



**THE  
STATE  
OF THE  
NATION**

**INFRASTRUCTURE  
2015**

**SCOTLAND**

# THE STATE OF THE NATION SCOTLAND: INFRASTRUCTURE 2015

## ABOUT ICE

The Institution of Civil Engineers (ICE) is a global membership organisation which qualifies civil engineers, exchanges knowledge and best practice, and provides expert advice to government. ICE is a leading source of professional expertise in transport, water supply and treatment, flood management, waste and energy.

Our Constitution binds us to act in the public interest, and our 8,000 Scottish members design, build and maintain our nation's infrastructure. ICE Scotland is a registered charity.

## ABOUT THIS REPORT

ICE's State of the Nation reports aim to stimulate debate and to highlight the actions we believe are needed to improve the UK's infrastructure networks and associated services. This report has been compiled using evidence from members and external stakeholders, and expertise from within ICE's membership across the energy, transport, flooding, water and waste sectors. The report is issued to a wide range of stakeholders, including politicians, civil servants, local authorities, trade, regulatory and consumer bodies, as well as the media. ICE's previous State of the Nation reports are available at: [www.ice.org.uk/media-and-policy/state-of-the-nation](http://www.ice.org.uk/media-and-policy/state-of-the-nation).

## THE GRADES

ICE uses national experts to determine the infrastructure sector grades. A set of nine questions covering four main areas – leadership, resilience, economic and social factors, and condition and capacity – is issued to industry experts. Responses are analysed alongside the other qualitative evidence submitted to ICE to determine the grades. The + or – applied to each grade reflects performance within each grade.

## CONTENTS

<b>Foreword</b>	<b>03</b>
<b>Executive Summary</b>	<b>04</b>
<b>Grades and Recommendations</b>	<b>05</b>
<b>Context</b>	<b>06+07</b>
<b>Energy</b>	<b>08+09</b>
<b>Transport</b>	<b>10+11</b>
<b>Flood Management</b>	<b>12+13</b>
<b>Water and Waste Water</b>	<b>14+15</b>
<b>Waste</b>	<b>16+17</b>
<b>Skills and Capacity</b>	<b>18+19</b>
<b>Contributors</b>	<b>19</b>

**A****B****C****D****E**

### **FIT FOR THE FUTURE**

Infrastructure is well maintained and in good condition. There is excess capacity to cope with major incidents. There is clear strategic leadership with good plans to develop the sector to meet the needs of the next five years.

### **ADEQUATE FOR NOW**

Infrastructure is in an acceptable condition with a reasonable maintenance regime. It can meet current demand and deal with minor incidents across the network. However, investment will be needed in the next five years.

### **REQUIRES ATTENTION**

Infrastructure is infrequently maintained and requires attention. There is no excess capacity, resulting in deficiencies at peak periods or as a result of even minor incidents. Significant investment is required to improve it to meet functional requirements in the next five years.

### **AT RISK**

Infrastructure condition is below standard and poorly maintained. There is frequently a lack of capacity to meet demand and it is not resilient. In the absence of significant investment there may be an impact on the national economy.

### **UNFIT FOR PURPOSE**

Infrastructure is in unacceptable condition with little maintenance. There is insufficient capacity and resilience is of serious concern. The state of the infrastructure is impacting on the national economy.

# WELCOME TO THE STATE OF THE NATION SCOTLAND REPORT ON INFRASTRUCTURE 2015

## Steering Group

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It is now widely accepted that Scotland needs high quality infrastructure which is resilient and well maintained to provide for continued economic growth and a good quality of life. Transport systems, energy, water, flooding and waste disposal are fundamental infrastructure requirements for civilised living and allow us to thrive in a competitive world. Climate change requires resilience to be built into our systems. When we invest our scarce monetary resources in an asset it is essential that we maintain it; an increasingly non-performing infrastructure is a wasting asset. This document looks at our Infrastructure, grades it against defined criteria and suggests improvements to ensure Scotland's infrastructure is fit for purpose.

Our analysis has used an evidence based approach. Our Steering Group has sifted the evidence and come to a series of conclusions which have been subjected to Peer Review. ICE is required to act not for itself but for the good of our society. Those involved have been educated at public expense; the output represents their contribution to society and it is deserving of detailed consideration. It is clear that Infrastructure competes with Health, Welfare and Education for funding priority. What is also clear is that reduced or delayed funding can only result in one outcome: non-performing infrastructure. Non-performance impacts on quality of life and hinders economic activity. Why would anyone want that?

My thanks to those who tirelessly provided evidence, to the Steering Group, Reviewers and to our Policy Team.

Scotland needs optimum infrastructure and it needs it now.



**Ronnie Hunter**

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

# EXECUTIVE SUMMARY

A high level of investment in Scotland's infrastructure has driven a period of sustained economic growth<sup>1</sup>.

Our ability to generate and maintain this growth, along with a good quality of life for people living in Scotland, depends on resilient, high-performing infrastructure networks. These networks should provide predictable energy supply and distribution, good connectivity, reliable water supply and waste management, and effective transportation of people and essential goods into and around Scotland by rail, road, sea and air. The state of the nation's economic infrastructure is vital to the wellbeing of Scotland's economy, underpinning the success of its social infrastructure and the day-to-day lives of the people living here.

The State of the Nation Infrastructure Scotland 2015 report assesses the performance, capacity and condition of Scotland's economic infrastructure networks. It determines the actions required to improve and enhance performance and, importantly, to ensure our infrastructure is resilient in the face of future challenges, including climate change and population growth. This report also considers cross-cutting issues, such as

decarbonisation, infrastructure design, and the availability of infrastructure services.

## STATE OF SECTORS

Our findings indicate improvements have been made in some sectors since our last report in 2011, and that strategic infrastructure planning and investment are beginning to deliver tangible results. Major investment in **strategic transport** infrastructure is improving capacity in key sections of the network, reducing journey times between Scotland's cities by road and rail, and preparing networks for the future. Capital investment projects, like the Queensferry Crossing and Borders Railway, have created greater network capacity, stimulated economic growth and attracted inward investment.

The **waste** sector is improving, but meeting our ambitious landfill diversion targets is dependent on waste infrastructure projects progressing smoothly through procurement. The **water and waste water** sector has continued to improve, although a recent spike in water quality issues has highlighted

the need for continued focus in areas which have generally performed well. Energy and carbon efficiency will become even more important in future regulatory periods, as will water conservation. Developments in flood warning systems are being delivered, and improvements in **flooding** infrastructure will be contingent upon the successful enactment of local delivery plans and continued capital investment. A mixture of adaptive and mitigating measures is required to ensure that homes, businesses and critical services – health care, schools, energy supplies, transport – are resilient to the impacts of flooding.

Other areas give cause for concern. The gap between capacity to supply **energy** and demand in the market in Great Britain is narrowing. Over the next decade more than half of Scotland's electricity generating capacity will be retired. Policy uncertainty, rapid changes to renewables subsidy regimes, and a continued lack of binding decarbonisation targets at a UK level have created insecurity in our electricity market, and a system of generation and distribution which lacks resilience. Clear, long term energy policy guided by expert advice is required in Scotland and the UK to ensure sustainable and predictable energy supplies now and into the future. A declining grade for **local transport** reflects a continued lack of investment in local roads maintenance, and the risk of further network deterioration without decisive action. Underinvestment in local road networks undermines strategic investments. The Scottish Government has implemented strategies to promote active transport but uptake remains modest. Improving access to high quality, integrated and low cost public transport is vital to reducing reliance on private transport – reducing congestion on road networks, improving air quality and enabling people's access to essential services.

1. Pricewaterhouse Cooper (2015) *Infrastructure investment boosts Scottish growth as further austerity looms* - PwC/FAI economic commentary. Blog article, available at: <http://pwc.blogs.com/scotland/2015/>



# GRADES AND RECOMMENDATIONS

## ENERGY



**GRADE C-**  
(2011 GRADE C)



## TRANSPORT



**LOCAL D+  
STRATEGIC B-**  
(2011 GRADE C)



## FLOODING



**GRADE C**  
(2011 GRADE C)



## WATER AND WASTE WATER



**GRADE B**  
(2011 GRADE B)



## WASTE



**GRADE C+**  
(2011 GRADE C)



### TEN POINT PLAN

#### The next Holyrood administration should:

- 1 Undertake an assessment of Scotland's long-term infrastructure needs, taking account of their interdependencies. This assessment should inform the prioritisation of capital investment projects to deliver sustainable economic growth, international competitiveness, and positive social outcomes for people in Scotland.
- 2 Align strategic plans and delivery pipelines at national and local levels. A modernised planning system should engage with the interdependencies of energy, water, transport, flooding and waste infrastructure.

