



**THE
STATE
OF THE
NATION**

**INFRASTRUCTURE
2014**

THE STATE OF THE NATION: INFRASTRUCTURE 2014

ABOUT ICE

ICE is a leading source of professional expertise in transport, water supply and treatment, flood management, waste and energy. Established in 1818, it has over 80,000 members, 25% of whom are outside the United Kingdom. ICE has long worked with the government of the day to help it achieve its objectives, and provides independent professional advice to all political parties. We work with industry to ensure that construction and civil engineering remain major contributors to the UK economy. Consequently, ICE is seen by parliamentarians and industry alike as the authoritative voice of infrastructure.

ABOUT THIS REPORT

State of the Nation reports have been published each year since 2000. Their aim is 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 expertise from within ICE's membership and external stakeholders 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 report are available at ice.org.uk/stateofthenation

THE GRADES

ICE uses regional, devolved and national experts to determine the sector grades. A set of eight questions covering four main areas – leadership, resilience, economic and social, and condition and capacity – is issued to members. Responses are analysed alongside the other qualitative evidence submitted to ICE to determine the grades. The + or – applied to each grade reflects the predicted direction of travel if the current situation is maintained.

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THE GRADES

A

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.

B

ADEQUATE FOR NOW

Infrastructure is in 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 to meet needs in the next five years.

C

REQUIRES ATTENTION

Infrastructure is infrequently maintained and requires attention. There is no excess capacity resulting in deficiencies at peak periods and if there are even minor incidents. Significant investment is required to improve it to meet needs in the next five years.

D

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.

E

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 REPORT ON INFRASTRUCTURE 2014

Steering Group

Keith Clarke CBE (Chair)	ICE Vice President
Prof Denise Bower	Executive Director of the MPA and Professor at the University of Leeds
Simon Grubb	Independent Consultant
Prof Jim Hall	Director of the Environmental Change Institute, University of Oxford
Adrian Johnson	Technical Director, MWH
David Nickols	Group CEO, IT Power Group
Glen Owen	Regional Director, ICE
Rachel Skinner	Director, Europe Marketing and Communications, Parsons Brinckerhoff



ICE, as the oldest and one of the most well respected professional engineering institutions in the world, exists to serve society by developing the knowledge, skills and expertise necessary to deliver the infrastructure it needs – quickly, efficiently and at a cost it can afford. We also draw on the intellectual strength of our membership to offer politically independent policy advice to Government, opposition parties and the entire civil engineering supply chain. It is these twin aims of providing technical engineering expertise and independent policy advice in order to improve our infrastructure networks that drive ICE to produce our State of the Nation reports.

ICE, as the oldest and one of the most well respected professional engineering institutions in the world, exists to serve society by developing the knowledge, skills and expertise

As President of ICE, I would like to extend my sincere thanks to the Project Steering Group, which has been led by Keith Clarke CBE, Vice President of ICE. Their expertise and dedication has underpinned the delivery of this report and exemplifies the value that ICE and its members contribute to society. I would also like to thank all of those who have provided written and oral evidence to the project. Without this generous knowledge sharing, ICE would not be able to produce this assessment of our infrastructure in 2014.

Geoff French
President,
Institution of Civil Engineers



EXECUTIVE SUMMARY

Infrastructure is vital to society – our quality of life depends on it functioning effectively and our reliance becomes painfully evident when infrastructure systems fail.

The UK's ranking for quality of infrastructure has dropped from 24th to 28th in the World Economic Forum rankings.¹ Our ability to compete in the global race and to generate and sustain economic growth with appropriate quality of life depends on infrastructure networks that provide predictable energy generation and distribution, water supply, waste management and the transportation of people and essential goods into and around the UK by rail, road, sea and air.

State of the Nation is ICE's flagship report on the current state of the UK's infrastructure. This State of the Nation Infrastructure 2014 report assesses the performance, capacity and condition of the UK's economic infrastructure² networks, and determines the actions required in order to improve and enhance performance, and importantly, to ensure that our infrastructure is resilient when faced with the many challenges ahead – from climate change to population growth.

STATE OF INFRASTRUCTURE

ICE's overall view is that the approach to delivering and maintaining infrastructure requires attention. If we are to compete in the global economy the UK cannot afford to settle for infrastructure which does not meet the challenges we are now encountering. Increasingly extreme climatic conditions compounded by demands from a growing population mean that we can no longer provide and operate infrastructure to the standard required.

1. World Economic Forum www.weforum.org/content/pages/competitiveness-library 2. By economic infrastructure ICE means transport, energy, water, waste and flooding management 3. HM Treasury (December 2013) National Infrastructure Plan 2013 www.gov.uk/government/uploads/system/uploads/attachment_data/file/263159/national_infrastructure_plan_2013.pdf



The establishment of Infrastructure UK (IUK) and the iterations of the National Infrastructure Plan (NIP)³ have advanced the way Government and industry engage over infrastructure. The Devolved nations have each produced their own infrastructure investment plans.⁴ This progress should be built upon to ensure that the UK possesses world class infrastructure.

ICE's findings indicate that three sectors – energy, flood management and local transport – are of particular concern. A narrowing gap between capacity to supply energy and demand; inadequate resilience to flooding, and the decline in maintenance of local roads and flooding assets due to investment cuts have all contributed to the current grades.

These are the three sectors that require the most attention from policymakers and industry; however, water, waste and strategic transport will all require 'future proofing' if they are to deliver the transition to a low carbon economy and meet the needs of society and the environment.

As well as the six sector chapters this report also addresses cross-cutting issues, such as decarbonisation, the standards to which infrastructure is designed, the availability of infrastructure services and the impacts of changing weather patterns and population growth on the UK's infrastructure.

INFRASTRUCTURE CHALLENGES

As the 2013/14 winter flooding showed, Government ultimately bears the risk for major, unplanned interruptions in infrastructure networks and the resulting impact on society and the economy. A growing population and changing weather patterns are the two factors that will place the greatest pressure on our networks in both the short and long term.

