Established in 1818 and with over 92,000 members worldwide, ICE is the independent voice of infrastructure and the leading source of expertise in infrastructure and engineering policy. Under our Royal Charter, ICE has a public duty to provide advice to all political parties and work with industry to ensure that civil engineering remains a major contributor to the UK economy.

Get in touch
For more information, please contact:
ICE Scotland
e: Scotland@ice.org.uk
ice.org.uk/Scotland

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STATE OF THE NATION SCOTLAND 2018: INFRASTRUCTURE INVESTMENT
High quality, well performing and resilient infrastructure is fundamental to quality of life and economic prosperity. In recognition of its importance, recent years have seen a significant increase in infrastructure investment by both the UK and Scottish governments. Indeed, the Scottish Government has made a welcome commitment to steadily increasing annual infrastructure investment in its recent Programme for Government.

However, a range of factors including an aging population and climate change have created an estimated £500bn UK infrastructure funding gap that the state alone cannot fund. Additional sources of funding will have to be found to meet the level of investment needed to bridge this gap.

Scotland faces a period of unprecedented economic, demographic, fiscal and environmental challenges, many of which may potentially be exacerbated by the UK’s impending exit from the European Union (EU).1 Future parliamentary elections may deliver minority administrations or coalition governments, underlining the importance of building cross-party consensus in our approach to addressing such complex challenges.

Against this background infrastructure investment must be targeted where it can most effectively provide solutions and address the challenges we face. Since 2016, ICE has called for an independent Scottish Infrastructure Commission to recommend investment priorities and produce cross-party consensus on these proposals. We welcome the SNP’s recent announcement that it plans to establish such a Commission and stand ready to support its development and contribute to its work as we have done at UK level.

I would like to extend my thanks to everyone who has input to this report but particularly to the Steering Group and ICE Scotland’s Policy Manager, Kelly Forbes, who has worked tirelessly on this project. My thanks also to the Fraser of Allander Institute for their valuable context-setting contribution.

Mac West
Chair, State of the Nation Steering Group,
Institution of Civil Engineers Scotland

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1 Referred to as ‘Brexit’ throughout.
Purpose of this report

This report considers Scotland’s infrastructure investment priorities in a shifting and increasingly complex political and economic environment. This report is separate from that produced for England, Wales and Northern Ireland, *State of the Nation 2018: Infrastructure Investment*, reflecting different investment priorities and drivers. Where appropriate, this report supports and reiterates the recommendations from this parallel report.

In Section 1, Fraser of Allander Institute set out the economic context for infrastructure investment and we seek to clarify the complex nature of infrastructure investment and decision making in Scotland, in line with our public benefit objectives. In Section 2, the report recommends actions from government and industry to maximise impact from new and existing investments. Finally, Section 3 makes recommendations for core areas of economic infrastructure – roads, rail, energy and water.
Scotland’s infrastructure is the foundation of its ability to compete in global economy, and to ensure good quality lives for the people who live here. Major capital investments – like the M8 motorway, the electrification of the Edinburgh Glasgow Improvement Programme (EGIP) and Beauly-Denny powerlines – represent necessary investment. Sustained investment has helped Scotland to play ‘catch up’ with its neighbours: 2017 saw Scotland’s £3.1bn infrastructure investment outpacing the rest of the UK, followed by London at £2.7bn.²

The most recent Programme for Government (PfG) set out the Scottish Government’s intention to increase infrastructure investment so it is £1.5bn higher per year by 2025-26 than in 2019-20.³ This uplift in investment will require careful stewardship. A consistent approach to long-term investment, coupled with evidence-based decision making and prioritisation of investment, will realise maximum social, environmental and economic value from our infrastructure systems.

Getting maximum value from our existing infrastructure is essential to the economy. Direct replacement costs for all our water and waste water related assets would cost around £70.5bn.⁴ Reconstructing our trunk roads, only 6% of our road network, would cost £20bn.⁵ Our extant infrastructure represents a sizeable existing investment. Achieving maximum value from this investment is dependent upon well-funded, planned and preventative maintenance regimes.

Unplanned and reactive interventions are costly and disruptive. The closure of the Forth Road Bridge for emergency repairs in December 2015 put substantial pressure on alternative road routes, increased journey times, strained train services, increased carbon emissions and costs to commuters.⁶ The eventual direct cost of remedial work was £16m.⁷ Road hauliers calculated the impact on the freight sector alone at £37m.⁸

The public wants greater visibility of benefits from investment, increased transparency in decision making, and a reduction in infrastructure costs.⁹ The new Scottish Infrastructure Commission should have a central role in developing and articulating a long-term vision for Scottish infrastructure considering the whole-life needs of existing infrastructure as well as future capital investment. It should look to make independent, evidence-based recommendations which support the transparency and prioritisation of infrastructure decision making.

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⁴ Scottish Water figures.
⁵ Peeling et al. (2016) The value of the trunk road network to society and the economy of Scotland.
⁷ Sunday Post (1 January 2017) Forth Road Bridge closure cost taxpayers £16 million.
⁸ RHA (2016) Forth Road Bridge continues to cause financial misery for hauliers.
⁹ This refers to five focus groups that Copper Consultancy ran on ICE’s behalf with members of the public.
Scotland needs a single, coherent vision for the future of infrastructure. This should be underpinned by an understanding of our long-term infrastructure requirements, and how supporting investment should be prioritised to deliver maximum impact. It should consider the role and funding of our existing assets, as well as future capital investments, and take steps to drive out waste and inefficiencies in delivery. This vision should be supported by a resilient construction and engineering sector which delivers not just our domestic priorities but competes internationally.

To support this, ICE Scotland makes the following recommendations to support the work of policy makers.

**Overarching policy recommendations for the Scottish Government**

- The Scottish Infrastructure Commission should be independent and build cross-party consensus to support a consistent, long-term approach to infrastructure planning and investment. The Commission should undertake an assessment of Scotland’s long-term infrastructure needs to inform its future work.
- Long-term asset planning and maintenance should be declared as a National Infrastructure Priority. Asset maintenance is a fundamental part of a resilient and productive Scottish infrastructure system.
- The Scottish Government, infrastructure clients and industry should work together to address the problems associated with transactional industry contract models and ensure that risks in delivering public infrastructure projects are allocated fairly and appropriately.

**Sector specific recommendations to maximise value from infrastructure investment**

- **Roads:** The Scottish Government and local authorities should commit to multi-year funding for roads. The Scottish Government should consider how replacements for VED and fuel duty could be used to fund road asset maintenance, and should consider the potential benefits from regulation of Scotland’s roads.
- **Energy:** The Scottish Government should accelerate its efforts to decarbonise heat as a matter of priority. Scottish and UK governments should continue to work together to focus on achieving maximum value and resilience from existing energy infrastructure. Both governments should explore the legislative mechanisms available to enable new technologies, like storage, to access the market.
- **Water:** Expenditure should increase on water and waste water asset maintenance which is critical for maintaining service, reducing the risk of loss of this vital service to customers. Industry should seek to advance its use of data and analytics to support maximum efficiency in delivery, operation and maintenance.
- **Rail:** Increased efforts should be made to identify opportunities for improved efficiency in delivery and maintenance, building on lessons learned during control period 5.
Section 1: Infrastructure needs and the investment context

Resilient and predictable infrastructure performance is the foundation of a competitive economy where citizens enjoy a good quality of life.

The political and economic uncertainties arising from Brexit underline the need for our infrastructure investment to deliver both economic and social benefits and maximise return on that investment throughout its life.

Good quality infrastructure must meet changing social and economic needs. The following section sets out some of the complexities of infrastructure decision making and funding in Scotland, outlining some of the challenges faced.

Economic Outlook & Analysis

This analysis has been prepared by the Fraser of Allander Institute at the University of Strathclyde. The FAI is a leading academic research centre focused on the Scottish economy. This section of the report aims to summarise the outlook for the Scottish economy, with a particular focus on construction, repair & maintenance and capital spending.¹

The global and UK economies

The world economy continues to grow with the Organisation for Economic Co-operation and Development (OECD) forecasting growth of 3.7% for this year and next.

Following major tax cuts, the US is expected to perform particularly well with forecast growth of 2.9% this year. While in Europe, business and consumer confidence is back to 2007 levels.

Closer to home, UK growth in the three months up to August was 0.7%, which is the highest since last summer, boosted by consumer facing activities. This pick-up follows a challenging start to 2018, when the UK lagged behind other G7 economies.