#### Government and private providers should:

- 3 Enhance the resilience of all networks to climate and demographic change, preparing systems to meet future needs and challenges.
- 4 Continue to provide foresight of national infrastructure projects for industry and investors, along with likely timescales for procurement.
- 5 Ensure public bodies have access to appropriate levels of infrastructure procurement expertise.
- 6 The construction and engineering industry should take a central role in addressing skills shortages, by developing strategies for upskilling the existing workforce and encouraging young people and underrepresented groups into the sector.

#### Sector specific:

- 7 Scottish Government energy policy should seek to meet future energy needs in both a sustainable and resilient way, making full use of expert scientific and technical advice. Energy policy development should consider all viable energy modes and sources, their implications and interactions. The United Kingdom (UK) Government should focus on creating a stable environment for investment in energy infrastructure, particularly low carbon energy, to build system resilience and meet our energy needs.
- 8 The Scottish Government and local authorities should fully commit to addressing the road maintenance backlog, moving to a system of planned and preventative maintenance, underpinned by a multi-year investment programme.
- 9 Local transport planning should be more closely aligned with city region structures and issues of overlapping planning and governance should be addressed. Greater integration between different modes of transport should be prioritised to promote modal shift to public and active transport.
- 10 Increased energy efficiency, water conservation, and demand management in our water industry should be central features of future improvement and infrastructure investment, alongside enhanced resilience in treatment and supply.



# CONTEXT

## *“Wealthier and Fairer, Healthier, Safer and Stronger, Smarter, Greener”*

Infrastructure is central to delivering Scotland’s strategic objectives – enhancing connectivity, generating economic growth, and protecting and improving our environment. Civil engineers are vital to the provision of high quality, resilient and sustainable infrastructure.

International Monetary Fund (IMF) analysis of infrastructure investment and growth demonstrates that a 1% increase in investment as a share of GDP leads to a direct increase of 0.4% in annual economic growth. Within four years the additional growth in GDP potentially reaches 1.5% a year.<sup>2</sup> Infrastructure investment has been prioritised in Scotland with £11 billion invested in the three years to 2015/16<sup>3</sup> which, alongside successfully attracting foreign investment, has driven Scottish output growth despite a challenging financial environment<sup>4</sup>. High performing infrastructure is central to maintaining our economic competitiveness.<sup>5</sup>

As well as facilitating our day-to-day lives, infrastructure must be resilient to climate and demographic change. Mott MacDonald estimates that within 20 years US\$200bn of investment each year will be required globally to combat losses from climate change.<sup>6</sup> The human consequences of failing to plan for climate change - loss of homes, businesses, and access to vital resources - are not hard to imagine.

Scotland’s population is expected to rise to 5.78m by 2037. Of more concern is our demographic profile with the number of people aged 65+ increasing by 59%, from 0.93 million to 1.47 million<sup>7</sup> and our working age population decreasing over the same period.

These factors change our infrastructure requirements, increase strain upon existing assets, and raise questions about funding streams for new infrastructure. They also underline the importance of planning and designing for the future, achieving value for money, and continuing to make Scotland attractive for private investment.

### **INFRASTRUCTURE INVESTMENT PLAN**

The infrastructure and construction sectors have driven growth in Scotland in recent years due to the number of large infrastructure projects being delivered.<sup>8</sup> However infrastructure output is likely to decline over the period 2016-2020<sup>9</sup> as several major public infrastructure projects reach completion. The Scottish Government has sought to give industry and investors foresight of major projects, which has been instrumental in creating stability and enabling industry forward planning. We support a continuation of this approach.

The Infrastructure Investment Plan (IIP) outlines the Scottish Government’s strategic priorities over the next 10 to 20 years. The Scottish Government should consider the benefits of a holistic assessment of our longer-term national infrastructure needs, considering all key economic infrastructure in parallel, as called for at a UK level by ICE and EEF, and outlined in the Armitt Review of 2013. This should acknowledge the interdependencies of different infrastructure sectors, build cross-party consensus and a long-term vision for infrastructure investment and delivery.



2. International Monetary Fund (2014) The Time Is Right for an Infrastructure Push. Available at: <http://www.imf.org/external/> 3. The Scottish Government (2015) Scotland's Economic Strategy. Edinburgh. 4. Pricewaterhouse Cooper (2015) Infrastructure investment boosts Scottish growth as further austerity looms - PwC/FAI economic commentary. 5. World Economic Forum (2015) The Global Competitiveness Report 2014-2015. Available at: <http://reports.weforum.org/> 6. Mott MacDonald (2015) Climate change and business survival; The need for innovation in delivering climate resilience 7. National Records of Scotland (2014) Scotland's Population 2013 - The Registrar General's Annual Review of Demographic Trends. Available at <http://www.gov.scot/> 8. Pricewaterhouse Cooper (2015) Infrastructure investment boosts Scottish growth as further austerity looms - PwC/FAI economic commentary. 9. Construction Skills Network Observatory, 1st Round Forecasts 2016-20 10. Scottish Futures Trust (2015) NPD Model Explanatory Note. Available at: <http://www.scottishfuturestrust.org.uk/> 11. UK Government (2014) Glasgow and Clyde City Deal. Joint commitment



## FUNDING AND FINANCING

There are only two ways to pay for infrastructure, both of which ultimately fall on the consumer - direct taxation or user charges. The balance between the two is a choice for Government to implement through social, economic and environmental policies. However, an aging population will impact upon funding from taxation, and may compel consideration of user charges. Irrespective of this balance, efficiency and effectiveness of procurement, delivery and operation are paramount to the achievement of value for money.

Public sector budget constraints are expected to grow, and a significant proportion of infrastructure investment will be financed by the private sector. A greater certainty of lifetime costs, using the 'non-profit distributing' (NPD) model<sup>10</sup> amongst others, will enable investment to progress in spite of challenging economic circumstances.

Scotland's first City Deal will progress infrastructure development and regeneration, creating an estimated 29,000 jobs<sup>11</sup> using £1bn of joint UK and Scottish Government financing to unlock £3.3bn of private financing. This approach offers the opportunity to future-proof regional infrastructure, and is being explored by other Scottish cities. However, infrastructure interventions need to respond to both future (as well as current) needs, should take account of the interdependencies between different infrastructure sectors, and will require strategic planning.

Greater borrowing powers, further to those outlined in the Scotland Act, are due to be

devolved to the Scottish Government under the Smith Commission agreement. This is in part intended to support major capital investment.<sup>12</sup> However, these powers have not yet been discussed in detail<sup>13</sup> and should be an issue of high priority for the Scottish and UK Governments.

ICE Scotland intends to consider the investment and financing of public infrastructure in Scotland in greater detail over the course of 2016.

## PROCUREMENT

Professional qualification and the attendant commitment to continuing professional development is key to the highest possible standards in the construction industry and helps effective project delivery. A lack of infrastructure procurement expertise in some public sector organisations can lead to excessively risk-averse procurement processes, increased project costs and overruns.<sup>14</sup> Organisations with the necessary expertise, referred to as 'intelligent clients', can specify project requirements and manage delivery outcomes. Transport Scotland is a good example of an intelligent client, with a commitment to lifelong learning for employees and appropriate levels of in-house infrastructure procurement expertise to specify projects with confidence and deliver value for money.

Ensuring appropriate levels of qualification across the breadth of the project structure in public contracts helps deliver value for money. The Central Procurement Directorate of Northern Ireland has extended the professional qualifications sought beyond

Chartered employees and 'graduates under training' to include civil engineering technicians (Eng Tech) and apprentices. Including such qualifications in Pre-Qualification Questionnaires (PQQ) enables tenderers to demonstrate the wide-ranging competence of their employees and more accurately define the quality element of submissions including community benefits. This aligns with the recommendations outlined in *The Review of Public Sector Procurement in Construction*.



GRADE

C-

## RECOMMENDATIONS

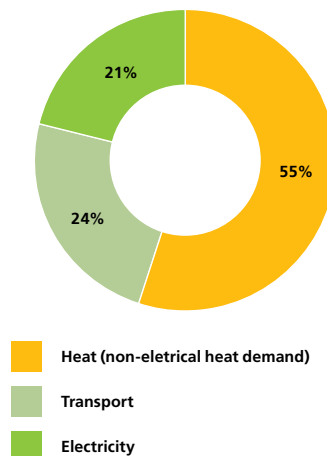
1. **Scotland needs a clearly articulated vision of its future energy needs and how these will be met in a sustainable and resilient way. This vision must acknowledge the interdependencies of all energy uses, and should be guided by scientific and technical expertise.**
2. **The UK Government must focus on creating a long-term, stable policy environment establishing investor confidence in the GB energy market. Recent changes to renewables support programmes should be assessed by the UK Parliament, and a clear commitment given to 2030 decarbonisation targets.**
3. **The Scottish Government should review its Electricity Generation Policy Statement in light of the many substantial changes to the electricity generation sector in both Scotland and the UK.**

# ENERGY

Scotland faces what has been characterised as an energy 'quadrilemma': reducing carbon emissions, ensuring a fair cost to the consumer, maintaining security of supply, while also achieving public acceptability.<sup>15</sup>

and 80% by 2050 against 1990 levels.<sup>16</sup> Emissions are currently down by 34.3%<sup>17</sup> but decarbonising heat and transport<sup>18</sup> will be tougher than electricity.<sup>19</sup> We support Scotland's climate change targets, but meeting these and maintaining security of supply requires altering the way that Scotland generates and uses all forms of energy.