In ICE's 2010 State of the Nation Infrastructure⁵ report, resilience was highlighted as a key concern to the UK's economic performance, particularly following the flooding and extreme weather events between 2007 and 2010.⁶ While there has been a welcome political emphasis on infrastructure's contribution and transformative powers since 2010, not enough has been done to address this important issue of resilience or the constraints on the provision and maintenance of our infrastructure networks.

MAKING CHOICES – CONSTRAINTS ON INFRASTRUCTURE

Nationally significant infrastructure projects are, by their nature, political and subject to a decision making process, with public and parliamentary involvement. This means that Government has to make difficult political decisions regarding infrastructure provision and operation. Government should build on the progress made in the NIP to mature a set of criteria to make it easier to compare complex infrastructure sectors.

Funding for infrastructure will always be constrained. There are only two sources; tax and user charges which both ultimately fall on the consumer. The balance between the two is a choice for the Government of the day to implement through social, economic and environmental policies. Irrespective of this balance, efficiency of procurement, delivery and operation are paramount to the achievement of value for money.

MAKING CHOICES – AVAILABILITY

The expectation of infrastructure availability will need to change. A changing climate is expected to bring more extreme weather conditions and it will not be cost effective to safely run all services in all conditions. The UK must be prepared using the rapidly developing sophisticated prediction techniques, to manage the operation of services such as rail, airports and roads. This was evident during the St Jude's storm in autumn 2013 when parts of the rail network were closed due to extreme weather. Such an approach will require transparent and effective engagement with the public.

4. The Scottish Infrastructure Investment Plan, the Wales Infrastructure Investment Plan, the Investment Strategy for Northern Ireland
5. ICE (2010) State of the Nation Infrastructure www.ice.org.uk/getattachment/c198a95f-69bd-4c46-8110-51b057ec20f1/State-ofthe-Nation-Infrastructure-2010 6. Met Office www.metoffice.gov.uk/climate/uk/interesting



ICE RECOMMENDS THE FOLLOWING ACTIONS TO IMPROVE THE COMPETITIVENESS OF THE UK'S INFRASTRUCTURE:

STRATEGIC CRITERIA

1. Infrastructure UK should build on the prioritisation criteria for major infrastructure projects established in the National Infrastructure Plan with the addition of interdependencies, resilience, availability and the pathway to a low carbon economy
2. Government and private providers of infrastructure should be prepared to make tough choices regarding the levels of resilience in the UK's infrastructure networks. This will require an assessment of costs and the management of public expectation regarding availability
3. Provide more clarity, certainty and transparency for potential investors through the regularly published National Infrastructure pipeline. This should provide detail on investable projects, their status, planning approval, ownership structure and revenue streams

SECTOR SPECIFIC

4. Enact the secondary legislation to implement Electricity Market Reform (EMR) by the end of this Parliament, establishing long-term investor confidence and entrenching cross-party support for electricity decarbonisation
5. Extend devolved transport powers and funding through the creation of more powerful, fully integrated transport authorities in city regions
6. Government and local authorities should establish a more ambitious joint programme to finally clear the maintenance backlog, and commit to a regime which moves to planned, preventative maintenance
7. Government should provide the longer-term certainty needed to improve flood resilience by committing to a long-term capital and maintenance programme for flood management which protects funding beyond the current six-year plan

ENGINEERING STANDARDS

8. Engineering professionals should simplify and speed up their standards change process utilising the UK's deep and proven skills. This will drive delivery of efficient and innovative infrastructure that will save costs, time and carbon

RESEARCH AND DEVELOPMENT

9. Dedicated multi-disciplinary engineering teams should be seconded directly into the latter stages of significant research projects with the task of implementing the benefits from academic research, so that they can be practically and efficiently applied to meet the UK's infrastructure needs

2014 INFRASTRUCTURE GRADES

ENERGY

GRADE C-  (2010 GRADE D)



STRATEGIC TRANSPORT

GRADE B  (2010 GRADE B)



LOCAL TRANSPORT

GRADE D-  (2010 GRADE D)



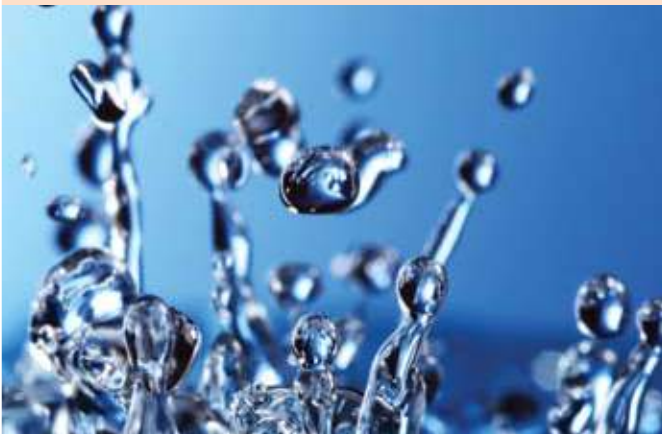
FLOOD MANAGEMENT

GRADE C-  (2010 GRADE C)



WATER

GRADE B  (2010 GRADE B)