¹ Construction includes the construction of buildings (including offices, schools, hospitals etc), civil engineering (including roads, rail and utilities), and specialised construction activities (e.g. demolition).
The Scottish economy
Scotland is a prosperous nation, consistently ranking in or near the top 20 of OECD countries in terms of income per person. Over the past decade, the Scottish economy has been experiencing a period of unusually weak growth. Total per capita growth over the past decade amounts to less than the average single year in the decade prior.

After this sustained period of weak growth however, the Scottish economy has been showing some signs of strengthening. Growth over the year to June 2018 – whilst still below average – was the fastest since late 2014/early 2015 and the Scottish economy has outpaced the UK for the last two quarters. This upturn has been broad based, with growth across production, construction and services.

Scotland’s labour market continues to be strong. Unemployment remains near historic lows and employment near record highs.

However, despite recent improvements driven by changes in hours, productivity growth remains poor in Scotland and the rest of the UK. This means that Scotland takes five days to produce what it takes four days to produce in the Netherlands.

With an ageing population, employment at a near record high, and uncertainty over the future of migration post-Brexit, it is not difficult to see why turning around Scotland’s productivity performance is crucial to future prosperity. As the economist Paul Krugman puts it: “Productivity isn’t everything, but, in the long run, it is almost everything.”

In Scotland, business investment as a proportion of GDP fell from 10% of GDP in 1998 to 7% in 2003, where it has remained ever since. This gap in Scottish business investment equal to around £4bn in the latest year.

In the end, it is investment that will drive improvements in productivity.

Scotland’s construction sector
Scotland’s construction sector plays an important role in Scotland’s economy. The sector itself represents 6% of Scotland’s GDP and directly employs over 186,000 people. Whilst not quite back to the peak in 2007, the sector has in recent times been showing encouraging growth, with growth of 1.8% in the latest quarterly data.

Another important part of the economy is Repair and Maintenance, which represents around 1% of the Scottish economy, and supported around £2bn of Scottish GDP in 2015. By way of comparison, this is around the same size as the Agriculture and Fishing Industries combined.

Outlook for public sector investment
Public sector investment is an important part of supporting productivity growth in the economy, to provide the infrastructure necessary for firms to grow. There have been a number of high profile investment projects in Scotland in recent years, including the Queensferry Crossing and new South Glasgow Hospitals. However, the UK lags behind the OECD average for public sector investment as a proportion of GDP – around 2.5% compared to the average of over 3.0%. This picture is similar for Scotland.

During the years of austerity, the Scottish Government’s has seen its budget squeezed. Between 2010/11 and 2018/19, the Scottish Government’s resource budget has decreased by 4.6% in real terms. This includes the additional funding the Scottish Government will raise through their new income tax policy. Looking at the block grant in isolation, this has decreased by 6% in real terms over the same period.

Whist the capital budget has also been squeezed in the period 2010/11-2015/16, the story since then, and the outlook, is much more positive. This is due to both increases in the block grant from Westminster and increased flexibilities that the Scottish Government has at its disposal following the Scotland Act 2016 and associated fiscal framework.
This gives the Scottish Government the power to borrow up to £450m for capital investment each year, up to a maximum cap of £3bn. The Scottish Government chose to exercise this power in 2017/2018 and 2018/2019, borrowing the maximum amount available.

The capital block grant is due to increase by 5% in real terms in 2019/20, to £3.4bn. It will increase by almost 20% in real terms over the parliament (from 2016/17 to 2021/22), with most of this increase being over the period 2016/2017-2019/2020.

On this basis real terms capital spend at the end of the parliament (£3.5bn) will still be slightly below the 2010/11 peak of investment spending (£3.7bn in 2017/18 prices). However, should the Scottish Government choose to borrow the maximum £450m it is entitled to, as it did in 2018/2019, capital spending could be £3.9bn in 2019/2020.

In 2015, the Scottish Government published its latest Infrastructure Investment Plan, with a Pipeline updated periodically. As of March 2018, projects costing £2.5bn have been completed with £3.6bn in construction and a further £1.3bn planned. Future strategic investments will be guided by advice from the newly-formed Scottish Infrastructure Commission.

Drivers of future demand

New technologies and changing societal norms may reduce demand on infrastructure. Improvements in digital connectivity enable improved teleworking, which reduces demand on transport infrastructure.

People are living longer and migrating more, concentrating in our towns and cities, whilst social change means that families are getting smaller and more people are living alone. Infrastructure providers in Scotland are already seeing a noticeable west-to-east population drift, which has implications for the prioritisation of infrastructure investments.

The National Records of Scotland (NRS) predicts that the Scottish population will increase from 5.4m in 2016 to 5.69m in 2041.10 The Infrastructure Transition Research Consortium forecasts that the whole UK population will be 75m by 2050.11 Both these outputs assume population growth continues at the rates projected in 2016. The impacts of Brexit are uncertain, but the NRS statistics highlight that low migration scenarios will result in a decreasing Scottish population.

The number of people aged 75+ is projected to increase by 27% over the next 10 years and by 79% over the next 25 years12 making this the fastest growing age group. By 2050, four million people will experience sight loss and many more will face infirmity.13 This means thinking differently about who we design infrastructure for, and the decisions we make when renewing assets.

Climate change requires difficult choices – like whether we can justify building on flood plains, or whether it is more practical to resettle people from flood-prone areas rather than continue to build or extend flood defences. Increased frequency of extreme weather events will require different design assumptions in asset construction and renewal.

ICE set out in a series papers some of the challenges to engineering and construction from Brexit, covering skills, investment, codes and standards, research and universities.14 Access to skilled labour, plant and materials post-Brexit is a source of concern for planned and ongoing infrastructure projects. A third of construction employers are already experiencing difficulties in recruitment, and half of construction employers expect that recruitment of skilled staff will become more difficult in the next few years.15

To meet these challenges Scotland and the UK need to ensure that investment in our infrastructure is equal to the task in capacity, resilience and intelligent use.

Who pays?

Decision making in the Scottish economic infrastructure arena is complex. Most infrastructure decisions are devolved to the Scottish Government, but several are reserved to Westminster. These reserved sectors require collaboration between governments. Within these reserved policy areas, the Scottish Government has some flexibility – such as the decision against new nuclear generation in Scotland or choosing to fund R&D for electricity storage.16

Infrastructure in Scotland is funded and financed in several ways; user charges, private sector, UK Government, and local authorities, as well as the Scottish Government and some EU sources. It is not always clear to the public how infrastructure is paid for, or why money must be used in certain ways. Regardless of the way a project is funded or financed, the infrastructure user always pays, through general taxation and/or user charges. The table at figure 1, although not exhaustive, sets out some of the complexities.

10 NRS Projected Population of Scotland (2016-based)
12 NRS Projected Population of Scotland (2016-based)
13 Office for National Statistics (2017) Overview of the UK Population
14 Brexit Infrastructure Group briefings, available from the ICE policy archive.
16 Scottish Government also has devolved powers over social, educational and justice infrastructure, as well as housing.
Scotland employs a range of investment models to deliver social and economic infrastructure:

- **Non-Profit Distributing (NPD):** An alternative to after private finance initiatives (PFI).
- **Tax Incremental Funding (TIF):** Using local authority investment to capture upturn in local revenue rises.
- **Growth Accelerator:** Using local authority investment to leverage in private investment.
- **City Deals:** Collaborative investment to deliver regeneration, jobs and economic growth.

Figure 1: Scottish economic infrastructure policy decision making, ownership, delivery, payment and financing by sector.

