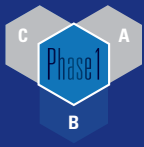C

A

Phase1

B

Infrastructure
Commission
for Scotland

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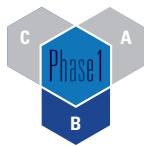
Part B draws on the findings of Part A to consider:

> 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

Phase1

C A
B

Part B:
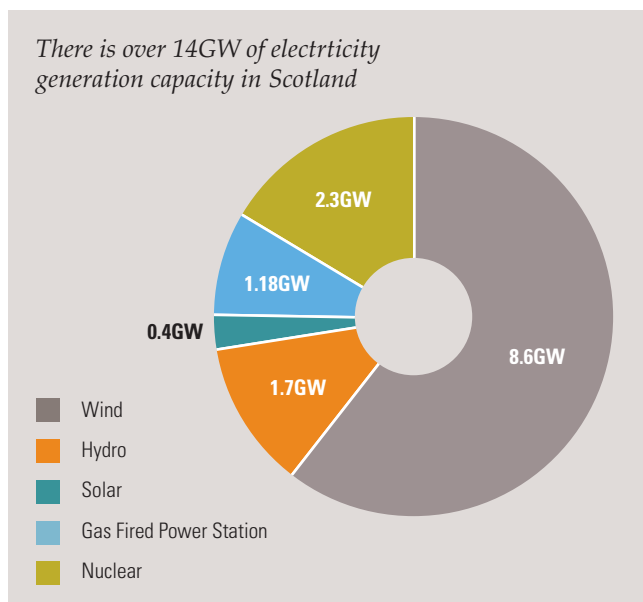Sector Summaries
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Energy

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**.

There is over 14GW of electrticity generation capacity in Scotland

- 8.6GW
- 1.7GW
- 0.4GW
- 1.18GW
- 2.3GW

- ■ Wind
- ■ Hydro
- ■ Solar
- ■ Gas Fired Power Station
- ■ Nuclear

2.2 Where our energy comes from[i]

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 distributed[ii]

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 gas[iii]. 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

23.5% — 24.4% — 52.0%

- Electricity
- Transport
- Heat
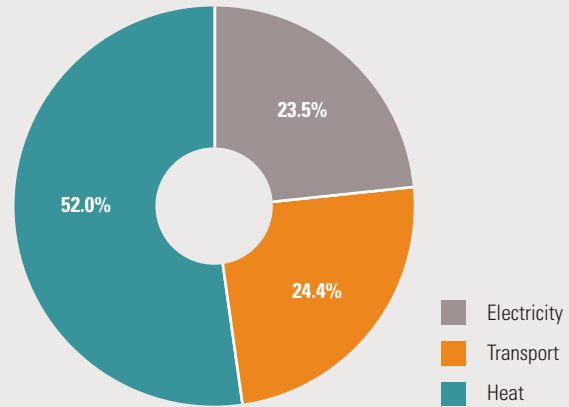
Around 20% of Scotland's total; energy consumption is from renewable sources, comprising:

> 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.

Phase1

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Part B:
Sector Summaries
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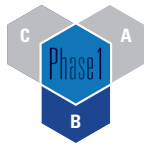
Energy

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
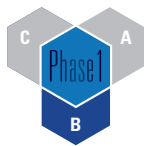
Scottish Government's Heat Policy Statement:

> ## 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.
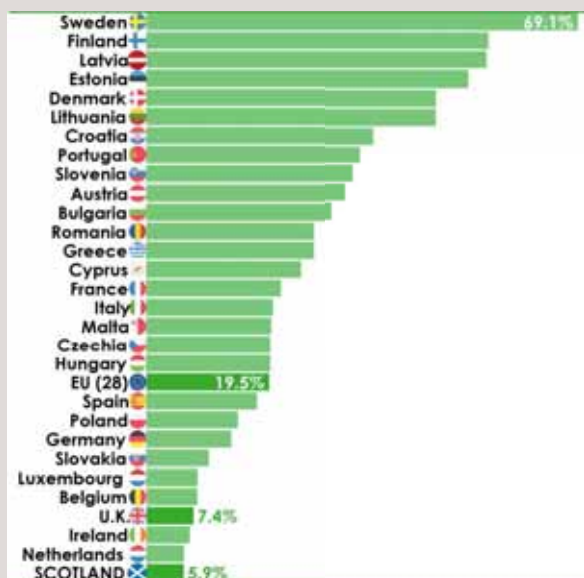
Part B:
Sector Summaries
(continued)