**FIGURE 1**  
Total Energy Consumption  
Scotland, 2012



Source: Scottish Government

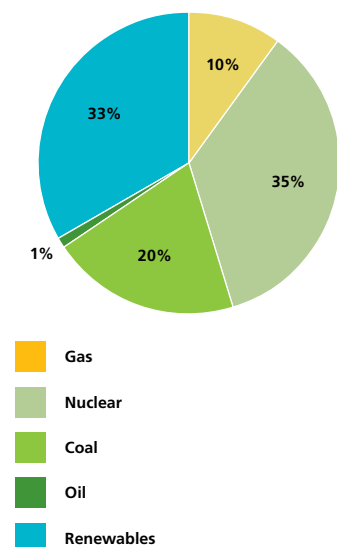
Energy policy is reserved to Westminster but the Scottish Government influences its direction in Scotland using the planning system. Under the terms of the Smith Commission outcomes, OfGem must report to the Scottish Parliament on its annual report and accounts, improving accountability. Scottish policy precludes new nuclear and unabated coal electricity generation, focussing on renewables, at odds with the rest of the UK where new nuclear generation has been agreed. Both the UK and Scottish Governments see gas playing a continued role in generation in the future.

Scotland aims to reduce total greenhouse gas emissions by 42% by 2020

## ELECTRICITY GENERATION IN SCOTLAND

Excess electricity supply over peak demand in winter 2015/16 could fall to 1.2% from 4.1% in 2014/15<sup>20</sup> - a large reduction from the 20% margin before privatisation. Within eight years 55% of Scotland's electricity generation capacity will be retired - Longannet coal-fired power station (2016), Hunterston and Torness nuclear plants (2023)<sup>21</sup> - increasing pressure on the margin further.

**FIGURE 2**  
Electricity Generation Mix in  
Scotland, 2013



Source: Scottish Government

15. The Royal Society of Edinburgh (2015) *Options for Scotland's Gas Future*. Advice Paper (BP15-01). 16. The Baseline Period uses 1990 for carbon dioxide, methane and nitrous oxide and 1995 for hydrofluorocarbons, perfluorocarbons, sulphur hexafluoride and nitrogen trifluoride. In 2013, Scottish emissions of the basket of seven greenhouse gases are estimated to be 53.0 million tonnes carbon dioxide equivalent (MtCO<sub>2</sub>e). 17. The Scottish Government (2015) *Scottish Greenhouse Gas Emissions 2013*. Edinburgh. 18. The Committee on Climate Change (2015) *Reducing emissions in Scotland 2015 progress report*. Available at <https://www.theccc.org.uk/> 19. Decarbonisation of transport is considered in more detail in the transport section of this report. 20. Although this will be bolstered to 5.1% by demand and supply side payments - including diesel generation and paying large consumers, such as factories, to shut down to reduce consumption. 21. Off-shore wind, hydro, wave, tidal power. 22. Institution of Civil Engineers (2015) *Proposed changes to onshore wind funding - behind the numbers*. Blog article, available at: <https://www.ice.org.uk/media-and-policy/the-infrastructure-blog/> 23. Institution of Civil Engineers (2015) *Electricity Storage: Realising the potential*. Briefing paper. 24. Pumped-storage hydroelectricity is a type of hydroelectric energy storage. The method stores energy in the form of gravitational potential energy of water, pumped from a lower elevation reservoir to a higher elevation. 25. An expansion at Cruachan hydroelectric plant and a new development at Coire Glas hydro electricity scheme are currently being explored.





Renewables can drive decarbonisation and decrease reliance on imported fuels, but development is constrained by the remote location of natural resources<sup>22</sup>, high transmission charges and the intermittent nature of some renewables. Uncertainties prior to the implementation of Electricity Market Reform, early closure of Renewables Obligation funding, and the lack of a binding 2030 target for renewable electricity generation at a UK level has created an unstable investment environment.<sup>23</sup> Scottish Government investment in the Beaulieu to Denny Power Line project is welcome as it opens up transmission from renewable electricity sources. Electricity storage could ease tightening capacity margins, manage peak demand and intermittency of renewables, and stem costs to the consumer.<sup>24</sup> Although some storage technologies are immature (e.g. batteries and liquid air) it is an area of increasing interest, and support should be given to exploring these technologies. Pumped storage<sup>25</sup> in Scotland could be developed further<sup>26</sup> but is dependent on market conditions and transmission costs.

Thermal generation is still required to meet baseload and dispatchable<sup>27</sup> demand as part of a resilient energy mix. Gas with Carbon Capture and Storage (CCS) could make up the bulk of a low-carbon electricity supply, but not without building new power stations, and CCS technology progressing beyond demonstration phases. Scotland's sole gas-fired power station, Peterhead, is insufficient to replace outgoing generation.<sup>28</sup> Market uncertainties undermine investment in new gas-fired plants throughout the UK<sup>29</sup> and final investment decisions have yet to be taken for CCS at Peterhead and Grangemouth. High grid connectivity charges in Scotland were cited by Scottish Power in their decision not to pursue a new gas-fired

power station at Crockenzie. Furthermore, the UK's growing reliance on imported gas increases our exposure to international gas prices, and onshore gas is currently subject to a moratorium in Scotland. The Culzean field off Shetland has received production approval, but low oil and gas prices and industry withdrawal present challenges.

In the absence of new thermal or nuclear development, Scotland will become a net importer of electricity.<sup>30</sup> Current interconnected capacity with the rest of the UK is only 40% of Scottish peak demand<sup>31</sup> and although additional interconnection to England will bolster import capacity the delivery project is experiencing delays. Importing electricity on the Irish Sea DC link is problematic in terms of controlling frequency and reactive power resulting from importing on a line originally planned for export. Reliance on imports is about quality of power on the grid as well as quantity<sup>32</sup> and the Scottish Government should explore the potential impacts of variable quality of electricity on the Scottish grid. The Scottish Government should also review its Electricity Generation Policy Statement in light of the many recent changes to the electricity generation sector in both Scotland and the UK.

### HEAT

Scotland spends £2.6bn annually on heating and cooling. Energy inefficient properties and heating systems mean a poor return on energy and monetary inputs, and many industrial processes dispose of heat as a by-product rather than harness it as a resource. We welcome the Scottish Government's decision to make energy efficiency a National Infrastructure Priority, the development of a national heat map, and the creation of a task force on rural fuel poverty.

Scotland has a target of 11% of non-electrical heat from renewables by 2020.

Although capacity has grown, estimates indicate there are too few projects in the pipeline to achieve this target. Furthermore, many schemes dependent on the Renewable Heat Incentive (RHI) are delayed pending the UK Government's Comprehensive Spending Review in November 2015. These factors represent a significant risk to Scotland's heat energy and decarbonisation ambitions.

### THE FUTURE OF ENERGY IN SCOTLAND AND THE UK

Scotland and the UK require a coherent vision of our future energy needs, the policies and infrastructure required to meet them sustainably, and the costs. All energy sources, including nuclear, on-shore gas and renewables, should be discussed. The interdependencies of electricity, heat and transport should be considered as part of a single energy system. Debates should be informed by expert scientific and technical advice and robust evidence. Bold political leadership and evidence based policy will build stability and investor confidence. No changes are consequence-free, nor is the decision to do nothing or to delay decisions.

Debate around controversial energy issues - nuclear and onshore gas - has highlighted mixed understanding of technology and risks, and Scotland's 'national conversation' on onshore gas is in its very early stages. Independent scientific and engineering advice has a key role in improving public understanding of energy options, and their impacts now and in the future.

<sup>26</sup> Baseload is the minimum level of demand on an electrical supply system over 24 hours. Dispatchable generation refers to sources of electricity that can be dispatched at the request of power grid operators to meet peaks in demand. <sup>27</sup> At less than 1GW. <sup>28</sup> It is worth noting that two 'peaking' gas-fired power plants were granted planning approval in July 2015 in Suffolk and Wales, but final investment decisions have yet to be made. <sup>29</sup> Energy, Economy and Tourism Committee, Scottish Parliament Official Report 20 May 2015. <sup>30</sup> 5.5GW. <sup>31</sup> 'Quality' is used to describe electric power that drives an electrical load and the load's ability to function properly. Without the proper power, an electrical device (or load) may fail or not operate at all.

