this research, which helped shape the Scottish Government's 5G strategy (launched in August 2019), a number of key economic sectors in Scotland could benefit from adoption of 5G technology, including healthcare, transport, education, public services, agriculture and aquaculture, immersive content and energy and resources.

The implementation of this strategy will be an important contributor to the delivery of Scotland's digital future. The Scottish 5G Centre (S5GC) was recently formed as a partnership between the Universities of Glasgow and Strathclyde, Scottish Government and The Scottish Futures Trust. The main purpose of the S5GC is to support the implementation of the strategy, and act as the national platform for accelerating the adoption of 5G to harness its economic and societal potential for Scotland.

The developments in 5G will help to underpin increased benefits to our wider infrastructure which will enable the delivery of new functionality and services from an asset. This includes, for example, the creation of truly smart buildings or smart traffic management systems and a more effective application of the Internet of Things which, among other things, is expected to revolutionise the optimum use of asset capacity and help drive greater levels of energy efficiency within a building; both through enhanced monitoring and managing of asset systems.

It is predicted that the roll out of 5G across Scotland will:

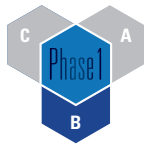
- > Add £17 billion to GDP by 2035
- > Lead to the creation of 160,000 new jobs
- > Play a part in creating 3,100 new businesses
- > Help deliver a £3.3 billion growth in export volumes.

There are different network options to how this might be achieved. However, in its National Infrastructure Assessment, the UK's National Infrastructure Commission has concluded that a full fibre network offers the best option^{xxx}, it offers faster upload and download speeds, is more reliable and is cheaper to operate than alternatives. A full fibre network for Scotland would enable significantly faster network connections and underpin the transition to 5G mobile network services across the country.

3.4 Scotland's Digital Connectivity With the Rest of the World

Scotland's "connectivity" with rest of world is limited with almost all of our internet traffic transiting via London. Indeed, Scotland is the only known European country which does not have a direct internet connection to more than one of the top 5 internet nodes in Europe (London, Amsterdam, Frankfurt, Paris & Moscow) for the purposes of national resilience. The consequence of Scotland's data traffic travelling to and from London, means an increased delay or latency between data being sent and received. This could make Scotland a less attractive location for certain business applications where resilience and low latency are crucial business requirements.





Part B:
Sector Summaries
(continued)

Digital



“Digital connectivity is the number one infrastructure priority for businesses across Scotland.”

CBI Scotland

As the next generation of digital services will require low latency to be fully effective this means that data centre capacity will need to be located close to those people using the available services. Currently, Scotland does not have a thriving data centre industry or associated infrastructure supply chain. Moreover, as size and scale of data centre provision is a key driver in underpinning the business case for them, it is unlikely that data centre infrastructure serving only Scotland will be economically attractive or viable. Consequently, there is commercial imperative for Scottish data centres to serve not only the domestic market but the international market too. That said, data centres are very large consumers of energy. However, given Scotland’s capacity to generate energy from renewable sources, there is an opportunity for the country to become a leader in green data centres. This potential is hampered by a lack of direct international subsea cables and a choice of diverse routes to international destinations.

3.5 Challenges

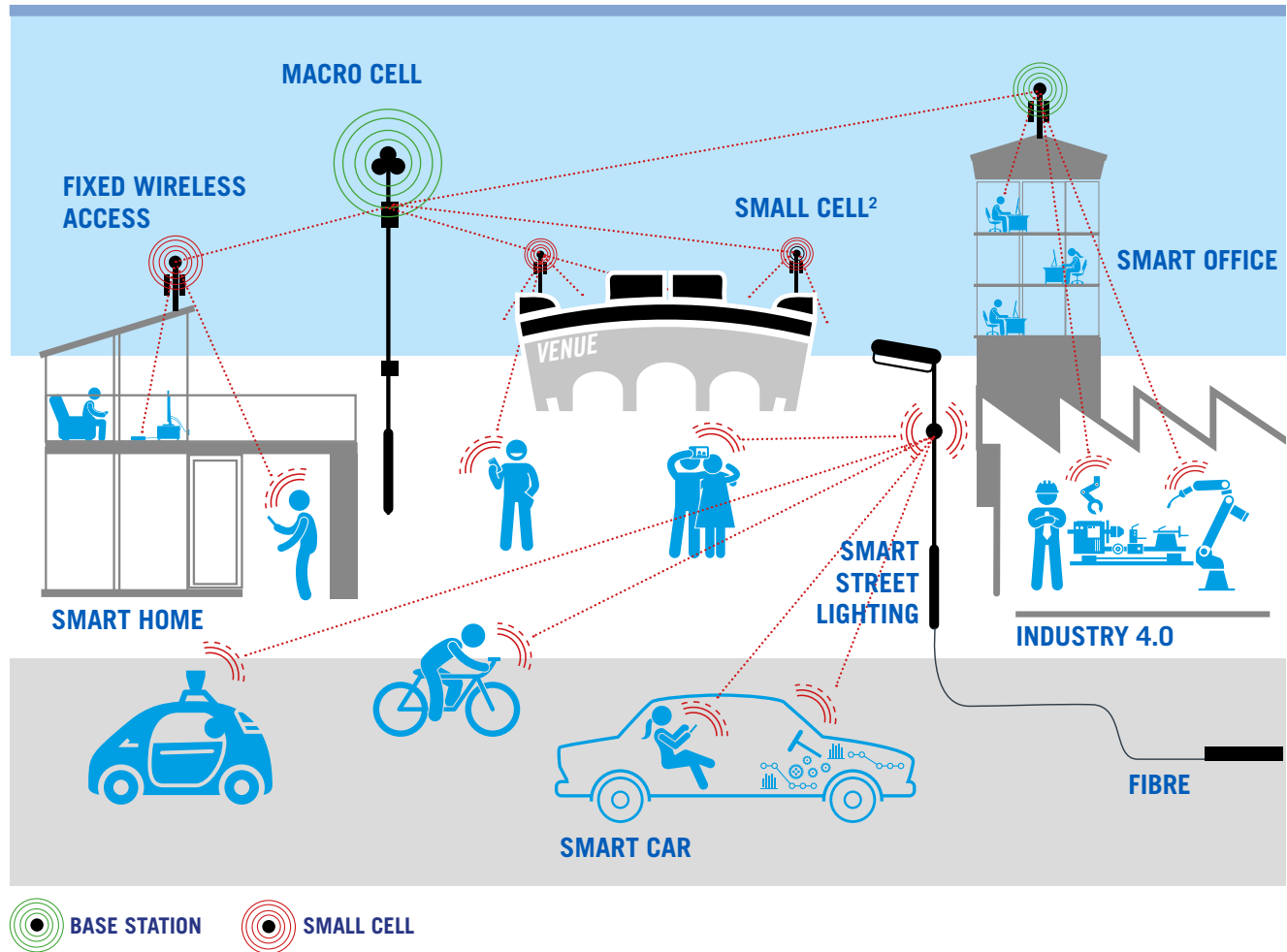
A key challenge for Scotland is not only creating the right environment to deliver its current digital commitments, but also ensuring that what is put in place is sufficiently future proofed. For example, full fibre connections will provide fast and reliable broadband, 5G will lead to improved connectivity and speed for remote access and is an enabler for Internet of Things applications. Providing full 5G coverage across all of Scotland underpinned by full fibre is both a big and long-term infrastructure project and may take 5 to 10 years to deliver. Thus, ensuring that new networks have sufficient inherent flexibility to keep pace with new and emerging developments will be challenging.

In addition, the network and systems will be installed by the digital service providers on a commercial basis. Consequently, this will need strong and consistent leadership by Government and regulators to ensure competition and address market failure if its ambitions are to be delivered as the market will look for clarity and certainty in order to underpin its long-term investment decisions.

A further challenge is how best to unlock the value of the already substantial amount of both public and private digital information held in Scotland. The ability to handle, interrogate and analyse this data in

5G, The basics

FIGURE 1 (NOT TO SCALE)



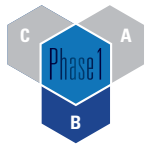
Source: <https://www.gov.scot/binaries/content/documents/govscot/publications/publication/2019/08/forging-digital-future-5g-strategy-scotland/documents/forging-digital-future-5g-strategy-scotland/forging-digital-future-5g-strategy-scotland/govscot%3Adocument/forging-digital-future-5g-strategy-scotland.pdf>

5G will offer faster download and upload speeds and allow more connected devices and sensors. And, with its lower latency, users will experience almost instant response times.

a more efficient and effective way will provide a solid foundation for taking informed evidenced based policy decisions to meet our net-zero carbon and inclusive economic growth commitments. There needs to be a fundamental change in thinking to view data as an asset, not an output as tends to be the case currently.

However, there are a number of complex barriers that make the sharing and utilisation of this valuable resource difficult. For example, at a very practical level, the development of data standards would not only ensure consistent data quality but would facilitate better data sharing – currently many national data assets are held in self-contained “silos”

- > At the end of 2017, the Scottish Government announced its plans to deliver superfast broadband (>30 Mbps) to every home and business in Scotland by 2021, under its £600 million R100 programme.
- > It will help to deliver a future-proofed superfast broadband network, making Scotland one of the best connected places anywhere in Europe.



Part B: Sector Summaries (continued)

which cannot interact with each other. Also, public and private data is not currently shared. While there are many obvious barriers to this, such as ethical considerations, better utilisation of this resource could bring significant benefits. However, finding ways round these tricky issues to enable the vast range of data resources held across Scotland to be used more effectively is likely to bring huge benefits to the country as a whole. As a presumption, however, we should always seek to make data sets public where possible to encourage transparency, academic research, service design and entrepreneurial use.

Consequently, a national digital infrastructure is an essential requirement for a modern, economically sustainable country. While much good work has already been done in achieving this aim, there is still much to do and developing a broader digital infrastructure provides an opportunity for Scotland to position itself differently in Europe and re-engineer how it delivers public services.

With regard to Scotland's current limited connectivity with the rest of the world, there is a good argument that this should be improved significantly – a Scottish data centre industry with access to international subsea cables has the potential not only to provide an enhanced level of service for Scotland's domestic, business and public sector data needs, but also service international markets too. Moreover, this will help to strengthen Scotland's connectivity resilience, increase

our data handling speeds and reduce our reliance on our data being supported in data centres operated in other countries. However, given that data centres are high consumers of energy, care will be needed to ensure that any data centre developments do not compromise Scotland's net zero carbon targets – innovative and creative solutions will be required to directly couple renewable energy to data centre developments. Nevertheless, it also provides an exciting opportunity for Scotland to place itself in the vanguard of green data centres. The bottom line, however, is that this will require leadership and policy commitment from the Scottish Government to the data centre market along with potential investment in international subsea cables where there is market failure.

Given the important role that digital and data issues will play in optimising asset management and use in the future, it will be essential that these aspects are subject to full and proper consideration in any investment appraisal decisions. For example, ensuring new buildings are equipped with "Internet of Things" sensor technology that enables

"...need to consider future proofing infrastructure investment with digital and SMART infrastructures increasing growth and indeed importance for other infrastructure types (transport and energy grid)"

Scottish Cities

smart services and optimal asset performance insight should be regarded as essential to meet NZC objectives and not an optional extra.

Finally, despite the Ofcom Scotland Director appointment, it still remains that Scotland has no devolved powers over the regulation of telecommunications. During our engagement, it was contended that a UK wide regulatory approach doesn't recognise sufficiently some of the distinct regional differences and challenges faced in investing in and operating a telecommunications network in Scotland compared to other parts of the UK. This issue was highlighted by the UK National Infrastructure Commission in its recent report, "Strategic Investment and Public Confidence"^{xxxi} which, among other things, calls for changes in the regulatory approach to ensure that the "process for making long term strategic investment decisions need to reflect the decision making landscape, and the varying needs of consumers, across the UK".

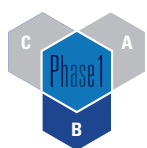
Key issues summarised here are incorporated into a number of recommendations at Part C, most specifically those relating to Leadership, Digital and Technology and Regulation.

Ofcom's Connected Nations 2019 Scotland Report notes:

- > Superfast broadband coverage in Scotland remains at around 92% of homes & businesses
- > Over 200,000 homes and businesses now have access to full-fibre broadband – this is 150,000 more than last year
- > 4G mobile coverage from at least one operator now reaches 80% of Scotland's landmass.



Sector Summary Transport



Part B:
Sector Summaries
(continued)

Transport

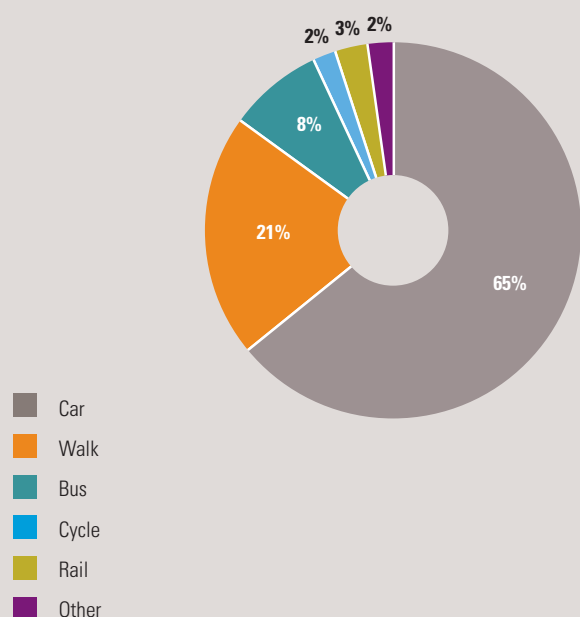
4.1 Background

Good connectivity is believed to be a key component in both supporting and growing Scotland's economy. We expect to be able to move around quickly and easily and by many modes on a system that is reliable and resilient, we expect that deliveries can be made to our shops to keep them fully stocked, and business expects that goods and products made in Scotland can reach their market efficiently and on time. The cost of travel represents a significant proportion of the average Scottish household budget, with some 14% of household spend being on travel.

But creating, managing and maintaining that connectivity and associated transport systems is complex and multifaceted – and as the recent Glasgow Connectivity Commission noted, there is no single recipe for success. Moreover, if Scotland is to achieve its aims of delivering an inclusive net zero carbon economy, much will depend on the final shape, structure and implementation of its new National Transport Strategy (NTS) and Strategic Transport Projects Review 2 (STPR2). It is therefore encouraging that both the draft NTS and the initial development of STPR2 are signalling a clear focus on delivering these outcomes. However, until final decisions are taken on the strategy and review, this issue remains unresolved.

14% of Scottish household spend is on travel

Modal share of all journeys



4.2 Scotland's Transport System

The key elements of Scotland's transport system are as follows.

Roads and Traffic^{xxxii}

The total length of Scotland's road network is around 56,400 kilometres, the vast majority of which – around 80% - comprises minor roads. The remainder of the network comprises non-trunk A roads (13%) and motorway and trunk roads (7%). Responsibility for the management of the motorway and trunk road network rests with the Scottish Government, which spends currently some £620m per annum on road maintenance, lighting and new investments. The local authorities are responsible for managing the non-trunk and minor road network, spending around £300m per annum on maintenance and lighting.

In terms of usage, there are currently some 48 billion vehicle kilometres driven on Scotland's roads annually, of which 39% are on the motorway and trunk road network and 48% on rural roads.

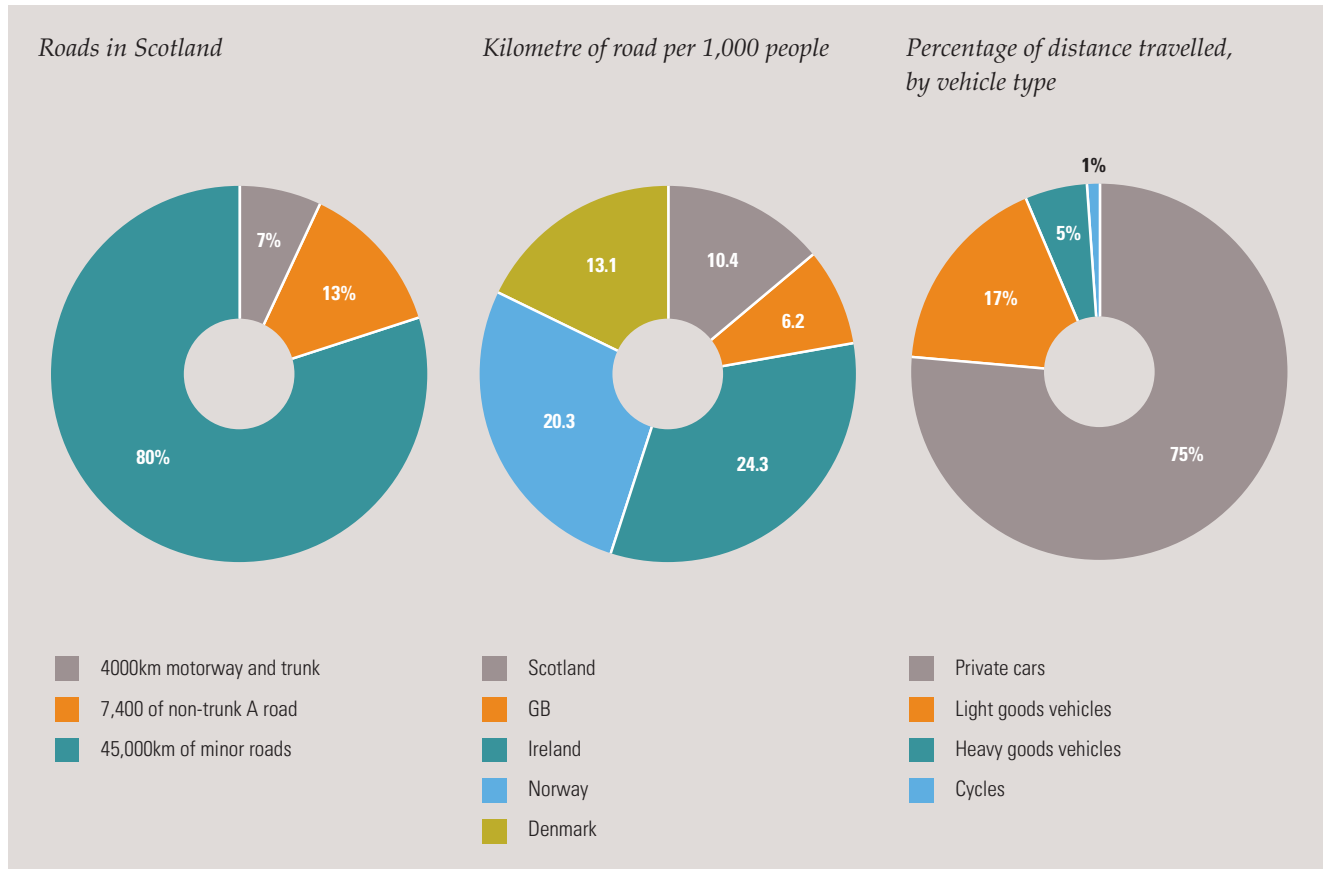
Private cars account for the highest users of the network (75% of distance travelled) followed by light goods vehicles (17%), heavy goods vehicles (5%) and public transport (2%). Cycles represent just 1% of vehicles using the network.

Around 13 billion tonnes/kilometre of freight originating in Scotland was transported by road in 2017, most of which was lifted and delivered in Scotland. As a result, most road freight journeys are relatively short, of 50 kilometres or less. However, around 15 million tonnes of freight are delivered to the rest of the UK and around 180,000 tonnes of goods were transported to international destinations, principally France and the Netherlands.