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[xviv]:

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.
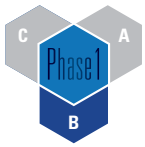
Nevertheless, even when cost parity between conventional and electric vehicles is reached and the other barriers and technical issues have been addressed, it is likely that electric vehicles will continue to remain unaffordable and out of reach to large sections of Scotland's population for many years 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. Succesful 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 abilty 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

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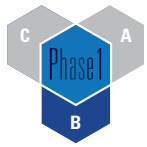
A 100% update in electric vehicles across the UK could increase electricity demand by more than 25% by 2050

Sector Summary
Digital

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.
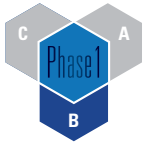
Digital

> "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.
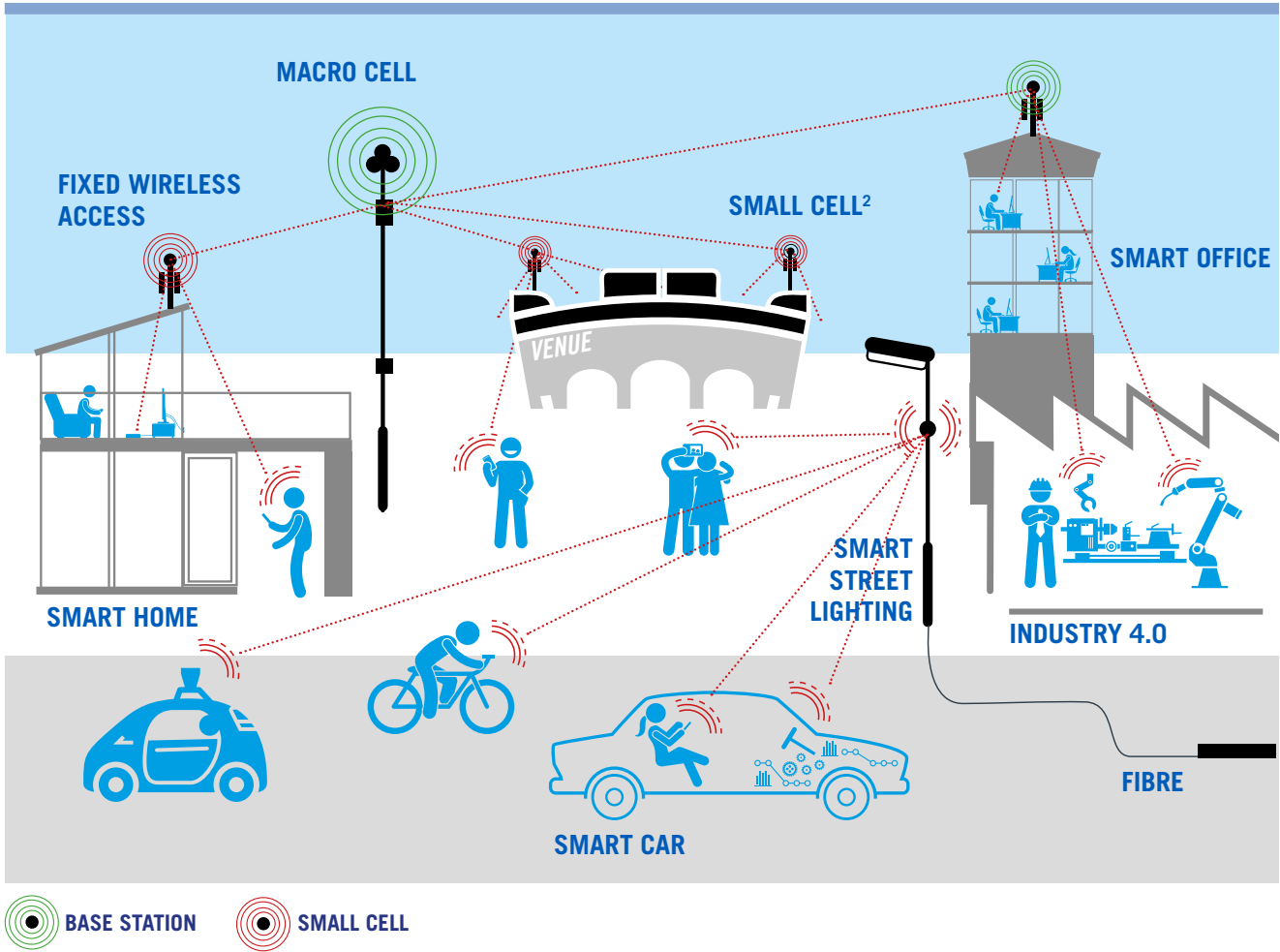
3.5 Challenges