<table>
<thead>
<tr>
<th>Sector</th>
<th>Powers devolved or reserved</th>
<th>Ownership</th>
<th>Scottish Delivery bodies</th>
<th>How is it funded?</th>
<th>Where can they borrow from?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Road</td>
<td>Devolved powers</td>
<td>Public</td>
<td>Transport Scotland (trunk roads)/local authorities (non-trunk roads)</td>
<td>Tax</td>
<td>Scottish Government/Private PPP</td>
</tr>
<tr>
<td>Rail</td>
<td>Scottish Government - internal services. UK government - cross-border services</td>
<td>Public</td>
<td>Transport Scotland/Scotrail Alliance</td>
<td>User charges/tax 44%/56% 17</td>
<td>Recent transition to public budgets/regulated asset base</td>
</tr>
<tr>
<td>Major Airports</td>
<td>Devolved powers, with some minor exceptions</td>
<td>Private</td>
<td>Transport Scotland</td>
<td>User charges</td>
<td>Private corporate</td>
</tr>
<tr>
<td>Rural airports18</td>
<td>Devolved responsibility</td>
<td>Public</td>
<td></td>
<td>Tickets/tax (26m)19</td>
<td>Scottish Government</td>
</tr>
<tr>
<td>Major and Trust Ports</td>
<td>Devolved powers, with some minor exceptions</td>
<td>Private</td>
<td>Local authorities</td>
<td>User charges</td>
<td>Scottish Government</td>
</tr>
<tr>
<td>Local authority ports</td>
<td>Public</td>
<td></td>
<td></td>
<td>Tax</td>
<td>Scottish Government</td>
</tr>
<tr>
<td>Energy</td>
<td>Reserved powers20</td>
<td>Private</td>
<td></td>
<td>User charges</td>
<td>Private/part regulated</td>
</tr>
<tr>
<td>Communications</td>
<td>Reserved powers</td>
<td>Private</td>
<td></td>
<td>User charges</td>
<td>Private/part regulated</td>
</tr>
<tr>
<td>Water/Waste Water</td>
<td>Devolved powers</td>
<td>Public</td>
<td>Scottish Water</td>
<td>User charges</td>
<td>Scottish Government</td>
</tr>
<tr>
<td>Flooding</td>
<td>Devolved powers</td>
<td>Public</td>
<td>Local authorities</td>
<td>Tax</td>
<td>Scottish Government</td>
</tr>
<tr>
<td>Waste</td>
<td>Devolved</td>
<td>Public and Private</td>
<td>Local authorities</td>
<td>Tax</td>
<td>Scottish Government/Private PPP</td>
</tr>
</tbody>
</table>

Historically, use of PFI contracts to procure public infrastructure has been met with public criticism, with concerns raised about whole-life costs. This can be dependent upon the PFI model used. Stakeholders have noted that the value of PFI contracts lies in knowing the whole-life cost of that asset, including operation and maintenance.

NPD has been used since 2009, but in 2015 the Office of National Statistics ruled that under new EuroStat tests several major projects previously classified as private had to be considered public projects, disrupting infrastructure plans. However, as highlighted in the Scottish Parliament Information Centre’s analysis of the Scottish Government’s commitment to increase infrastructure investment, there is scope to make greater use of NPD and other similar approaches.21

Glasgow, Aberdeen, Edinburgh and Inverness have secured City Deals, with other regional deals imminent. Stakeholders have been critical of a lack of strategy in selecting infrastructure elements, particularly in the early deals. In any ‘City Deal 2’ arrangements, infrastructure investment must better align with national priority outcomes.

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17 Percentage of total cost of running the railway as of 2014/15. The rate of subsidy on the Scottish route is higher than the rest of the UK and is largely but not wholly paid by the Scottish Government.
18 Highlands and Islands airports and Prestwick Airport.
19 Scottish Government (2017) Funding for Scottish Airports 2016-17: FOI release
20 While energy policy is reserved, the Scottish Government has some powers around energy efficiency and granting/refusing permission for generation (renewables) through planning powers. The Scottish Government is also committed to setting up a publicly owned energy company.
The Infrastructure Investment Plan

The Scottish Government's Infrastructure Investment Plan (IIP) was designed to provide the construction and engineering sector with a forward roadmap of work and activity. It sets out projects worth over £20m where the Scottish Government has a lead role in procurement or funding.22

Certainty of future work allows industry to plan for long-term skills development, improves job security and reduces the costs associated with short-term contracts. It should also increase the viability of large long-term investments, like off-site manufacture and construction centres. Additionally, it enables the education sector to prepare to meet demand. In Scotland consideration should be given to the competitive environment for available skills which will develop as large projects coming on stream elsewhere in the UK. When refreshed, the IIP should provide enhanced detail about projects and timing.

The traditional capital budget and increased borrowing might be expected to cover most of the IIP programme, making use of low-cost finance availability from HM Treasury. It is expected that NPD and other innovative approaches to leveraging private capital will be essential to delivering the IIP programme. The public acceptability of PFI/PPP-like finance schemes, particularly in the wake of the recent Edinburgh schools' failures, may be a barrier to increased use.23

Access to EU investment

The European Investment Bank (EIB) provides low cost financing for new infrastructure projects and has been instrumental in supporting the growth of renewable energy. If the UK Government is unable to negotiate continuing access to the EIB, a vital component of infrastructure financing will be lost. ICE has called on the UK Government to provide clarity about the UK's future relationship with the EIB and to consult on a possible UK investment bank if this is not possible.24

Scotland has benefited from the EIB investing some €31.3bn in the UK economy between 2012 and 2016.25 This included funding for several Scottish projects including MeyGen phase 1B26 and a £525m loan to support the construction of the Beatrice offshore wind farm. Finance from the EIB has declined greatly since the UK's vote to leave the EU, with just €1.8bn invested in 2017 – a 72% drop from 2016.27

In 2017 the Scottish Government announced it would set up a Scottish National Investment Bank (SNIB), setting aside £340m for initial capitalisation between 2019-2021. The bank will take a "mission driven" approach to provide finance and catalyse the investment required to achieve a step-change in inclusive economic growth and decarbonisation.

Investor Sentiment

Private investment primarily raised on the open markets through debt-finance or else financed by institutional investors such as sovereign wealth funds, banks and pension funds, where the main cost is the expectation of a return on investment, has had a substantial impact when tied to the UK's regulated utilities markets. Several international investment groups – including the Kuwait Investment Authority, Canadian and British pension funds – have entered the UK utilities market, attracted in part by stable regulatory regimes, despite Brexit. The long-term nature of infrastructure in providing steady and predictable returns is attractive to investors. Ireland's 'Project Ireland 2040' 23-year plan, is proving similarly attractive to investment houses.28

The EY 2018 Attractiveness Survey for Scotland29 highlighted that Scotland is second only to London as the most attractive place to invest in the UK, and that a skilled local workforce is the biggest consideration for potential investors. The survey notes that the importance of transport infrastructure has declined by 17% versus 2017, and foreign direct investment into utilities infrastructure dropped by 27% between 2016 and 2017. In contrast, other reports suggest that investors see energy and transport as key areas for investment in the UK, and both smart cities and electric vehicles (EVs) are key issues for urban infrastructure.30

22 Scottish Government (2015) Infrastructure Investment Plan
23 This refers to five focus groups that Copper Consultancy ran on ICE’s behalf with members of the public.
24 ICE (2017) Brexit Infrastructure Group Investment Briefing
25 EIB (2017) The EIB in the United Kingdom
26 The next phase of the MeyGen tidal array, to be built adjacent to the existing 6MW MeyGen Phase 1A in the Pentland Firth, Scotland.
27 EIB (2017) The EIB in the United Kingdom
28 Project Ireland 2014
29 EY (2018) Attractiveness Survey Scotland
30 DL Piper (2018) UK Infrastructure: Defining the future
ICE’s own research suggests that infrastructure is seen as a desirable core asset of most financial portfolios, however, the attractiveness of the sector as a destination for private investment faces risks:

- Whilst the UK has a strong regulatory, legal and business environment, and finance is internationally focused, fluid and mobile, other countries can be and are becoming more attractive.
- There are early warning signs of increasing risk, market spreads in the sector have increased and some traditionally domiciled funds have begun to see a preference for Euros.
- Decision making remains slow, with time to main gate decisions measured in years, if not decades.
- The political environment remains fraught with concerns about the politicisation of economic infrastructure and private finance, discussion about nationalisation of UK-wide private assets, and uncertainty surrounding Brexit all serving to cool appetite.

Public Opinion
To establish public perceptions of infrastructure funding and priorities for the future ICE undertook several public focus groups and surveys around the UK, including Scotland.31

Across the UK the public is supportive of infrastructure investment and understands its value but believes that the UK lags behind other countries in terms of provision and service. However, respondents also feel that that people in the UK pay too much for infrastructure, through both taxation and customer bills, and that investments in infrastructure should be matched with cost savings and reductions in waste.

Respondents want greater visibility of benefits from investment and increased transparency in decision making. Scottish respondents were more likely than the rest of the UK to want more information about infrastructure investment decisions.

There is strong support for government funding and ownership of infrastructure – people believe it is government’s responsibility to provide critical infrastructure and it should play a coordinating role for major projects. Many people believe that private sector companies engaged in infrastructure make excessive profits, which should be capped and any additional profit reinvested to improve infrastructure. Scottish survey respondents were more likely to favour taxes as a means of funding infrastructure than the rest of the UK.