Rail^{xxxiii}

Scotland's rail network extends to just over 2,800 kilometres in length (of which around 700 kilometres (25%) is electrified) and is served by 360 stations. It is estimated that by the end of 2019, 75% of all ScotRail passenger journeys will be by electric traction. The current ScotRail franchise covers all services within Scotland, operating around 2,400 train services per day and delivering almost 98 million passenger journeys per year - this represents a 31% increase in passenger journeys over the past 10 years. Services from Scotland to England and Wales are provided by other operators.

Most journeys originating in Scotland also have a destination in Scotland (some 91%) with journeys to the North of England (5.6%) and to London (2.3%) the next most common. The ScotRail franchise is the biggest single contract let by the Scottish Government, worth more than £7 billion over its 10-year life.



In terms of rail freight, around 8 million tonnes per annum is carried in Scotland.

Bus^{xxxiv}

The annual number of bus journeys made in Scotland is currently about 390 million, of which one third, (approximately 130 million journeys) are made under the National Concessionary Travel Scheme. There are 1.4 million people who are registered to use this scheme in Scotland.

However, bus use is changing. Over the past 5-years, journey numbers are down by 8%, bus fleet sizes are down by 10% and staff employed by bus operators down 2%. Vehicle kilometres travelled, however, have risen by 2% per annum.

Air^{xxxv}

The annual number of air movements in Scotland is currently around 480,000, with some 29.5 million passengers using Scottish airports. The

vast majority of these passengers (81%) travel to or from Edinburgh or Glasgow Airports. Over the past 3 years, there has been growth in passenger numbers at each of Scotland's principle airports - Edinburgh, Glasgow, Aberdeen and Inverness.

Although relatively small in gross terms, the quantity of airfreight in Scotland continues to grow. Around 60,000 tonnes of air freight were carried in 2018, compared to 45,000 tonnes in 2011

Water^{xxxvi}

Scottish ports currently handle more than 65 million tonnes of freight per annum and 25% of Scotland's total freight tonnage is carried by ship.

Scottish ferry routes carry around 8.5 million passengers and 3.1 million vehicles per annum, of which around 6 million passengers and 1.5 million vehicles are on the subsidised ferry routes or "lifeline services" serving the Clyde, West Coast and the Northern Isles.



Part B:
Sector Summaries
(continued)

Transport

4.3 How We Choose to Travel

The latest available statistics show that people in Scotland are making fewer trips in 2017 than 10 years ago – 73% reporting travelling the previous day compared with 80% in 2007^{xxxvii}. This correlates with the findings in the First Report of the Commission on Travel Demand^{xxxviii} which noted that “we travel substantially less today, per head of population, than we did one or two decades ago.” In addition, the Commission also noted that younger people, and in particular younger males, are far less likely to have a driving licence and to subsequently drive less than previous generations. The reasons for these changes in travel behaviour are complex, but in summary are thought to lie outside transport and have been driven by changes in young people’s socio-economic situations, including increased higher education participation, the rise of lower paid and less secure jobs, a decline in disposable income and rising costs of car ownership. Changing living situations are also playing a part here, with many more young adults living at home for longer. In terms of modal share of all journeys, the private car is still the most prevalent with 65% of all journeys, followed by walking 21%, bus 8%, cycle 2%, rail 3% and other 2%^{xxxix}.

Of the 525 million journeys made by public transport in 2017, 74% were by bus and 19% were by rail. High income and rural households are more likely to travel to work by car, whereas in urban households, there is a greater degree of modal split reflecting the increased transport choice available^{xl}.

4.4 Challenges

The key challenge we face is ensuring an appropriate level of effective and efficient connectivity in Scotland to enable:

- > people to move around;
- > business to access markets; and
- > the movement of goods

but in a way that delivers a net-zero carbon inclusive growth economy. For the purpose of this report, the following section focusses primarily on issues around road transport. Issues that relate to aviation will require separate consideration and have not been covered here.

As transport is currently a major contributor to greenhouse gas emissions, reducing these emissions will be essential if the Government’s net-zero carbon targets are to be met. The Scottish Government is due to publish its new National Transport Strategy (NTS) and Strategic Transport Projects Review 2 (STPR2) shortly and these provide a timely opportunity for the outcomes of these processes to reflect fully the shift to an inclusive net zero carbon economy by 2045. While the draft NTS and initial work on STPR2 have demonstrated a

clear intent to achieve these aims, it will be important for the final versions to demonstrate how the formulation, prioritisation and implementation of future transport infrastructure plans will deliver safe, affordable, inclusive and efficient net zero carbon solutions to ensure effective connectivity for people, goods and services.

The existing transport hierarchy, which places in order of importance the range of possible interventions that can be made, will be helpful in identifying options to inform transport planning decisions. As a first step the initial focus should be on options which lead to i) management and reduction of demand, followed by ii) increased use of active travel, then iii) increased use of public transport and finally, iv) management of car transport.

A move to ultra-low emission vehicles (ULEVs) will certainly have an impact on reducing greenhouse gas emissions, but a recent report by the UK Energy Research Centre (UKERC) indicates this could be challenging as average carbon dioxide (CO₂) emissions from new passenger vehicles have been increasing over the past three years^{xli}.





There are around
525m
passenger journeys
by public transport
each year

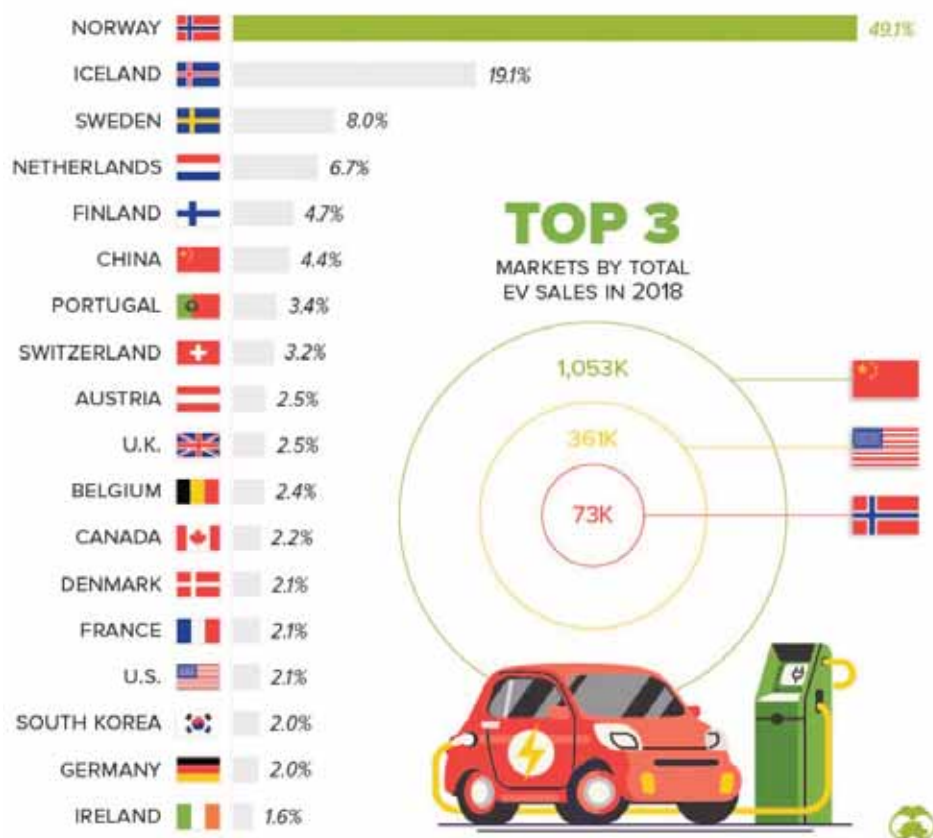
The main types are:

- > Bus (388 million passenger journeys) and
- > Rail (100 million passenger journeys)

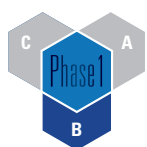
This is attributed to a significant rise in sales of larger cars, in particular Sports Utility Vehicles (SUVs) which emit 25% more CO₂ than a medium-sized car – over the past 10 years, the proportion of SUV sales has risen three fold, from just under 7% of total passenger car sales to more than 21%. UKERC concludes that as the majority of these vehicles will be in use for at least the next decade, the cumulative effect of their emissions is going to be felt for some time to come.

Even if a successful transition to ULEVs can be achieved, it is reasonable to assume that the associated traffic management and congestion challenges will not only remain but are likely to increase if the growth in the numbers of registered vehicles continues. However, the introduction of connected and autonomous vehicles might help to mitigate these congestion effects. Connected vehicles, which can communicate directly with other vehicles or with the road network infrastructure, are expected to result in drivers being better informed about their journeys and to assist them in making real time decisions about route selection.

EVs as a percentage
of total vehicle
sales, by country



Source:
<https://www.visualcapitalist.com/electric-vehicle-sales/>



Part B:
Sector Summaries
(continued)

Transport

“STAG should be reconsidered if... journey times may no longer be key element of productivity”

Scottish Cites

Increasingly autonomous (driverless) vehicles could, over the longer run, take this to another level and utilise an even wider range of technologies and systems to reduce the need for driver involvement while undertaking a journey. It is believed the impact of such changes could have a significant disrupting effect to current thinking around infrastructure planning and design, travel patterns and the interactions between other modes of transport. Although these concepts and the detailed application of them are still at an early stage of development, the underpinning technology is moving quickly and follows many decades of similar change – we are well used to assisted braking and adaptive cruise control, and support for new manoeuvres is becoming mainstream, for example, self-parking. The UK National Infrastructure Commission^{xiii} notes that some estimates suggest self-driving vehicles could be on our roads within the next 10 years, though others predict a much longer timescale. Nevertheless significant change is coming and in spite of uncertainties around timing, preparation is underway. This includes the recently published Connected and Autonomous Vehicles Roadmap, published in December 2019^{lxixiv}.

However, policies focused on delivering an inclusive net zero carbon economy must not focus solely on zero emission vehicles or connected and autonomous vehicles, but for also on the opportunities for shared mobility and on-demand services as well as a much greater role for evolved public transport in the overall provision of mobility. Changing behaviours and an increased willingness to adopt new ways of accessing and paying for mobility (for example, app-based ride hailing) coupled with the emergence of new modes to support short distance trips and first/last mile trips to key interchanges (for example, e-bikes and on-demand shared transit) have the potential to change connectivity.

The challenge therefore is to consider Scotland’s transport infrastructure and the vehicles and services that use it as a holistic system rather than



a series of separate components. This may mean, for example, developing guiding principles that balance across the whole system reductions to private vehicle capacity, or reallocating road space from private vehicles to public transport in favour of increased new road capacity.

For many years, Scotland has utilised the Scottish Transport Appraisal Guidance (STAG)^{xiii} to help inform its transport planning decisions. The guidance is well regarded both at home and internationally. It has a particular focus of investment on connections across and with Scotland, improving reliability and journey times and maximising employment and business opportunities. It also considers public transport and sustainability priorities. STAG is complemented by Transport Scotland’s Investment Decision Making Guidance.

As illustrated, the scale and rate of infrastructure change required to support the delivery of an inclusive net zero carbon economy within the next 30-years will be considerable. As a consequence, the level of investment that will need to be sustained over a long period will be significant. In parallel, the expected changes are likely to have an impact on the ability to raise revenue – for example, a move to electric powered vehicles away from fossil fuelled vehicles will reduce the amount of fuel duty that can be raised. As a reserved power, fuel duty raises more than £28 billion per year in the UK, £5.7 billion is raised from VAT on fuel duty and Vehicle Excise Duty raises a further £6.5 billion^{xiv}. While tax revenue is not generally hypothecated or ringfenced in the UK, it is notable that road users are contributing in the order of 5% of the UK’s gross annual tax receipts (£40 billion a year). Losing this revenue would therefore leave a significant gap in the country’s resources that would need backfilling through other means.

Finally, while it is likely that a level of road freight is inevitable – as goods require distributing at a local level to the destination – there is potentially



greater scope to increase volumes of freight transported by other modes. Rail freight levels have dropped significantly from the highs achieved during the early part of this century. However, at that time the rail network was carrying large volume of coal and minerals, for which there is now no longer a market as we have moved to cleaner fuels.

Scotland also has limited container connectivity from the two terminals at Grangemouth and Greenock now that the Rosyth/Zeebrugge route is no longer operating. As a result, many products manufactured in Scotland for export to international markets must be transported to deep water

ports such as Liverpool, Felixstowe or Southampton for onward shipping. During its engagement, the Commission heard that enhanced deep water port facilities in Scotland would make it easier and quicker for industry to get its goods exported to market.

Key issues summarised here are incorporated into a number of recommendations at Part C, most specifically those relating to Leadership, Place, Heat and Transport, Digital and Technology and Independent Long Term Advice.

The total spending on transport in Scotland in 2017/18 was around £3 billion, comprising:

- > **£2.1 billion** by the Scottish Government
- > **£0.8 billion** from the local authorities

Spending on roads

In addition, the Scottish Government spent around



£620m

by Scottish Government
on motorways and trunk
roads (capital and
maintenance works)



£221m

by local authorities
on local roads



£63m

by local authorities
on street lighting



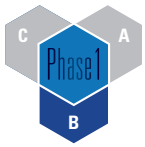
£755m

on rail services



£200m

on the National
Concessionary
Travel Scheme



Part B:
Sector Summaries
(continued)

Transport



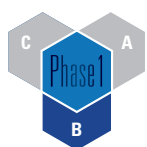
In 2017:

- > 67 million tonnes of freight was handled by Scottish ports
- > 25% of Scotland's total, freight tonnage was carried by water
- > There were 8.5 million passengers and 3.1 million vehicles carried on Scotland's ferry routes



Sector Summary

Housing



Part B:
Sector Summaries
(continued)

Housing

5.1 Background

A safe and affordable home is a fundamental human need, a basic moral right and a key element of the baseline infrastructure that an inclusive society needs. For example, good quality housing, which is affordable and energy efficient, is seen as an important component in the delivery of Scotland's ambitions of eradicating child poverty and homelessness, ending fuel poverty, tackling the effects of climate change and promoting inclusive economic growth.

However, it is recognised that realising these ambitions will be complex and dependent on many factors. For example, dealing with significant demographic changes, such as Scotland's ageing population and the growth in the numbers of people living in the east of the country, along with changes in how we live (we have more single person households today than at any time previously) will be key considerations in the development and successful implementation of future housing policies. In short, as a country, we need to ensure that we have the right type and numbers of affordable housing in the right place.

The Scottish Government's vision for housing is that everyone in Scotland has a high quality and sustainable home that they can afford, and which meets their needs. Work is currently progressing to develop a vision for Scotland's homes and communities for 2040, with a related route map to realise this vision. In December 2019, the Government commenced a consultation on policy options^{xlv} which will inform the final vision and route map to be published in 2020.

5.2 Demand for Housing

Whilst in its nature very complex, in very simple terms the demand for housing is driven by the level of population. Scotland's population has increased in recent years and is projected to continue to increase – the population in 2018 was around 5.44 million and is expected to increase to almost 5.7 million by 2041^{xlvi}.

However, the rate of growth in population is not constant or consistent across the country. There is a clear trend that shows the greatest population growth is in the east of Scotland with the lowest growth (and in some cases decline) in the west. For example, it is projected that the number of households in Midlothian will increase by some 31% from current levels by 2041, whereas, the number of households in Inverclyde is predicted to decline by 5% over the same period. Also, the majority of Scotland's population, some 71%, live in large urban or other urban areas, with around 12% in small towns and 17% living in rural areas^{xlvii}.

Scotland's population is also ageing – today, around 19% of the population in Scotland are aged 65 and over, compared with 16% ten years ago. People aged 75 & over are projected to be fastest growing

For the year ending December 2018, 20,000 new homes were completed. The first time this number was reached since 2008.

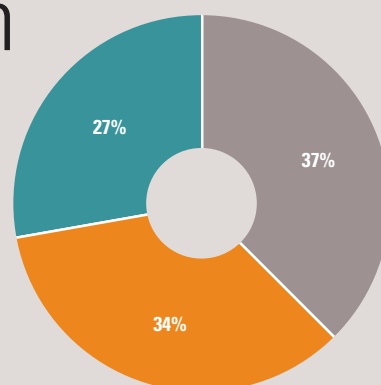
age group in Scotland, with the number in this category expected to increase by 27% by 2026 & by 79% by 2041. At the same time, the number of people aged 16 to 64 is projected to decrease - from 66% at present to 64% by 2041. Scotland's ageing population is considered to be having an impact on the number and type of households across Scotland; one person households are now the most common as more older people are more likely to live alone. In addition, the number of properties to accommodate wheelchair access is predicted to increase from 17,226 to 31,700 households in 2024^{xlviii}.

Homes for Scotland estimates that there is a current shortfall of 80,000 new homes^{xlix}. This shortfall has amassed over the last decade and is considered due to underinvestment as a result of the 2007/08 financial crisis and the subsequent recession. This lack of supply, particularly in key economic growth areas, is considered to be acting as a brake on Scotland's economic growth. Moreover, investment in house building can have a strong 'multiplier effect' through the generation of economic activity in other areas of the economy - the housing charity Shelter Scotland estimated recently that the construction of 12,000 affordable new homes per year could sustain up to 19,000 jobs and generate £2.6 billion of economic output^l.

Percentage of household occupancy



2.62m
dwellings



- One person households
- Two person households
- Three person households



19,428

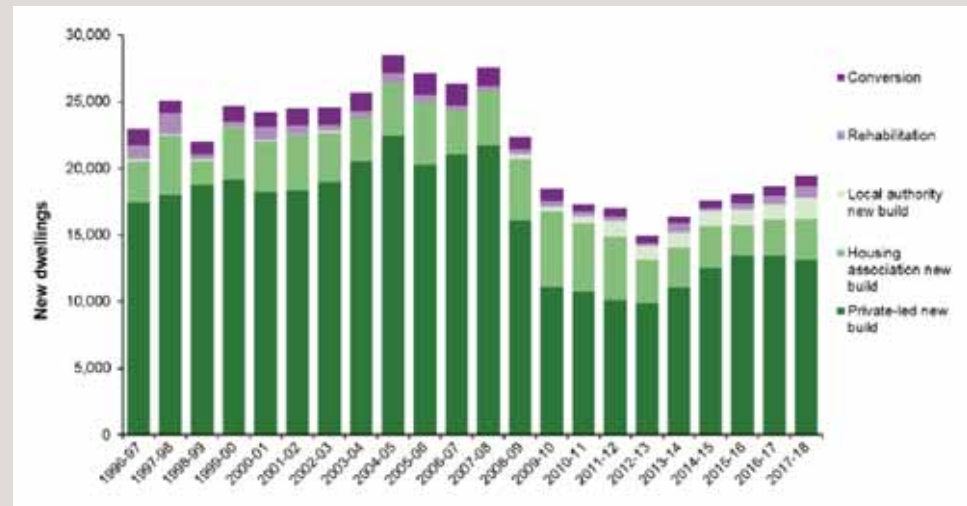
new homes were
supplied



3,130

homes via Affordable
Housing Supply
Programme

Supply of new housing in Scotland 1996-97 to 2017-18



5.3 Strategic Planning to Meet Demand – National Planning Framework

Scotland's approach to strategic planning is set out in its National Planning Framework, that is enshrined in law and implemented through policy, guidance and decisions. This system is designed to identify where development and infrastructure is required to support sustainable and inclusive growth. Under the current system, Scotland's local authorities are responsible for assessing housing demand and need in their areas. There is also a local housing strategy that sets out a strategic vision for the delivery of housing and housing-related services locally.