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

MACRO CELL

FIXED WIRELESS ACCESS

SMALL CELL²

SMART OFFICE

SMART HOME

SMART STREET LIGHTING

INDUSTRY 4.0

FIBRE
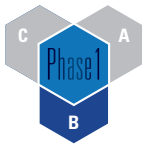
SMART CAR

⦿ **BASE STATION**   ⦿ **SMALL CELL**

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.

> 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.

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"

Phase1

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 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

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.

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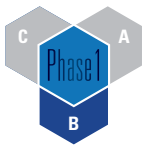
Key issues summarised here are incorporated into a number of recommendations at Part C, most specifically those relating to Leadership, Digital and Technology and Regulation.

Sector Summary
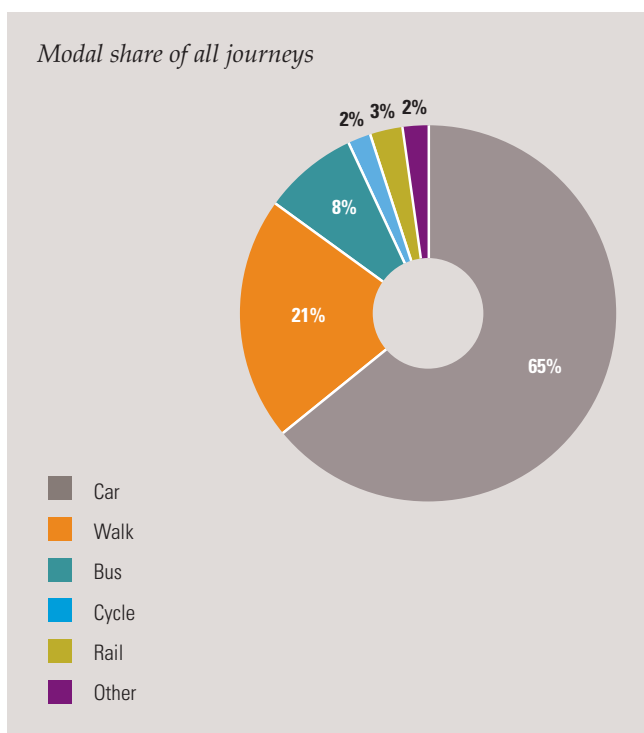Transport

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 STRP2 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