GRADE

STRATEGIC TRANSPORT

**B-**

LOCAL TRANSPORT

**D+**

# TRANSPORT

High quality transport infrastructure, good modal connections, and resilient networks are essential to delivering sustainable economic growth and a good quality of life for people living in Scotland.

## TRANSPORT PLANNING

Overlapping layers of local transport decision-making across catchments results in poorly integrated services and unclear lines of accountability. A city region approach<sup>39</sup> can help frame transport planning in a way which integrates effectively with other planning areas, such as housing. The Strategic Development Plan (SDP) process should be reviewed to integrate with transport and infrastructure planning. A review of current transport planning arrangements, and establishment of integrated and democratically accountable regional transport and planning authorities with increased power would be beneficial.

ICE Scotland welcomes the Scottish Government's commitment to review the National Transport Strategy. An update of the Strategic Transport Projects Review (STPR) to include timelines associated with transport improvement priorities would help industry to plan future investments.

## PUBLIC AND ACTIVE TRANSPORT

Shifting from private to public and active transport<sup>40</sup> will reduce pressure on road networks, improve air quality and reduce energy consumption, but significant modal shift has proven difficult to deliver in spite of increasing use of our rail networks.

The Scottish Government has committed to improving rail infrastructure, and the Borders Railway and Edinburgh to

Glasgow Improvement Project, amongst other investments, are increasing network capacity and sustainability. While improvements to the Aberdeen-Inverness line and Highland lines are planned, enhanced rail connection from northern cities to the central belt is required if rail is to compete with road and aviation.

The development of high speed rail between London and Scotland is the best option for increasing rail capacity, reducing journey times and encouraging shift from air to rail particularly if a journey time under 3 hours can be achieved.<sup>41</sup> A joint Scottish and UK Government study exploring potential route options to Scotland will inform the Scottish Government's objective of ensuring Scotland's early inclusion within a high speed rail network.<sup>42</sup> ICE Scotland welcomes such efforts and look forward to further announcements in February 2016.

Transport accounts for over a quarter of Scotland's carbon emissions. Of this, road transport is nearly three quarters.<sup>43</sup> Air pollution, including Nitrous Oxide and brake dust, was responsible for 2,094 deaths in Scotland in 2010 alone<sup>44</sup>, and several of our urban areas<sup>45</sup> breach European air pollution safety levels.<sup>46</sup> The Scottish Government's consultation on the creation of Low Emissions Zones (LEZs) is welcome. Opportunities should be taken to create linkages between LEZs, urban place-making and active travel measures to maximise co-benefits.

Only 1% of journeys are made by bicycle.<sup>47</sup> Numbers of cars on the road and perception of risk<sup>48</sup> are cited as barriers to participation. Modal shift would have the greatest impact on congestion and

## RECOMMENDATIONS

- 1. The Scottish Government and local authorities should fully commit to addressing the road maintenance backlog, moving to a system of planned and preventative maintenance, underpinned by a multi-year investment programme.**
- 2. A progressive system of road user charging should be considered to help meet the financial demands of constructing and maintaining good quality roads infrastructure.**
- 3. Local transport should be delivered in a way aligning more closely with city region structures, embedding partnership approaches to transport delivery across boundaries. Planning and transport governance systems should be better aligned. Transport providers and stakeholders should look for opportunities to improve modal interconnection, and increase the share of journeys made by public and active transport.**

32. Heat Network Partnership for Scotland. Leadership. Webpage, available at: <http://www.districtheatingscotland.com/content/leadership> [August 2015] 33. Which arises mainly from the costs of heating for households not connected to the gas grid. 34. Energy Saving Trust (2014) *Renewable heat in Scotland, 2013 - A report by the Energy Saving Trust for the Scottish Government*. 35. The Committee on Climate Change (2015) *Reducing emissions in Scotland 2015 progress report*. 36. Often incorrectly referred to as fracking 37. Scottish Government (2015, 8 October) *Moratorium on underground coal gasification*. Press release, available at: <http://news.scotland.gov.uk/>. 38. The term 'city region' describes territories from which core urban areas draw people for work and services. 39. Walking and cycling. 40. Transport Scotland (2011) *Fast Track Scotland - Making the Case for High Speed Rail Connections with Scotland*. Edinburgh. 41. Transport Scotland (2014, 8 January) *Cabinet Secretary Keith Brown announces step forward for High Speed Rail in Scotland*. Press release, available at: <http://www.transportscotland.gov.uk/news/> 42. Transport Scotland (2014) *Carbon Account for Transport No. 5: 2013/14 Edition*. 43. Environmental Audit Committee (2014) *Action on Air Quality*. (HC 212, session 2014-15). London. 44. Including Glasgow, Edinburgh, Dundee, Aberdeen, Greenock, Rutherglen, Kilmarnock, East Kilbride, Falkirk, Perth, Crieff, amongst others. 45. Sheeden, S. (2015, 30 September) *In numbers: How green is Scotland?* The Scotsman. 46. Transport Scotland (2015) *2014 Transport Statistics* 47. UK Government (2013) *British Social Attitudes Survey*. Public attitudes towards transport 48. Possible intersections with the creation of Low Emissions Zones, blue-green city developments, sustainable urban drainage planning, and place-making more generally. 49. European Commission (2014) *Transport Eurobarometer: congestion and maintenance are the major challenges for EU roads*. Press release, available at: <http://ec.europa.eu/transport/media/news/> 50. Audit Scotland (2013) *Maintaining Scotland's Roads - An audit update on councils' progress*. 51. Society of Chief Officers of Transportation Scotland (2015) *Backlog Modelling*. Unattributed paper, available at: <http://scots.sharepoint.appix.net/General%20Publications/SCOTS%20Backlog%20Modelling%202015%20V1.2.pdf>. 52. Transport Scotland (2012) *Economic, Environmental and Social Impacts of Changes in Maintenance Spend on Local Roads in Scotland*. Transport Research Laboratory report.



emissions in urban areas, and urban centres should be targeted for interventions to enable active transport, including segregated and off-road urban cycleways.<sup>49</sup>

78% of the 541m public transport journeys made in 2012 were by bus, but private cars remain the dominant form of passenger transport, particularly in rural areas such as Dumfries and Galloway. Public transport connections between local settlements are essential to enable access to key services. It is unlikely that markets alone would ever fully support adequate transport connections, so continuing to improve access to rural transport should remain a government priority.

Good infrastructure, better availability and connections, and affordable, integrated tickets are key to delivering modal shift.<sup>50</sup> Work at Haymarket Station in Edinburgh has created an effective transport hub with connections to a variety of other transportation, including Edinburgh's new tramway.

## ROADS

Around a third of Scotland's local roads are in an unacceptable condition<sup>51</sup> and the maintenance backlog stands at over £2bn.<sup>52</sup> Local authorities are under continuing pressure to deliver core statutory duties while cutting spending, resulting in neglect of local road maintenance. The long term benefits of preventative road maintenance and the savings accrued outweigh savings from short term cuts.<sup>53</sup>

Addressing the backlog and moving to a system of planned and preventative maintenance will lead to long-term savings. Simply preventing further deterioration of already sub-optimal assets is calculated to

cost £245.5m per year.<sup>54</sup> We recommend that the Scottish Government specify the level to which local roads should be maintained to prevent further under-investment and deterioration. We also recommend that local authorities identify opportunities for partnership working – such as the Ayrshire Roads Alliance - to maximise existing resources.

Investment in major roads projects has helped reduce congestion in spite of motorway usage growing by 8.7% over the past 5 years.<sup>55</sup> Roads projects have received a substantial share of the £14bn invested in transport since 2007.<sup>56</sup> However, investment must be long-term and sustainable. We recommend a progressive system of road user charging be considered where appropriate<sup>57</sup> to help meet the financial demands of constructing and maintaining good quality roads infrastructure. Direct charging, either as a flat fee or on a pay-as-you-go basis, should be explored. Hypothecation<sup>58</sup> of VED to local road maintenance in Scotland should be considered in the Scottish and UK Governments' discussions on the allocation of VED income.