However, the Government is in the process of developing and implementing a new planning framework, NPF4, looking ahead to 2050. It is intended that NPF4 will provide guidance on spatial development, set out national policies, designate national developments and reflect regional spatial priorities. Current Strategic Development Plans, will transition to new regional spatial strategies for all of Scotland. In doing so, NPF4 will align with wider programmes and strategies, including those related to the delivery of infrastructure, net zero carbon and inclusive economic growth. In addition, NPF4 will provide a renewed focus on rural development including rural repopulation while giving stronger guidance on housing delivery and diversification including the setting of targets on land for housing.

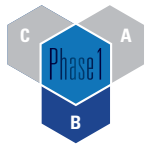
The current system requires each local authority to undertake an all-tenure housing need and demand assessment (HNDA) for their administrative area. This underpins the Local Housing Strategy, which is a statutory requirement on all local authorities under the 2001 housing

act. The HNDA is also the evidence base on which a local authority may establish a local affordable housing policy, which requires affordable housing contributions from private sector developers under the planning system.

5.4 House Building

At the start of the economic downturn in 2007/08, the annual number of new home completions was around 25,000. Completions then fell year on year until 2012/13, when around 14,000 new homes were built and numbers began to increase again. The latest data available shows that over 20,000 new homes were completed during 2018, the first time since 2008 that annual house completions exceeded 20,000ⁱⁱ. However, Homes for Scotland also estimate that to keep up with current demand, new housing output must increase to the pre-recession levels of constructing at least 25,000 new homes per yearⁱⁱⁱ. For its part, the Scottish Government has committed to delivering 50,000 affordable homes by 2021ⁱⁱⁱ.

While the economic environment over the past decade has clearly constrained investment in new housing, the recession has not been the only barrier. The viability of all new housing developments is dependent on an underpinning network of supporting infrastructure, such as water, drainage, electricity, gas and local roads. However, a lack of a common approach across Scotland as to how this supporting infrastructure is delivered has had a major impact on the construction industry's ability to provide the homes that have been allocated in plans and for which there is a clearly identified need.



Part B:
Sector Summaries
(continued)

Housing



92%

of households reported that they were satisfied or fairly satisfied with their housing in 2017



5.5 Challenges

At its highest level, the challenge is how to meet our future housing needs in a way that aligns with predicted demographic changes. However, this disguises the various strands of complexity that are interwoven throughout this sector.

As noted above, National Records of Scotland forecasts indicate a steady drift in population from the west of Scotland to the east. In very simple terms, this leads to significant localised demand pressures on one side of the country and surplus property on the other. This raises a fundamental question whether this population drift should be managed – if so, how and to what extent? If not, what needs to be done to manage and mitigate the potentially negative effects of both increasing and decreasing populations? However, while this question is beyond the immediate remit of the Infrastructure Commission for Scotland and for others to address, its resolution is complex and will have a practical impact on the delivery of Scotland's future infrastructure needs. For example, it is not simply a case of determining what new assets may be required in areas of population growth, but also consideration of what to do with existing infrastructure in areas of population decline which may become underutilised or even redundant.

Enabling and supporting infrastructure is considered to be an important component to successful housing and commercial property development across Scotland and a more coordinated, structured and systematic approach to its delivery, such as that described by the principle of "Infrastructure First", would help to address some of these issues^{iv}. This would seem to be more crucial in a situation where policies aimed at delivering an inclusive net zero carbon economy will take an increasing priority in future development design and implementation.

Such an approach would also help to support the better implementation of the Place Principle which aims to create a more joined-up and collaborative approach to services, land and buildings within a place to achieve better outcomes. Alongside the Place Principle, the Place Standard is a tool designed to support the assessment of places and what is needed. The Place Standard has a number of indicators which help to define a "place" from accessibility to public transport, work and the economy to influence and a sense of control to feeling safe.

For example, while a well-designed, warm, affordable, energy efficient home is a key component of a new housing development, equally key is where the development is located, and sense of place it creates. From our call for evidence, it sometimes appears that when developments are being planned and constructed, insufficient thought or regard has been given to these wider requirements, such as good connectivity and access to local services, facilities and utilities. Given the cross-cutting effects, it is important that housing should not be looked at in isolation and a whole system coordinated approach is required.

In April this year, the Scottish Government and CoSLA agreed to adopt the "Place Principle" "to help overcome organisational and sectoral boundaries, to encourage better collaboration and community involvement, and improve the impact of combined energy, resources and investment." While this is welcome and a significant step in the right direction, the approach now needs to be implemented in a consistent way across Scotland as an important contributor towards improving the lives of people, supporting an inclusive net zero carbon economy and creating more successful places.

Key issues summarised here are incorporated into a number of recommendations at Part C, most specifically those relating to Leadership, Place, Digital and Technology and Independent Long Term Advice.



Sector Summary

Natural Infrastructure



Part B:
Sector Summaries
(continued)

Natural Capital

6.1 Background

Natural capital is a collective term used to describes the habitats and ecosystems that provide social, environmental and economic benefits to humans. This includes, the food we eat and water we drink, and materials we use for fuel, building materials and manufacturing. In addition, our natural environment also contributes to climate regulation, natural flood management through our forests and wet lands, removal of air pollutants by vegetation, and the pollination of crops by insects.

In 2019, the Scottish Government published a report setting out its estimates of the quantity and value of services being supplied by Scotland's natural capital^{lv}. This noted, among other things, that:

- > in 2015, the asset value of Scotland's natural capital was estimated to be more than £290 billion, or 37% of the total UK asset value
- > fish capture in Scottish waters rose by over two-thirds between 2003 and 2016;
- > Scottish timber production nearly doubled from 1997 to 2017;
- > during 2017, water abstraction for public water supply in Scotland fell to its lowest level in the series history, partly due to less leakage;
- > in 2017, five times as much energy was produced from renewable sources in Scotland than was produced in 2000; and,
- > between 2009 and 2017, annual outdoor recreation time spent per person was 56 hours (65%) higher in Scotland than the UK average.

Investing in natural capital can improve the attractiveness of places, improve peoples' health and wellbeing and contribute towards reducing carbon emissions. The high quality of Scotland's natural environment and the quality of life it supports are considered to be a major selling point for the Scottish tourist sector – for example, it is reported that nature-based tourism supports around 40,000 jobs and generates over £1.6 billion in revenue across the country^{lvi}.

Investment in green infrastructure is often seen as a way of driving increased amenity value in areas of multiple deprivation by creating high quality greenspace in local environments that helps to support healthy living. In addition, appropriate investment in natural capital can contribute to increasing resilience to climate change, such as interventions to protect Scotland's peatland which can both lock up carbon and provide a natural reservoir to reduce flood risk. Investing in natural capital can also contribute to delivering inclusive economic growth, for example, ensuring healthy and productive soils to support Scotland's agriculture and forestry and a high-quality aquatic environment to enable our aquaculture sector to prosper.

In view of its important role, we agreed that natural capital should be recognised within the definition of infrastructure, covering both "green" and "blue" (aquatic) infrastructure. However, natural capital, as with all assets, should not be looked at separately or in isolation from Scotland's



£290bn

Estimated value of
Scotland's natural capital

other infrastructure, assets but as a component part of the whole system. If properly designed and delivered, integrating blue/green infrastructure into wider plans can increase the county's connectivity with the natural environment and deliver efficiencies in investment.

The Government is already working towards the integration of a natural ecological network and the principle of biodiversity net gain in the next National Planning Framework (NPF4). This is expected to drive investment in natural assets through local infrastructure investment.

6.2 Challenges

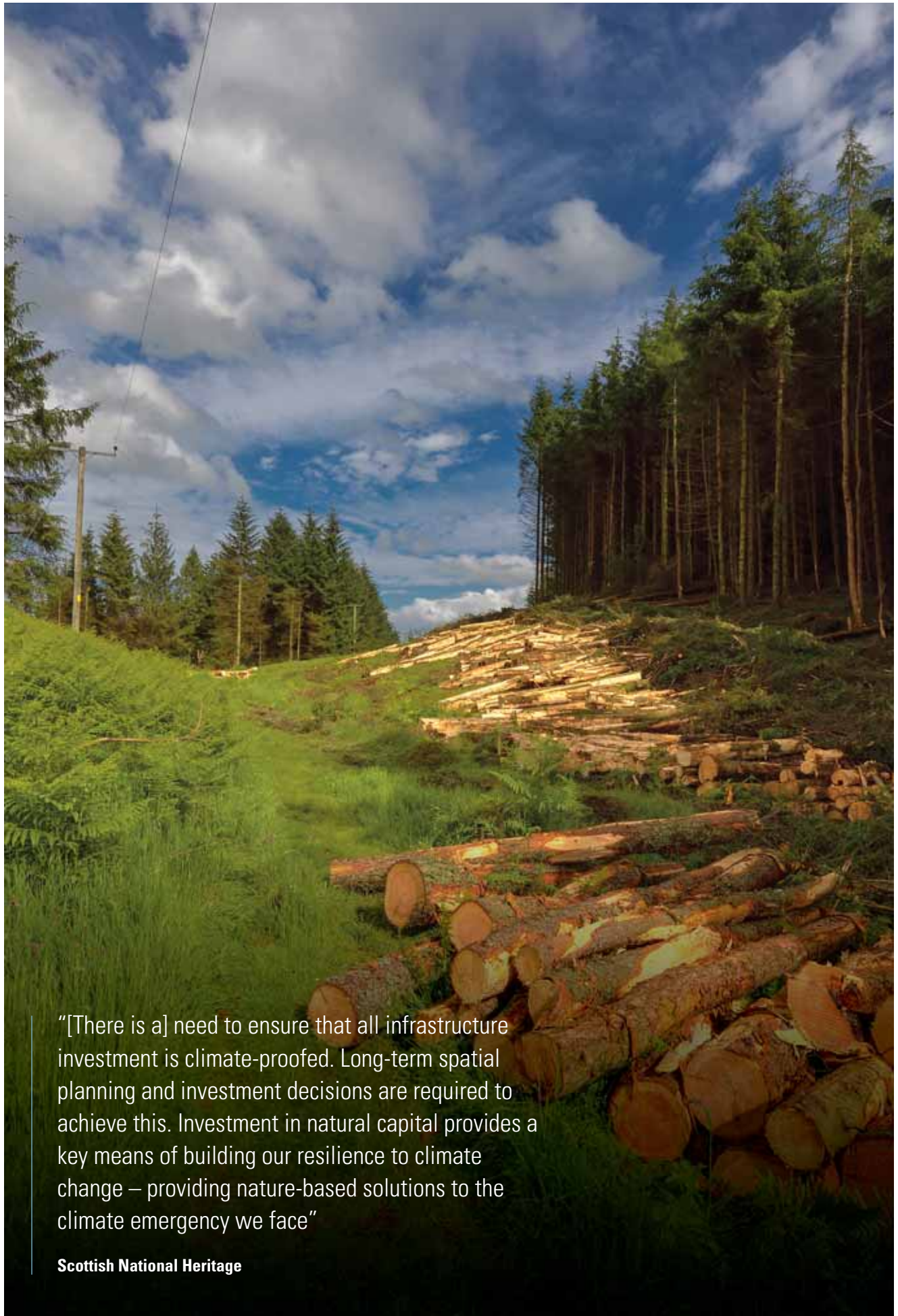
A key challenge for infrastructure investment is the need to make better connections across different categories of infrastructure. In its response to the Commission's Initial Call for Evidence, Scottish Natural Heritage noted that, for example, transport infrastructure can, if properly designed and delivered, increase connectivity for nature and drive efficiencies in investment. On the other hand, the planning system does not easily facilitate infrastructure connections to be established between different types of land use, such as agriculture and forestry. Similarly, the interface between the marine and terrestrial environments is not addressed in full by the planning system.

Consequently, there is scope for better integration:

- > across the planning system, land-use strategy, marine spatial planning and forestry,
- > among transport, environment and health policy frameworks that support active travel for commuting, recreation and leisure trips
- > across infrastructure investment streams for rural and urban areas

We also need to find ways of dealing with and decommissioning redundant infrastructure which can cause an ongoing pollution threat, reduce the attractiveness or areas for future investment or lock up valuable land or materials that could be put to better use.

Key issues summarised here are incorporated into a number of recommendations at Part C, most specifically those relating to Leadership, Place, Making the Most of Existing Assets, Heat and Transport, Digital and Technology and Independent Long Term Advice.



“[There is a] need to ensure that all infrastructure investment is climate-proofed. Long-term spatial planning and investment decisions are required to achieve this. Investment in natural capital provides a key means of building our resilience to climate change – providing nature-based solutions to the climate emergency we face”

Scottish National Heritage



Part B:
Sector Summaries
(continued)

Water & Wastewater

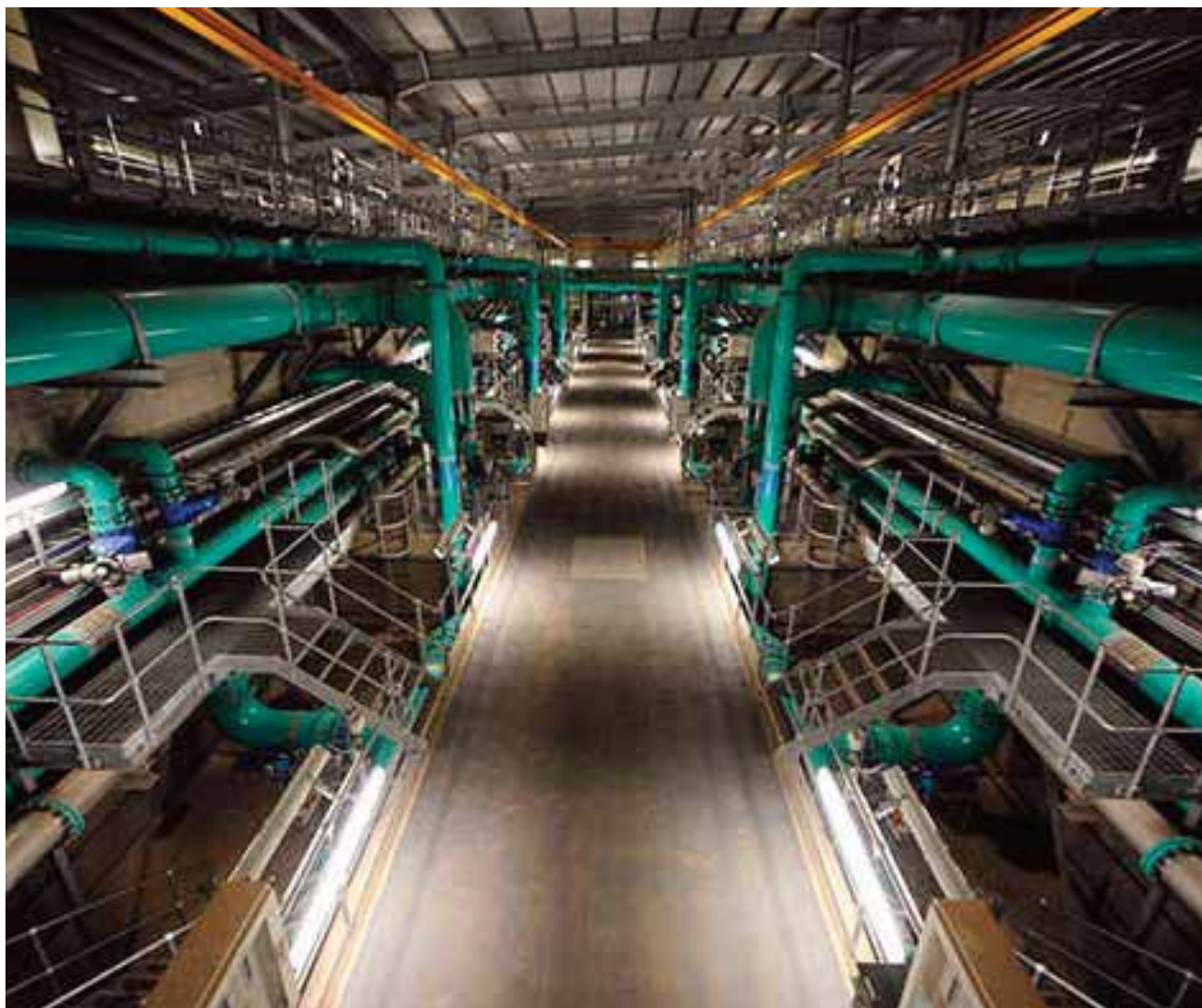
6.3 Background

Scottish Water is responsible for providing water and wastewater services to around 2.5 million domestic premises and to 152,000 businesses across Scotland. It owns and operates around 240 water treatment works and delivers almost 1.5 billion litres of drinking water to customers each day through its network of water mains and distribution pipes extending some 48,000 kilometres. In addition, Scottish Water owns and maintains a sewerage network of some 53,000 kilometres which carries almost 1 billion litres per day of raw sewage for treatment at 1,800 wastewater treatment works^{lvii}.

However, Scottish Water does not provide water to every consumer in Scotland. A recent report by the Drinking Water Quality Regulator for Scotland notes there are nearly 22,000 private water supplies in Scotland serving around 200,000 people (3.6% of the population)^{lviii}.

6.4 Scottish Water – a Public Corporation

Scottish Water is a public corporation of a trading nature and is answerable to the Scottish Parliament through the Scottish Ministers. It is charged with delivering the investment objectives set by the Scottish Ministers for a defined regulatory period within the funding allowed by the Water Industry Commission for Scotland (the water industry's economic regulator in Scotland) through the Strategic Review of Charges. Scottish Water is funded through revenue raised from customer charges and borrowing from the Scottish Government. These finance Scottish Water's investment programme, Private Finance Initiative service fees and interest charges on loans.





In 2018/19 Scottish Water invested nearly
£660 million
 upgrading treatment works, water mains and sewers

6.5 Scottish Water's Current Objectives and Investment Programme

Scottish Water have been set objectives by Ministers for the 2015-21 period which reflect the following challenges:

- > **Climate change** – responding to the impact that climate change has on the quality and availability of water resources; managing the impact of increased levels of rainfall run-off going to sewer and stricter quality standards and limits in discharging wastewater back to the aquatic environment.
- > **Demographic changes & resource availability** – assessing the impact on supply of increased demand due to an expected growth in population and households over the next 15-years or so, coupled with the predicted population shift (from west to east). In short, is there enough capacity in the system and is it in the right place to meet the projected demand?
- > **Statutory obligations** – meeting enhanced standards to comply with relevant statutory requirements.

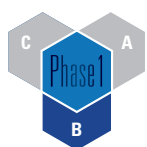
In planning to address these challenges, Scottish Water indicated that it would focus on improving the resilience of water supplies – for example, in 2015 Scottish Water estimated that it had the capability to continue to provide normal supplies in extreme events to its customers and it has set in motion plans to improve this to 100% by 2040. In addition, it aimed to further improve the quality of drinking water to ensure 100% compliance with relevant standards by 2040, compared to around 99.92% in 2018/19.

Since its creation capital expenditure of around £600m per year has been undertaken by Scottish Water to deliver these and the other objectives set out by Ministers. In 2018/19, Scottish Water delivered £659.9m of investment across Scotland. Of this, £384.3m was made on capital maintenance of assets, which accounted for 58.2% of investment^{tlx}.

6.6 Challenges

Although the process to set the investment objectives and agree funding for Scottish Water for the next regulatory period (2021-27) is underway, this work is not expected to conclude until June 2020. While the precise terms of this will be for the Scottish Ministers and Scottish Water to determine, the Commission's extensive engagement with stakeholders has enabled it to form a detailed understanding of the challenges it will face.