- Car — 65%
- Walk — 21%
- Bus — 8%
- Cycle — 2%
- Rail — 3%
- Other — 2%

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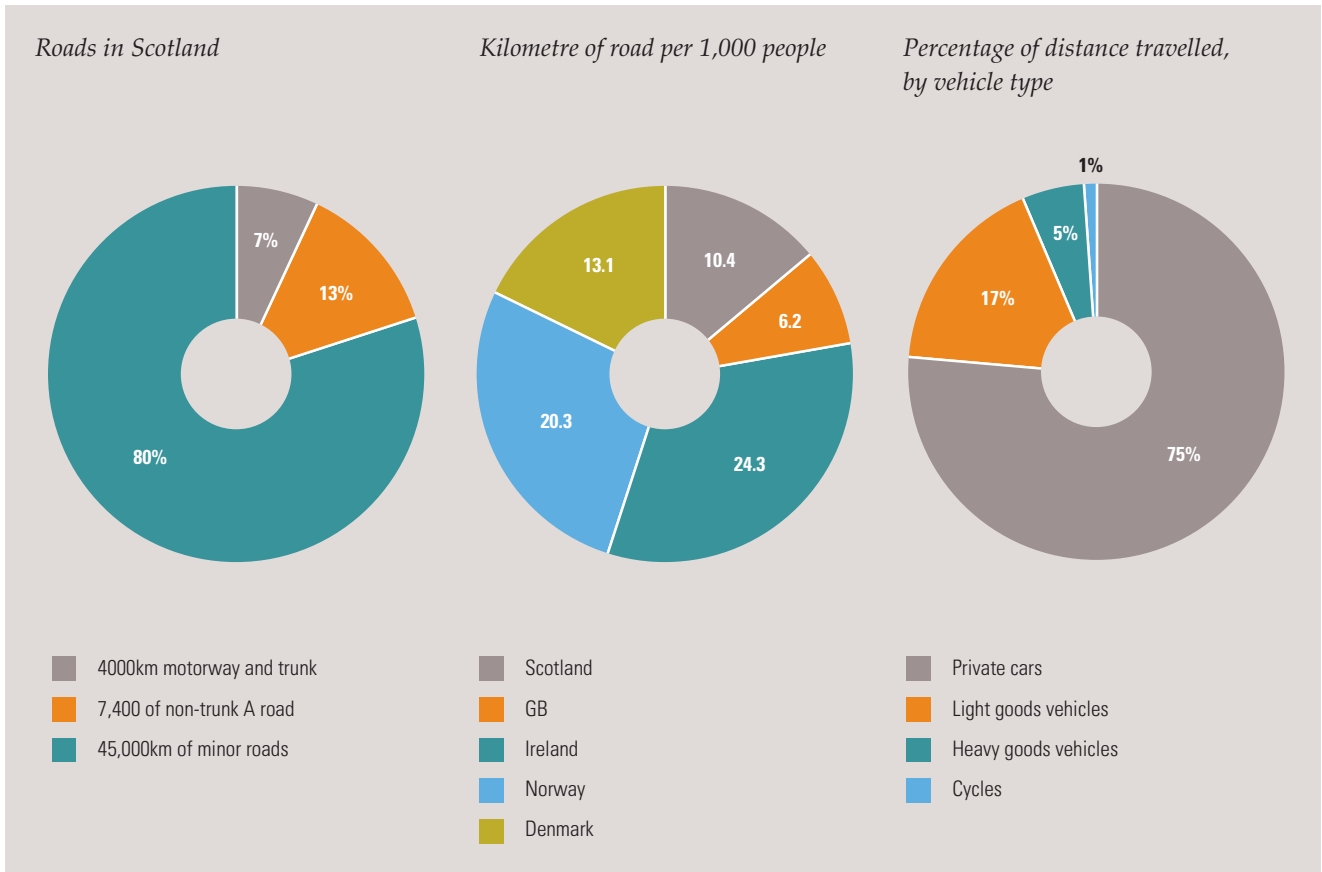
Private cars account for the highest users of the network (75% of distance travelled) followed by light goods vehicles (17%), heavy goods vehicles (5%) and public transport (2%). Cycles represent just 1% of vehicles using the network.

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.

Roads in Scotland

- 4000km motorway and trunk
- 7,400 of non-trunk A road
- 45,000km of minor roads

Kilometre of road per 1,000 people

- Scotland
- GB
- Ireland
- Norway
- Denmark

Percentage of distance travelled, by vehicle type

- Private cars
- Light goods vehicles
- Heavy goods vehicles
- Cycles

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)
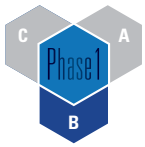
Transport

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;