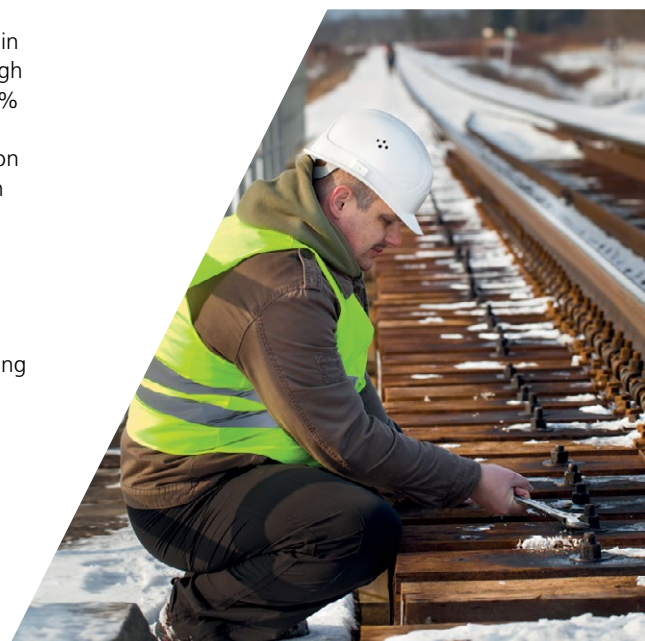
While Electric Vehicles (EVs) are gaining in popularity, technological barriers and high purchase prices limit uptake (less than 1% of registered vehicles). Electrification of road transport will increase demand upon already challenged electricity generation and transmission networks and this is an issue which should be considered in conjunction with other energy issues.

## AIR AND SEA PORTS

Short-sea shipping is recognised as playing a role in reducing freight transport by

road, and in 2013 Scotland's ports handled 72m tonnes of freight. However, figures have been in decline since the early 2000s.<sup>59</sup> Scotland's ports and harbours are considered to be in good condition, but concern has been expressed about a lack of private owner investment at some facilities. This may impact upon Scotland's connections to Europe and our ability to respond to economic opportunities, such as oilrig decommissioning.

Discussions regarding the location of additional aviation capacity in the South East of England continue to create uncertainty for Scottish businesses which rely on connection to international markets. In addition to delivering economic and environmental benefits a high speed rail journey time of under 3 hours between both Glasgow and Edinburgh to London could help ensure availability of slots at London airports for north of Scotland air links. ICE Scotland urges the UK Government to carefully consider the importance of hub airport access for economic recovery and growth, and to act decisively to avoid further uncertainty.



<sup>53</sup>. Society of Chief Officers of Transportation Scotland (2015) Backlog Modelling. Unattributed paper. <sup>54</sup>. From 6683m vehicle Km to 7262m vehicle Km. Transport Scotland (2015) *Scottish Transport Statistics No 33 – Datasets*. <sup>55</sup>. Transport Scotland (2015, 6 March) *Scotland's key industry sectors to give their say on future transport investment*. Press release, available at: <http://www.transportscotland.gov.uk/news/> <sup>56</sup>. For example, on roads where there is both congestion and a viable public transport equivalent. <sup>57</sup>. Hypothecation is the term used to describe the process of assigning tax revenues to a specific end, or - in certain cases - ensuring that they are not spent on one particular end. <sup>58</sup>. British Ports Association – Scottish Ports Committee (2015) Submission to the Infrastructure and Capital Investment Committee of the Scottish Parliament inquiry on Freight Transport. Available at: [http://www.scottish.parliament.uk/S4\\_InfrastructureandCapitalInvestmentCommittee/Inquiries/](http://www.scottish.parliament.uk/S4_InfrastructureandCapitalInvestmentCommittee/Inquiries/)

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## RECOMMENDATIONS

- 1. Flood risk adaptation strategies which enhance resilience in the event of high rainfall need to be integrated into spatial and infrastructure planning. This should include designing future infrastructure to include the adequate routing of exceptionally high flows.**
- 2. Provide clearer guidance and regulation of Sustainable Urban Drainage System (SUDS) adoption and maintenance to address issues relating to ownership and responsibility. Improving information regarding the condition, type and ownership of flooding infrastructure would enable authorities and agencies to better understand asset performance during extreme events.**
- 3. Forward planning by local authorities is required to ensure that the resources, capacity and skills required to deliver the requirements of FRM legislation are in place for the future. Identifying opportunities to share or enhance resources as early as possible will support smooth FRM delivery.**

# FLOOD MANAGEMENT

Flooding has devastating social, environmental and economic consequences, and is estimated to cost Scotland £700m<sup>60</sup> per year. While Scotland has tended to suffer less than other areas of the UK, Scottish Environment Protection Agency (SEPA) has identified 243 potentially vulnerable areas (PVAs) where the potential impact is sufficient to justify the further assessment and appraisal of flood risk management actions.

The value of flood schemes highlighted in earlier ICE reports<sup>61</sup> has been clearly demonstrated. In 2014, whilst only partially completed, the Elgin scheme protected approximately 270 residential and 75 business premises from flooding, avoiding damages of an estimated £29 million.<sup>62</sup> Infrastructure investment delivers long-term savings and protects other vital systems. Flooding in Scotland costs Network Rail on average £0.91m per year in delay charges, and causes an average of 46,444 minutes of delays to passengers and freight.<sup>63</sup> Network Rail is making use of SEPA's flood maps to inform its climate change resilience work identifying areas where infrastructure may require enhancement to adapt to changing weather patterns, which is to be welcomed.

## ADAPTATION

Since 1990 the UK has experienced 8 of the 10 warmest years on record, and 5 of the 10 wettest years.<sup>64</sup> With increased intensity and frequency of heavy rainfall predicted, but with a high degree of uncertainty, adaptive measures in addition to defence infrastructure are necessary to ensure resilience in the face of changing weather patterns.

Adaptation of other infrastructure to manage exceedance flows, for example using road infrastructure as a flood channel to protect housing, is an area of ongoing debate. A balance has to be struck between the designed purpose of the infrastructure and potential FRM applications. However, non-critical space, such as parks, can be readily used to manage flood water if appropriate plans are put in place. Potential FRM adaptation of infrastructure should be considered in planning where applicable.

Natural flood management (NFM) techniques<sup>65</sup> in upper river catchments form part of a sustainable portfolio approach to FRM. However, the potential contribution from these methods is as yet unclear, and long-term study is required to understand their full impact. Tensions exist between delivering of NFM, agricultural land-use and private ownership of flood defences.

Restoring natural water cycles, bringing together water management and green infrastructure, represents the application of adapted NFM in an urban environment. This is part of what is referred to as the 'Blue-Green Cities' approach. This approach integrates surface water management and reduction of storm water flow to sewer systems with public realm improvements and reduces the need for heavy infrastructure interventions and creates attractive environments. It is an approach which fits well with Scotland's place-making ambitions.

The Climate Change Committee (CCC) Scotland highlighted that future flood risk requires greater consideration in Local

59. Sniffer (2013) *Summer floods spur Scotland wide planning group*. Press release, available at: <http://www.sniffer.org.uk/news-diary/> 60. Institution of Civil Engineers Scotland (2011) *State of the Nation Infrastructure Scotland report*. 61. The Moray Council. *Elgin Flood Alleviation Scheme*. Webpage available at: [http://www.moray.gov.uk/moray\\_standard/page\\_81702.html](http://www.moray.gov.uk/moray_standard/page_81702.html) [30.09.15] 62. Network Rail (2014) *Route Weather Resilience and Climate Change Adaptation Plans Scotland*. 63. Institution of Civil Engineers (2014) *State of the Nation - Infrastructure*. 64. Flood plain and meander restoration, reforestation<sup>65</sup>, wetland, and embankment set-backs. 65. Committee on Climate Change Adaptation. Update on the work of the Adaptation Sub-Committee for Scotland. Letter to Dr Aileen McLeod dated 7 January 2015. Available at: <http://www.theccc.org.uk/>



Authority Local Development Plans (LDPs).<sup>66</sup> This is important if Scotland is to meet its current and future housing requirements in a sustainable way. Better climate change data is being made available, but it is important that this is translated into useable guidance for planning and development and to identify appropriate mitigation strategies.

### **DELIVERING FLOOD MANAGEMENT**

Our evidence points to an improvement in partnership working since the introduction of the Flood Risk Management (Scotland) Act 2009 which established a more sustainable approach to flood risk management. It provides a framework for coordination and cooperation between organisations delivering FRM. There has also been a welcome shift toward catchment-wide systems thinking. However, competing objectives - flood management, water resource management and renewable energy production - within organisations may impact upon effective FRM delivery. Identifying tensions within their remits which may impact upon FRM delivery and resolving or prioritising as necessary will help the responsible agencies deliver on their flood risk management responsibilities.

The creation of local FRM and delivery plans are part of a strategic approach to managing flood risk at a local and national level, with prioritised lists of interventions within each Local Authority area. This clarity will help local authorities' financial planning. However, local authority capacity to deliver FRM duties is variable, and represents a risk to delivery. Local authorities should ensure that they have the appropriate capacity and

resource to deliver FRM duties, and should identify opportunities to share resources where appropriate.