It is clear that the impacts of climate change will continue to have an adverse effect on Scotland's aquatic environment, leading to an increased risk of flooding and drought. From a supply perspective, ensuring an adequate water supply to meet demand and maintaining quality in times of drought is challenging – not only is less raw water available for extraction and distribution, but it will require enhanced treatment to bring it up to the required standards for potable water. In addition, the impact of drought is expected to present a major problem and serious health risk for a significant number of private supplies outwith the Scottish Water network.



Part B:
Sector Summaries
(continued)

Water & Wastewater

At the other end of the spectrum, flooding events are likely to occur more frequently and with more intensity. Managing the impact of increased levels of rainwater run-off going to sewer, while at the same time ensuring discharges to the aquatic environment comply with stricter quality standards will require careful handling.

In addition, significant future capital investment on Scottish Water's assets is expected in order to maintain and improve compliance levels with statutory obligations. Also, and in parallel, increased expenditure will be required on Scottish Water's capital maintenance programme as assets begin to age and deteriorate. Keeping the system properly maintained and operational by replacing those assets which have reached the end of their life is a major management problem for Scottish Water given the scale and size of its extensive estate.

Water and wastewater treatment processes are very energy intensive and as a consequence, Scottish Water is one of the largest consumers of electricity in Scotland^{ix}. It requires around 442 GWh per year of electricity, which is enough to power nearly all the homes in Stirling, Falkirk and Clackmannanshire (140,000 homes). However, Scottish Water is committed to becoming net zero by 2040 and progress is being made towards that target. Currently, Scottish Water self generates around 35 GWh per year enabling more than 70 of its water and wastewater

treatment works to be either self-sufficient, or partly self-sufficient in terms of their power requirements. While this is encouraging, this represents only around 8% of Scottish Water's annual energy demand so meeting its 2040 target continues to be a major challenge.

Increasing its energy efficiency will also contribute to Scottish Water meeting its 2040 target. At present, while Scottish Water delivers 1.5 billion litres per day to customers, around 480 million litres per day is also lost to leakage. Again, while good progress has been made in reducing leakage – 10 years ago or so ago, leakage rates were more than double this volume – reducing leakage levels further would, in turn, help to reduce Scottish Water's annual energy demand^{ix}.

As a regulated industry, Scottish Water is subject to the requirement of the regulatory economic framework set by the Water Industry Commissioner for Scotland. This framework enables the Commission to:

- > Set prices for water and sewerage services that deliver the Scottish Ministers' objectives for the water industry at lowest reasonable overall cost;
- > Facilitate competition in the Scottish water industry for non-domestic consumers; and,
- > Monitor and report on Scottish Water's performance.

Scottish Water owns and maintains assets worth some £70 billion comprising:

- > 240 water treatment works and a network of 48,000 kilometres of water mains
- > 1,800 waste water treatment works and a sewerage network of 53,000 kilometres



Through the Commission's engagement process, a general consensus emerged that this regulatory framework was delivering broadly the levels of investment currently required. However, looking forward towards the next 10-15 years, it is likely these levels will need to increase significantly in order to enable Scottish Water to properly invest in maintaining and renewing assets where appropriate. While long term plans have been established, this will entail scoping for NPF4 and while long term plans have been established, it will be important to ensure that future investment decisions are prioritised on the basis of their contribution to an inclusive net zero carbon economy.

Finally, as a key utility in supporting the viability of new housing developments, it will be important that Scottish Water plays a full part in all place-based Infrastructure First assessments in responding to the long-term housing supply and demand issues in Scotland.

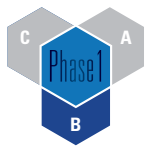
Key issues summarised here are incorporated into a number of recommendations at Part C, most specifically those relating to Leadership, Place, Making the Most of Existing Assets, Regulation, Digital and Technology and Independent Long Term Advice.



Each day, Scottish Water delivers almost 1.5 billion litres of drinking water to customers and treats around 1 billion litres of raw sewage for safe discharge back into the aquatic environment.

Source: <https://www.scottishwater.co.uk/en/Your-Home/Your-Water/Leakage>
<https://www.heraldsotland.com/news/15340682.a-third-of-scottish-water-leaks-before-it-reaches-the-tap/>





Part B:
Sector Summaries
(continued)

Flood Management



Annual cost of flood damage in Scotland estimated to be between £200m and £250m.

Nearly 300,000 homes, businesses and services considered to be at risk of flooding in Scotland.

6.7 Background

One of the major consequences of climate change is the increased risk of heavy flooding and coastal erosion. The Met Office has reported that over the past 110 years, there have been 17 record breaking rainfall months or seasons across the United Kingdom. However, 9 of these have been since 2000^{lxii}.

It is estimated that there are currently 284,000 homes, businesses and services at flood risk in Scotland. This is more than double the number identified to be at risk in 2015. Moreover, it is expected that the continuing impact and effects of climate change will increase the numbers of properties at risk by a further 110,000 by 2080. In addition, some 2,000 kilometres of Scotland's roads, 500 kilometres of rail network and 200,000 hectares of agricultural land are deemed to be at risk^{lxiii}.

The impact of flooding can be devastating, leading to huge economic losses and major disruption and distress to those affected. Dealing with consequences can extend for many months, or sometimes years, after the initial flood waters have receded. Recent estimates of the annual

cost of flood damage to property in Scotland range from £200 to £250 million per year^{lxiv} – Aberdeenshire Council report that it has spent around £12 million to help communities recover from the impact of floods caused by Storm Frank in December 2015^{lxv}.

In addition to the effects of climate change, a number of other factors can affect flood risk. These are under the control of a number of organisations and include:

- > Planning decisions – avoiding development in areas of known flood risk;
- > Drainage design and capacity and the use of Sustainable Urban Drainage Systems (SUDS) to ensure drainage systems can cope with predicted future rainfall volumes and intensities;
- > In urban areas, limiting the amount of hard surfacing in favour of porous surfacing; and
- > Effective river catchment management to reduce flood risk.

6.8 Scotland's Approach to Flood Risk Management

While individual property owners are deemed to be the “first line of defence” in protecting their property or businesses against flooding, a range of public bodies in Scotland also play a major part in managing and mitigating flood risk. In brief, these are as follows:

- > **Scottish Environment Protection Agency (SEPA)** – amongst its other responsibilities, SEPA is Scotland's national flood forecasting, flood warning authority and strategic flood risk management authority responsible for producing Scotland's Flood Risk Management Strategies;
- > **Local Authorities** – responsible for producing Scotland's Local Flood Risk Management Plans and implementing and maintaining flood protection actions. Local authorities also inspect, clear and repair watercourses to reduce flood risk and maintain road gullies on public roads. When severe flooding occurs, local authorities will work with the emergency services and coordinate the provision of temporary accommodation for people evacuated from their homes;
- > **Scottish Water** – responsible for the drainage of surface water from roofs and paved ground surfaces within a property boundary;
- > **Scottish Government** – sets the policy framework to manage flooding in Scotland and oversees the implementation of the Flood Risk Management (Scotland) Act 2009, which establishes the requirement for Flood Risk Management Strategies and Local Flood Risk Management Plans to be produced.

6.9 Funding for Flood Risk Management

Since 2007 the Scottish Government has provided £42 million per year through the annual local government settlement for new flood protection schemes. Until 2015/16, local authorities were able to apply for this funding based on a set of criteria agreed by the Scottish Government and CoSLA. However, from 2016/17, the Government and CoSLA agreed that future flood protection work should be based on a more sustainable funding arrangement, with 80% of the total available allocated to large scale projects prioritised in the Flood Risk Management Strategies and the remaining 20% allocated to local authorities to contribute to other elements contained in these strategies.

6.10 Current Priorities

42 Flood Protection Schemes were prioritised for the period 2016-21. These have been selected on the basis of a number of criteria, including

their cost and benefits as well as the social and environmental impact of the schemes. It is estimated that around 10,000 properties will benefit from the flood protection afforded by these schemes.

Going forward, the Government and CoSLA have agreed that a minimum of £42 million per year capital grant will be available in the 10 years from 2016-2026 for flood protection schemes. SEPA, the Government and the local authorities are now working together to develop a list of priority schemes for the period 2022-28^{lvi}. The Grangemouth flood protection scheme has been identified as the highest priority project. When complete, this will protect a large number of residential and non-residential properties and significant national infrastructure at risk of flooding from the River Carron, Grange Burn, River Avon and Forth Estuary.

6.11 Challenges

Coastal Erosion

Coastal erosion and coastal flooding are interlinked and must be considered jointly. It is predicted that both will change in the near future – moreover, coast changes can happen suddenly, with the resulting damage being significant.



£42m

provided each year
for new flood
protection schemes.



110,000

further properties
at risk of flooding
by 2080



865km

of soft coastline has
moved position
since the 1970s



33-50%

of coastal buildings,
roads, rail and water
networks lie in erodible
areas



The Dynamic Coast Project is a pan-government partnership that has transformed Scotland's public sector's understanding of coastal change. The initial research, which spanned from January 2015 to March 2017, has helped to establish an evidence base of national coastal change via the National Coastal Change Assessment (NCCA). This summarised the last 130-years of coastal change across all of Scotland's erodible shores (beaches, dunes and saltmarshes) and projected the changes forward to 2050. The project has been valuable in helping to identify those areas which may remain, or may become, susceptible to erosion in the coming decades and require supplementary support. Identifying susceptible areas and assets will enable the development of future management policies and adaptation plans that are based on a sound strategic and objective evidence base.

"Dynamic Coast" has identified that Scotland's natural coastal defences are playing an essential role in protecting assets worth some £13 billion and if erosion continues at current rates, around £400 million of assets will be threatened by 2050^{xvii}. These include residential and non-residential buildings, railway, roads and the freshwater aquatic environment.

Responsibility for funding coast protection works rests with local authorities from within their own resources. However, where erosion leads to an associated flood risk and works are included in their Local Flood Risk Management Plans, resources from the flood risk capital funds may be available.

Surface Water Run-Off

The effective management of surface water run-off is a key factor in limiting flood risk and the obligation for Sustainable Urban Drainage Systems to be provided within all new housing developments is

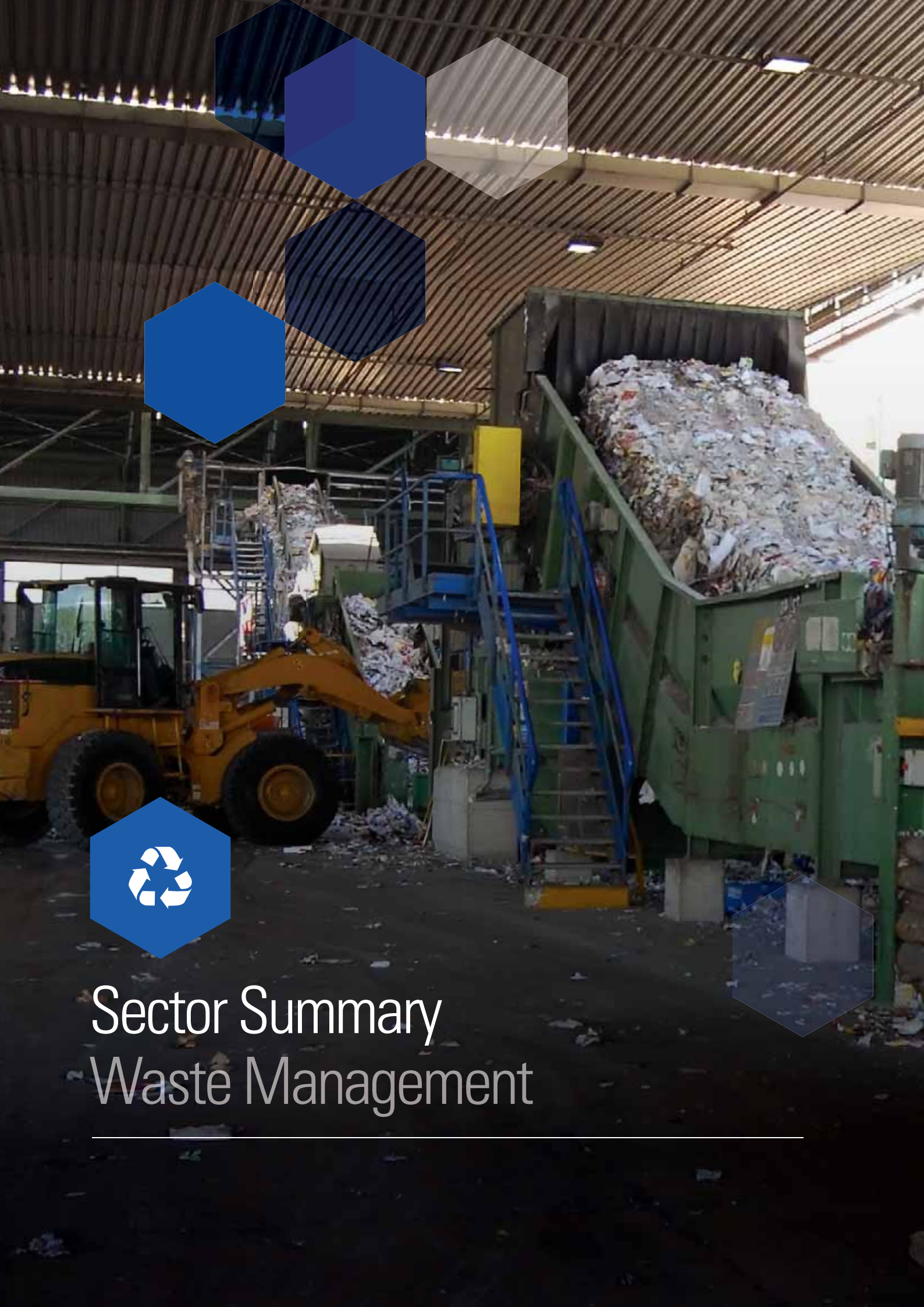
prescribed within the Water Environment (Controlled Activities) (Scotland) Regulations 2011, with Scottish Water the body deemed responsible for their future maintenance and capital replacement. However, where SUDS collect water from both roads and the land surrounding a house, responsibility for the maintenance of the system lies jointly with the local authority and Scottish Water.

A recent Report on Sustainable Urban Drainage Systems^{xviii} (SUDS) in Scotland has concluded that there is no regular monitoring and evaluation of current SUDS as recommended by The SUDS Manual – monitoring tends to be on a reactive, as needs, basis. As the effectiveness of SUDS depends on a regime of their maintenance, the report concludes there is a need for maintenance of SUDS to become more formalised and regular. A key recommendation of the report calls for earlier and more frequent communication between local authorities and Scottish Water over the vesting and sharing maintenance of SUDS.

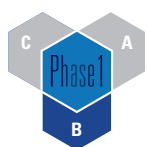
While this is a very specific issue, it nonetheless serves to further illustrate a key theme running through the Commission's conclusions that the effective delivery, management and maintenance of Scotland's infrastructure requires greater collaboration and cooperation between relevant parties.

In summary, it is clear that Scotland has a well-developed flood management strategy for both inland and coastal flooding. However, as noted above, there may be considerable merit in seeking to establish a more coherent and less fragmented system across all the parties involved in the various but related aspects of water and flood management and resilience.

Key issues summarised here are incorporated into a number of recommendations at Part C, most specifically those relating to Leadership, Place, Making the Most of Existing Assets, Regulation, Independent Long Term Advice.



Sector Summary Waste Management



Part B:
Sector Summaries
(continued)

Waste Management

7.1 Background

The total amount of household waste generated in Scotland each year is in the order of 2.5 million tonnes, which means each household is disposing of approximately 1 tonne of waste per year. Of this, around 45.5% is reported as being recycled and 45.1% is sent to landfill. However, the total amount of household waste generated continues to decrease on a year by year basis – roughly by around 1.5% per annum – and in 2017, the proportion of total waste recycled exceeded that sent to landfill^{lxix}.

However, in terms of total waste generated, household waste only contributes 25% with the biggest contributor being waste from construction and demolition, some 45% of the total^{lxx}.

The carbon impact of household waste generated and managed in 2017 was nearly 6 million tonnes of carbon dioxide equivalent (TCO2e) which is equivalent to around 1 TCO2e per person. This represents a decrease of almost 1.00 million TCO2e since 2011^{lxxi}.

7.2 Future Targets & Strategies

In order to reduce waste and the exploitation of natural resources, the Scottish Government has stated a clear intention to develop a circular economy for Scotland. It sees considerable benefits in such an

approach, for example cutting waste and carbon emissions, strengthening the economy and benefitting communities. In November 2019, it launched a consultation on legislative proposals for developing Scotland's circular economy^{lxxii}. This sets out a number of its key targets and strategies over the next 5 to 6 years include the following:

- > A minimum of 60% recycling rate for household waste by 2020
- > Ban on all non-biodegradable municipal solid waste to landfill by 2025
- > A 15% reduction below 2011 levels in tonnes of waste generated, of which a 33% reduction below 2013 levels in per capita food waste tonnage by 2025
- > A maximum 5% of waste to landfill by 2025
- > A minimum of 70% of all waste being recycled by 2025
- > Introduction of "Deposit Return Scheme" for plastic and glass bottles and metal cans during 2021

Delivering this vision will not be easy, for example, the Government estimates that its strategy envisages reducing the amount of waste produced in Scotland by 1.3 million tonnes compared to a 2017 baseline.

The proposed approach focuses on tackling Scotland's throwaway culture through banning the use of single use items and attaching a "value" to goods previously seen as disposable, for example charging



for single use beverage cups. It also wishes to encourage an increase in the use and reuse of goods – for example, encouraging the reuse and redistribution of unwanted surplus stock, such as clothing and textiles – as well as maximising recycling opportunities and improved enforcement of statutory provisions designed to underpin these policy proposals.

7.3 Challenges

As part of its engagement with stakeholders, the Infrastructure Commission for Scotland heard that while the Government's initiatives were broadly welcomed, there was also a recognition that their successful implementation would be challenging. For example, the Commission was informed that at present, Scotland's waste collection, recycling and repurposing system is complex and fragmented. There appears to be a lack of real understanding and data about the types and quantities of material currently going through our waste system. As a consequence, there is limited ability at present to establish a reasonably accurate estimate of the scale of how much material is available for recycling, reuse and repurposing. Without such an understanding, it is difficult to determine the most effective and efficient systems for circular waste management in Scotland.

In addition, the current system of waste management in Scotland is not geared or designed around the resource opportunities that the reprocessing of recycled waste will bring. Finally, the incentive mechanisms available are not yet aligned, nor is the market organised at the appropriate scale to stimulate investment in end to end system recycling and reprocessing facilities in Scotland.

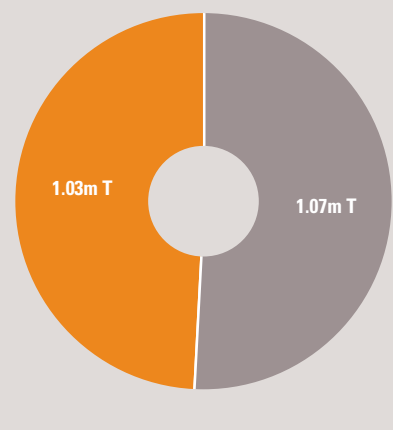
The above comments are not intended to be a pessimistic or negative view of the opportunities that will arise from the development of a circular economy – more a realistic assessment of where we are and what needs to be implemented if these welcome but ambitious plans are to be delivered.

The Scottish Government Deposit Return Scheme (DRS) for drinks containers (PET plastic, aluminium, steel cans and glass bottles) currently being introduced is anticipated to improve the quality and collection rate across those products, and should enhance their reprocessing and repurposing potential, supporting the principles of a Circular Economy in Scotland. One of the potential benefits for Scotland of a Circular Economy is the additional employment and investment opportunities that could arise from this reprocessing. It is important that implementation of a successful DRS creates an integrated and scalable approach that maximises the potential for these full Circular Economy benefits to be realised.