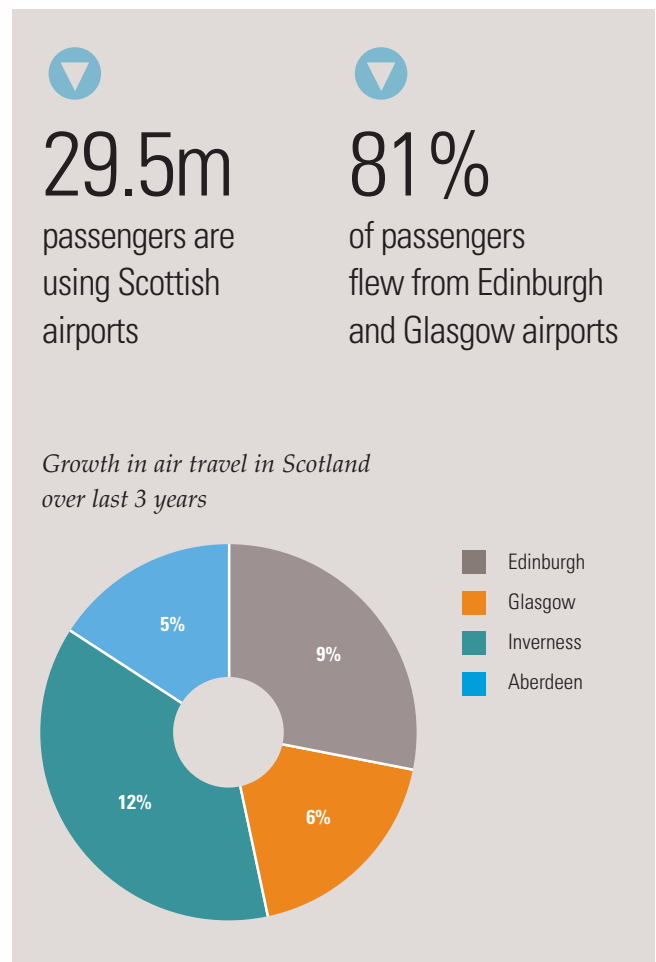> business to access markets; and

> 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 (CO_2) emissions from new passenger vehicles have been increasing over the past three years[xli].

▼

29.5m

passengers are using Scottish airports

▼

81%

of passengers flew from Edinburgh and Glasgow airports

Growth in air travel in Scotland over last 3 years

■	Edinburgh
■	Glasgow
■	Inverness
■	Aberdeen

5% 9% 12% 6%
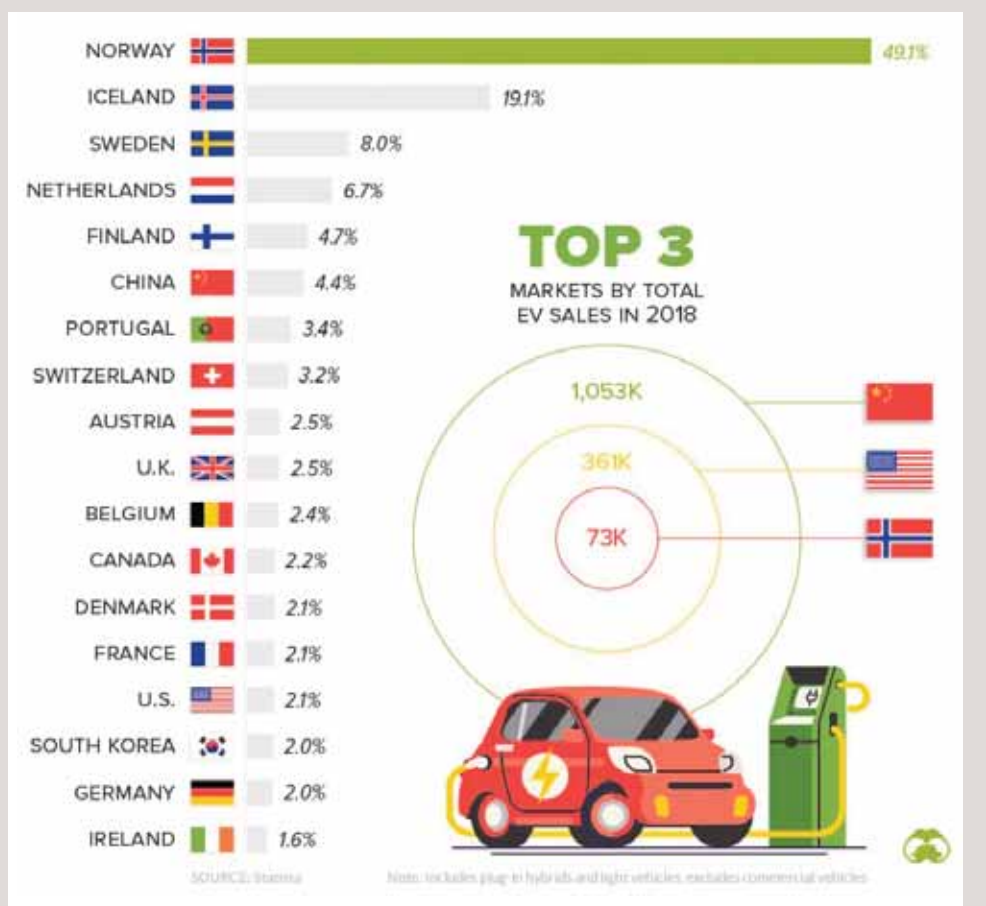
There are around

525m

passenger journeys
by public transport
each year

The main types are:

> Bus (388 million
  passenger journeys)
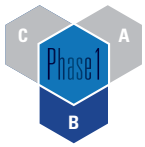 and

> 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 CO_2 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

Country	EVs %
NORWAY	49.1%
ICELAND	19.1%
SWEDEN	8.0%
NETHERLANDS	6.7%
FINLAND	4.7%
CHINA	4.4%
PORTUGAL	3.4%
SWITZERLAND	3.2%
AUSTRIA	2.5%
U.K.	2.5%
BELGIUM	2.4%
CANADA	2.2%
DENMARK	2.1%
FRANCE	2.1%
U.S.	2.1%
SOUTH KOREA	2.0%
GERMANY	2.0%
IRELAND	1.6%

TOP 3
MARKETS BY TOTAL
EV SALES IN 2018

1,053K
361K
73K

SOURCE: Statista

Note: includes plug-in hybrids and light vehicles, excludes commercial vehicles

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[xlii] 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[lxxxiv].

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)[xliii] 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[xliv]. 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
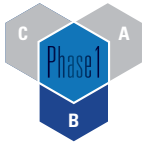
In addition, the Scottish Government spent around

£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

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[xlvii].

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
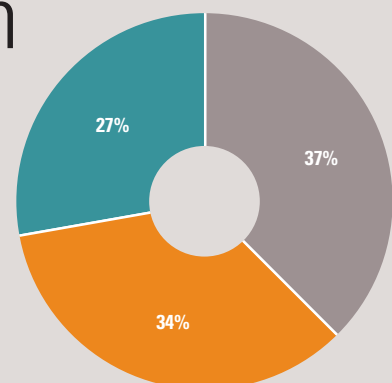
- One person households — 37%
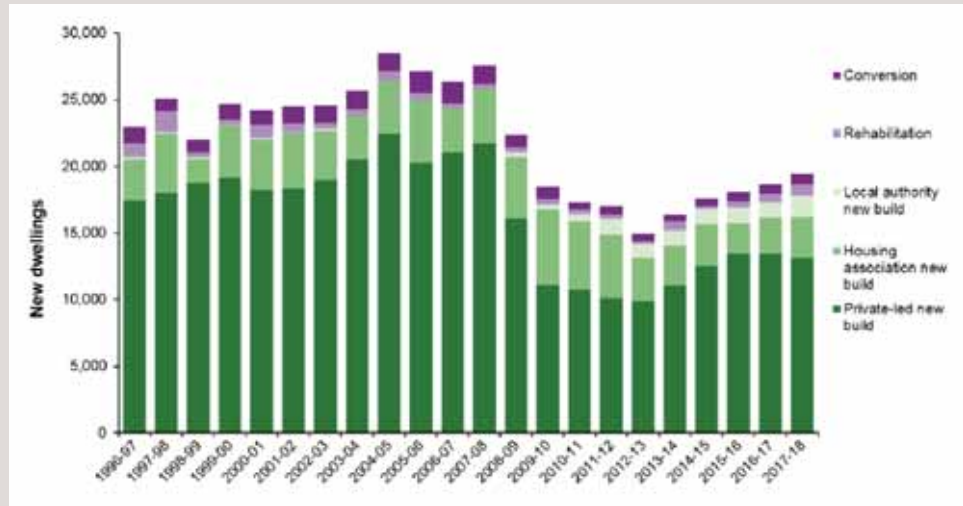- Two person households — 34%
- Three person households — 27%

19,428

new homes were
supplied

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

3,130

homes via Affordable
Housing Supply
Programme

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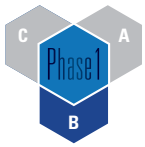
The current system requires each local authority to undertake an all-tenure housing need and demand assessment (HNDA) for their administrative area. This underpins the Local Housing Strategy, which is a statutory requirement on all local authorities under the 2001 housing

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 20,000[li]. 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 year[lii]. For its part, the Scottish Government has committed to delivering 50,000 affordable homes by 2021[liii].