‘Road user charging’ was seen as a possible ‘necessary evil’. It was generally not welcomed but might be accepted if it could offset other motoring costs and deliver improvements either to road maintenance or public transport. However, when considered as a direct replacement for Vehicle Excise Duty (VED) and fuel duty, where a ‘pay as you go’ model supports local road maintenance, most Scottish respondents were supportive even where it potentially would mean higher costs.

ICE believes that there should continue to be an investment mix between public and private finance. This mix brings benefits through leveraging high availability of liquidity, ensuring diversified financing streams to meet individual project needs and allowing for the potential to exploit the benefits of delivering socially important infrastructure in an efficient manner.”

31 This was an independent review run by Copper Consultancy on behalf of ICE.
Section 2: The role for the Scottish Government and industry

ICE Scotland has identified policy and practical interventions required by government and industry to optimise the impact and quality of investments and support the prioritisation of investment.

Recommendations

To support investment in quality assets for the long-term:

• The new Scottish Infrastructure Commission should be independent and build cross-party consensus to support a consistent, long-term approach to infrastructure planning and investment. The Commission should undertake an assessment of Scotland’s long-term infrastructure needs to inform its future work.

• Long-term asset planning and maintenance should be declared as a National Infrastructure Priority. Asset maintenance is a fundamental part of a resilient and productive infrastructure system.

• The Scottish Government, infrastructure clients and industry should work together to address the problems associated with transactional industry contract models and ensure that risks in delivering public infrastructure projects are allocated fairly and appropriately.

An Infrastructure Commission for Scotland

ICE Scotland supports the formation of a Scottish Infrastructure Commission (SIC), the need for which we outlined in our Manifesto for Infrastructure in 2016. The SIC should take the lead on developing evidence-led infrastructure recommendations and coordinating strategies to support the Scottish Government's ambitions for a strong and inclusive economy.
The new Commission should:

• undertake a National Needs Assessment of Scotland’s long-term infrastructure requirements;
• be independent, transparent and evidence-led in its recommendations to Ministers;
• seek to build cross-party support for priorities beyond political cycles;
• consider priorities for existing infrastructure as well as requirements for new capital investment;
• inform long-term infrastructure investment decisions to address economic, social and environmental challenges, and;
• take an overarching view across the whole of Scottish and cross-border infrastructure to develop a long-term vision for Scottish infrastructure.

Continued investment in new and upgraded infrastructure is essential to address the challenges presented by climate change, changing demographics and disruptive new technologies. It presents the opportunity to maximise the potential for inclusive economic growth and productivity. Long-term investment commitments require continuing, cross-party commitment and consensus. This will be particularly important during the period of political and economic uncertainty following Brexit.

The Scottish Government’s 2018-19 PIG commits to increasing infrastructure investment, so it is £1.5bn higher per year by 2025-26 than in 2019-20. This investment will support faster broadband, improved transport and low-carbon energy infrastructure. This multi-parliamentary commitment to increased investment is welcome and will be essential in supporting a low carbon transition. The new Commission will have a key role in guiding this investment.

Close, coordinated working with Scotland’s infrastructure clients and industry will be essential for the Scottish Government and the SIC to deliver maximum value from proposed investment. At a UK level, ICE supports an Infrastructure Client Group (ICG) which addresses client organisation and supply chain issues. These are often barriers to innovation and sustainability of the supply chain and significant drivers for higher cost. ICE Scotland is exploring the possibility of forming a Scottish equivalent, and how this could support the work of Scottish Government and the SIC.

ICE’s National Needs Assessment (NNA), published in 2016, took stock of the performance of the whole of the UK’s infrastructure and set out the steps needed for a national infrastructure system which is efficient, affordable and sustainable. This work laid the foundations for the National Infrastructure Commission’s (NIC) own National Infrastructure Assessment (NIA). While focused on England and Wales, the NIA makes recommendations for public spending within the UK Government’s fiscal envelope to 2050, including energy, communications, and some transport.

Infrastructure policy cuts across all areas of people’s lives and underpins the Scottish Government’s social and economic ambitions. Therefore, it is essential that the intersections between different policy areas are fully understood, that policies are fully aligned, and the policy decisions are evidence-led.


61% of Adults would like more information about how public money is spent on GB infrastructure projects.

YouGov (2018)
**Asset Management as a National Infrastructure Priority**

Scotland has invested heavily in building new economic and social infrastructure capacity, reinforcing existing networks to underpin economic growth, address population growth and adapt to climate change. This has been delivered via agencies including Transport Scotland and Scottish Water, but also through local authorities and other agencies like Network Rail.

These agencies operate and maintain a large portfolio of assets, all of which are at various stages of their design-lives. Agencies have asset management plans and a body of asset data, and these can be of varying quality. Additionally, new types of assets are using networks – like EV charging infrastructure or renewable generation – changing the job existing assets were designed to do.

As budgets continue to be cut, local authorities are finding it increasingly challenging to balance their full range of services. Resources are focused on delivering core care and education duties, which requires around 60% of council budgets. The Fraser of Allander Institute predicts funding for non-protected services, which include several infrastructure and built environment services, could fall between 8.8% and 13.9% between 2016/17 and 2020/21. In this environment asset maintenance and long-term asset replacement planning is a ‘hard sell’ to prioritise. Scotland’s infrastructure is worth billions of pounds, but portions of it are failing to realise their full benefit to the economy as they deteriorate and lose their value. This is undermining the benefits which are realised to health and education through enabling access to such services.

Long-term asset replacement and maintenance planning gives decision makers foresight of periods of necessary investment, supports work-force and budget planning and helps to prevent expensive unplanned interventions. Infrastructure is a long-term investment, far beyond political or regulatory cycles, and requires a long-term approach. There are encouraging signs in certain sectors such as rail and water that the Scottish Government has a good grasp of such imperatives but more needs to be done to address shortfalls in funding for infrastructure at all levels.

"Asset maintenance is an essential part of a resilient and productive infrastructure system, and long-term asset planning and maintenance should be designated as a National Infrastructure Priority."

**The role for industry**

The engineers who design, build and maintain the infrastructure on which Scotland depends do so with the benefit of everyone in mind. It is an imperative that the built environment sector operates in a way which earns trust, which meets the standards which people expect, learns lessons, operates efficiently, treats people fairly and makes the best use of the economic resources given to it, deploying it to the best effect.

**Procurement and contract management**

Construction and engineering operate under low margins. Pre-tax profit margins for the UK’s 100 major contractors has grown to around 2.8%, however, the average pre-tax profit margins for the ten largest tier 1 contractors sits at 0.5%. A culture of price driven procurement, coupled with contracts which do not allow enough contingency should things go wrong, has had disastrous effects for much of the industry, the collapse of Carillion being a case in point. As larger companies leave the market this can result in smaller firms securing contracts where they are less well placed to withstand unexpected problems. The impacts of Brexit may serve to amplify the problems which already exist in industry.

One of the benefits of private sector involvement in public sector projects is risk sharing. That transfer of risk must be realistic and recognise that ultimately that risk never is, and should not be, fully removed from the public sector. Profit motivation can encourage more efficient management of risk. However, procurement which encourages a ‘race to the bottom’ on price and deprioritises quality, sustainability and skills development will not deliver the industry or built environment we need. Infrastructure clients must have the ability to procure, contract and oversee projects with expert knowledge – to be able to act as intelligent clients. Public sector procurement must better balance capital cost with whole-life asset value and performance.

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36 Construction News (2017) CN100 2017: Construction’s top 100 contractors
Protecting the supply chain through an enterprise business model

Infrastructure investment will only be effective if the sector performs well, exploits advances in technology and innovation, learns from best practice and ends the cycle of low margins. Poor investment in skills development and innovation, stop-start investment, and dysfunctional relationships have been hallmarks of transactional infrastructure procurement.

Financial constraint has exacerbated a risk avoidance culture in the public sector, creating barriers to innovation. More can be done to encourage a ‘fail fast but fail forward’ attitude, and public sector clients need to move from a ‘risk avoidance’ mindset to one of risk management. Initiatives like the CivTech® programme, and joint working between SEPA, Zero Waste Scotland and Entrepreneurial Scotland to address social and environmental challenges, are a step toward mainstreaming ‘innovation mindedness’.

ICE and the Infrastructure Client Group37 (ICG) are working together to identify a better approach to delivering high performing infrastructure. The output, Project 1338 is an industry-led response to infrastructure delivery models that fail not just clients and their suppliers, but also the operators and users of our infrastructure systems and networks.