WASTE

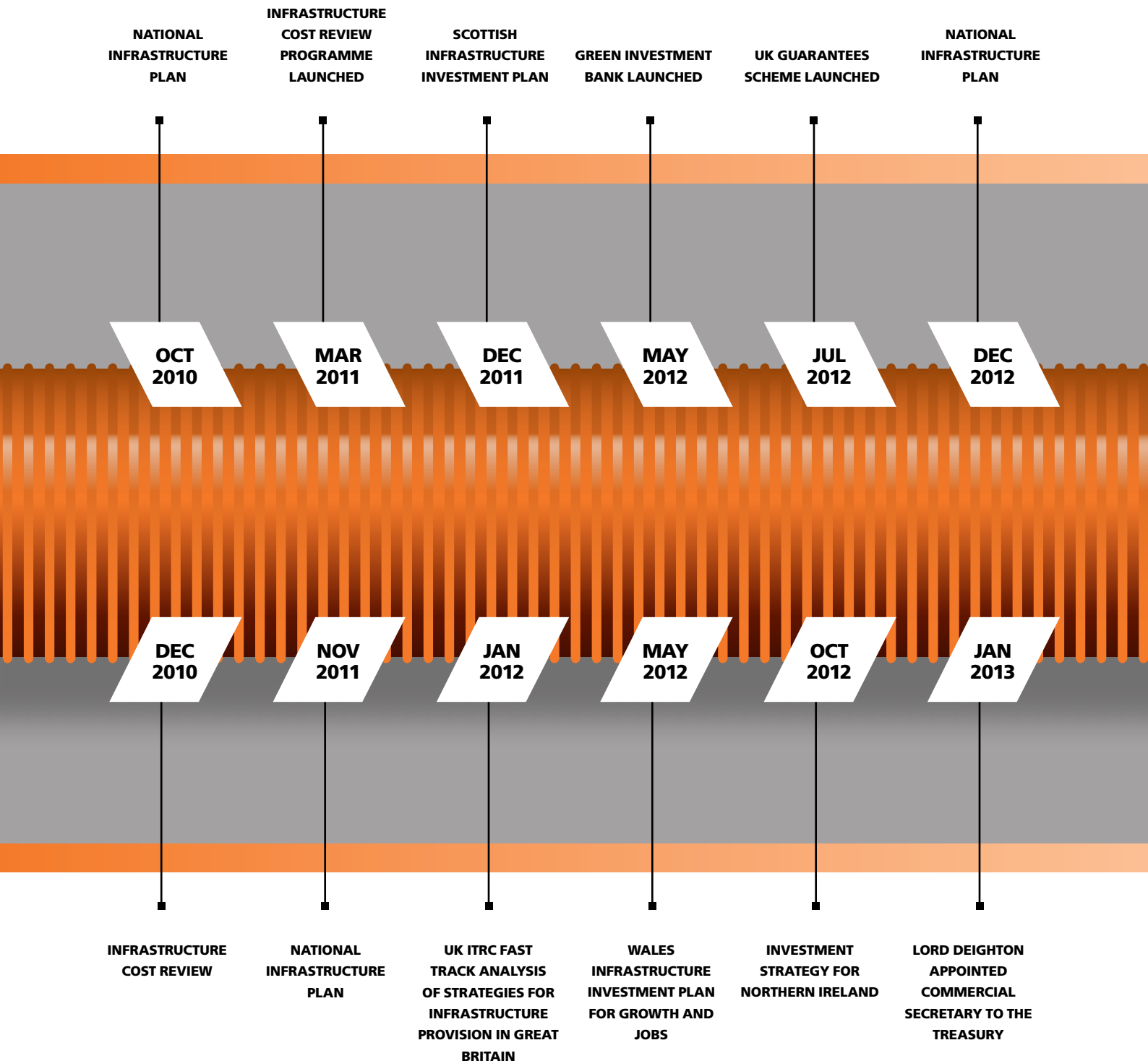
GRADE C+  (2010 GRADE C)



INFRASTRUCTURE SINCE 2010

Since our last State of the Nation Infrastructure report in 2010 the case for infrastructure has been more effectively made by Government and industry.

The momentum achieved by IUK should be accelerated to ensure that further efficiencies and benefits can be achieved to deliver the resilient and interdependent infrastructure networks that the UK will require. This timeline highlights the key infrastructure milestones that have been achieved since our last report in 2010.





**LORD DEIGHTON
LAUNCHED
GOVERNMENT
CAPABILITY REVIEW**

**CONSTRUCTION
2025 PUBLISHED**

**INFRASTRUCTURE
CARBON REVIEW**

**MAJOR
INFRASTRUCTURE
TRACKING UNIT**

**NATIONAL
INFRASTRUCTURE
PLAN FINANCE
UPDATE**

**JAN
2013**

**JUL
2013**

**NOV
2013**

**DEC
2013**

**MAR
2014**

**JAN
2013**

**OCT
2013**

**DEC
2013**

**JAN
2014**

**INFRASTRUCTURE
PROCUREMENT
ROUTEMAP**

**INDEPENDENT
ARMITT REVIEW OF
INFRASTRUCTURE**

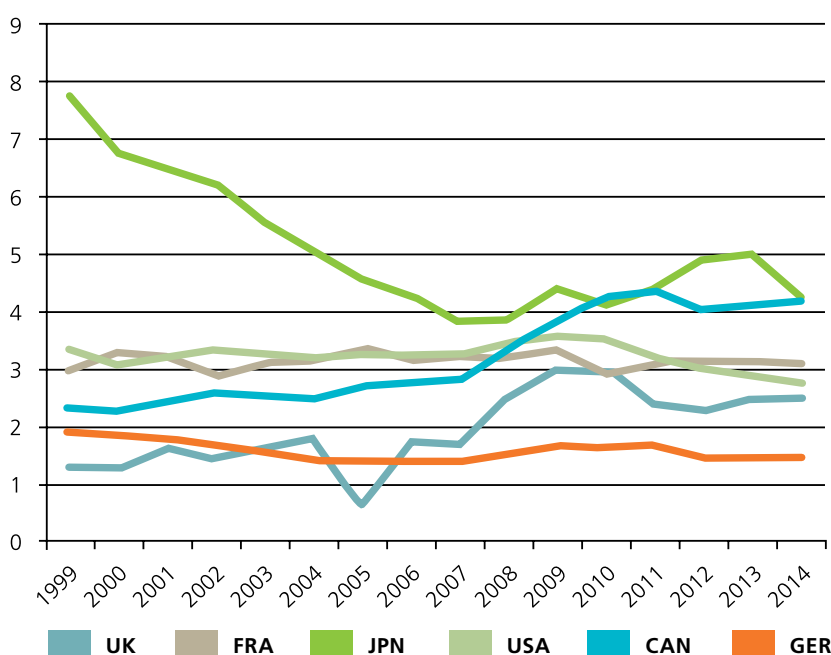
**NATIONAL
INFRASTRUCTURE
PLAN**

**UK ITRC BRITAIN'S
INFRASTRUCTURE
FOR THE 21ST
CENTURY**

BACKGROUND

According to McKinsey, global investment in infrastructure needs to increase by 60% to \$57 trillion (approximately £34 trillion) between now and 2030 just to support economic growth during the same period.⁷

FIGURE 1
Public investment as a % of GDP, 1999-2014¹⁰ (OECD)



As Figure 1 shows, over the last 15 years, public investment as a percentage of GDP has remained behind many of our principal competitors.⁸ Although infrastructure investment has increased from £41 billion per annum from 2005-2010 to £45 billion from 2011-2015,⁹ further infrastructure investment is required at a time when economic growth is still fragile and pressure remains on the public purse.