Household waste



For the first time ever in 2017, recycled waste in Scotland exceeded landfill



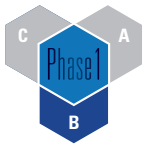
Household waste accounts for 32% of landfill waste generated, the largest generator is soils waste at 38%

Other suggestions raised with the Commission include developing greater transparency and clarity within waste stream data so that it can be subjected to thorough economic analysis. At present, accurate, reliable and comprehensive data on some waste streams is lacking. Finally, there was a recognition that more needs to be done to encourage a pace of change which will make progress in reducing the overall consumption of resources.

Key issues summarised here are incorporated into a number of recommendations at Part C, most specifically those relating to Leadership, Making the Most of Existing Assets and Independent Long-term Advice.



Sector Summary Public Service Infrastructure



Public Service Infrastructure

8.1 Background

Scotland's public sector comprises almost 150 separate organisations covering central government and its executive agencies, local councils, health boards, commissions and tribunals. All of these organisations own, manage and maintain a physical estate to enable them to undertake their duties and deliver the services they are intended to provide. These include, for example, administrative buildings and customer facing facilities, schools, hospitals, police facilities and fire stations. The list is extensive and wide ranging and has evolved over time in response to need and demand.

The following examples provide an illustration of the scale and size of specific elements of Scotland's public sector estate.

8.2 Education

Scotland has a long and renowned history in the provision of education. In the 17th century, it introduced universal education open to both girls and boys - the first country in the world to do so. The current education system is designed to provide early learning and childcare for two to five-year olds, primary and secondary education for those aged 5 to 18 and then further and higher education through a network of colleges and universities.

Early Learning & Childcare^{lxxiii}

The entitlement to a prescribed number of hours of free pre-school education has existed in Scotland for some time. However, in 2014 the Scottish Government introduced new legislation to increase the entitlement of free sessions from 475 hours per year to 1,140 hours per year by 2020. There are around 97,000 children currently registered for early learning and childcare places, which represents 99% of 3 and 4 year olds and 10% of 2 year olds.

About 80% of households with pre-school aged children are known to use some form of childcare. This includes local authority nursery or pre-school, private nursery or pre-school, play groups or childminding. However, the majority of these – some 43% - will use a local authority nursery.

There are around 97,000 children currently registered for early learning and childcare places, which represents 99% of 3 and 4 year olds and 10% of 2 year olds.

There are approximately 1,800 local authority early years and childcare settings delivering this service. To ensure there is sufficient capacity to meet the commitment to 1,140 hours of childcare, there are 900 new build, refurbishment and extension projects underway, including 160 new builds.

School Education^{lxxiv}

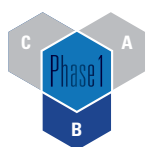
Responsibility for the delivery of primary and secondary education in Scotland, including the provision of the necessary schools, rests with the local authorities. The local authority system provides education to the vast majority (95%) of school aged pupils, with a small, independent sector catering for the balance. There are around 2,500 local authority schools in Scotland, comprising some 2,000 primary schools, 360 secondary schools and 130 special schools - the independent sector has around 100 schools. The size and scale varies immensely – from Holyrood Secondary School in Glasgow, with a roll of 2,100 pupils, to Minard Primary School in Argyll & Bute where the current roll is just 3 pupils. In gross terms the overall value of Scotland's school estate, based on current replacement costs, is estimated at some £26 billion.

The age of the estate varies widely also – from new schools to those built 50 or more years ago. However, the past 12-years has seen a programme of major investment in Scotland's schools with around 930 schools (37% of the entire estate) either built or substantially refurbished. As a result of this investment and reorganisation of the school estate, the proportion of schools in good or satisfactory condition has increased from 81.7% in 2012 to 88.3% in 2019. This means that 90% of Scotland's pupils are attending schools deemed to be in good or satisfactory condition compared to 83% in 2012.

Further Education^{lxxv}

There are 26 colleges operating in 13 regions across Scotland providing further education to around 240,000 students. The sector enables students of all ages and from all backgrounds to gain new skills and qualifications to allow them to progress towards their chosen career. Colleges also work in partnership with schools, universities, and employers to ensure the delivery of inclusive, high-quality and innovative learning and teaching which meets the needs of industry and enables individuals to thrive.

The last 10 years has seen some major changes in college estate as a result of a modernisation programme. Some £900 million has been invested allowing the construction of 15 new campuses, 9 major campus upgrades and 5 new specialist facilities.



Part B:
Sector Summaries
(continued)

Public Service Infrastructure



Higher Education^{lxvii}

With 19 higher education institutions, Scotland is home to more world-class universities per capita than anywhere else in the world and has the highest concentration of universities in Europe. Around 50,000 international students choose to study at Scottish Universities each year, with an estimate economic impact of over £2 billion per annum to the Scottish economy.

The university estate is diverse, for example some 20% is listed, a further 25% constructed before 1939 and over 70% prior to 1980. The age profile of the estate presents many challenges – growing maintenance requirements alongside the need to develop facilities that help to secure quality and market competitiveness. A study in 2017 for the Scottish Funding Council noted a need for the sector to invest £250 million annually simply to maintain the current estate

8.3 Health^{lxviii}

The National Health Service Scotland (NHSS) owns a wide range of physical assets with an estimated value of more than £7 billion. The vast majority of this comprises of land and buildings – other major assets include medical equipment and information and communications systems. It also has a number of other assets, worth a further £1.4 billion, mainly hospitals and health centres, which are managed under Public Private Partnership agreements. In addition to the NHSS owned and leased properties, there are also a large number of smaller facilities, providing community or family health services – for example GP Surgeries, Pharmacists, Dental Surgeries and Opticians. Many of these are owned or leased by the various practitioners and paid for indirectly by NHSS through a range of charging measures.

The latest figures show the total number of hospitals in the National Health Service Scotland (NHSS) estate at 202, comprising 37 acute hospitals, 39 long stay, 27 mental health, 12 psychiatric, 65 community and 22 “other type of health facility”. This is a reduction of 14 hospitals since the previous report on the NHSS estate, which is due to the consolidation of a number of services onto one site and the disposal of redundant properties following the completion of new facilities.

About 20% of the estate is under 10 years old, which is an indication of the significant levels of capital investment in property assets in recent years. However, NHSS notes that there still remains scope for considerable improvements and further investment in the estate in order to move away from old, poor quality and functionally unstable properties. For example, 22% of the estate is over 50 years old, though it should be noted that some of the older properties have been refurbished to modern standards rather than being replaced.

The revenue and lifecycle costs associated with asset ownership and use represent a considerable proportion of NHSS budgets where annual expenditure currently extends to some £700m per annum. These costs include:

- > Property maintenance – regular day to day maintenance including expenditure on backlog maintenance
- > Energy costs – the gross annual cost of energy across the NHSS hospital estate is around £100m
- > PFI facilities management costs – primarily Hard Facilities Management
- > Rent and Rates
- > Cleaning
- > Waste Disposal.

As part of its estate management strategy, NHSS aim to hold only the space needed to support the efficient and effective delivery of the service. At present, around 83% of the estate is fully utilised, 8% underused, 5% over-crowded and 4% empty. Most of the underutilisation can be found in the NHS Highland and NHS Orkney areas which reflects the challenges faced in providing and delivering critical healthcare facilities in sparsely populated areas.

Going forward, it is predicted that Scotland’s health services will face some significant challenges. For example, by 2033 the number of people over 75, who are the highest users of health and care services, is expected to have increased by almost 60% based on 2010 levels. These changes alone could increase health and social care costs by over 70%. There is also likely to be an increase in the number of people with multiple conditions and complex needs, such as dementia.



These and other expected changes will continue to add pressures on primary and community services. As a result, NHSS recognises the need to redesign those services around communities and ensure that they have the right capacity, resources and workforce. It is anticipated these changes will require the freeing up of capacity in hospitals and acute care, allowing for specialist diagnostic and elective centres to provide better-quality services to people and potentially changes to be made to the location of some services. The aim is to ensure that services are organised and delivered at the level where they can provide the best, most effective service for individuals. This will require, among other things, a significant change in the way the existing health estate is managed and operated.

In terms of future development, NHSS has stated that further investment will be required, both in major hospitals and supporting infrastructure across Scotland. In addition to this, investment will be required for primary and community care projects – this investment is considered key in delivering Scotland's emerging Health and Social Care Integration agenda and shifting the balance of care from hospitals to local facilities and people's homes.

A consequence of this investment in new assets means that surplus accommodation no longer required can be sold - NHSS estimate that disposing of these surplus assets could generate around £160 million in receipts.

NHSS is a major user of energy across Scotland's hospital sites, using more than 1.6 billion kWh in 2015/16 at a cost of almost £98 million, although this is a decrease on the previous year. Nevertheless, these are significant quantities and although NHSS remains proactive in driving down costs and consumption, meeting the net zero carbon targets will be a challenge going forward.

8.4 Police and Fire & Rescue Services

When Police Scotland was created in 2013, it inherited a large, complex and aging estate that, despite improvements, remained a legacy of the operational structures that pre-dated it. Not only does Police Scotland occupy the second largest police estate in the United Kingdom, but it also has the widest geographical coverage.

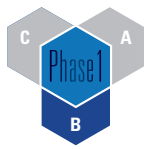
In 2017/18, the estate comprised some 605 individual assets^{lxviii}, as follows:

- > 349 operational properties (police stations and administrative offices)
- > 113 residential properties; and
- > 143 telecommunication masts.

The operational estate is valued at around £480 million, 80% of which is owned outright by the Scottish Police Authority – most of the remainder is leased. There is one PFI property – the police training facility at Jackton, with that contract due to conclude in 2026.

“From our experience of working in this field, well-designed places and the spatial planning that supports them are essential to making the best use of resources, enabling access to services for all and creating vibrant, mixed-use settlements and neighbourhoods. The importance of collaboration in achieving this cannot be under-played”

Architecture & Design Scotland



Part B:
Sector Summaries
(continued)

Public Service Infrastructure

Police Scotland have the largest geographical coverage of any UK police force at 58,168 square miles.

The value of the operational estate is £478m, 80% owned outright by Police Scotland



In terms of its age, a large proportion of the estate (about 66%) predates 1980, with 33% predating 1950 and a small number pre-date 1900. As a result, many of the older buildings lack the flexibility of modern workplaces with some of these older buildings proving to be disproportionately expensive to both occupy and maintain. Only a small part of the estate (around 20%) can be considered as new, purpose-built premises, suitable for supporting modern day policing.

The Scottish Fire and Rescue Service (SFRS) was also formed in April 2013 by amalgamating 8 legacy fire and rescue services into a single national organisation. All 356 fire stations in place at the amalgamation in 2013 are still in place today^{xxxix}. In terms of type, there are:

- > 74 wholetime fire stations, i.e. continually staffed on a 24/7 basis;
- > 240 retained duty fire stations; and
- > 42 volunteer fire stations.

These fire stations vary significantly in terms of their suitability – from modern facilities at wholetime stations to wooden sheds with no facilities or running water in remote rural areas.

In addition to its physical estate, SFRS also has a large asset base of specialist rescue equipment – for example personal protection equipment for firefighters, ladders, cutting equipment. This places considerable pressures on its operating and capital budgets and in May 2018, Audit Scotland reported^{xxx} that “to bring [SFRS] property, vehicles and other assets across Scotland up to a minimum satisfactory condition and maintain them over the next 10 years, the SFRS requires an average annual investment of £80.4 million. To simply ensure that its current assets do not deteriorate further than the current condition would require an annual investment of £37.8 million over the next 10 years.” However, Audit Scotland note that “preventing further deterioration” would result in SFRS’s property, vehicles and other assets not meeting the needs of a modern service.

Following the creation of Police Scotland and Scottish Fire and Rescue Service in 2013, there has been steps to introducing more co-location of assets between partners. For example, over the past 6 years, a total of 2,770m² of co-locations between Police Scotland and partners (local authorities, Scottish Fire and Rescue Service, Scottish Ambulance Service, Crown Office and the Procurator Fiscal Service) have been completed.

8.5 Justice

Scottish Prison Service^{lxxxii}

Compared to Police Scotland and Scottish Fire and Rescue Service, Scotland's prison estate is of a much smaller scale. There are 15 prisons, of which 13 are publicly managed and 2 managed and operated by the private sector under PPP contracts. The first of these contracts is due to complete in 2024 and the second in 2033.

While the majority of prisons in Scotland are modern facilities of less than 25-years old, there remain 4 which were built over 100 years ago (Barlinnie, Castle Huntly, Dumfries, Greenock and Inverness). Among current planned investments are a new National Facility for Women and three new build prisons to replace existing prisons in Glasgow, Highland and Greenock.

Crown Office & Procurator Fiscal Service (COPFS)^{lxxxiii}

The COPFS' estate comprises 51 properties across Scotland. Of these, 8 are owned outright by COPFS, 13 are leased and 26 are "embedded" within other buildings – for example, where COPFS is located within a court operated and owned by the Scottish Courts and Tribunal Service.

The vast majority of the COPFS estate is standard office accommodation, of various types, age and configurations. COPFS also has 2 "data centres" (in Glasgow and Edinburgh). The capital value of the 8 properties owned by COPFS is estimated to be around £6.5m, however, one property – Crown Office, Chambers Street, Edinburgh – is valued at £4.4m, or approximately 67% of the value of the entire estate.

COPFS has developed a 10-year estate strategy (for the period 2016 to 2026) which prioritises buildings:

- > in the right place;
- > of the right size;
- > of the right configuration;
- > of the right condition; and
- > delivered for the right price

Scottish Courts & Tribunal Service (SCTS)^{lxxxiii}

The STCS estate comprises 71 buildings – courts, vulnerable witness suites and offices – across Scotland. The estimated total value of the estate is currently some £470m. In addition our tribunals use some 70 venues across Scotland for hearings. Whilst the majority of these are provided by Local Authorities or NHSS, the scale and geographic extent of the total SCTS estate is significant.

Approximately 44% of the estate is pre-1960 in age with 86% being historic, listed and pre-1900. This brings a substantial obligation in terms of maintaining a significant part of Scotland's built heritage, for example Parliament Hall in Edinburgh. Whilst 46% of the estate falls within the 1981-2000 age range, even this group can contain listed buildings such as Glasgow Sheriff Court.

SCTS has an estate strategy, which similar to COPFS, prioritises buildings:

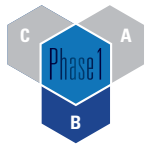
- > in the right place;
- > of the right size; and
- > of the right configuration;

8.6 Challenges

With 152 separate public sector bodies delivering a wide and diverse range of services, the emerging picture of the supporting infrastructure required across Scotland to enable them to fulfil their duties is of a large, complex and diverse landscape. This short overview has focussed on five areas – education, health, police, fire and rescues and prisons. This does not mean that other areas not covered here, such as sport and culture, are unimportant, but given the challenges faced across all the public sector are broadly similar, these areas provide a good illustration of the general situation.

For example, between them, their estate extends to nearly 3,700 physical assets, with the majority serving only a single purpose. This would suggest, historically, a sector led and somewhat fragmented approach to investment decision making and raises questions about whether we are getting the most effective infrastructure solutions delivered in the most cost-efficient way. This also extends to delivering an inclusive net zero carbon economy. While all parts of the public sector will endeavour to "do their bit", which is to be welcomed, more could be achieved through greater collaboration.

A more strategic and cross-cutting approach to planning and investing in new infrastructure would help. While there are some examples of good practice, such as the approach taken in developing Scotland's Learning Estate, there needs to be a greater of focus on the benefits of



Part B:
Sector Summaries
(continued)

Public Service Infrastructure

sharing resources and buildings and being more open to opportunities to ensure the most effective use of assets.

Having invested in new infrastructure, it is important to ensure that adequate resources are available to enable full and proper maintenance of the building. It is all too easy to fail to provide properly for maintaining buildings, especially when there is significant pressure on resources. However, to do so is a false economy and a major challenge facing our public services is to ensure proper maintenance regimes are developed and implemented.

Full and proper maintenance will not only ensure the building performs more effectively during its lifetime but buildings that have been well maintained are potentially easier to repurpose, adapt and refurbish when needs and requirements change. Rebuilding is not always the best option. However, there appears to be an absence of clear guidance for public sector bodies on a whole life approach to investment prioritisation along with assessing the wider net zero carbon and inclusive growth priorities which need to be established.

That said, there will be some cases when new build is the most appropriate way forward. However, the emergence over the past few years of construction problems in a number of public sector buildings has resulted in significant reputational damage to both the construction sector and public sector clients. All parties involved in the construction of a new building must play their part with both public sector clients and the construction sector needing to work together to ensure a safe and high-quality product is delivered.

Developing appropriate skill levels and capacity in the Scottish construction sector will help to address some of the issues, as will a greater focus on utilising alternative methods of construction to reduce construction failures. In addition, public sector clients need to be more aware of the potential benefits of utilising “infrastructure technology” in a more efficient and effective way that leads to “smart” public buildings.

Decisions about changes to our public service infrastructure are never easy. For example, proposals to close a school or hospital can be extremely contentious and difficult to implement. This is presenting some major challenges to the health sector, where the changing nature of healthcare will require a repurposing of how services are delivered and the supporting infrastructure this requires.

People feel very “attached” to the services in their area and as tax and council tax payers, believe assets provided by a public body “belong” to their wider community. The reasons for the change are often perceived as simple cost savings, rather than wider improvements that reflect how services can be delivered more efficiently and effectively in a modern society. There is also a sense that proposals for change are imposed on

“The use of data and intelligence to support a robust evidence base for decision making on future planning will allow the impact and demand for each of the identified infrastructure categories to be considered against a timeline. Combined with a whole life capacity approach... this should allow for the identification of the appropriateness of upgrades for existing infrastructure as well as the need for new infrastructure.”

Glasgow City Region

them, with any consultation being superficial, lacking transparency and with no realistic possibility of a different outcome being achieved.

While some attempts have been made to address these issues through legislation it can be difficult to implement effectively. The Schools (Consultation) (Scotland) Act 2010 prescribes a very detailed consultation process local authorities must follow when making a change to their school estate. However, the Act proved very difficult to implement effectively, in spite of it having full cross party support in the Parliament and within two years of it coming into effect, was subject to a fundamental review with significant amendments being introduced in 2014.

Looking ahead, it is clear that achieving an inclusive net zero carbon economy over the next thirty years will be extremely challenging and disruptive, requiring behavioural changes from both infrastructure providers and users. Difficult decisions will need to be made that affect everyone and it is inevitable that some trade-offs and compromises will be required. If these changes are to be delivered, a significantly better and more mature level of engagement with the wider public will be required than is currently the case, in order to secure acceptance and buy in.

Key issues summarised here are incorporated into a number of recommendations at Part C, most specifically those relating to Leadership, Place, Making the Most of Existing Assets, Digital and Technology and Long-Term Independent Advice.



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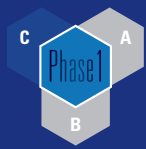
Phase 1

B

Infrastructure
Commission
for Scotland 

Part C

Cross Cutting Recommendations



Part C: Cross Cutting Recommendations (continued)

Introduction

Having placed an inclusive net zero carbon economy at the core of its thirty-year vision, the Commission does not underestimate the nature and scale of the challenges as well as the opportunities that this presents to Scotland. Whilst the journey to this vision has already started, the urgency and pace of change will need to increase, and the scale of change required will affect almost every aspect of daily lives. It is also becoming clear that the vision of an inclusive net zero carbon economy will sometimes require difficult choices to be made and trade-offs to be addressed. Therefore, if we are to be successful in capturing the opportunities whilst facing up to the challenges, it is not a matter of choosing change or no change; it is a matter of what, how and when future change will happen and the choices we make to get there. Informed, enhanced and inclusive engagement with users and citizens throughout that process of change will be critical.