Information about the location, type and performance of our flooding infrastructure is granular and incomplete, particularly those assets constructed prior to 1960s or in private ownership. Local authorities and the Scottish Environment Protection Agency (SEPA) each have responsibility for gathering aspects of this information, but there are gaps in knowledge. A lack of consistency in data gathered across the country makes establishing a complete picture difficult, and insufficient resourcing adds to this burden. Consideration should be given to how a better picture of Scotland's flooding assets and their condition can be created, and the role this could play in optimising current assets and future investment.

Sustainable Urban Drainage Systems (SUDS), which allow slower movement of water into the drainage system, are part of Scotland's flooding infrastructure. They also improve water quality and provide landscape and biodiversity benefits. Uptake of SUDS has risen significantly in Scotland over the past eight years, but so too have debates around responsibility for such assets and their maintenance between local authorities, water authorities, and private developers. ICE Scotland recommends that regulation and guidance is clarified for both maintenance and adoption to bring these discussions to a satisfactory conclusion.



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## RECOMMENDATIONS

1. **A Total Expenditure (TOTEX) approach and the use of soft engineering techniques such as catchment management, should be fully incentivised through the economic regulatory system.**
2. **Increased focus should be given to enhancing network resilience in coming control periods, particularly in remote and rural communities.**
3. **The Scottish Government, regulators and the water industry should continue to focus their joint efforts on reducing the energy requirements and carbon impact of Scotland's water industry, whilst maintaining high water quality standards.**

# WATER AND WASTE WATER

Infrastructure investment has delivered significant improvements in Scotland's drinking water quality and the water environment, reduced leakage and increased sustainability. The performance of the Scottish water industry is now comparable with the leading water companies in the rest of the UK.<sup>67</sup>

## REGULATION

This year Scottish Water entered a six year regulatory cycle with interim reviews every three years. This transition is intended to smooth out peaks and troughs in investment, which negatively impact industry skills development and staff retention, leading to higher costs and inefficiency. The Water Industry Commission Scotland (WICS) should regularly assess whether a smoother investment model is indeed being delivered over coming review periods.

£2.5b was invested during the last regulatory period with £3.5b planned for 2015-21 - an average of £590m per year over 12 years.<sup>68</sup> Much of this has been spent on infrastructure improvements

to enhance water quality in line with EU legislation. The balance of spending will eventually shift from capital investment (CAPEX) toward maintenance and a total expenditure (TOTEX) model. The TOTEX approach 'unshackles' the industry from a tendency toward high-cost heavy infrastructure solutions when more sustainable, lower cost approaches may exist. The *Review of Public Sector Procurement in Construction* noted the importance of quality in design and whole life assets costs, which should be central to procurement decision making. Scottish water industry stakeholders need to continue to work together to develop a shared understanding of TOTEX and its implications, and develop clear guidance to support the industry supply chain.

## SECURITY OF SUPPLY

Reducing leakage must remain a priority for Scottish Water and regulators. Work to date has reduced leakage by 47% between 2004/05 and 2013/14.<sup>69</sup> But around a third of the total clean water to supply is still lost to leakage, which is high compared with the rest of the UK.<sup>70</sup> WICS has incentivised





Scottish Water to drive leakage figures down to the lower end of the economic level of leakage (ELL)<sup>71</sup> during 2015-21. This target is welcome, and Scottish water industry stakeholders should consider how leakage can be further improved.

Water scarcity events in recent years, particularly in the south west of Scotland, have highlighted the importance of planning our water resources. More must be done to challenge public perception of water as a 'free' resource. Water conservation measures reduce water abstraction levels, the use of costly resources required in water treatment – energy and chemical – and the pressure on treatment and transmission infrastructure. Metering of properties can be effective in informing consumer's and industry's understanding of water usage, as well as driving down leakage, and should be kept under consideration as a way of lowering costs for consumers. However, we acknowledge the costs associated with such a move. The water industry's work to manage demand is welcome, and efforts to raise public awareness should encourage the public to be active participants in water conservation.

### **CARBON IMPACT**

Few consumers are aware of the energy required to treat water to drinking water quality standard and that the water industry has a sizeable carbon footprint.<sup>72</sup> *The Infrastructure Carbon Review* highlighted that carbon is a 'proxy measurement of resource efficiency'. Cutting carbon could generate significant savings, and may include low cost soft-engineering solutions with a lower carbon impact than traditional infrastructure solutions. Scottish Water is one of the biggest single electricity users in Scotland, consuming 450 GWh/annum of electricity at a cost of over £40m.<sup>73</sup> Work is being undertaken to increase energy efficiency through process optimisation, technology

change, and in-house energy generation, to counter rising energy costs. Maximising energy efficiency, reducing demand, and encouraging innovation are key to creating a more sustainable water industry. It is worth noting that all of the water we currently use in our homes is of drinking water quality, and innovation in domestic and industrial building design has a role to play in ensuring we are not using drinking water to flush toilets.

### **ENHANCING RESILIENCE**

Valuable work is being undertaken to ensure water infrastructure is resilient to extreme weather. Flood risk assessments for water treatment centres and integrated catchment studies are helping to build a picture of the performance of our water and waste water infrastructure in adverse weather events. Additionally, Scotland's first National Water Scarcity Plan sets out water resource management in the event of prolonged dry weather, striking a balance between protecting the environment and providing resource for human and economic activity. Climate change may double the frequency of summer low-flow events by 2050, impacting upon water quality and treatment.<sup>74</sup> It is increasingly important to design our infrastructure for low-flow as well as high-flow events to ensure infrastructure integrity and continued water quality compliance.

There are still areas of the country where poor cross-connection creates a risk of service interruption. Enhancing resilience of supply to these communities will be a vital area of work for future regulatory periods. Provision of centralised water and waste water services to geographically dispersed communities is problematic and high-cost. Decentralised water and wastewater systems powered by local and renewable energy sources offer an attractive alternative to the centralised model, but may be challenging to deliver. Research should be commissioned to establish the

feasibility and benefits of decentralised models for remote and rural communities.

### **WATER QUALITY**

Controlling pollutants at source is more efficient than end-of-pipe solutions, which are often high-cost and energy intensive. Discharge licences are granted on the basis of spot-checks at outflow points, and while individual outflows may be compliant the cumulative impact of multiple outflows on the receiving water is harder to assess. ICE Scotland commends the Scottish Government, SEPA and Scottish Water's commitment to addressing diffuse pollution, and recommends undertaking work to improve understanding of the cumulative impact of multiple discharges into receiving bodies of water.

Although drinking water standards have risen substantially in the past 10 years, achieving 99.89% compliance, the DWQR reported a substantial rise in microbiological water quality issues in 2014<sup>75</sup> compared to 2013. This increase in incidents reinforces the importance of designing, building, maintaining and operating resilient assets.



72. Scottish Water (2013) Submission to the Economy, Energy and Tourism Committee on RPP2. 73. Scottish Environment Protection Agency (undated). *The Impact of Climate Change on Water Scarcity*. Available at: [http://www.sepa.org.uk/media/159070/climate\\_change\\_water\\_scarcity.pdf](http://www.sepa.org.uk/media/159070/climate_change_water_scarcity.pdf) 74. Drinking Water Quality Regulator (2015) *Drinking Water Quality in Scotland 2014 – Public Water Supply* 75. Green Alliance Scotland (2015) *Circular Economy Scotland*.

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## RECOMMENDATIONS

1. To support Scotland's ambition to be a European leader in the implementation of the Circular Economy strong government leadership will be required to ensure that the circular economy approach is fully understood and embedded throughout the public and private sectors.
2. The Scottish Government should continue to focus on creating a policy, regulatory and commercial environment encouraging private investment in infrastructure serving all our waste streams. New waste management infrastructure currently progressing through procurement processes must be delivered in order to meet challenging residual waste targets.
3. Greater consideration should be given to the role that "energy from waste" (EfW) can play in addressing our national energy requirements.