This extra investment is required just to maintain the UK's competitiveness under current conditions; however, both population growth and a changing climate will put increased pressure on our infrastructure networks. Figure 2 shows the estimated population growth trend to 2037 with increases across the UK.

Since 1990, the UK has experienced eight of the ten warmest years on record and five of the ten wettest years – 2000 and 2012 were the wettest on record. Defra's Climate Change Risk Assessment suggest that by the 2050s, summer river flows may reduce by 35% in the driest parts of England and by 15% for the wetter river basin regions in Scotland.¹¹ This will impact on the water available for a range of activities, including cooling for energy plants.



FIGURE 2

**UK population projections
millions**

	2012	2017	2022	2027	2032	2037
United Kingdom	63.7	65.8	68.0	70.0	71.7	73.3
England	53.5	55.4	57.3	59.1	60.7	62.2
Wales	3.1	3.1	3.2	3.2	3.3	3.4
Scotland	5.3	5.4	5.5	5.6	5.7	5.8
Northern Ireland	1.8	1.9	1.9	2.0	2.0	2.0

ONS November 2013

The impacts of population growth on demand and pressures from climate change and extreme weather events will require resilient infrastructure.

STATE OF THE SECTORS

Alongside these challenges the UK's infrastructure sectors have other specific issues to address. In **energy** over the next decade, around a fifth of the UK's electricity generating capacity (fossil and nuclear) is expected to be retired putting further pressure on de-rated capacity margins which are at 4% at peak demand periods.

In **strategic transport**, without action, the costs of congestion could more than double between 2005 and 2025, to £3.6 billion. Rail passengers travelled 59 billion kilometres in 2013/14, an increase of almost 50% since 2003/04, stretching the capacity of the network. In aviation UK airport delays are above the European average with significant capacity challenges in the South East of England likely without new runways.

Local transport reveals more concerns as maintenance investment in local roads has declined by 11% in real terms from 2010/11 to 2014/15. This has left one-third of local roads in urgent need of attention.

Maintenance is also a concern in the **flood management** sector where funding for watercourses – which includes flood barriers and pumping stations; managing grass, trees and bushes on flood embankments; and inspection and repair of flood defence structures – will be as low as £39 million by 2014/15. Between 2015 and 2021, Government will spend £1.4 billion less on flood management than the Environment Agency's estimated need.

Despite its ageing infrastructure profile, **water** continues to perform well and proposed changes to economic regulation should provide water companies with opportunities to rely less on large capital projects and use soft engineering techniques and technology. Issues of water availability, particularly in the South East and London are the main challenge.

Finally, **waste** policy in England lacks direction and investment in infrastructure has suffered. The Devolved nations have outlined clear waste strategies. The UK is obliged to reduce levels of Biodegradable Municipal Waste (BMW) sent to landfill by 65% by 2020, compared with 1995 levels. The UK has targets under the EU Framework Directive to recycle 50% of household waste by 2020 and recover 70% of construction and demolition waste by 2020.



FUNDING, FINANCING AND LEADERSHIP

RECOMMENDATIONS

1. **Government should set out clearly what our infrastructure networks need in order to achieve future strategic objectives, what this will cost, and be prepared to make tough choices to achieve the most appropriate balance between taxation and consumer charging. This approach should build upon criteria established by IUK with the addition of interdependencies, resilience, availability and the pathway to a low carbon economy**
2. **Establish much needed transparency and stability for potential private investors and the infrastructure supply chain through the regular publication of the National Infrastructure pipeline; providing detailed investable projects with their progress status, ownership structure and revenue streams to secure investment at optimal value for money**
3. **Government should continue to work with private investors to increase spending on both capital and maintenance infrastructure projects. The Pension Infrastructure Platform (PIP) and Green Investment Bank (GIB) have largely unrealised potential to make a material contribution. Government should leverage these mechanisms alongside the UK Guarantees scheme to enable accelerate the rate of investment in infrastructure**

'The government's ambition is to equip the UK with world-class infrastructure, which rivals that of all its Organisation for Economic Co-operation and Development (OECD) counterparts in every sector and ensures the country can compete in the global race.'¹²

Since 2008 the UK's quality of infrastructure has ranked no higher than 24th in the World Economic Forum's competitiveness index.¹³ The relative position of the UK's total infrastructure stock as a percentage of GDP¹⁴ suggests that the current low rate of infrastructure investment is increasingly unsustainable.

LEADERSHIP AND DELIVERY

ICE commends the cabinet level responsibility for infrastructure provided by the Chief Secretary to the Treasury chairing National Infrastructure Plan Strategic Engagement Forum, and the impact the Commercial Secretary to the Treasury has made with the current pipeline, his capability review of Government departments and the establishment of the Major Infrastructure Tracking Unit are also welcome.

Since our last report significant debate has taken place regarding decision-making mechanisms for infrastructure projects and programmes. Whether through IUK or an infrastructure commission, a live and transparent list of such projects and programmes would assist in the debate on relative priorities and the rationale for their alternatives.

Significant progress has been made at putting in place improved mechanisms and resources; however, increased promoter and developer skills are required within government to make the case for strategically important schemes at an earlier stage and in a more robust manner. In addition, this would enable more efficient and effective delivery of the increasing infrastructure requirements of the UK, including the Infrastructure Cost Review.¹⁵

The 'Green Book Plus'¹⁶ approach could help better identify and articulate the wider social, environmental and economic benefits, outcomes and outputs expected of any given scheme. Reducing the cost of delivering infrastructure should receive continued focus from government and industry and ICE will work with government to deliver the Cost Review legacy programmes.