These changes and choices clearly go far beyond infrastructure. However, infrastructure is and can continue to be a key enabler of, and contributor to, wider change. In relation to long term infrastructure investment and prioritisation, the ability to demonstrate the contribution these choices will make, to achieving the desired inclusive net zero carbon economy outcomes, will be essential. Building on the excellent start made through the National Performance Framework, “measures of success” for an inclusive net zero carbon economy from infrastructure investment urgently need to be established. The work of the Commission has also highlighted the need, in both the public and private sectors, for a transition to a system wide approach to infrastructure strategy, planning, delivery and operation across all infrastructure sectors supported by a coherent place-based approach to planning and decision making. Building on the work presented in Parts A and B, we have developed a series of recommendations for Ministers to consider.

01

Key Recommendation
Leadership

To provide leadership and demonstrate intent, the Scottish Government should prioritise all new infrastructure investment decisions based on their contribution to the delivery of an inclusive net zero carbon economy.

Infrastructure investment has an important role to play in delivering the aim of an inclusive net zero carbon economy. However, it is not simply a case of determining the demands for infrastructure and developing an assessment of infrastructure investment to achieve those demands.

As the OECD indicated

“While the size of an infrastructure gap commands attention to the challenges of infrastructure planning, an infrastructure gap as traditionally considered, principally reflects the scale of the latent investment demand, and it does not distinguish between productive and wasted investment or relate to what outcomes countries would like to accomplish through infrastructure provision”

The OECD has also suggested that...

“the historic approach of “predict and provide” infrastructure planning is now obsolete, as most countries have stopped focusing solely on rapidly rising consistent levels of economic growth in the face of new outcome-based challenges”

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Part C: Cross Cutting
Recommendations
(continued)

Key Recommendations

Leadership



The OECD also indicated that a key challenge to infrastructure planning is now the need to incorporate different demand and supply-side considerations into the decision-making framework including demand management measures.

A refreshed Infrastructure Investment Plan – that in particular sets out the infrastructure investment priorities over the next 5 years - is due to be published by the Scottish Government during 2020. Much of the preparatory work is already underway across Government, and it is very encouraging to note from our discussions with Scottish Government officials that the priorities for investment are to be focused on the delivery of inclusive economic growth and net zero carbon outcomes, reflecting the broad principles set out above by the OECD. Place is also viewed as a key consideration for investment, and as identified in Part A of this report the Commission also view Place based approaches to investment to be a key component of effective investment prioritisation and planning.

Whilst robust evidence and assessment frameworks are in place, including some work recently developed by the Scottish Government's Scottish Centre for Regional Inclusive Growth, there is still work to be

done in the applicability of tools and in particular in relation to infrastructure investment. This is not a uniquely Scottish challenge; the Fraser of Allander research commissioned by the the Commission re-affirmed the progress made in Scotland and elsewhere, but also highlighted the need for further development, as well as the the challenges involved. This situation does contrast slightly with the position in relation to Net Zero Carbon. Whilst achievement of net zero carbon by 2045 will clearly be extremely challenging, measuring the progress being made and demonstrating the reduction in CO2 emissions by specific investment interventions and programmes is, at this stage, better understood. In order for future long terms investment decisions and priorities to be informed from an evidence based perspective, and to enable the relative trade offs required to achieving the desired outcomes, it is the view of the Commission that a long term, over-arching assessment framework and methodology across all infrastructure asset types, does still need to be developed. The establishment of a fully developed assessment framework and methodology that is focused on contributing to inclusive growth and



Scottish Government committed to increasing infrastructure investment by £1.5 bn per year higher by 2025-26 than in 2019-20 (the National Infrastructure Mission)

This will require additional investment of over £1 billion per year over and above the existing plans set out in the Five-Year Financial Strategy

net zero carbon outcomes will be an important component to inform the basis of future infrastructure investment plans and priorities. Successfully achieving this will be essential to enable system wide, long-term trade offs and choices across the range of outcomes to be made. This framework will need to be established in advance of the development of the next update to the Infrastructure Investment Plan beyond 2020.

To support this ongoing development, the Commission also considers it beneficial for a long term infrastructure needs assessment to be completed. This would be undertaken in parallel with the establishment of the assessment framework, and incorporate the output of a number of additional recommendations made by the Commission. This work would help to underpin a detailed understanding of need across the entire infrastructure system and also establish greater clarity in relation to the key interdependencies, constraints and requirements.

It is though recognised by the Commission, that investment priorities need to be established in the immediate short term as part of the 2020 Infrastructure Investment Plan, in advance of this further development of any assessment framework. These immediate short term investment decisions should be based on the most appropriate methodology available that prioritises, on a “no regrets” basis, the contribution to an inclusive net zero carbon economy.

On this basis it is recommended that:

1. **All Scottish Government funded projects included in its 2020 Infrastructure Investment Plan should be prioritised against available inclusive net zero carbon economy outcomes.**
2. **The Scottish Government should, by 2021, develop and publish a new infrastructure assessment framework and methodology that will enable system wide infrastructure investment decisions to be prioritised on the basis of their contribution to inclusive net zero carbon economy outcomes.**
3. **The Scottish Government should publish by 2023 a system wide Scottish Infrastructure Needs Assessment covering all infrastructure sectors defined by the Scottish Government and we recommend the inclusion of natural infrastructure. The Assessment should be refreshed and updated at least every 5 years thereafter.**
4. **A fully updated Infrastructure Investment Plan should be developed by the Scottish Government for publication by 2025 using the new assessment framework and methodology and informed by the Infrastructure Needs Assessment.**

02

Key Recommendation
Place

To achieve an inclusive net zero carbon economy, the Scottish Government should put “place” at the heart of coherent, infrastructure prioritisation and planning.

“Place is where people, location and resources combine to create a sense of identity and purpose and is at the heart of addressing the needs and realising the full potential of communities. Places are shaped by the way resources, services and assets are directed and used by the people who live in and invest in them”

The Place Principle

This Place Principle was agreed between Scottish Government and COSLA in February 2018, and seeks to embed a more joined-up and collaborative approach to services, land and buildings within a place, to achieve better outcomes - one size does not fit all. Within this picture of Scotland's places, the spatial levels for decision-making are clearly important and can be seen to have developed in recent years. Place-based interventions have often been developed at a local level i.e.



community or town level and are supported by considerable legislation as identified in Part A of this report. Local authorities are central to the implementation of this with a range of resources and mechanisms at their disposal, including their role as the local planning authority. In driving local policy and investment decision-making for better places, they therefore have a strong co-ordination and partnership role.

Spatial decision-making is further built up through regionalisation developments. Building on the establishment of City Region and Growth Deals there is an increased regional focus that has brought together groups of authorities and their partners to understand and plan regional priorities. While these strategic partnerships are in their infancy for many, they are following a different strategic planning approach, that encompasses not only issues previously covered by strategic development plans, but wider economic, social and environmental shared priorities. Place-making is often explicitly referenced as important by these partners, as well as being implicit in activities. Reflecting this increased focus on the region, the Planning (Scotland) Act 2019 has introduced a requirement for all authorities to develop regional spatial strategies. In addition, through national bodies, including Transport Scotland, Scottish Enterprise and Scottish Futures Trust, it is recognised that infrastructure investments can significantly impact on the quality of places and the priorities of local people.

Place therefore is an increasingly referenced policy area, with implications at different interlinked spatial levels. Decision-making that has a role in place-making is taken at a national, regional and local level. During our engagement activities, stakeholders who were aware of tools such as the Place Standard believed they provided a strong resource for local decision making, however also suggested place-making was not sufficiently embedded in practice. Appropriate co-ordination of all partners' activities was also a theme, to ensure the different spatial priorities are blended to create places that most meet residents' expectations. Trade-offs and best-fit of priorities across areas needs to be considered.

The recently published guidance on the National Planning Framework 4 by Scottish Government also identifies Place as a critical component of how this Framework will be developed.

Early engagement by Scottish Government also identifies Place as a critical component of how this Framework will be developed.



In our engagement, a number of essential elements of place have emerged that contribute to a successful vision of an inclusive net zero carbon economy, that in combination need to be further developed to tackle both the challenges of achieving this vision as well as seeking to exploit the opportunities. This manifests itself in relation to labour supply and markets and the benefits of developing a coherent long-term approach to housing demand and supply, as well as the desire to ensure that the economic and employment opportunities can be fully capitalised upon.

Housing has been highlighted by a range of stakeholders as a key driver and enabler of inclusion, from both a spatial and affordability context. Scottish Government are currently in the midst of their Housing 2040 Consultation which is due to report during 2021, and are seeking to better understand and address these issues. One of the fundamental aspects that has been highlighted to the Commission by a range of stakeholders is the need for a clear long term, coherent national housing needs and demand assessment to be completed. It is acknowledged that a Housing Needs and Demand Assessment (HNDA) is periodically completed by local authorities, however stakeholders considered that the approach would benefit from greater coherence at a regional and national level. A revised approach was also seen as vital to assess the implications of the current demographic forecasts,

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Part C: Cross Cutting
Recommendations
(continued)

Key Recommendations

Place

both in terms of geographic and age based trends that have been identified from the evidence provided to the Commission.

Enabling and supporting infrastructure is also considered by a range of stakeholders as an important component to successful housing and commercial property development across Scotland, and is often referred to as the principle of an Infrastructure First approach to development planning and implementation. Local and strategic planners, infrastructure providers (both private utilities and public asset owners) and many house developers that the commission engaged with, all identified a need to address the systemic challenges currently faced. In a situation where inclusion and net zero carbon are also going to figure highly in future infrastructure development, design and implementation, the need to create a coherent approach is even more crucial.

The Independent Planning Review set out the potential benefits of strengthening such an Infrastructure First approach, which has been built upon most recently through the Scottish Land Commission and Scottish Futures Trust report which set out a potential approach to implement this in the context of land value capture. Most recently,

research undertaken for Scottish Government in relation to the ongoing development for NPF4 has recommended that an Infrastructure First approach be adopted, which the Commission supports. This coherent place based approach to development planning and investment across all of Scotland should include:

- > a strategic national perspective in the first instance, for all tenure housing supply and demand, driven by, in particular, demographic and inclusive net zero carbon economic trends over the long term;
- > assessment of existing and currently planned infrastructure investment that could impact on this strategic housing demand profile through effective utilisation of existing assets;
- > an across Scotland integrated and effectively co-ordinated Infrastructure First approach to development planning and investment; and
- > integrated with a place based assessment at a local, regional and national level that considers key labour market and supply opportunities from an inclusive net zero carbon economy.

It is anticipated that such a coherent and iterative process would promote greater infrastructure planning coherence across spatial geographies and also assist in identifying the potential economic and business opportunities from an inclusive net zero carbon economy.

On this basis it is recommended that:

5. **The Scottish Government should lead the development of a place based assessment of long term housing supply and demand across Scotland by 2021, supported by the development of a coherent strategy for the labour market and business opportunities arising from an inclusive net zero carbon economy.**
6. **To support the implementation of National Planning Framework 4, and the new system of development plans a co-ordinated and appropriately resourced Infrastructure First approach to the planning system should be introduced by the Scottish Government by 2021. This should be undertaken with infrastructure providers, developers and other public bodies, to ensure the effective delivery of a Scotland wide, integrated and coherent outcome based approach to planning spatial land use; with implementation to be undertaken at the appropriate regional, local and community level.**





Rethinking spatial land use and
planning as a whole

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Key Recommendation

Making the most of existing assets



Most of the underlying infrastructure that will be used in 30-years time already exists today. It is therefore essential that these assets are most effectively and efficiently utilised, maintained and enhanced to net zero readiness.

Infrastructure

With around 150 separate bodies delivering a wide and diverse range of services across Scotland, the emerging picture of the supporting infrastructure required across Scotland is one of a large, complex and diverse landscape. Even when only considering schools, health, police, fire and rescues and prisons, between them, their estate extends to nearly 3,700 physical assets, with the majority serving only a single purpose. This would suggest a sector led and somewhat fragmented approach to investment decision making and raises questions about whether we are getting the most effective infrastructure solutions delivered in the most cost-efficient way. A more strategic and cross-cutting approach to planning and investing in both existing and new infrastructure would help to address this. There needs to be a greater focus on the benefits of sharing resources and assets and being more open to opportunities to ensure the most effective use of the assets already at our disposal.

It is important to ensure that adequate resources are available to enable full and proper maintenance of assets. It is all too easy to fail to provide properly for maintenance, especially when there is significant pressure on resource budgets. However, to do so is a false economy and a major challenge facing our public services is to ensure proper maintenance regimes are developed and implemented.

Full and proper maintenance will not only ensure assets perform more effectively during their lifetime but infrastructure assets that have been well maintained are potentially easier to repurpose, adapt and refurbish when needs and requirements change. Rebuilding is not always the best option.

There is a broad range of evidence from stakeholders and contributors to the work of the Commission that highlights the requirements to make the most of existing assets. This has been highlighted in Part B in relation to the majority of the sectors being considered by the Commission.

In order to illustrate this in terms of overall infrastructure investment and prioritisation, the following hierarchy can provide a useful framework within which to consider the context of this:

- > assess the future demand and requirement of services to determine the overall infrastructure needs in a place, within the context of an inclusive net zero carbon economy;
- > assess the capacity and suitability of existing assets to meet those needs, including consideration of place based collaborative opportunities;
- > determine if assets are fit for purpose and what adaptation or repurposing is required;
- > assess the viability and sustainability of action required; and then
- > consider what assets need to be replaced

It is clear from this hierarchy that there may well be circumstances where replacement assets are a requirement. However, designers and decision makers should consider this in the context of what is required and whether or not existing assets can be adapted or repurposed. Across a portfolio, it will also be necessary to consider additional functionality or capacity through investment in existing infrastructure resilience.

On this basis it is recommended that:

7. **By the end of 2020, the Scottish Government should require all public sector infrastructure owners to develop asset management strategies containing a presumption in favour of enhancing, re-purposing or maintaining existing infrastructure over developing options for new infrastructure. New infrastructure should only be considered where the relevant authority has demonstrated this is the most appropriate response.**
8. **To support this, the Scottish Government should now prepare guidance for relevant authorities on a whole-life approach to infrastructure maintenance and prioritisation which includes both cost and build resources. It should also include guidance on assessing the wider net zero carbon and inclusive economic growth priorities that need to be established.**
9. **There should also be a presumption against like-for-like replacement of existing assets and the construction of new, single organisation/purpose assets in favour of shared facilities.**



2.5m tonnes

total amount of household waste generated in Scotland each year



1 tonne

of approximate waste disposed by each household in Scotland

Resources

There is a recognition that the non-sustainable use of natural resources, alongside air, soil and water pollution from increased use of our natural and manufactured resources are now at a critical stage. These activities are also major contributors to the climate emergency. At a roundtable event hosted by the Commission a number of key factors were identified:

- > The waste collection, recycling and repurposing system is complex and fragmented with limited knowledge and capability to establish what resources are available at scale.
- > The current system is not geared towards, nor explicitly designed around, the resource opportunities from the reprocessing of recycled waste
- > Incentive mechanisms are not currently aligned, nor is the market organised at the appropriate scale, to stimulate investment in end to end system recycling and reprocessing facilities in Scotland.

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Part C: Cross Cutting
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(continued)

Key Recommendations

Making the most of existing assets



The Scottish Government is due to introduce a Deposit Return Scheme (DRS) for plastic (PET), aluminium and steel cans and glass bottles during 2021.

The opportunities to stimulate market investment in Scotland are recognised and considered to be potentially substantial, and it is hoped will be stimulated by for example the DRS Scheme currently being developed. Nevertheless, this is still in its infancy and as it currently stands, this investment has yet to be secured for reprocessing facilities associated with the DRS and addressing this was identified as a key requirement to enable the full business and inclusion benefits of the scheme to be realised. In addition, the DRS currently only deals with glass, steel and aluminium cans and PET plastics, although it has been designed so that other materials can be included at a later date. The development of opportunities for other materials to be considered in the future was viewed as essential. It was also suggested that there could be benefit in an over-arching national function, that is integrated with approaches to collection and recycling, with the purpose of stimulating and supporting waste management reprocessing projects, to generate and deliver indigenous opportunities.

Participants agreed that there is an urgent need for less complexity and greater transparency within the waste stream. It was recognised that

Zero Waste Scotland have set out a vision for Scotland, however there was also wide acknowledgement of a required increase of pace in recycling, reuse and repurposing of natural or manufactured resources. This would reduce the overall consumption of new resources; as well as to maximising economic and business potential from lifecycle management and reprocessing of resources in Scotland.

Reliable data collection, that is available to policy makers, is a priority and should not be confined to the private sector. Public bodies with data relating to waste should be expected to share it more widely so that the full benefits and requirements of a circular economy can be analysed.

Infrastructure resilience and adaptability was also a key stakeholder concern, and ranged from specifics around climate resilience and how flood management is being co-ordinated to the wider issue of how infrastructure design and investment is planned to ensure its resilience. This highlights the diversity of outcomes that resilient and adaptable infrastructure will be required to meet. It includes both the ability to respond quickly to low probability high impact events, but also the need

to design redundancy into a system to manage and mitigate the impact of events whilst they are happening. There are inevitable vulnerabilities across our infrastructure. Establishing a clear system-wide understanding of these vulnerabilities is an important component of establishing their scale. The Scottish Government's 2nd Scottish Climate Change Adaptation Programme^{lviv} identifies 7 key outcomes, including infrastructure resilience. In addition, there is a statutory UK-wide requirement for the Committee on Climate Change to prepare Climate Change Risk Assessments^{lvw} every 5-years, again including the risks to infrastructure. This is a clear step to begin to addressing vulnerabilities and increasing prevention measures to minimise potential system failures. A system-wide approach is critical to moving beyond asset specific risk management and to identifying the key systemic interdependency risks; it should also increase the potential for system-wide resilient design and planning.

On this basis it is recommended that:

- 10. To support the creation of a vibrant circular economy for Scotland, by 2023 the Scottish Government should establish a route map for the implementation of a viable outcome focused system of resource use, reduction, collection, treatment and repurposing.**
- 11. Drawing upon available evidence, including the 2nd Scottish Climate Change Adaptation Programme, by 2023, the Scottish Government should develop a clear implementation plan, to address critical natural and built infrastructure climate resilience and adaptation needs.**



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Key Recommendation Heat and Transport



Key priorities for Scotland in reaching net zero carbon over the next 30-years will be accelerating the decarbonisation of heat and transport.

Decarbonisation

Transport and heat emissions combined contribute the majority of CO₂ emissions in Scotland and have therefore been a key focus for the Scottish Government in its planning to achieve a Net Zero Carbon target by 2045. The Scottish Government's current Energy Strategy has set out an action plan to address some of the key challenges to achieving this target across the wide spectrum of energy generation and consumption. As both transport and heat are devolved matters, it is vital that in these areas the Scottish Central and Local Governments, industry and civil society bodies work together to make material progress.

In relation to heat emissions a number of specific programmes and legislation have been introduced by the Scottish Government to begin to address the challenge. These include legislation to:

- > require improvements to energy efficiency to minimise the consumption of energy in existing domestic, commercial and public buildings; and
- > control the installation of domestic gas boilers to new homes from 2024.

These measures will be critical to a transition to net zero carbon. However, as a result of the 2019 increase in ambition to net zero carbon, it is recognised that more will need to be done to accelerate the pace and scale of development and implementation across all building types and owners, including incentive and support mechanisms and appropriate standards.