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[liv]. 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.
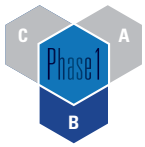
In April this year, the Scottish Government and CoSLA agreed to adopt the "Place Principle" "to help overcome organisational and sectoral boundaries, to encourage better collaboration and community involvement, and improve the impact of combined energy, resources and investment." While this is welcome 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 Natural Heritage
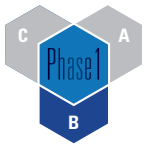
Part B:
Sector Summaries
(continued)

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?

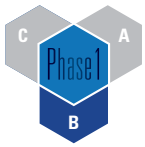> **Statutory obligations** – meeting enhanced standards to comply with relevant statutory requirements.

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 it 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[lix].

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.

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[lx]. 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[lxi].

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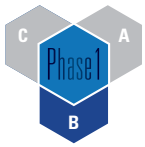
Key issues summarised here are incorporated into a number of recommendations at Part C, most specifically those relating to Leadership, Place, Making the Most of Existing Assets, Regulation, Digital and Technology and Independent Long Term Advice.

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.heraldscotland.com/news/15340682.a-third-of-scottish-water-leaks-before-it-reaches-the-tap/

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 devasting, 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[lxvi]. 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[lxvii]. 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[lxviii] (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.
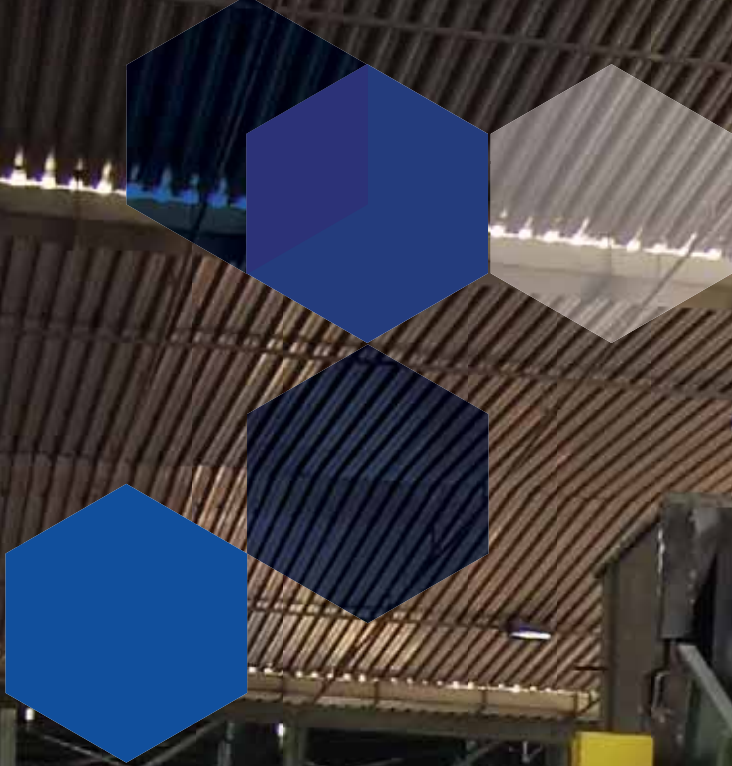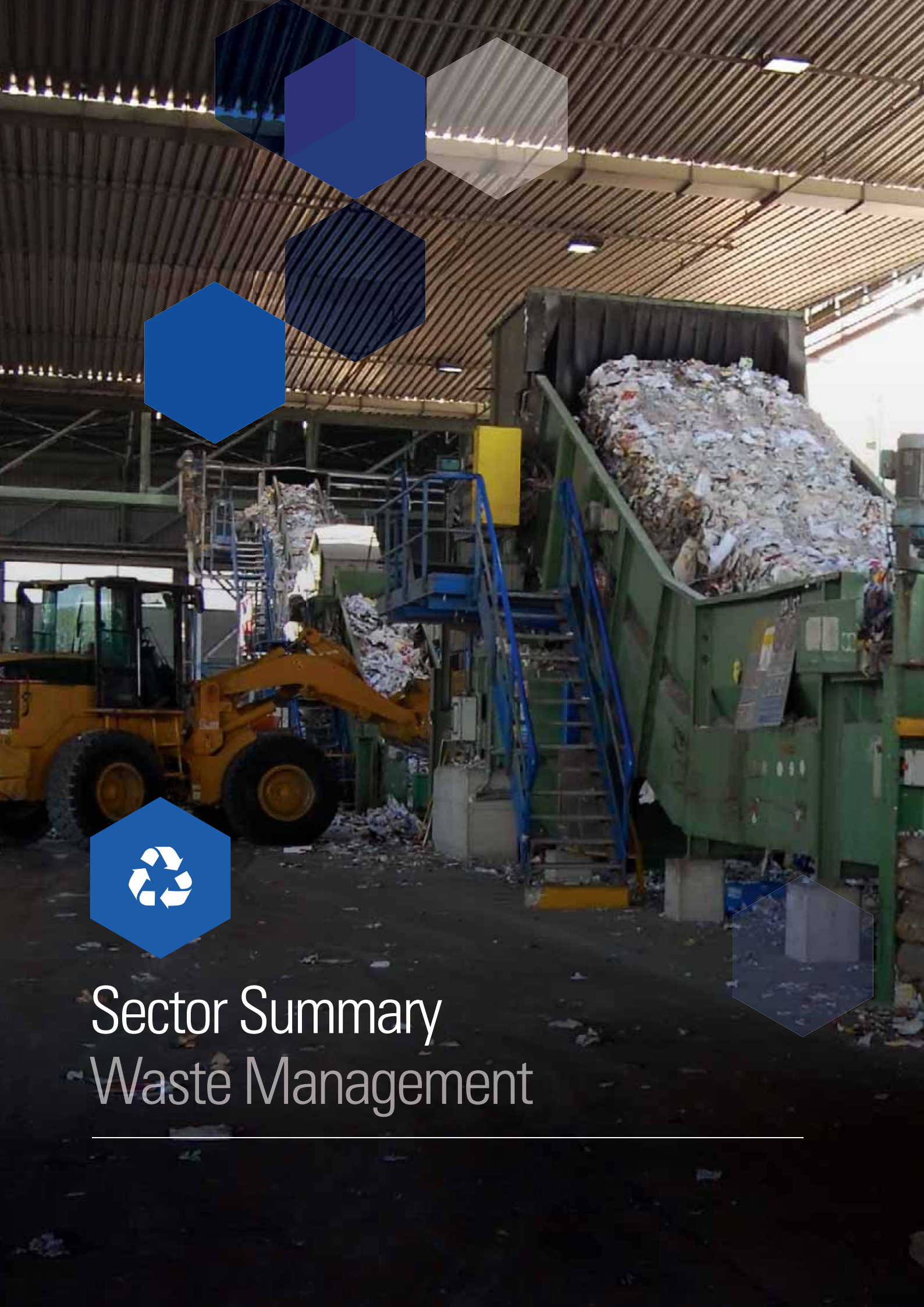
Sector Summary
Waste Management