High level sponsorship of infrastructure development, a stable regulatory environment and the retention and augmentation of teams in Infrastructure UK (IUK) and elsewhere in Government will support increasing confidence in infrastructure owners and investors. In turn, this will lead to more efficient procurement and delivery, greater incentive for the supply chain to invest and innovate, lower unit costs and improved value for money.

FUNDING

The Infrastructure Transition Research Consortium¹⁷ research indicates that in the UK, under a range of scenarios, infrastructure investment will vary between around £0.6 trillion and £1.7 trillion by 2050.¹⁸ About £1 trillion of the upper range of estimates is needed to achieve carbon reductions; in the case of a 'capacity expansion' scenario – one of the scenarios analysed – annual infrastructure investment would need to increase by about 10% above current levels.

The sources of funding available to enable infrastructure investment are limited to tax, user charges or a combination of the two.¹⁹ As both are constrained resources, politicians along with industry and academia, should stimulate a mature, evidence-based debate about the most appropriate levels of service required from infrastructure networks. More efficient routes to reduce emissions result in lower levels of investment over the period but are more complex and rely more heavily on new and emerging technology for smart prioritisation of infrastructure services and management of demand.

¹². HM Treasury (December 2013) National Infrastructure Plan 2013 ¹³. World Economic Forum www.weforum.org/content/pages/competitiveness-library ¹⁴. McKinsey and Co. (2013) 'Infrastructure productivity: How to save \$1 trillion a year' www.mckinsey.com/insights/engineering_construction/infrastructure_productivity ¹⁵. HM Treasury (2010) 'Infrastructure Cost Review: Main Report' www.gov.uk/government/uploads/system/uploads/attachment_data/file/192588/cost_review_main211210.pdf ¹⁶. Major Projects Association (2014) 'What is the true value of Major Projects?' ¹⁷. Infrastructure Transitions Research Consortium www.itrc.org.uk ¹⁸. Infrastructure Transitions Research Consortium (2014) National Infrastructure Assessment, Interim report www.itrc.org.uk/wordpress/wp-content/results/ITRC-First-results-WEB.pdf



FINANCING

As public budget constraints are expected to continue throughout the next Parliament, an increased level of infrastructure investment will require a greater proportion of new investment to be financed by the private sector. The UK is recognised for leading infrastructure investment expertise, excellent access to the capital markets and is seen as an attractive place to invest.²⁰

Information on where financing opportunities exist for programmes and projects within the NIP pipeline is clearer thanks to the ongoing development of the NIP and the NIP Finance update. Figure 3 shows the expected sources of finance for projects within the NIP Infrastructure Pipeline. These extra layers of information should be built on to provide further clarity to potential investors.

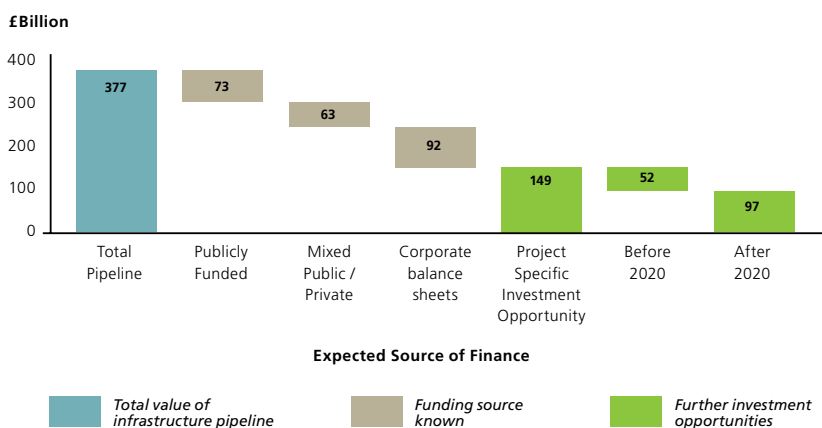
Capital markets are prone to change quickly and the Government needs to ensure the UK competes on an international stage for infrastructure finance, recognising that capital remains highly mobile.

INSTITUTIONAL INVESTMENT

The Green Investment Bank is the first of its kind with a clear focus on investing in sustainable projects. While the direct commitment of £0.8 billion has attracted further private capital, the current committed total of £3.2 billion²² should be materially enhanced.

The establishment of both the Pension Infrastructure Platform and Insurer's Infrastructure Investment Forum are also expected to make positive contributions. Investors of all kinds, and the supply chain, require regular updates of a transparent and stable National Infrastructure Pipeline to optimise the potential for, and reduce the cost of, infrastructure investment.

FIGURE 3
NIP Pipeline Investment²¹



MANAGING RISK

The focus of investment and majority of finance attention to date has been on debt finance. Up to 40% of projects in the current infrastructure pipeline (total value of around £150 billion) could require more complex financing solutions.²³ Combined with an increased desire to exploit the development of opportunities arising from government funded infrastructure research, ICE expects that a different risk allocation between the public and private sectors will be required to commercialise these opportunities. To secure finance to achieve this objective we believe that the public sector will have to assume more equity-type risk than is typical at present, for example commercial scale demonstration of Carbon Capture and Storage.

Achieving value for money for taxpayers and/or consumers is likely to be a function of both competition and the efficiency with which projects are brought to market. These contributors drive value for money, and ultimately the economic viability and deliverability of each scheme. From all elements of the supply chain through to government, predictability of deal flow is of fundamental importance. Having made progress with the top 40, often 'shovel ready' projects and programs, increased emphasis and prioritisation should be placed on schemes with the greatest strategic value.