It is estimated that in the region of 80% of the buildings in existence today will still be in existence in 2050. Therefore, in addition to the measures outlined above, a fundamental component of reaching net zero carbon for heat is in relation to domestic buildings, as well as commercial and public sector assets. There are currently 2 million homes in Scotland with a gas boiler, and if net zero carbon is to be achieved by 2045, it is widely considered that there will need to be a transition over the next 20 years from natural gas to an alternate heat supply. The scale of the transition is significant, although it is not



Registered electric vehicles have seen an increase of over 130% in the last 12 months.

without precedent as demonstrated during the 1970's with a transition from "town" gas to natural gas. However, this time the challenge is of a far greater scale and is also considerably more complex. One of the key challenges is the likely multiple alternative solutions which include:

- > ground or air source heat pumps in individual buildings;
- > mains electricity;
- > ground, air and water source heat pumps and/or industrial waste heat connected to district heating networks;
- > natural gas/hydrogen mix;
- > full hydrogen gas (green, blue or grey, including Carbon Capture and Storage);
- > hydrogen fuel cells

Evidence that we have seen points to a potentially complex phasing of replacement heat sources with a range of solutions being introduced based on infrastructure and geographical characteristics as well as investment profile and technological advancement. There is also a matter of how best the repurposing of existing oil & gas infrastructure can be taken into consideration.

As highlighted in Part B, there are some pilot schemes in place to test a range of potential alternate technical options, but many of these are still at a very early stage of development and at a non scalable stage of innovation.

There is a similar level of scale and complexity associated with transport emissions and the transition to net zero carbon. There exists a transport hierarchy that places in order of importance of any given interventions:

- > management of demand.
- > increased use of active travel.
- > increased use of efficient public transport.
- > management of car transport.

Whilst the assessment and implementation of this hierarchy is dealt with more broadly later in this section, it is worth focusing on the current

plans in relation to road based transport and emissions. Road based CO2 emissions are the most significant contributor within the transport sector with diesel and petrol cars the most significant contributor within that. Both the UK and Scottish Governments have established legislation in relation to the reduction of CO2 emitting car vehicles setting targets for no new sales by 2035 and 2030 respectively; the presumption is currently that cars will, in the main transition to in-vehicle electric batteries. However, much work remains to be done across a range of elements including the car manufacturing industry, charging networks and technology, battery technology development, electricity generation and transmission infrastructure as well as pricing and taxation; all to be considered and managed as we transition to this alternative approach from the current dependency on petrol and diesel.



12,000

registered battery
& plug-in hybrid
vehicles in Scotland



>1,000

public charge points

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Part C: Cross Cutting
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Key Recommendations

Heat and Transport

In relation to other road transport such as buses and commercial goods vehicles, there appears to be a wider range of alternatives that include in-vehicle electric batteries as well as overhead and subsurface re-charging and supply as well as hydrogen engines. As noted, all of these alternatives are at a very early stage of innovation and development and are not currently scaleable to meet the needs of operators; all of them have considerable implications for the scale, type and phasing of the supporting infrastructure that will be required.

Across both Heat and Transport, this all points to a complex set of scenarios that requires an evolving level of clarity and a system wide approach to be developed over a 30-year horizon that considers the technical, regulatory, financial, social and spatial matters. Work has begun on this through the Climate Change Committee and the Scottish Government scenario modelling, which provides an initial “no regrets” basis for investment and development. However there is an urgent need for this to be further developed and implemented to cover the areas discussed above for both Heat and Transport. It is critical therefore that this be undertaken in combination for both sectors, along with the energy generation implications, to help identify infrastructure priority investment trade-offs as well as the phasing of investment. Early engagement with UK regulators and OFGEM in particular will be an essential component of this work.

On this basis it is recommended that:

12. **By the end of 2020, and to augment legislation already being considered, the Scottish Government should set out proposals to substantially accelerate the development and implementation of incentives, support mechanisms and standards for energy efficient, net zero carbon buildings across Scotland. This should include ‘whole building’ solutions and systematic public engagement, customised to the needs of different groups, to ensure that all property owners engage with proposed changes and are committed to upgrading their property.**
13. **By 2022, the Scottish Government, local authorities, regulators and industry should work together to establish the viability, incentivisation mechanisms and a route map for the transition to net zero carbon that in combination addresses heating for domestic, commercial and public buildings as well as all surface-based transportation.**

Transport

The Scottish Government is due to publish its new National Transport Strategy (NTS) and Strategic Transport Projects Review 2 (STPR2) shortly. It is imperative that the outcomes of these processes fully reflect the shift to net zero carbon emissions by 2045 and promote inclusive economic growth and can reflect and adapt to the output of the route map recommended at 13.

The draft NTS and initial work to develop STPR2 have demonstrated a clear intent to achieve this. Therefore, the new NTS and STPR2 should follow this intent and set out how the formulation, prioritisation and implementation of transport infrastructure project choices will deliver safe, affordable, inclusive and efficient Net Zero Carbon solutions for people, goods and services.

To achieve this, the new Strategy and selected projects and programme must consider infrastructure and its use as a holistic system. Policies must promote not only the use of zero emission transport, but also new opportunities for shared mobility and on-demand services, a much greater role for public transport in the overall provision of mobility, and substantial increases in the proportion of journeys made by the active modes.

Specifically, given the urgent need to reverse the growth in carbon emissions from transport in Scotland, we recommend that the final versions of the NTS and STPR2 adopt the following principles for future transport policy in Scotland:

- > There should be a presumption in favour of investment to future proof existing road infrastructure and to make it safer, resilient and more reliable rather than increase road capacity;
- > When new/upgraded road capacity (such as bypasses) is deemed necessary it must be as part of a package of interventions that includes a broadly equal reduction in road capacity for private vehicles on the existing network;
- > Following on from the above, and to help arrest the decline in bus patronage, there should be a general programme of reallocating significant road space from private vehicles to public transport in each of Scotland’s cities and the larger towns;
- > There should be a binding national target for road traffic in Scotland derived from the requirement to achieve Net Zero Carbon by 2045, with targets set for each 5-year milestone from the 2020 baseline to 2045;



- > Existing high-capacity rail that is resilient and reliable should be more fully optimised to make the most of that capacity, in advance of new capacity being developed;
- > A national integrated fares scheme for all public transport prioritising a substantial reduction in the cost of local trips should be costed by 2022;

On this basis it is recommended that:

14. The Scottish Government should ensure that its new National Transport Strategy and Strategic Transport Projects Review 2, which are due to be published during 2020, fully reflect the need to deliver an inclusive net zero carbon economy and consider the infrastructure and use of it as a holistic system. This should include:

- **Aligning strategic investment decisions to address fully the requirement for demand management, a substantial increase in the proportion of journeys made by active travel, and opportunities for shared mobility as well as a much greater role for public transport.**
- **For such roads investment that is made as part of the above, a presumption in favour of investment to future proof existing road infrastructure and to make it safer, resilient and more reliable rather than increase road capacity.**

Scottish Transport Appraisal Guidance (STAG) is an internationally renowned appraisal framework, developed before the declaration of the climate emergency, the focus on achieving net zero carbon, and the policy shift to pursue inclusive economic growth. STAG is complemented by Transport Scotland's Investment Decision Making Guidance. In order to deliver recommendation 14 above, and build on the intent demonstrated in the draft NTS, we recommend that the existing process is redeveloped:

- > Putting the requirement to achieve net zero carbon as the unequivocal priority of the transport infrastructure project appraisal system;
- > Adopting inclusive economic growth as the standard against which to measure the economic impact of transport infrastructure projects;
- > Appraising all potential future projects on the basis of their impact on the carbon and inclusion outcomes of the overall mobility system rather than specific transport issues in isolation.

On this basis it is recommended that:

- 15. Investment decision making based on the above framework will require a significant change to investment guidance. Therefore, by the end of 2021, the Scottish Government and Transport Scotland should develop a new investment appraisal and decision-making process, incorporating necessary changes to the current Scottish Transport Appraisal Guidance (STAG) and Investment Decision Making Guidance.**

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Part C: Cross Cutting
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Key Recommendations

Heat and Transport



The nature of that infrastructure will require considerable investment over the long term, and the regime of taxation and pricing will also need to evolve to reflect the anticipated changing use of transport as well as the potential as a lever to incentivise demand management and modal shift. In light of the anticipated transition away from CO₂ emitting transport fuels over the next 10-15 years and the required infrastructure investment there is a need to consider urgently and explore alternatives to the current fuel duty regime. Building on the principles outlined above in relation to making the most of existing assets and the example of Scottish Water highlighted in Part B of this report, there is strong evidence that developing an increased certainty and transparency of investment through long term infrastructure investment regulation can be an effective approach.

On this basis it is recommended that:

16. **To enable a managed transition to an inclusive net zero carbon road infrastructure, the Scottish and UK Governments should immediately commit to establish a charging/payment regime alternative to the existing fuel and road taxation based structure. The Scottish Government should also consider additional options to provide a more stable long term investment regime for the management and maintenance of road infrastructure to meet the priorities identified in 14 above.**

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Transport is a devolved matter and therefore development of policy and investment is led by Scottish Government. As has already been identified, the scale of infrastructure change needed to encourage and support an inclusive net zero carbon economy is going to be considerable over the next 30-years

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Key Recommendation
Regulation

To incentivise investment at the necessary pace and scale to meet future infrastructure requirements for Scotland, regulation will be a critical component to the delivery of a 30-year inclusive growth net zero carbon economy vision.

As already identified in preceding sections, many of the network infrastructure assets considered by the Commission such as energy and telecoms are owned and operated by the private sector, and will require significant investment over the next 10-15 years if the outcomes of an inclusive net zero carbon economy are to be achieved. These assets are regulated at a UK or GB level by either Ofcom or Ofgem and at a devolved level for Scottish Water by the Water Industry Commission for Scotland (WICS). The Commission received strong evidence from infrastructure providers to its call for evidence and also at a specialist roundtable, which highlighted a number of key issues that needed to be addressed to enable the scale of investment to be considered. These were namely the need:

- > for a clear strategy and vision to be established to guide and steer regulatory investment for the 30-year vision;
- > to allow distribution and transmission providers to invest in anticipatory infrastructure immediately, and to enable the required increase in infrastructure capacity to be invested in and developed to meet the forecasted increases in requirements;
- > for an obligation on regulators to consider investment needed for inclusive economic growth and net zero carbon policy outcomes;
- > for cross regulator strategy and implementation plans to be developed and ideally mandated; and
- > for increased devolved regulatory requirements and implementation to ensure the specific obligation and policy aspirations can be planned for and delivered

In parallel to the work of the UK National Infrastructure Commission, the Infrastructure Commission for Scotland, has also undertaken engagement and assessment of the network utilities regulatory framework, and the outcome of our work established findings similar to those above. This additional work also highlighted that to achieve an overall inclusive net zero economy, regulatory oversight should not result in exclusive outcomes and should consider equitable outcomes and consequences for all of Scotland.

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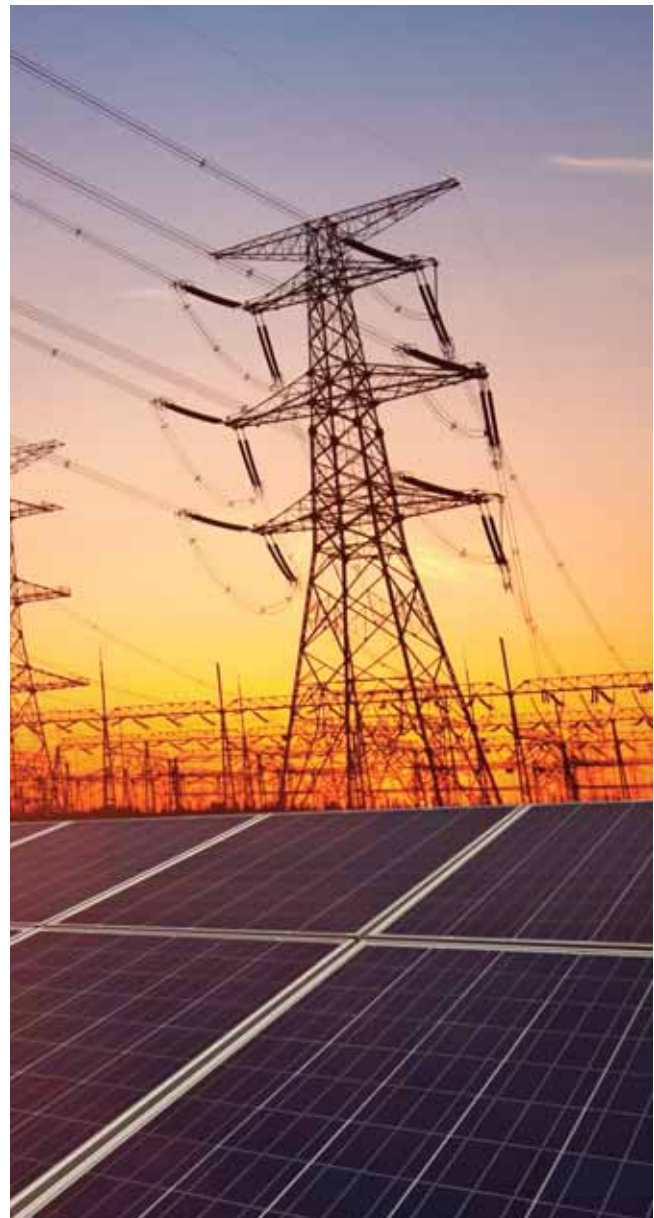
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In relation to the water regulatory framework in Scotland, it was considered through the engagement process that this was broadly delivering the required levels of investment, although the levels required over the next 10-15 years do require a considerable uplift in maintenance and renewals for Scottish Water. The issue of wider water management and investment was also considered. This does feature in the initial scoping for NPF4, and whilst long term plans have been established across Scotland, there is considered merit in seeking to establish a more coherent and less fragmented system across the various parties involved in water and flood management and resilience, from an implementation and also potentially funding perspective.

On this basis it is recommended that:

17. **Building on the findings of the recent UK National Infrastructure Commission review of Energy and Telecoms regulation, the Scottish and UK Governments should immediately commit to work together to develop by 2021, an appropriately devolved regulatory and pricing framework that enables energy and telecoms infrastructure investment to be planned and delivered to meet the future needs of Scotland.**
 18. **Building on the existing plans and the Commission's recommendation to incorporate natural infrastructure, the Scottish Government should by 2021 consider options for longer term implementation and regulatory coherence across water provision and flood management and resilience.**
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Key Recommendation Digital & technology



Ensure every citizen, organisation and business in Scotland has an ability to access digital public services, to undertake trade and commerce and to participate in future global economic markets regardless of geographic location.

The Scottish Government is committed to ensuring that

“Scotland is recognised throughout the world as a vibrant, inclusive, open and outward-looking digital nation”

This recognises the pivotal role that digital connectivity will play in contributing to the future economic growth and societal needs of Scotland. In 2011, the Scottish Government published an ambitious digital strategy charting a route extending connectivity, promoting the digital economy, digitising public services and promoting digital participation. While good progress has been made in delivering this agenda, it has only created the foundation, albeit a very solid one, from which Scotland must move forward if it is to realise its full potential in a digital world.

In addressing this challenge, the Government published a revised Digital Strategy in 2017 which set out its plans for ensuring that

“we put digital at the heart of everything we do”

The strategy recognises the complexity and scale of what this will entail and has been designed for the whole of Scotland.

A key challenge for Scotland is not only creating the right environment to deliver its current digital commitments, but also ensuring that what is put in place is sufficiently future proofed and inherently flexible enough to keep pace with new and emerging technology developments. For example, while full fibre connections will provide fast and reliable broadband and 5G will lead to improved connectivity and speed for remote access it also is a key enabler for Internet of Things (IoT) applications.

In addition, the network and systems will be installed by the digital service providers on a commercial basis. Consequently, this will need strong and consistent leadership by Government if its ambitions are to be delivered as the market will look for clarity and certainty in order to underpin its long-term investment decisions. Priority should be given to investment in full fibre fixed network infrastructure for the whole of Scotland by 2027. As this is principally a reserved matter it will require strong leadership from Scottish and UK Governments, and Ofcom, supported by the regulatory recommendations highlighted previously.

To maximise the potential from the exploitation of the advancements promised by 5G – all new public services should not only be available online but new 5G use cases for service mobility should consider starting immediately in 2020. A good example of this is health services which could be delivered at home or in the community. Social care could be revolutionised by adaptation of 5G use cases as could many other public services.

Scotland's "connectivity" with the rest of world is limited with almost all of our internet traffic transiting via London. Indeed, Scotland is the

only known European country which does not have a direct internet connection to more than one of the top 5 internet nodes in Europe (London, Amsterdam, Frankfurt, Paris & Moscow). The consequence of Scotland's data traffic travelling to and from London, means an increased delay or latency between data being sent and received.

Next generation digital services will require low latency which requires data centre capacity located close to people using the services. That data will become commercially extremely valuable. To underpin and accelerate the technical and economic transition of the Scottish Economy into the forthcoming 4th Industrial Revolution, the Scottish Government should consider (with the appropriate security) whether there should be a presumption in favour of all public services being based upon scalable public cloud infrastructures, and specifically a presumption against single use, single geography or a single public body bespoke infrastructure.

A Scottish data centre industry with access to international subsea cables has the potential not only to service domestic data needs but also service international markets too.



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Part C: Cross Cutting
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Key Recommendations Digital & Technology

On this basis it is recommended that:

- 19. In conjunction with the regulatory reforms highlighted in 17, the Scottish Government should provide the leadership required to ensure the delivery of a full fibre network for Scotland by 2027 to enable the transition to 5G across the whole of Scotland.**
- 20. To ensure Scotland's place in the world and increase its international presence and connectivity resilience, the Scottish Government should prioritise support for an indigenous data centre market and investment in direct international fibre optic cables.**

A further challenge is how best to unlock the value of the already substantial amount of both public and private digital information held in Scotland. The ability to handle, interrogate and analyse this data in a more efficient and effective way will provide a solid foundation for taking informed evidenced based policy decisions to meet our net-zero carbon and inclusive economic growth commitments. There needs to be a fundamental change in thinking to view data as an asset, not an output as tends to be the case currently.

All new publicly funded infrastructure should consider the future data potential of the asset and also the digital services potential of the asset. All new assets should have embedded sensor technology to provide data which will give insight to the optimal operation of the asset and help to deliver new functionality and services from the asset. Also, this will help to reduce/avoid unnecessary consumption of resources. All new assets should be considered as a potential platform for the delivery of digital services to the Scottish public. Every major project should have a digital component related to data generation, storage and use. Every major project should consider how it will enable and facilitate digital communications services for the public good. Every major project should consider how it will make its data set publicly available where appropriate. This could bring benefits to society as a whole but could be life changing for individuals with impairments.

A further challenge is how best to unlock the value of the already substantial amount of both public and private digital information held in Scotland.



Buildings will become smart buildings, transport links such as roads or railways or ferries will become 'smart' i.e. sources of data and information as well as consumers of data and information. The IoT will revolutionise the optimum use of asset capacity, avoidance of unnecessary use and carbon consumption.

In order to meet our net zero carbon targets, investment cases for public buildings should consider the production and storage of data, the consumption data for optimisation and the facilitation of digital communications services for the public good.

On this basis it is recommended that:

- 21. From 2020, the Scottish Government should consider the future data requirements and data potential for all new publicly funded infrastructure as well as the potential for the use of digital services associated with the assets.**



£600m

investment
commitment to
reaching 100%
broadband
coverage



5G

could add £17bn to the
Scottish economy by
2034 and create
160,000 new jobs



Superfast broadband coverage has
increased by 5 percentage points
from 87% to 92%

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Key Recommendation **Role of the Public**



Much greater participation of the public needs to be incorporated as an integral part of infrastructure investment decision-making.