# WASTE

## CIRCULAR ECONOMY

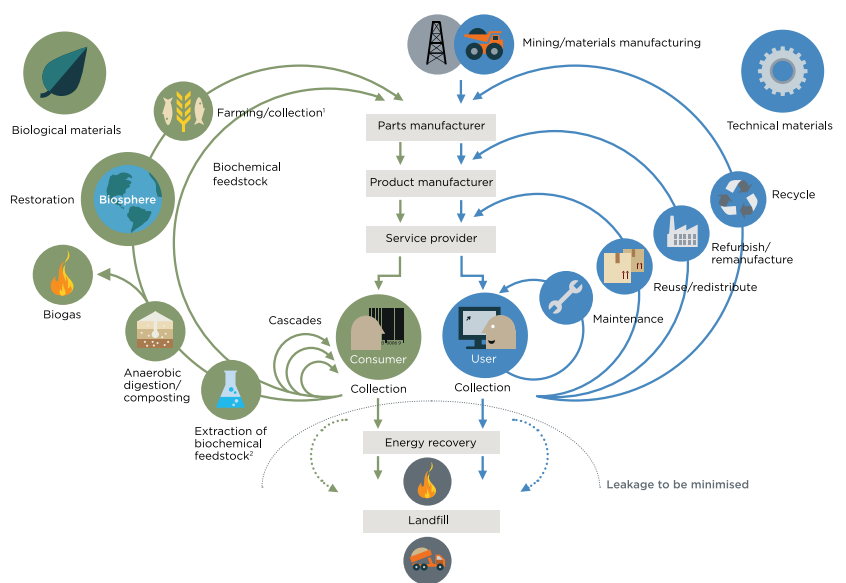
In 2013 Scotland became the first country to sign up to the Ellen MacArthur Foundation's Circular Economy 100 program. The Circular Economy model reframes waste as a resource to be carefully managed, rather than a problem to be disposed of. There is potential for considerable economic and environmental savings.<sup>76</sup> Changing attitudes toward waste will be central to embedding the circular economy in both the public and private environments, and will require continued strong leadership from the Scottish Government.

Minimising material sent to landfill is already a priority for the Scottish Government and local authorities, and a great deal has been achieved since our last report. In contrast to the rest of the UK, Scottish legislation introduced the requirement to collect food waste from households and

for most businesses to work with recycling companies to recycle their wastes.<sup>77</sup> Both initiatives are innovative and will do much to promote a greater level of recycling.

However, there is no statutory duty for businesses to report the waste they generate. SEPA derives the information from statutory waste data received from operators of waste management sites. Business waste data falls within commercial and industrial (C&I) waste data<sup>78</sup>, and waste from the C&I sector comprises about 80% of the total waste generated in Scotland.<sup>79</sup> If a circular economy is to be achieved, accurate data for all sectors will be essential. The electronic duty of care (EDOC) has the potential to make waste data reporting more accurate<sup>80</sup> and providing an anonymised system of C&I forecasting, but effectivity would be dependent on mandatory reporting.

**FIGURE 3**  
The Circular Economy



Source: Scottish Government (2013) Safeguarding Scotland's Resources - Blueprint for a More Resource Efficient and Circular Economy

76. Waste (Scotland) Regulations 2012. 77. The C&I sector includes public sector organisations, such as local authorities, and construction and demolition (C&D) companies. 78. Scottish Environmental Protection Agency. *Business Waste Data*. Webpage, available at: <http://www.sepa.org.uk/environment/waste/waste-data/waste-data-reporting/business-waste-data/> [September 2015]. 79. Reducing instances of double-counting and removing the need for a paper-based system, while also speeding up data returns. 80. Although there are some products which cannot be disposed of by other means and for which landfill capacity will continue to be required. 81. combustion, gasification, pyrolysis and anaerobic digestion.





**FIGURE 4**  
**Hierarchy of Waste**

- 1 **Prevention**  
If you can't prevent, then...
- 2 **Prepare for reuse**  
If you can't prepare for reuse, then...
- 3 **Recycle**  
If you can't recycle, then...
- 4 **Recover other value (eg. energy)**  
If you can't recover value, then...
- 5 **Disposal**  
Landfill if no alternative available.



Source: Zero Waste Scotland

### MARKET VOLATILITY

Recyclable commodities are a global market. In 2014/2015 the price of crude oil dropped dramatically, making the price of some virgin materials cheaper than reprocessed materials. Reductions in market demand impact upon the price of commodities, and consequently upon local authorities' financial projections. In the context of ongoing budgetary pressures this is particularly problematic. The creation of stronger internal markets reduces our exposure to global market trends, and brings us closer to closing the circular economy loop in Scotland.

The Waste Brokerage Scheme, due to go live in 2016, is intended to create a secure and visible supply chain for specific commodities. Its success will depend upon both the quality and quantity of available materials. A legacy of locally defined recyclable materials and commodity mixes across the country creates public confusion, leading to contamination by non-target and non-recyclable materials. Additionally, pre-existing long-term municipal waste contracts limit available inputs. The higher the quality of materials collected, the greater the range of potential uses and market value. We recommend that all local authorities sign up to the Household Recycling Charter and that a common commodities mix is agreed.

### LANDFILL SITES

Landfill is at the bottom of the waste hierarchy as the least preferable option for disposal.<sup>81</sup> By 2025 no more than 5% of all waste generated in Scotland should be sent to landfill. With the majority of waste diverting from landfill, Scotland may eventually have an overcapacity of landfill sites. Closure and forward management of these sites will need to be handled in an acceptable fashion, particularly in light of the early closure of renewable energy subsidy regimes which will impact upon landfill gas extraction.

### ENERGY FROM WASTE

Energy from waste (EfW)<sup>82</sup> has a role to play in maximising value from waste as a resource, generating electricity, heat, and even fuel for transport. EfW has the potential to play a bigger role in achieving a secure energy supply in Scotland.

Ensuring sufficient feedstock is key to attracting private infrastructure investment. Over-capacity of EfW facilities in Europe, relatively limited domestic EfW capacity, rising landfill tax and increasingly efficient waste supply chains to Europe mean that the export of residual waste is currently the most commercially attractive option for the UK waste industry.<sup>83</sup> By 2020 the UK is likely

to be exporting 1.5- 2m tonnes of residual waste per year.<sup>84</sup> Consideration should be given to how this resource can be retained and used to meet our energy needs.

The development of an integrated waste management site at Polmadie, comprising recycling, anaerobic digestion and waste to energy gasification, is a visual statement of the viability of waste as a resource. Co-location of Smart Material Recovery Facilities (SMRF) with energy recovery facilities is pragmatic, as is its location in a major urban centre from which materials are collected. Such locations are well suited to contribute to local heat demand. Proposed EfW projects, such as those being taken forward by Clyde Valley Partnership, Edinburgh and Midlothian Council, and Dundee, need to be realised if Scotland is to meet its 5% waste to landfill target.

### CONTAMINATED AND VACANT LAND

Scotland has around 10,874 hectares of brownfield land classed as derelict and urban vacant land.<sup>85</sup> This is roughly equivalent to an area one and three quarters the size of Dundee<sup>86</sup>, but annual reductions of land registered in these categories tend to be very small. The cost of remediation of contaminated soils on brownfield sites can be a disincentive for development, particularly compared with greenfield sites which tend to have fewer risks and unknowns. The Clyde Gateway project has delivered complex remediation on former industrial land as part of wider regeneration of Glasgow, a legacy of the 2014 Commonwealth Games. Greater emphasis is needed on the principle of 'brownfield first' in development, to meet our housing needs, drive remediation of contaminated land, make best use of existing infrastructure and leverage improvements. Proposals in the Land Reform Bill (Scotland) have the potential to enable this.

82. Green Investment Bank (2014) *The UK residual waste market*. Available at: <http://www.greeninvestmentbank.com/media/25376/gib-residual-waste-report-july-2014-final.pdf>. 83. Green Investment Bank (2014) *The UK residual waste market*. 84. Scottish Government (2015) *The Scottish Vacant Land Survey 2014*. 85. The University of Glasgow (2015) *Urban Land Reform in Scotland*. Available at: <http://policyscotland.gla.ac.uk/urban-land-reform/>. 86. Construction Skills Network Observatory, 1st Round Forecasts 2016-20



# SKILLS AND CAPACITY

## RECOMMENDATIONS

- 1. Scottish Government should use its Infrastructure Investment Plan Project Pipeline to assess and plan for future capability and capacity needs in order to ensure the Scottish work force fully benefits from infrastructure projects.**
- 2. Civil engineers should take responsibility for the learning and career development to ensure that they are properly equipped to deliver and manage the transition to a low carbon economy.**
- 3. The construction and engineering industries should take a more active role in increasing diversity in their own ranks. Greater business/corporate involvement in gender-focused forums, and a more joined-up approach between the public, private and third sector will be key to embedding lasting change.**

## WORKFORCE AND THE ECONOMY

Engineers and the competencies they possess continue to be in great demand across the Scottish economy, due in part to a period of sustained economic growth and a doubling in infrastructure output from 2012–2015.<sup>87</sup> This is likely to remain the case both in terms of the numbers of engineers needed and the breadth of capabilities required despite a predicted decline over the period 2016–2020<sup>88</sup> due in part to the completion of a number of large infrastructure projects.