It seeks to develop a new business model based on an enterprise, not on traditional transactional arrangements – to boost certainty and productivity in delivery, improve whole-life outcomes in operation and support a more sustainable, innovative, highly skilled industry.

ICE’s research drew a picture of the supply chain where a culture of ‘play to win’ dominates, driven by a low margin environment. A sector focused narrowly on winning bids and seeking competitive advantage acts as a barrier to benefits from collaborative working and sharing of best practice. It is important that the industry improves its practices and builds resilience to deliver high quality projects and programmes.

Sharing risk

The transactional model seeks to move risk down the supply chain, rather than manage it. This has led to cost inflation, with tier 2 and tier 3 suppliers assigning amounts to overhead and profit to mitigate that transfer of risk. Yet it is driven by an industry culture which has seen the top 10 contractors’ margins fall from just under 3% in 2013 to 0.5% in 2016. The failure of this approach has been highlighted by sector profit warnings; 7 FTSE construction and materials category companies issued profit warnings in 2017, with 6 issued in the 6 months to June of 2018.39 In Scotland well-known SME construction firms went into administration in 2018 highlighting supply-chain impacts and job losses.

Clients, contractors and the supply chain need to arrange themselves in a way which realises the collective management of risk and establishes clear pre-determined lines of accountability.

As the major infrastructure client in Scotland, the Scottish Government has considerable influence in shaping industry behaviours and supporting industry resilience.

“ICE Scotland recommends the Scottish Government works with industry to address the problems associated with transactional industry models and unbalanced risk share.”

Skills

ICE recently undertook a comprehensive professional skills review.40 The review set out the type of skills civil engineers will need as industry changes and what ICE will do to ensure Members have the right skills for their full career.

The report recommended:

• Skills requirements should reflect the whole lifecycle of infrastructure;
• Continuous learning is essential;
• ‘Soft’ skills – should be promoted at all levels;
• A breadth of skills and knowledge is required by individuals for effective team working;
• Technological skills are increasingly important and training should reflect this; and,
• More people from non-engineering backgrounds should be enabled to enter the discipline.

Employers, universities and colleges must improve collaboration. Employers need to invest in training, development and partnerships as part of enhancing their talent strategies and engage with higher and further education to enhance their recruitment of talent. Academy9, an education collaboration tied into the A9 dualling programme to encourage more children into STEM careers, is a good example of the type of joined-up working which benefits industry, higher and further education, and realise a long-term skills pipeline.

37 The Infrastructure Client Group is a forum for driving client-led initiatives.
38 http://www.p13.org.uk/
39 CIOB (2018) Construction profit warnings double
Section 3:
Sector specific investment

Recommendations

• **Roads:** The Scottish Government and local authorities should commit to multi-year funding for roads. The Scottish Government should consider how replacements for VED and fuel duty could be used to fund road asset maintenance, and should consider the potential benefits from regulation of Scotland’s roads.

• **Energy:** The Scottish Government should accelerate its efforts to decarbonise heat as a matter of priority. Scottish and UK governments should continue to work together to focus of achieving maximum value and resilience from existing energy infrastructure. Both governments should explore the legislative mechanisms available to enable new technologies to access the market.

• **Water:** Expenditure should increase on water and waste water asset maintenance which is critical for maintaining service, reducing the risk of loss of this vital service to customers. Industry should seek to advance its use of data and analytics to support maximum efficiency in delivery, operation and maintenance.

• **Rail:** Increased efforts should be made to identify opportunities for improved efficiency in delivery and maintenance, building on lessons learned during control period 5.
Background

In addition to interventions which benefit the wider built environment, support the finance community or better utilise or incentivise public money, sector specific interventions by government and industry have the potential to improve the circumstances of that sector or reform the sector with policies which better support users, professionals and companies.

ICE Scotland has examined four major infrastructure sectors: Road, Energy, Water and Rail, where specific policy interventions have been identified which could boost funding, support strategic policy decisions, improve delivery or fix market failures.

Interdependencies

Whilst separate infrastructure sectors each have specific challenges, they should not be viewed in isolation. The different sectors have always been reliant on each other to some extent, and as the nation’s infrastructure continues to evolve and adapt the increasing importance of digital technology, connectivity and whole system approaches will serve to deepen these interdependencies.

Some interdependencies have existed for centuries and are well accounted for. Delivery of most projects requires transport infrastructure to ferry plant, materials and labour. Electric and/or hydrogen vehicles and (eventually) connected and autonomous vehicles will demand new charging infrastructure requiring more energy and increased connectivity. This will require road engineers, the automotive industry, the energy sector and telecommunications to work together, and consider how cross sector approaches to investment can support this transport revolution.

It is also possible to think innovatively about assets and how they can have multiple uses. The Metropolitan Glasgow Strategy Drainage Partnership, for example, will allow existing historic canals to be used for dynamic drainage, reducing pressure on waste water systems and freeing up land for productive use.

Our lives are increasingly dependent on digital communications, and infrastructure is no different. This has implications for where we choose to invest in the future and how we use existing systems. Better communications infrastructure and the full rollout of 4G (and eventually 5G) has the potential to increase teleworking, reducing pressure on transport systems. Planning for the flexible use of infrastructure assets will become more important due to the uncertainties of population growth, climate change and impacts of disruptive technologies.

Understanding and making use of interdependencies can deliver financial and running cost benefits. Scottish Water, one of Scotland’s biggest energy consumers, has developed a programme of on-site energy generation to drive down its dependency on grid supply.

Critical thinking in this area could also increase revenue resilience through multiple use and reduce the overall demand impact on other sectors. It is vital that both industry and both governments seek measures to identify and exploit these where possible.

““ The Government has committed to a fiscal envelope of between 1% and 1.2% of public spending on economic infrastructure to 2050. ””

75% of Adults believe that more money should be spent on improving the UK’s core infrastructure networks.

YouGov (2018)

58 ONS (2017) Developing new measures of infrastructure investment: July 2017
59 IPA (2017) Analysis of the National Infrastructure and Construction Pipeline
60 IPA (2017) UK Guarantees Scheme
**Roads**

**The value of Scotland’s roads**

Road infrastructure is one of Scotland’s biggest capital investments, and comprises 56,000km of roads. Transport Scotland is responsible for 3,600 kilometres of motorways and trunk roads (7%), and local authorities are responsible for 52,400km of A, B, C and unclassified roads (93%).

The Trunk Road Network (TRN) has a gross asset value of over £20 billion, carries 35% of all traffic and 60% of heavy goods vehicles. From 2016/17 the value of local roads has been calculated on the cost of replacing all roads to their current condition. This change is likely to lead to a significant increase in the reported value of Scottish councils’ road networks.

63% of local roads are currently in ‘acceptable’ condition. Road maintenance spending has been cut by 14% between 2011/12 and 2014/15, and further cuts are anticipated. There is a well-known £1.2bn backlog of road maintenance.

Transport Scotland’s recent review of roadworks in Scotland may be instrumental in addressing poor road conditions resulting from inadequate reinstatements.

The Scottish Government’s £80m capital investment in active travel is a positive step toward making active travel a more attractive option and making journeys by bike and foot safer. However, the additional costs and practical challenges of maintaining these assets can mean that some assets are likely to deteriorate.

Retaining the value of road investments means ensuring appropriate levels of funding are available to deliver planned and preventative maintenance, ensuring road assets do not become unusable.

**The future of road funding**

The Scottish Government has set an ambitious target of banning the sale of new non-zero emission cars and vans by 2032, as part of its decarbonisation and emission reduction agenda.

The shift to non-carbon sourced fuels has implications for road and vehicle taxation. Whilst Vehicle Excise Duty (VED) and Fuel Duty are not hypothecated to road maintenance they do contribute to the public perception that they are the gateway payments to the road network.

Under the current regime, the tax take will decline. These tax receipts from Scotland are collected centrally by UK Treasury, partially returned to the Scottish Government via the Barnett Formula.

There will be a tax revenue crunch which has both short and medium-term considerations. Ultra-low emission vehicles with a value less than £40,000 are currently VED exempt – the UK Treasury will need to balance any reconsideration of this exemption with supporting the UK Government’s 2040 target. Fuel duty is tied to traditional vehicle fuel sources, as these are phased out the value of this revenue raising measure will diminish further, even when taking into consideration the inflationary depreciation of the continuing 8-year freeze of the fuel escalator announced at the UK Autumn 2017 Budget. This has left a £850 gap per driver in public finances, or nearly £5bn per annum since 2011.