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

1.03m T   1.07m T

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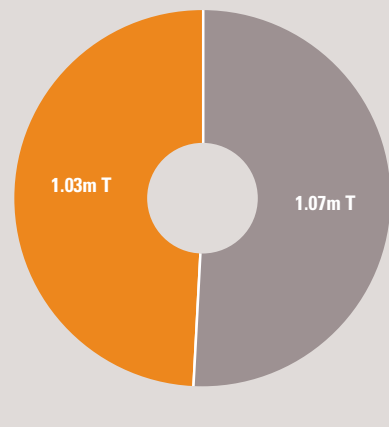
Household waste accounts for 32% of landfill waste generated, the largest generator is soils waste at 38%

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 date 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
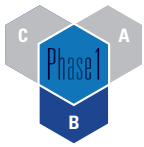
Public Service Infrastructure

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[lxiii]

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 refurnished. 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.
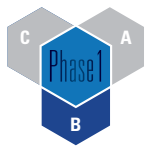
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Higher Education[lxxvi]

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[lxxvii]

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[lxxviii], 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

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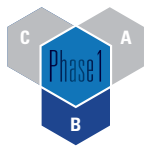
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Police Scotland have the largest geographical coverage of any UK police force at 58,168 square miles.

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[lxxix]. 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[lxxx] that "to bring [SFRS] property, vehicles and other assets across Scotland up to a minimum satisfactorily 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[lxxxi]

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)[lxxxii]

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

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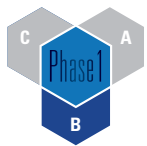
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sharing resources and buildings and being more open to opportunities to ensure the most effective use of assets.

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 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.

The Scottish Fire and Rescue Service (SFRS) was formed in April 2013 by amalgamating 8 legacy fire and rescue services into a single national organisation.

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