19. HM Treasury (December 2013) National Infrastructure Plan 2013 20. Nabarro LLP (2013) Nabarro Infrastructure Index
21. National Infrastructure Plan Finance Update, HMT, March 2014 www.gov.uk/government/uploads/system/uploads/attachment_data/file/293688/PU1656_NInfrastructure_Finance_Update.pdf 22. Transactions to date, Green Investment Bank, March 2014
23. HM Treasury (December 2013) National Infrastructure Plan 2013

GRADE

C-

OBJECTIVES FOR 2018

- Sufficient ongoing investment confidence to provide security of the electricity energy supply; capacity margins during peak periods that ensure the UK continues to have sufficient generating capacity to meet demand
- Clear decarbonisation pathways to 2030 that demonstrably put the UK on the road to its 2050 commitments

ENERGY

RECOMMENDATIONS

1. **Government needs a more determined approach through policies, behaviours and technologies that actively drive energy demand management. It should look to bolster the attractiveness and pace of existing schemes such as the Green Deal and smart metering.**
2. **Parliament should enact the secondary legislation to implement Electricity Market Reform (EMR) by the end of this Parliament, establishing long-term investor confidence and entrenching cross-party support for electricity decarbonisation.**
3. **The Office of Gas and Electricity Markets (Ofgem) should have its remit for resilience strengthened to factor in future demands on energy capacity from other infrastructure sectors and to improve resilience against interruptions caused by extreme weather events.**

For the UK to meet its legally binding targets for decarbonisation beyond 2020, it must transform the way that it generates and uses energy.

The UK is bound by domestic targets to reduce greenhouse gas emissions by 34% from 1990 levels by 2020, and 80% by 2050. It is also bound by EU directives to reduce energy consumption and greenhouse gas emissions, and increase its share of renewables to 15% by 2020. The policy decisions taken in the course of this decade will determine whether the 2050 commitments can be delivered and at what cost.²⁴

Significant quantities of the UK's existing electricity generation capacity are expected to be retired soon, with major implications for security of supply unless the conditions to attract investment in new generation are provided. This situation is expected to be further exacerbated as the use of electricity for transport and residential heat increases demand.²⁵ We must also increase the intensity of efforts to maximise energy efficiency and reduce demand.

The transition to a low carbon future is feasible, but will require political vision and cross-party support in order to deliver long-term policy commitments and investment certainty.

MANAGING DEMAND

To transform the way we use energy will require policies, behaviours and technologies that actively drive energy efficiency and demand management. 'This will involve much greater energy and resource efficiency and needs to incorporate all relevant sectors including the built environment, power generation, industry and transport.'²⁶ The policy framework, including fiscal incentives, needs to be further adjusted in order to shift investment and stimulate innovation in low-carbon energy infrastructure.

²⁴. Infrastructure Transitions Research Consortium (2014) National Infrastructure Assessment, Interim report www.itrc.org.uk/wordpress/wp-content/results/ITRC-First-results-WEB.pdf p.39 ²⁵. National Grid (2011) 'UK Future Energy Scenarios' www.nationalgrid.com/NR/rdonlyres/86C815F5-0EAD-46B5-A580-A0A516562B3E/50819/10312_1_NG_Futureenergyscenarios_WEB1.pdf ²⁶. The Prince of Wales's Corporate Leaders Group The Trillion Tonne Communique www.climatecommuniques.com/Trillion-Tonne-Communique ²⁷. In 2012/13, National Grid recorded system availability of 99.99999% ²⁸. Royal Academy of Engineering (2013) GB electricity capacity margin - A report by the Royal Academy of Engineering for the Council for Science and Technology www.raeng.org.uk/news/publications/list/reports/RAEng_GB_Electricity_capacity_margin_report.pdf ²⁹. DECC (2012) Gas Generation Strategy www.gov.uk/government/publications/gas-generation-strategy ³⁰. National Grid (2013) Gas Ten Year Statement www2.nationalgrid.com/UK/Industry-information/Future-of-Energy/Gas-Ten-Year-Statement ³¹. Ibid ³². Institution of Civil Engineers (2013) Shale Gas Policy Position Paper www.ice.org.uk/Information-resources/Document-Library/Shale-Gas-Position-Paper ³³. Royal Academy of Engineering (2010) Nuclear Lessons Learned [www.ice.org.uk/getmedia/40969b76-4717-4514-b0da-01fc88619c1d/Royal-Engineering-Nuclear-v2-22-Oct\(2\)](http://www.ice.org.uk/getmedia/40969b76-4717-4514-b0da-01fc88619c1d/Royal-Engineering-Nuclear-v2-22-Oct(2)) ³⁴. Renewable UK



Major savings in energy consumption and carbon emissions can be achieved through better insulated buildings, the uptake of smart technologies and changes in the way that we consume energy. Reducing our energy consumption can also help cushion the impact of rising energy costs and address concerns associated with fuel poverty, while reducing carbon emissions.

Existing government-backed schemes, such as the Energy Company Obligation and Green Deal, are currently failing to promote demand management sufficiently. A more determined approach is required to attract uptake of the Green Deal by consumers and achieve the transformation of energy efficiency in the built environment.

ELECTRICITY GENERATION

The UK has a mature and reliable electricity network²⁷ with sufficient generation capacity (77.9GW) to meet expected peak demand (58GW).²⁸ In the near term, these margins are expected to tighten as existing generation assets are retired and ongoing political uncertainties delay investment in new generation capacity, risking the security and reliability of our supplies. To maintain the reliability of our electricity networks, resilience needs to be strengthened to factor in future demands on energy capacity from other infrastructure sectors and to mitigate supply and distribution interruptions caused by extreme weather events.

The Energy Act (2013) has sent the clearest indication of the government's intent to attract the more than £110 billion of investment required by creating the conditions to incentivise generation, maximise investor confidence and ensure sufficient capacity to meet peak demands; however, the secondary legislation required is not yet complete.

By 2015, unabated coal generation will have been phased out. Gas is expected to play a more prominent role in our generation mix, but market uncertainty continues to delay investment in new plants. Planning approval for around 15GW of new gas plants has been consented, but no final investment decisions have yet been taken.²⁹

Our increasing reliance on gas imports, the continuing decline in domestic production from the North Sea and a lack of storage facilities relative to demand³⁰ have increased our exposure to the volatility of international gas prices and our vulnerability to external shocks to the network, such as unplanned outages in international pipelines. In March 2013, for example, technical problems with the Langeled line supplying gas to the UK from Norway temporarily disrupted gas imports, resulting in price spikes. The Government's decision to rule out public support for the development of further gas storage facilities has been identified as a barrier to development, resulting in the cancellation or mothballing of several storage projects.³¹ The discovery of potentially exploitable shale gas reserves is of growing interest to policymakers, but its long-term significance for the UK's energy mix remains unclear.³²

Carbon Capture and Storage (CCS) is anticipated by policymakers to be an important technology for retaining fossil fuels in our generation mix. Projects are progressing at White Rose and Peterhead to determine the technical and economic feasibility of CCS. Lessons from these pilots should be shared so that future projects can attract the investment required to move CCS from concept to reality. This may require further direct government support.