Neither trunk roads nor local roads in Scotland receive long-term funding settlements. This makes it more challenging for Transport Scotland and local authorities to deliver long-term asset maintenance plans and renewals. While local authorities have maintained a steady state in road condition despite cuts it is unlikely that this can continue.
The move away from the current taxation regime because of the push toward EVs represents an opportunity to reassess the approach to how road maintenance funding is delivered.

ICE’s research indicated that 52% of respondents in Scotland (from a GB-wide poll) support ‘pay as you go’50 as a replacement for VED and fuel duty, and 55% would support it if it meant more money would be spent on improving and maintaining roads in their local area. Scotland was more supportive of ‘pay as you go’ than other areas of the UK, especially if it is hypothecated to road maintenance.

“If the Scottish Government should consider how replacements for VED and fuel duty could be used to fund road asset maintenance.”

Percentage of GB and Scottish adults51 who chose Roads as a main priority for infrastructure spending

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<th>Scotland</th>
<th>GB</th>
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<td>Roads 57% YouGov (2018)</td>
<td>55%</td>
<td>47%</td>
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More than 50% of Scottish Adults would support the introduction of ‘pay as you go’ on the busiest roads if it replaced both Vehicle Excise Duty and Fuel Duty.52

More than 50% of Scottish Adults would support the introduction of ‘pay as you go’ if it meant more money would be spent improving and maintaining local roads.

50 By ‘pay as you go’ we mean charging drivers for the use of roads they drive on.
51 All figures, unless otherwise stated, are from YouGov Plc. All stats are taken from a GB-wide poll. Total sample size was 1,643 adults, of which 141 were in Scotland. Fieldwork was undertaken between 21-24th September 2018. The figures have been weighted and are representative of all GB adults (aged 18+).
52 All figures, unless otherwise stated, are from YouGov Plc. All stats are taken from a GB-wide poll. Total sample size was 1,722 adults, of which 139 were in Scotland. Fieldwork was undertaken between 5-6th September 2018. The figures have been weighted and are representative of all GB adults (aged 18+).
Alternative Approaches

A ‘pay as you go’ model could be applied to the Trunk Road Network (TRN) and would rely on a technological solution. There are examples of how this could work:

Distance Based Approaches

Germany has successfully used a distance-based road pricing scheme since 2005 – the LKW-Maut. This road pricing scheme is applied to goods vehicles based on the distance driven, the number of axles the vehicle has and the emission category of the vehicle, taxing based on the most efficient route, and the wear and tear to the road from heavy goods vehicles and environmental externalities. This scheme has an average charge of €0.135 per kilometre and uses an on-vehicle electronic system to monitor distance against road side markers. The scheme raises some €2.4bn (£2.1bn) per year.\(^5\)\(^3\)

Road monitoring of vehicles is already deployed in the UK with insurers using telematics technology to monitor distance and average speed. The UK Government has announced the creation of a taskforce between the automotive industry and the insurance industry to promote this usage in the Road to Zero Strategy.\(^5\)\(^4\)

This technology, alongside infrastructure supporting connected and autonomous vehicles, could be adopted to monitor a distance-based road user levy. Crucially, however, it could also incentivise behaviour which rewards efficient driving, at speeds which maintain traffic flow, by passively adjusting the distance charge for drivers or vehicles maintaining a speed which supports traffic flow and shift, particularly short journeys, to other, more efficient, forms of transport, particularly public transport, walking and cycling.

A system connected with real-time road traffic monitoring could also better manage traffic flow by advising drivers or vehicles of routes which are not congested, have road works or have suffered an accident, encouraging rerouting and better using the capacity of the whole network.

Linking road user charging to outcome value

The UK Government has a limited number of mechanisms, including VED, by which to raise revenue from road use. New mechanisms will have to be found as EVs and hydrogen vehicles become the norm. ‘Pay as you go’ systems could be developed in relation to long-term economic outcomes and public benefits. Network upgrades and maintenance where there is a demonstrable value in terms of performance e.g. capacity, reliability and resilience would align with the Scottish Government’s inclusive growth ambitions.

The case for regulation and multi-year funding

Scotland’s roads are currently funded on a year-to-year basis and are not regulated.\(^5\)\(^5\) Single year funding makes it challenging to plan asset maintenance and renewals with a long-term view because of the inherent lack of certainty of funds year to year.

Local authorities do not ring-fence funding for roads but could achieve greater certainty by committing to a set funding level for a period of several years. This would enable more effective forward-planning and the ability to commit to multi-year programmes of work. This should be echoed by the Scottish Government in funding for trunk road maintenance.

Effective regulation can drive efficiencies, improve customer service and enforce good practise. The lessons from Scottish Water’s regulation journey, and long-term funding agreements demonstrate the benefits from regulation. The Scottish Government and local authorities should explore approaches to delivering multi-year funding for roads to underpin long-term asset planning.

“ The Scottish Government should consider the potential benefits from regulation of the Scottish road network. ”

\(^5\)\(^3\) https://www.roadtraffic-technology.com/projects/lkw-maut/
\(^5\)\(^4\) Department of Transport (2018) Reducing emissions from road transport: Road to Zero Strategy
\(^5\)\(^5\) Except in the case of the Scottish Road Works Commissioner.
Case study – Scottish Water and improvement through regulation

Under the Water Industry Commission, economic regulation has driven considerable cost and service improvements into the water industry in Scotland and the success of that regulatory model is now globally recognised. Under the Scottish economic regulatory regime, Scottish Water has reduced its operating costs by 40%, reduced leakage, improved customer service, and since 2002 has delivered around £500m of capital investment annually to improve water quality and environmental standards. Scottish Water's average charge for the water and waste water service is one of the lowest in the UK.

The Water Industry Act 1999 established the position of Water Industry Commissioner to advise Ministers on customer protection and economic regulation of the three regional water authorities. Following recommendations from the Water Industry Commissioner, Scottish Water was created in 2002 by a merger of those three water authorities under the Water Industry (Scotland) Act 2002.

In 2005, the Water Industry Commission for Scotland (WICS) took over from the Commissioner as the economic regulator of the water and waste water industry in Scotland. It is an executive non-departmental public body of the Scottish Government with statutory obligations.
Energy – addressing complexity

Scotland’s energy system – electricity, heat, transport – is subject to the quadrilemma of affordability, carbon reduction, security of supply and public acceptability in decision making. Through the United Nations Framework Convention on Climate Change agreement to limit global mean surface temperature rise to less than 2°C, Scotland and the rest of the UK has a commitment to decarbonise its systems. In 2017, the Scottish Government’s Energy Strategy set a target of:

• “an equivalent of” 50% of energy for Scotland’s heat, transport and electricity consumption to be from renewable sources by 2030.
• An increase by 30% in the productivity of energy use across the Scottish economy.

Key energy decisions, including capacity auction, subsidies, and generation decisions are reserved to Westminster. Scotland has some powers on renewables via the planning system, as well as energy efficiency, and gives Ministers some powers in governing the overall energy mix.56

Energy infrastructure is privately owned, and investment is necessarily long-term. Scotland’s electricity and gas transmission networks, and existing generation, represent a significant body of investment. Neither government nor investors wish to risk existing assets becoming stranded by technological change. Balancing affordability, security of supply and decarbonisation at a point of technological and political change, as well as attracting necessary new investment, is a considerable challenge.

Electricity-Transport-Heat Interdependencies

ICE’s National Needs Assessment (NNA) mapped infrastructure interdependencies and modelled future scenarios for energy use. These considered scenarios ranging from unconstrained growth to the introduction of demand management, EVs and smart grid technologies. Under each of these scenarios it was expected that electricity demand would continue to grow, and a more flexible transmission and distribution grid would be required.

Heat – domestic and industrial - is recognised as the most challenging part of the energy system to decarbonise.

Heat

The Committee on Climate Change (CCC) recently noted that the decarbonisation of heat requires increased action;57 to reach the target of renewably sourced heat for 11% of heat from non-electrical heat demand by 2020 current uptake must double. Other low carbon heat sources should supply 35% by 2032.58

According to the Scottish Government’s independent advisors on Climate Change59, by 2030 that could require:

• Most of Scotland’s homes and buildings to be made more energy efficient
• 280,000 homes switching to low-carbon heat, mainly in rural areas
• A ten-fold increase in the number of buildings served by district heat networks

Gas networks, which underpin the UK’s heating systems, are a core component of energy infrastructure system. Around 2025 the UK Government will make critical decisions about the future of the gas network, and its role in the decarbonisation of the energy system.