There is good evidence from multiple sources that achieving an inclusive net zero carbon economy over the next 30 years will be extremely challenging and will require changes to current priorities as well as some trade-off decisions to be made. In order to deliver against this, whilst there will likely be a requirement for institutional change, there will also be a need for behavioural change from consumers and users. The Commission has gathered evidence from its own research by Ipsos Mori as well as the UK National Infrastructure Commission, The Turing Institute and others on the potential for an increased requirement for an informed participation of the public as part of any change process, and the benefits this could bring to establishing and assessing trade-offs and potentially buy in for some of the challenging decisions ahead.

An example of this approach is through deliberative engagement methods seeking to take participants to a more informed position, as opposed to the more immediate response seen in some other methods, such as more binary opinion polls. This requires therefore, not simply an understanding of the priority areas for users of infrastructure, but also how they would trade-off preferences. This reflects the realities of policy and budgetary challenges which are rarely simple; providing a more meaningful insight to what is important to infrastructure users. The Commission would emphasise the benefits of this approach and the need for engagement which takes us to a more informed and mature relationship between user and policy-maker.

On this basis it is recommended that:

22. **By 2022, the capacity and capability requirements for an informed approach to public engagement and participation needs to be clearly established and implemented by the Scottish Government to ensure that short and long term outcome trade offs are effectively debated, understood and taken into consideration.**

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Key Recommendation **Independent, long-term advice**



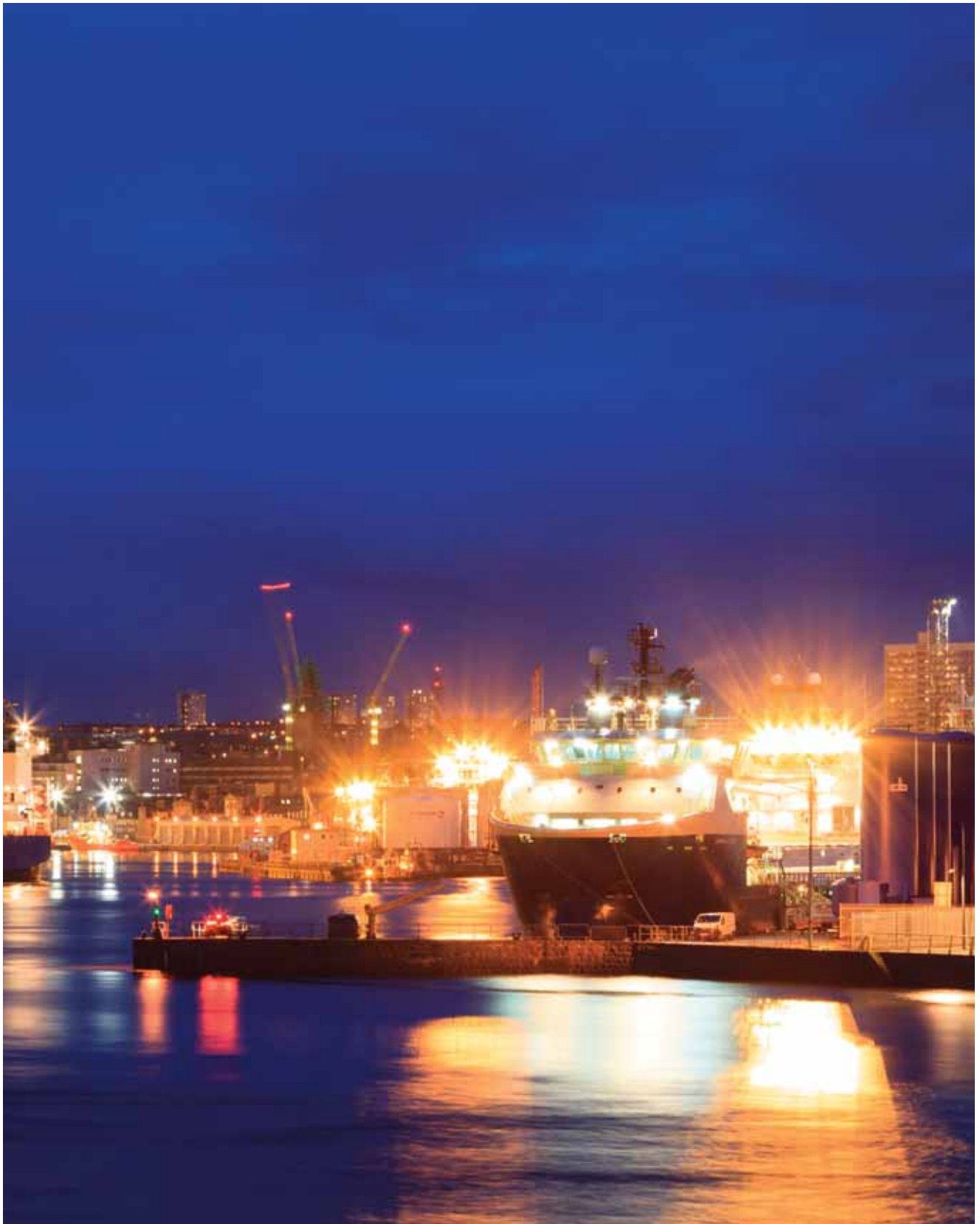
To enable government, regulators and industry to make the transition to a long-term, coherent systems wide approach to place-based infrastructure strategy and planning.

Infrastructure is by its very nature a long term consideration, with many major projects often a decade in the making with then many decades worth of useful life; indeed if appropriately managed and maintained their useful life can be extended into centuries. The true benefit and impact of infrastructure is also very often seen over a long, often inter-generational horizon. When the outcomes being sought – an inclusive net zero carbon economy – are also of such a long term nature, the importance of making appropriate long-term investment decisions worth £billions becomes even more critical. This is especially important when the scale and pace of change is accelerating and the future requirements require a degree of flexibility and adaptability; and where interdependencies of services, and the infrastructure that is required to deliver those services, is only likely to increase.

Experience from other countries including Australia, Netherlands, New Zealand, and the UK, indicate that in such a stage of transition it is increasingly important to establish a clearer, system wide, long term assessment of need across all infrastructure, to maximise the potential of investments being made – be that to enhance, adapt or repurpose existing infrastructure or in completely new or innovative infrastructure – and maximise the potential of the desired outcomes being achieved. In all of the examples reviewed, Ministerial decision making was still viewed as a critical component of this long term approach, however given the context described above the benefits of a strategic independent approach to inform these decisions was seen as an important component.

On this basis it is recommended that:

- 23. By 2021 a body should be given the responsibility by the Scottish Government to provide independent, long term, evidence-based advice to Scottish Ministers on investment decisions for the social, economic and natural infrastructure needs and priorities required to deliver an inclusive net zero carbon economy.**
-



The importance of making long-term investment decision worth £billions becomes even more critical, especially during this period of accelerated change.

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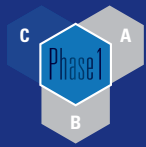
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Part C: Cross Cutting
Recommendations
(continued)

Next steps

The Commission is 12 months into an 18-month programme of work, and the recommendations set out in this report represent the findings of the first phase that has been focusing on the “why and the what” of infrastructure. As a result, a number of areas have yet to be considered by the Commission and will form the basis of the next phase of activity. The Phase 2 report will be aimed principally at the more downstream aspects of the work to date including the practical implications in relation to the “how” of infrastructure. This includes consideration of a Scottish National Infrastructure Company as set out in our remit. The Commission will continue to engage widely as we move towards the conclusion of our work during 2020.



Appendices

Appendix A

Infrastructure Commission for Scotland Remit

The Scottish Government charged the Commission with a broad remit, with an infrastructure definition that encompasses “the physical and technical facilities, and fundamental systems necessary for the economy to function and to enable, sustain or enhance societal living conditions.” This approach is unique in the inclusion of not only those sectors traditionally considered to support the economy, but also wider social infrastructure, such as hospitals. While this definition was broadly welcomed by all stakeholders, it was also suggested that blue-green infrastructure should be explicitly included, as assets which support the broadest priorities of economic, social and environmental policies.



Infrastructure Commission for Scotland Remit

(PDF Document)



Appendix B

Stakeholder Engagement Strategy

The Infrastructure Commission for Scotland (the Commission) recognised from the outset the importance of stakeholder engagement and ensuring that an appropriate strategy was employed to work with each stakeholder group. This ensured that the Commission worked within its remit in a way which was:

- > Engaging and widely consultative across all of Scotland and civic society
- > Credible, objective and evidence-based
- > Outward looking, forward thinking and innovative

The Stakeholder Engagement Strategy was developed to achieve these aims and identified the key stakeholder groups as:

- > Representative Bodies
- > Public Sector
- > Service Users
- > Private Sector
- > Third Sector
- > Political
- > Academics

Following the methodology set down in the strategy the Commission gathered evidence; provided throughout the report and appendices, which enabled a holistic understanding of Scotland's infrastructure needs. This evidence formed the basis for the Commission recommendations which are presented in section C of the main report.

The full Infrastructure Commission for Scotland: Stakeholder Engagement Strategy can be accessed below.



Infrastructure Commission for Scotland: Stakeholder Engagement Strategy

(PDF Document)



Appendix C

Initial Call for Evidence and Contributions

As part of Infrastructure Commission for Scotland's (the Commission) commitment to broad engagement the initial call for evidence was issued in March 2019. The Commission sought to gather evidence on Scotland's future infrastructure priorities and recognised that a number of organisations and individuals' from across industry, business, the public sector, academia, civic society and the wider public would have already considered many of the issues and challenges within the scope of the Commission's work.



Initial Call for Evidence and Contributions

(PDF Document)



Appendix D

Initial Call for Evidence Submissions

As part of Infrastructure Commission for Scotland's (the Commission) commitment to broad engagement the initial call for evidence was issued in March 2019. The Commission sought to gather evidence on Scotland's future infrastructure priorities and recognised that a number of organisations and individuals' from across industry, business, the public sector, academia, civic society and the wider public would have already considered many of the issues and challenges within the scope of the Commission's work.

The 'Call for Evidence' ran until the end of May 2019 and received around 150 responses from a wide range of organisations. The list of respondents is below, and where authorisation was received a copy of the organisation or individuals' response is attached.



**Infrastructure Commission for Scotland:
Initial Call for Evidence Submissions**

(PDF Document)



Appendix E

Regional Forum Report

A series of five regional forums were held across Scotland with the Chair; Ian Russell, of the Infrastructure Commission for Scotland (the Commission) attending all events. There were 139 individuals from 100 organisations in attendance. The regional forums were held in Aberdeen, Edinburgh, Glasgow, Inverness and Moffat with representation from industry, businesses, representative bodies, utilities, the third sector and the wider public sector. Thirty-one of Scotland's thirty-two local authorities were in attendance as were Highland's and Island's Enterprise and Scottish Enterprise.

The regional forums were structured to allow regional variations to be reflected in the discussions. This included ensuring that the Commission had the opportunity to understand the urban and rural variances. There were three key questions that all delegates were given the opportunity to contribute to:

- > **Immediate priorities:** what is important for the region and what are the barriers in meeting infrastructure needs.
- > **Inclusive economic growth and place-based principle:** from an infrastructure perspective what does inclusive economic growth mean and what are the main barriers for the region.
- > **Net zero carbon:** what does the 2045 target mean for the region and what are the largest challenges.



Infrastructure Commission for Scotland: Regional Forum Report

(PDF Document)



Appendix F

Thematic Round Tables Report and Investing in Nature Report

The Infrastructure Commission for Scotland (the Commission) held several stakeholder engagement sessions in the form of themed round tables. The round tables investigated further the evidence previously presented to the Commission through the initial call for evidence and the five regional forums. The events were by invitation only with the Commission seeking out recognised experts in their fields. A total of nine sessions were held with representation from industry, private business, academia, representative bodies, Scottish Government and the wider public sector.

In the Commission's previous engagement there were a number of key themes which emerged including public transport, digital infrastructure and housing. Many of the themes were sector cross-cutting with the round tables reflecting this. All round tables explored the Commission's remit around 2045 net zero carbon targets as well as inclusive economic growth and place impacts. Beyond these core considerations the Commission sought to bring together actors with whom we could delve further into complex issues and explore differing viewpoints more fully.

The nine thematic round tables:

- > Connecting People and Places
- > Accessibility and Mobility
- > Housing
- > Investing in Nature; in collaboration with Scotland's Natural Heritage and Scottish Enterprise
- > Networks and Regulation
- > Business and Economic Development Focused Organisations
- > Public Buildings and Assets
- > Circular Economy; in collaboration with Zero Waste Scotland



Infrastructure Commission for Scotland Thematic Round Table Report

(PDF Document)



Investing in Nature Report

(PDF Document)



Appendix G

List of Stakeholders

From its inception in February 2019 the Infrastructure Commission for Scotland (the Commission) has recognised the importance of wide stakeholder engagement across all of Scotland, in doing so the Commission identified nine key stakeholder groups:

- > Users or representative groups
- > Businesses or trade organisations
- > Private sector providers
- > Public sector providers
- > Public policy makers
- > Legislators/regulators
- > Third sector/civic society
- > Geography i.e. regional groupings.
- > Delivering Infrastructure

To ensure that all groups were appropriately represented the Commission deployed strategies including regional forums, thematic round table events and the initial call for evidence. Beyond these large-scale events there was recognition for more detailed one-to-one sessions. These were held to gain a greater understanding of specific sector or industry challenges and to engage with representative from across the political spectrum as an independent commission.

Stakeholder organisations are listed, individuals are only named where they have provided a response to our initial call for evidence in their own right.

The list of stakeholders can be accessed in the link below.



Appendix H

Scottish Government Thematic Round Table Reports

The Infrastructure Commission for Scotland (the Commission) collaborated with the Scottish Government Infrastructure Investment Division on a series of group discussions. The round tables investigated further the evidence previously presented to the Commission through the initial call for evidence, five regional forums and policy-lead engagement with the Scottish Government in the spring of 2019. There was a total of five sessions with cross-government representation for key policy professionals, analysts and decision makers.

In the Commission's previous engagement there were a number of key themes which emerged including public transport, digital infrastructure and housing. Many of the themes were sector cross-cutting with the round tables reflecting this. All round tables explored the Commission's remit around 2045 net zero carbon targets as well as inclusive economic growth and place impacts. Beyond these core considerations the Commission sought to bring together Scottish Government representatives with whom we could delve further into complex issues and explore differing viewpoints more fully.

The five Scottish Government thematic round tables:

- > Economics
- > Blue and Green Economy
- > Public Services
- > Data
- > Technical



Infrastructure Commission for Scotland: Scottish Government Thematic Round Table Reports

(PDF Document)



Appendix I

Ipsos Mori: Public Engagement Research

The Infrastructure Commission for Scotland (the Commission) commissioned public engagement research through four deliberative workshops to capture users’ opinions and direct priorities. The four sessions were held in Edinburgh, Glasgow, Kinross and Moffat to enable a rural and urban perspectives on infrastructure needs. These four face-to-face sessions were supplemented with a survey of over one thousand people.

Social research specialists Ipsos Mori were awarded the contract after a tendering process via the Public Contracts Scotland Portal.



Ipsos Mori:
Public Engagement Research
(PDF Document)



Appendix J

Inclusive Economic Growth: A Review

Delivering sustainable inclusive economic growth (IEG) across Scotland is an overarching objective of the Infrastructure Commission for Scotland (the Commission). The attached Report details desk research conducted by the Commission to establish historical and current thinking on IEG and contextualise this in reference to the Commission's remit (full remit available at appendix A).

This report identified the Scottish Government IEG journey from inclusion within the refreshed Scotland's Economic Strategy to the development of the Scottish Centre for Regional Inclusive Growth (SCRIG), as well as the embedding of IEG principles within policy development. The report also looks further into international research and the IEG evidence base, concluding that additional evidence gather would be commissioned. The Fraser of Allander: Inclusive Economic Growth Report; available at Appendix K, is the commissioned additional evidence.



Infrastructure Commission for Scotland: Inclusive Economic Growth: A Review

(PDF Document)

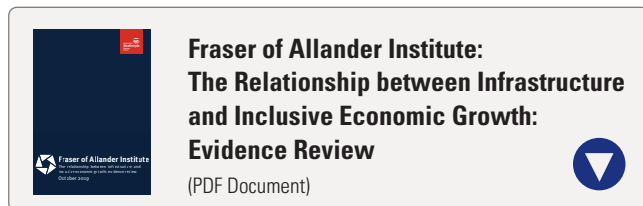


Appendix K

Fraser of Allander Institute: The Relationship between Infrastructure and Inclusive Economic Growth: Evidence Review

The Infrastructure Commission for Scotland (the Commission) commissioned desk-based research to identify, collate and analyse evidence on the relationship between infrastructure and inclusive economic growth as set out within the Commission's remit. The definition of inclusive economic growth used by the Commission is that which the Scottish Government set out in Scotland's Economic Strategy¹. Traditional economic growth is focused on measures such as GDP and productivity, it is widely recognised that additional measures will be required to capture the benefits of inclusive economic growth. This report looks at the specific enabling components of infrastructure to this wider 'basket' of measures and impacts to inform decision making. The research has focused on outcomes in the developed world as best suited to Scotland's future needs.

The Fraser of Allander Institute was awarded the contract after a tendering process via the Public Contracts Scotland Portal.



¹ <https://www2.gov.scot/economicstrategy>

Appendix L

Aventia Consulting: Low Carbon Infrastructure

The Infrastructure Commission for Scotland (the Commission) commissioned desk-based research to identify, collate and analyse evidence on the relationship between infrastructure; as set out in the Commission's remit, and carbon emissions across its full life cycle. The research considers the current plans to reduce carbon emissions, that they have been made to address carbon emissions within Scotland and how these plans may change the future balance of priorities for infrastructure. This includes a high-level critique of types of infrastructure investments and evaluation approaches that operate as a barrier to the transition to a net zero carbon economy, as well as those that accelerate the process.

Aventia Consulting was awarded the contract after a tendering process via the Public Contracts Scotland Portal.



**Aventia Consulting:
Low Carbon Infrastructure**
(PDF Document)



Appendix M

Scotland's Infrastructure Baseline

In order for the Infrastructure Commission for Scotland (the Commission) to provide informed advice on the vision, ambition and priorities on both the immediate (five-year) and long-term (30-year) strategy for infrastructure in Scotland there is a need to understand the current baseline of assets. The baseline reports focus on publicly owned infrastructure or assets utilised by everyone; for example, privately owned gas, electricity and telecoms networks. The reports set out key facts, such as type and number of assets as well as current condition, current estate strategies and investment programmes.

All data is current to at least September 2019, in some; but not all, instances this has been updated subsequently.

The baseline reports were produced in conjunction with the with the relevant policy leads across Scottish Government. The Commission would like to thank the Infrastructure Investment Division for their pivotal role in co-ordinating these responses.



Infrastructure Commission for Scotland: Scotland's Infrastructure Baseline

(PDF Document)



Appendix N

Bibliography

As part of the Infrastructure Commission for Scotland (the Commission) evidence gather a number of published reports, data and documents have been considered. This information has assisted the Commission to gain a clearer understanding of the wide-ranging infrastructure issues and to help inform the Commission's engagement strategy.

The Commission does not hold the rights to these publications and inclusion in the bibliography should not be seen as an endorsement of content nor acceptance of any recommendations included.



Infrastructure Commission for Scotland: Bibliography

(PDF Document)