Recent extensions to the lifespan of the UK's existing nuclear capacity will be important in bridging the transition to a fleet of new nuclear power stations. Government should ensure that the current new nuclear power station proposals (at Hinkley Point and Wylfa) represent the first of a new generation of stations, creating a pipeline of projects which will allow costs to be reduced and the wider economic value of these projects captured for UK industry.³³

DECARBONISATION

Political uncertainties around the lack of a clear decarbonisation target and the future of the carbon price floor at both the domestic and European levels have been identified as barriers to continued private investment in the growth of renewable technologies beyond the near term.³⁴

Onshore wind is expected to make the greatest contribution to our near-term targets, but in the longer term an array of technologies, including offshore wind, wave and tidal power, offers the potential to contribute significantly. These latter technologies require a continued commitment to research and development in order to be commercialised³⁵ and deployed at scale. In some of the most abundant areas of natural resource, such as the Scottish islands, development is further constrained by a lack of export capability, interconnection and grid infrastructure.³⁶ Intermediate 2030 targets for renewable electricity generation are needed to ensure we meet our 2050 obligations.

HEAT

Energy for heat accounts for around half of the UK's total energy demand, the majority of which comes from gas. The heat sector offers significant scope for decarbonisation through electrification and small-scale and distributed renewable technologies, and this decarbonisation will be crucial if we are to meet our 2050 obligations for reducing greenhouse gas emissions. Intermediate 2030 emissions targets are needed for heat as well as electricity generation.

ICE welcomes the creation of the Heat Network Delivery Unit in Department of Energy & Climate Change (DECC). The development support for local authorities will reinforce the case for the deployment of heat networks in major urban areas as the most cost-effective means of decarbonising heat. Furthermore, it has the potential to put heat distribution infrastructure on a comparable footing with gas and electricity networks.

(2013) Wind Energy in the UK www.renewableuk.com/en/publications/reports.cfm/state-of-the-industry-report-2012-13 35. It is important to differentiate between the varying stages of development that these technologies are at. Offshore wind, for example, is the most mature and commercially viable of these, although further at-scale deployment is needed to drive innovation to reduce its costs. Wave and tidal power still require significant research and development before being commercialised 36. Baringa (2013) Scottish Islands Renewable Project - Final Report www.gov.uk/government/uploads/system/uploads/attachment_data/file/199038/Scottish_Islands_Renewable_Project_Baringa_TNEI_FINAL_Report_Publication_version_14May2013_2_.pdf

GRADE

B

OBJECTIVES FOR 2018

- Long-term plans for strategic roads projects and their investment should be in place
- Railway infrastructure should be more resilient to severe weather and the capacity of the network should be increased
- Decisions regarding South East airport capacity should have been taken and be in the process of implementation

STRATEGIC TRANSPORT

RECOMMENDATIONS

1. **The development of an integrated national transport strategy for England, addressing the contribution of transport to wider objectives, investment priorities, future demand, technological change, and giving clear guidance to national and sub-national transport policymakers**
2. **Government should deliver reforms within the current Parliament to provide the Highways Agency with:**
 - a. Clear strategy for roads investment and performance
 - b. Secure, multi-annual funding
 - c. Effective regulatory arrangements to ensure the best service to users and taxpayers
3. **Continued investment is required to improve capacity and resilience of the rail network, particularly through:**
 - a. Further electrification and re-signalling
 - b. Improved asset management of structures and earthworks
 - c. Greater use of the network for freight, including through more effective support for strategic interchange hubs
 - d. Accelerated development of high speed rail from London to northern England and onwards to Scotland
4. **Government should act decisively to deliver new aviation capacity in the South East following the Davies Commission's report in 2015**

ICE's 2013 State of the Nation: Transport³⁷ noted that the UK has mature and highly-developed transport infrastructure. These have supported a tripling of distance travelled since the late 1950s – overwhelmingly achieved through increased private motoring.³⁸

The long-term increase in demand for transport has strained many parts of our network. Strategic road, rail and air networks are capacity-constrained at critical points, undermining their contribution to prosperity and quality of life. Rising demand has eased in the past decade but while some underlying changes in travel behaviour are apparent, with economic recovery and continued population growth, demand is rising again and likely to continue to do so.³⁹

Lack of spare or alternative capacity is already a chronic problem in congested areas and leaves networks vulnerable to shocks. Various forms of severe weather cause major disruption across the country.

Greenhouse gas emissions from transport are much more difficult to reduce than those from electricity generation or heat.⁴⁰ Increased travel has offset fuel efficiency gains and the slow progress towards alternatively-powered vehicles. Local pollutants remain a major problem too, with nitrous oxide (NOx) and particulate matter (PM) responsible for tens of thousands of premature deaths each year.⁴¹

Government's approach to competing and connected transport issues is not always clear. Very considerable road, rail and air investment is expected in the next two decades, but with insufficient consideration of how transport is integrated across modes, or with the wider objectives it contributes towards. ICE, in common with many other professional institutions and the Transport Select Committee, recommends development of a compelling national transport strategy, which establishes clear objectives, an investment hierarchy, and explains how the relationship between modes, local and national networks, and wider economic, social and

37. ICE (2013) 'State of the Nation Transport' www.ice.org.uk/getattachment/62287087-5d12-48b3-8619-b16b33292270/State-of-the-Nation-Transport-2013 38. DfT Modal comparisons (TSG801) www.gov.uk/government/statistical-data-sets/tsgb01-modal-comparisons#table-tsgb0101 39. DfT draft 'National Networks National Policy Statement' (2013) www.gov.uk/government/consultations/national-road-and-rail-networks-draft-national-policy-statement 40. Transport emissions rose by 11% from 1990-2010, even as emissions from all sources fell by 21%. Source: DfT Energy and environment (TSG803) statistics www.gov.uk/government/statistical-data-sets/tsgb03 41. Policy Exchange (2012) Something in the Air: The forgotten crisis of Britain's poor air quality www.policyexchange.org.uk/publications/category/item/something-in-the-air-the-forgotten-crisis-of-britain-s-poor-air-quality 42. Traffic on other roads was no higher in 2013 than 2003. It increased 18% from 1993-2007 but then fell 4% 43. August 2013 forecasts from the National Transport Model predicted growth on the strategic network of 46% from 2010 to 2040

environmental objectives should be reconciled. Such a strategy should guide the planning and investment decisions of national transport organisations, and be supported by formation of powerful, multi-modal authorities in our major city regions.