Gas is likely to be part of the transition to low carbon, and while it is low cost there is an opportunity to introduce the infrastructure which enables a transition to low carbon. Denmark has clear evidence of using gas Combined Heat and Power (CHP) to build its heat networks, economically and is replacing the CHPs with low carbon technology. The transition away from gas could thereafter be incentivised by Government, with sufficient warning.

In the meantime, continued investment in R&D to explore adapted uses – such as transmission of hydrogen within the gas network - for the gas network is required.

Rapid development of several options, with multi-project investments, is essential. Current carbon trajectories leave no room for sequential exploration of single options where they later may prove not to be scalable, economic or deliver necessary carbon reduction outcomes

Percentage of GB and Scottish adults who chose Energy as a main priority for infrastructure spending

58 Ibid. 59 Committee on Climate Change (2016) Scottish Emissions Targets 2028 - 2032
The picture for heat provision is further complicated by district heating, heat pumps and other technologies. Both governments are understandably focused on creating an environment where new technologies and uses can be explored rather than ‘picking winners’.

However, this should not be used as a reason to wait for a ‘silver bullet’ or indefinitely defer decision making. It is likely that the future energy mix will be a combination of solutions, and opportunities to plan these in should not be missed.

The Scottish Government, in its PfG 2017-18, announced its intention to set up a publicly owned energy company with the intention of selling energy to customers at as low a price as possible. The Scottish Government sees this as a mechanism to support those at risk of fuel poverty – 26.5% of the population – due to rising fuel costs, proportion of hard-to-heat housing stock, and higher instances of poverty. Scottish Government has proposed Local Heat and Energy Efficiency Strategies that are based on a socio-economic model, akin to Denmark’s Heat Law. This would mean that district heating zones could be justified by the socio-economic benefit and potentially customers mandated to connect. The developing regulation should remain firmly focused on the values that it was envisaged to achieve. Addressing fuel poverty has the potential to realise benefits across various policy areas.

Balancing resilience, decarbonisation and the cost of Scotland’s heat – domestic and industrial – is complex. As is ensuring that our existing assets, as well as future assets, meet the requirements of our future energy mix. It is also essential in a country which is colder than the rest of the UK, has older and hard-to-treat housing stock, and high levels of fuel-poverty.

“ICE Scotland recommends that the Scottish Government focus on and accelerate its efforts to decarbonise heat.”

**Electricity**

The UK electricity Grid infrastructure will need to cope with a significant degree of electrification of heat and vehicles, which will increase load on the system and local issues of grid balancing. The electricity grid network operators need to be transparent about the constraints in the public energy infrastructure and their infrastructure investment. This should include publishing this information in open-source Geographic Information Systems (GIS) formats so that Local Authority planners can ensure that they can undertake whole system energy infrastructure planning.

Although the price of renewable electricity has significantly decreased, its attractiveness has been hampered by the removal of subsidies, creating a less attractive environment for investors. Electricity Market Reform has gone some way toward helping to create a more stable platform and reducing uncertainty, but weaknesses remain.

Scotland, along with the rest of the UK, continues to depend upon its existing nuclear and thermal generation for baseload capacity, along with interconnectors as they come on stream, and it is likely to do so for some time to come. As storage technologies mature and legislative barriers to entry are dismantled, reliance on existing thermal generation may reduce, but this is not certain.

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60 Energy Action Scotland. Fuel poverty overview.
61 The minimum level of demand on the electricity grid over a given period of time.
62 Interconnectors are the physical links which allow the transfer of electricity across borders.
Transport

The uptake of EVs will require new grid capacity during the 2020s and 2030s. EVs are currently low in numbers – around 8500 out of 3m registered vehicles in Scotland63 – but forecasts (e.g. by OPEC) indicate future uptake is expected to accelerate. Under all EV uptake scenarios investment in new transmission capacity is going to be required. However, this can be delayed and reduced by managing the time of customers’ EV charging to use all available local network capacity, and by deployment of network automation to enable network reconfiguration in real time.64

Ensuring that the deployment of EV charging infrastructure and reinforcement of the local network are appropriately aligned to projected uptake (alongside multiple other energy system variables) is essential to get best value from investment. ICE Scotland supports the NIC’s recommendation in its National Infrastructure Assessment (NIA) that Ofgem:

- should take on the role of regulating the interaction between EV charging points and the electricity network immediately; and,
- should commission electricity network operators to work with charge point providers to identify potential anticipatory investments.

A continued focus on the development of the EV charging network in the 2018 PfG and phase 2 of the Switched-on Scotland strategy is necessary.65 However, we cannot ignore the spatial challenges associated with deploying on-street charging in busy urban environments and in high-density areas with no off-street parking.

“ICE Scotland is unconvinced that the current trajectory will deliver the infrastructure and market demand required to meet the 2032 target.”

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63 ICE (2018) Delivering electric vehicle charging infrastructure in the UK
64 National Grid (2017) Future Energy Scenarios
65 Scottish Government (2017) Switched On Scotland: phase two
**Contract for Difference**

A Contract for Difference (CFD) is a private law contract between a low carbon electricity generator and the Low Carbon Contracts Company (LCCC), a government-owned company. A generator party to a CFD is paid the difference between the ‘strike price’ – a price for electricity reflecting the cost of investing in a low carbon technology – and the ‘reference price’ – a measure of the average market price for electricity in the GB market. It gives greater certainty and stability of revenues to electricity generators by reducing their exposure to volatile wholesale prices, whilst protecting consumers from paying for higher support costs when electricity prices are high.

In its *State of the Nation 2018: Infrastructure Investment*, ICE notes the potential for a form of CFD to encourage the development of emerging technologies within the energy sector and makes the case for wider adoption of CFD. Finding ways to store energy generated from renewable sources addresses the issue of intermittent supply (when there is no wind) and could transform the way in which the energy sector works at a fundamental level. ICE Scotland supports the continued use of Pot 1 CFDs to increase renewable capacity in the next pricing round and believes there is a viable case for expanding support through Pot 2 CFDs to support emergent technologies—like storage, biogas and district heating—with a view to favouring projects which will ensure security of supply.

Given the continued and growing role for renewable and storage technologies, close joint working between governments remains crucial to achieving maximum value and resilience from existing energy infrastructure.

> Both governments need to explore the legislative mechanisms available to enable new technologies onto the market, providing increased support for R&D, particularly where this supports better use of existing assets.

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66 Established technologies such as solar or wind power
67 Less established technologies like off-shore wind and biomass
Water – long term asset management

Context
Scotland’s water and waste water networks are managed by publicly owned Scottish Water and regulated separately from the rest of the UK by the Water Industry Commission for Scotland (WICS). The Scottish Government shapes its priorities for the water industry, as well as responding to the requirements of EU water and environmental directives and the pressures of population growth and climate change. Funding of the water industry is determined by WICS regulatory strategic review cycles and this also means that the length of Strategic Review Periods (SRs) can be varied. Moving from SR15 to SR21 the regulatory period and its funding was extended from 5 years to 6 years with a 3-year interim review.

By 2021 Scottish Water will have invested circa £10.8bn in the network over 19 years. This investment has been driven primarily by EU directives to improve water quality and environmental performance and has realised service improvements which put Scottish Water amongst the best performing water companies in the UK. Scottish Water has assets with a replacement cost in the region of £70.5bn.

Asset replacement
As a public company with relatively long regulatory cycles and funding commitments Scottish Water can think about its infrastructure, and megatrends like climate change, in a long-term way. Scottish Water is engaged in discussion with WICS, exploring the possibility of further extending the 6-year regulatory period, which would fit with the long-term nature of asset planning.

Investment, even at the accelerated pace the sector has seen over the last 15 years, is not enough to maintain and replace assets as they wear out. While replacement rates for all underground assets is around 100 years, the average replacement period for above ground assets is 50 years. The cost of asset maintenance is likely to rise by a third in the medium to long term.

The Scottish Government and WICS have an ongoing focus on ensuring the affordability of water and waste water for customers. The consultation on the principles of charging to 2027 will have to balance customer affordability with this inevitable rise in maintenance costs. ICE research identified that the public does not see water infrastructure as a priority for investment, and as such may not understand the necessity of cost rises.

“Customers need to be aware of the reasons for potential cost rises from maintenance and the implications of failing to maintain assets.”

Future regulatory cycles will require an increased emphasis on the prioritisation of asset repair and replacement, and a strong political commitment to ensure funding is available across multiple SRs.