Several other major projects will remain ongoing and other sectors in which civil engineers are employed: housebuilding, repair and maintenance, and commercial sectors – are expected to grow over the same period. UK growth forecasts of 21.7% in construction by 2019 highlight the immediate need for a sufficiently numerous and skilled workforce.<sup>89</sup>

A clear pipeline of capital investment projects beyond 2019 is essential for industry planning for future demand. However, industry must also ensure that it is proactively planning, recruiting and upskilling its workforce in preparation for future needs. The UKCES Employer Skills Survey identified that those working in the construction sector were less likely to be offered training or development opportunities than other sectors, and longer term workforce and succession planning was lower than average.<sup>90</sup> An ageing workforce is also having a profound impact upon the UK labour market. Over 30% of people in employment in the UK are over the age of 50. Upskilling the existing workforce, addressing current shortages at a range of levels of seniority, and attracting new entrants are all part of the same challenge. A flexible, responsive skills pool is essential for the engineering and construction industry to play its part in government plans to increase productivity.<sup>91</sup>

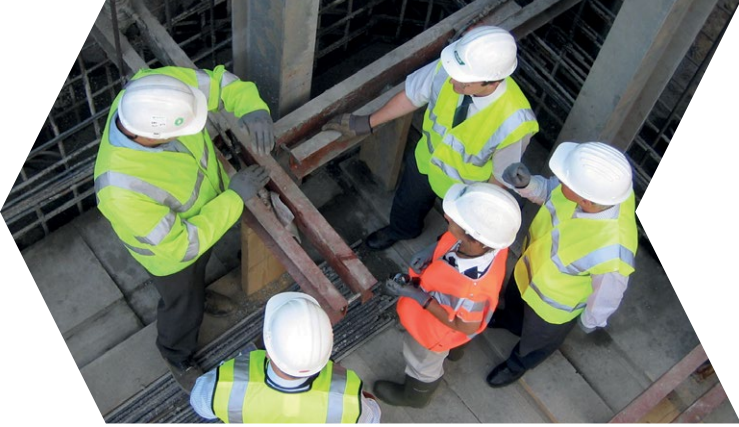
## ATTRACTION AND RETENTION

An estimated 760 additional civil engineers<sup>92</sup> are required each year to meet industry needs. However this sits in the context of a 9% reduction<sup>93</sup> in numbers of Higher Education students studying civil engineering in the period 2009–10 2013–14, and a 32% reduction<sup>94</sup> in the number of Further Education students on civil engineering courses over the same period. Numeracy, project management and problem solving skills make civil engineers attractive across a range of sectors beyond engineering, further eroding numbers of practising civil engineers. Interventions are required at all levels – from primary school to employment – to ensure that there are sufficient civil engineers and civil engineering technicians to deliver Scotland's vital social and economic infrastructure into the future.

Raising awareness of engineering, and what civil engineers do as a distinct discipline, is vital to attracting new entrants. Inspiring the next generation is a key part of ICE activity and we will continue to work in partnership to deliver an education outreach programme. Raising the profile of the profession with the wider public with our #ThisIsCivilEngineering campaign will also contribute to efforts to attract young people and diversify the industry.

Improving uptake of Science Technology Engineering and Maths (STEM) subjects in schools, the creation of clear pathways between school and further/higher education and the work place<sup>95</sup>, and improving awareness of Modern Apprenticeships as an entry route will help to attract more people into engineering in the long term. Industry efforts to actively create improved pathways, such as Foundation Apprenticeships in Civil Engineering for school pupils which engage local employers and build commitment to developing talent, are to be applauded.

87. Construction Skills Network Observatory, 1st Round Forecasts 2016-20 88. Construction Skills Network (2015) *Industry Insights – Construction Skills Network, Scotland 2015-2019*. 89. Construction Products Association (2015, 23 August) *CPA Forecasts Strong Growth for Construction Despite Public Housing Slowdown and Skilled Labour Shortage*. Press release, available at: <http://www.constructionproducts.org.uk/news/> 90. Skills Development Scotland (2015) *Skills Investment Plan for Construction*. 91. UK Government (2015) *Productivity Plan Launched*. Press release, available at: <https://www.gov.uk/government/news/productivity-plan-launched> 92. Taking into account attrition rates and those leaving and entering the industry to or from other sectors (but not including training) 93. Down from 3770 in 2009/10 to 3420 in 2013/14. Skills Development Scotland (2015) *Construction Skills Investment Plan*. 94. Down from 767 in 2009/10 to 509 in 2013/14. Skills Development Scotland (2015) *Construction Skills Investment Plan*. 95. Scottish Government (2014) *Education Working For All! Commission for Developing Scotland's Young Workforce Final Report* 96. *The Royal Society of Edinburgh. Women in STEM: Lifting Barriers To Women In Science, Technology, Engineering And Mathematics: A Strategy For Scotland*. Webpage, available at: [https://www.royalsoced.org.uk/877\\_WomenInStem.html](https://www.royalsoced.org.uk/877_WomenInStem.html) [September 2015] 97. WISE (2014) "Not for people like me?" *Under-represented groups in science, technology and engineering*. 98. The Scottish Government (2015). Website, available at: <https://scottishbusinesspledge.scot/>



The creation of the Shared Highland Apprentices in Construction scheme is helping to ensure apprentices are supported in the completion of their apprenticeship. ICE has partnered with other engineering institutions to raise the profile of engineering technicians and the value of professional qualification through the EngTech Now initiative. Campaigns such as this have a key role to play in increasing the attractiveness of the industry.

#### IMPROVING DIVERSITY

Although the number of women in the profession is slowly rising with graduate numbers at 18%, women represent only 10% of ICE's Membership – a number mirrored across all engineering disciplines in the UK, which continues to lag behind its European competitors. The link between a diverse workforce and business success is increasingly well understood so the poor representation of women in engineering and construction risks failure to make the most of a wider talent pool. The reasons for this are complex and manifold and require sustained interventions at all levels. Fewer young women choose STEM subjects at school, if they do go on to study science or engineering few end up in the industry. Once in the industry few return if and when they have children. It is clear therefore that the industry needs to consider how it can create positive changes in employment practices and workplace cultures which benefit everyone. Equate Scotland continues to help support industry through a range of including training and support for women in the industry and industrial placements for entrants.

Increasing the participation of women in the UK labour market could be worth between £15 billion and £23 billion (1.3-2.0% GDP), with STEM accounting for at least £2 billion.<sup>96</sup> It is clear that women, and other underrepresented groups, remain an untapped resource in

addressing the UK's skills crisis. Women into Science and Engineering (WISE) has highlighted a broad range of steps which can be implemented to improve diversity in STEM from school through to employment, focusing on an evidence led approach to interventions.<sup>97</sup> Reports including *The Role and Contribution of women to the Scottish Economy and the Tapping All Our Talents* contain a number of recommendations which should be implemented.

Government recognises the work and timescales required to address the gender imbalance in engineering, and STEM careers more generally. The construction and engineering industries should take a more active role in increasing diversity in their own ranks – one of the key aspects of the Scottish Business Pledge.<sup>98</sup> Greater business/corporate involvement in gender-focused forums, and a more joined-up approach between the public, private and third sector will be key to embedding lasting change.

#### ENHANCING CAPABILITY

A flexible and adaptable civil engineering industry is required to address future challenges. Leadership, communication, finance, legal knowledge and management skills enhance strong technical skills, and create a resilient industry. There is a vital need to look at increased technical skills as we move towards a more mechanical and electrical dependent infrastructure system. For instance, Smart motorways are just one area and that will require a very different set of skills. Low carbon infrastructure, whole life design, Building Information Modelling (BIM), smart cities and 'big data' will change the way we, and future civil engineers, work. ICE will lead by encouraging civil engineers to take control of their careers and raising awareness of skills for the future.

## THE STATE OF THE NATION INFRASTRUCTURE 2015 CONSULTEES

### ORGANISATIONS

Civil Engineering Contractors Association  
Construction Industry Training Board Scotland  
The Crown Estate  
Dundee City Council  
EDF Energy  
Edinburgh Centre for Carbon Innovation  
Greengauge 21  
Jacobs UK  
Kaya Consulting  
Nestrans  
Royal Haskoning DHV  
RPS Maritime (Scotland)  
Scottish Contaminated Land Forum  
Scottish Environmental Protection Agency  
The Scottish Government  
Scottish Water  
Sestran  
Society of Chief Officers of Transportation in Scotland  
Transport Scotland  
Tactran  
Water Industry Commission Scotland

### INDIVIDUALS

Professor Ian Arbon CEng FIMechE  
Mark Clough CEng MICE  
Stuart R. Cullen  
Kenny Dempster CEng FICE  
Professor Ian Docherty CMILT  
Hamish S Eadie CEng FICE  
Dr Neil Ferguson CEng MICE  
Dr Douglas Forbes  
Professor Campbell Gemmill  
Professor Paul Jowitt CEng FICE  
Neil Kermod CEng FICE  
Stuart Knowles CEng MICE  
Dr Richard Lord  
Edward Miller CEng MICE  
Professor Duncan MacLennan CBE  
Andrew Oldfield CEng MICE  
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