“Increased expenditure on asset maintenance is critical for maintaining service and reducing the risk of loss of this vital service.”

Percentage of GB and Scottish adults who chose water as a main priority for infrastructure spending

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<th>GB</th>
<th>Scotland</th>
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<tr>
<td>Water</td>
<td>16%</td>
<td>9%</td>
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Scotland YouGov (2018)
UK YouGov (2018)
Getting best value from existing assets

Intervening early to tackle the cause of water quality problems helps avoid expensive capital solutions and has better cost and sustainability outcomes. Scottish Water’s approach of identifying and employing no-build solutions to water quality challenges as part of its preparation for SR21 is to be commended.

Continued emphasis on asset data collection and analysis to better understand the performance of the network remains important. The water sector is generally seen to be ahead of other infrastructure areas in the deployment of sensors and use of data analytics, particularly where assets are underground or hard to access. Better use of data and information enhances infrastructure decision making and delivers benefits for customers and industry users.

Scottish Water should also explore how moving to an enterprise model could help to increase efficiency.

Case Study - Glasgow’s ‘Smart Canal’

Glasgow’s ‘smart canal’ scheme combines the 250-year-old Forth and Clyde Canal and 21st century technology to provide surface water drainage, supporting significant regeneration in the north of the city. The North Glasgow Integrated Water Management System is a pioneering surface water drainage system which will unlock 110 hectares of land across the north of the city for investment, regeneration and development, paving the way for more than 3,000 new affordable homes. The project will see North Glasgow passively absorb, clean and use rainfall.

Advanced warning of heavy rainfall will automatically trigger a lowering of the canal water level to create capacity for surface water run-off. Before periods of heavy rain, canal water will be moved safely through a network of newly created urban spaces – from sustainable urban drainage ponds to granite channels - that absorb and manage water, creating space for surface water run-off.

The project, delivered in partnership between Glasgow City Council, Scottish Canals and Scottish Water, under the Metropolitan Glasgow Strategic Drainage Partnership, will use sensor and predictive weather technology to provide early warning of wet weather to proactively reduce water levels in the canal before receiving runoff and excess rainfall.

This solution avoids the requirements to upgrade existing waste water systems and, through the diversion of surface water, creates additional capacity to enable the development of new communities in areas that were once considered too costly to invest in. In addition, there are significant environmental benefits through the inclusion of green infrastructure and the avoidance of significant excavation and construction activities.
Rail – meeting growing demand

Investment and demand in rail

Rail transport has experienced a renaissance in demand in the last 50 years. The number of passengers travelling by rail in Scotland has seen sustained growth since 1995/96, increasing by 96% to 96.1m journeys in 2014/15. Since 2007 nearly £8bn has been spent maintaining, improving and expanding the rail network.

During the current regulatory control period (CP5 2014-2019) several major upgrade projects have commenced or been delivered:
- Edinburgh Glasgow Improvement Programme (EGIP)
- Aberdeen to Inverness Phase 1
- Highland Main Line Phase 2
- Borders Railway
- Rolling Programme of Electrification
- East Coast Main Line to West Coast Main Line gauge

The rail sector across the UK, including Scotland, has faced a particularly challenging period in recent years. High profile asset failures, periods of poor performance and delays to network projects have created an atmosphere of customer dissatisfaction. While Scotland has avoided the worst of these problems, Network Rail and ScotRail have work to do to rebuild public trust.

Transport Scotland’s 2018 Rail Enhancements and Capital Investment Strategy acknowledges that some of the projects in CP5 have not been delivered in an efficient manner and highlights a real term cut in the availability of capital funding for rail from 2019. It is worth noting that any uplift in rail investment at a UK level will be reflected in funds made available to the Scottish Government via Barnett Formula consequentials, although these funds would not be ring-fenced for rail.

The outputs required by Scottish ministers from the £4.85bn to be allocated to rail in the next control period include:
- Improved services, journey time and inter-area connectivity;
- Improved capacity and use of existing capacity;
- Improved value;
- More effective integration; and
- Increasing inclusive economic growth.

68 Network Rail (2016) Scotland Route Study
69 Transport Scotland (2018) Rail enhancement and capital investment strategy
70 Transport Focus (2018) Customer attitudes survey
71 Transport Scotland (2018) Rail enhancement and capital investment strategy
This commitment to improving delivery, optimising programmes of work and focusing on whole-life value in decision making is to be welcomed.

While rail popularity has grown, as a mode of transport it is still costly to deliver relative to the number of people it carries.\(^{73}\) Due to a combination of factors (the extent of the network, lower than GB average loading, and longer distances) the cost per passenger kilometre is 27% higher in Scotland than other areas.\(^{74}\) Rail in Scotland is heavily publicly subsidised – in the region of 56%.\(^{75}\) Demonstrating value for money from public investment and passenger costs is vital, and where the value from investments is realised – both socially and economically – this could be more clearly articulated. Consideration should be given to market-led proposals for infrastructure investment, where proposals support Scottish Government outcomes.

Rail investment is advocated as delivering faster journey times, lower carbon impact, regeneration, economic growth, and higher productivity. However, faster journey times do not necessarily correlate with higher economic productivity. It is unclear how the time saved is otherwise used. Stakeholders suggested that benefits from improved on-train internet access may be more beneficial to productivity than faster journey times.

New capacity has in part delivered distributed economic growth. The Borders Railway investment is a case in point, driving tourism, improved public transport access, incentivising new housing and population distribution. However, the decision to pursue a single-track option failed to anticipate the failed to anticipate the popularity of the line.

Where there is a strong social and economic case for additional capacity as part of the wider Strategic Review of Transport Projects (STPR), new capacity should still be considered. More sophisticated measures for assessing the benefits from rail investment are required to fully understand where and to what extent different perceived benefits will be realised. Relatively high cost-to-outcome ratios mean the Scottish Government must clearly articulate the benefits from new capacity.

The £795m Edinburgh to Glasgow Improvement Project (EGIP) has seen the delivery of electrification, longer platforms, and reconfiguration of rail assets. However, limited time for optioneering at the outset of the project has resulted in avoidable complexities and delays. Learning from EGIP is being shared to inform future projects and avoid repetition of the challenges experienced. While future rail capital investment projects have yet to be decided, the whole rail asset base is aging and will require increasing levels of funding to ensure it is able to cope with growing demand and deliver a predictable service. Planned and preventative maintenance interventions are the best way to avoid costs associated with expensive reactive interventions to correct failures. Ensuring the cycle of maintenance and renewals work is as flat as possible is important in enabling industry to retain the right skills mix to deliver the necessary work as well as supporting fair employment.

Increased efforts should be made to identify opportunities for improved efficiency in delivery and maintenance, building on lessons learned during control period 5.

Percentage of GB and Scottish adults who chose rail as a main priority for infrastructure spending

<table>
<thead>
<tr>
<th>Percentage</th>
<th>Scotland</th>
<th>GB</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rail</td>
<td>44%</td>
<td>43%</td>
</tr>
<tr>
<td>Roads</td>
<td>43%</td>
<td>43%</td>
</tr>
</tbody>
</table>

\(^{73}\) BBC News, 1 October 2018, ScotRail pledges ‘faster journeys and more seats’ with new timetable.

\(^{74}\) Rail Delivery Group (February 2017) Scotland’s rail infrastructure; The rail industry’s advice for 2019 onwards.

Conclusion

Infrastructure is a long-term investment. We depend upon our assets for decades, if not centuries, and, as such, moving away from short-term decision making tied to political cycles is vital if we are to get best value from investments.

Continuing to do what we’ve always done, or choosing to do nothing, has consequences and will not meet our future social, economic and environmental requirements. Scotland is in the position to realise a complete step-change in our approach to infrastructure at all levels, and we must not waste it.

We have a responsibility to maximise the whole-life value from our new and existing infrastructure assets if Scotland’s ambitions of increased productivity and inclusive growth are to be realised. By preparing infrastructure networks for changing needs, funding them appropriately at all stages of their design life and planning for asset replacements, we can ensure that our infrastructure networks continue to support good quality lives and economic growth.

“Scotland needs a single, coherent vision for the future of infrastructure. This should be underpinned by an understanding of our long-term infrastructure requirements, and how supporting investment should be prioritised to deliver maximum impact. It should consider the role and funding of our existing assets, as well as future capital investments, and take steps to drive out waste and inefficiencies in delivery. This should be supported by a resilient construction and engineering sector which delivers not just our domestic priorities but competes internationally.”
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