ROADS

The vast majority of UK travel is by road. England's strategic road network (SRN) constitutes less than 3% of total road length, but carries around one-third of traffic and two-thirds of freight. Motorways have seen an 11% increase in the past 10 years.⁴² SRN performance and capacity pressures vary and there is a pressing need for remedial action at specific points. More severe congestion is anticipated in the longer term as stronger economic growth returns alongside population growth.⁴³

Estimates of the cost of congestion vary, but official data suggests that direct costs were around £2 billion in 2010, and would rise to £8.6 billion in 2040 in the absence of intervention.⁴⁴

To ease problems in the medium-term, government is planning to re-organise the Highways Agency to provide it with stable funding and clear strategy. In the longer term, ICE believes more sophisticated demand management, such as variable speed and managed motorways can reduce congestion and delay. This will make journey times more reliable, enhance economic performance and reduce emissions.

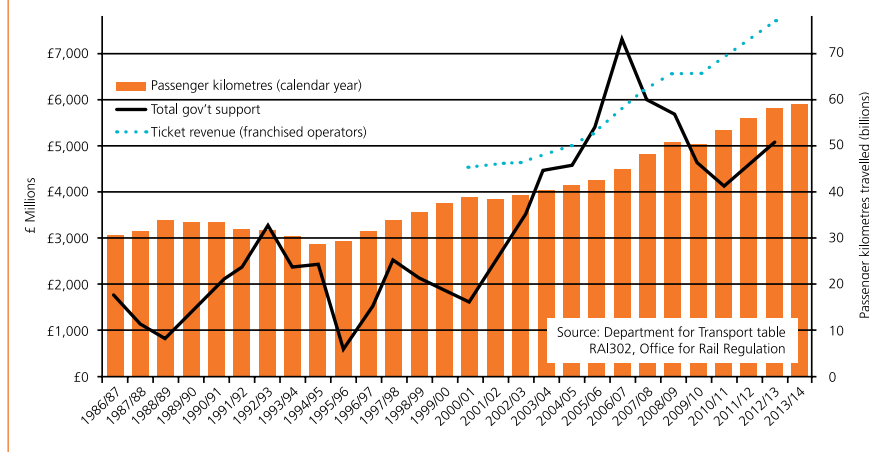
RAIL

Figure 4 shows that the cost to the Exchequer of running Britain's railways is around £5 billion per annum – approximately double the levels of the 1990s in real terms. Government's aim to move more of rail's costs to fare payers rather than taxpayers has also led to higher fares for many passengers.⁴⁵

Britain's rail network has seen a doubling in passenger kilometres over the past two decades (Figure 4), resulting in capacity constraints. In autumn 2012,⁴⁶ three quarters of morning peak hour trains into London had standing passengers, as did three-fifths into Leeds, and around half into Birmingham, Manchester and Sheffield.

Track and signalling faults continue to be the main sources of infrastructure-related delay, but problems with earthworks and structures caused

FIGURE 4
Government support, fare income and passenger-kilometres



almost triple the number of delays in 2012/13 compared to the previous year. Severe weather incidents in the winter of 2013/14 saw further problems of this nature and emphasised the need for greater resilience. Knowledge of the condition of the network's earthworks and bridges, while improving, remains incomplete and inconsistent.

Rail strategy and planning is relatively clear and well-developed. The 2014-19 'Control Period' (CP5) is largely in place and the industry is gearing up to deliver with greater efficiency. ICE endorses:

- Continued focus on greater efficiency (reducing industry costs by £3.5 billion by 2019) while also improving capacity and journey times
- Further investment in improving capacity and resilience, particularly by:
 - Continuing electrification and re-signalling
 - Improved asset management of structures and earthworks
 - Greater use of the network for freight, including through more effective support for strategic interchange hubs

ICE supports the development of high speed rail from London to Scotland as the best option for increasing rail capacity, reducing journey times and reducing the need for emissions-intensive short-haul flights. We support David Higgins' recommendation to accelerate delivery of HS2 – to Crewe in Phase 1 and Phase 2 to Leeds and Manchester by 2030.

AIR AND SEA PORTS

High quality international connectivity is vital to the UK's economic wellbeing. Our national hub airport, Heathrow, operates at almost full capacity. This limits the scope for improving connections to new markets and for UK regional connecting flights, exacerbating delays and undermining resilience to shocks such as severe weather.

The Davies Commission has been charged with recommending the optimum aviation capacity solution in the South East and Government should act decisively following the Commission's report in 2015. ICE also supports the Commission's interim report findings that 'there is a strong case for attaching a greater strategic priority to transport investments which improve surface access to our airports'.⁴⁷

The vast majority of our imports and exports move by sea. The new deep water container facilities at London Gateway are a valuable addition, particularly as forecasts suggest a tripling growth by 2030, focused mainly on the container sector.⁴⁸

Our major ports are generally well-equipped for development on their own estate, but Government should ensure that economic appraisals of land-side access improvements recognise ports' wider economic benefits.

44. DfT draft 'National Networks National Policy Statement' (2013) www.gov.uk/government/consultations/national-road-and-rail-networks-draft-national-policy-statement 45. Office of Rail Regulation dataportal.orr.gov.uk 46. DfT Rail passenger numbers and crowding statistics (Table RAI0212 www.gov.uk/government/publications/rail-passenger-numbers-and-crowding-on-weekdays-in-major-cities-in-england-and-wales-2012) 47. Airports Commission: Interim Report (2013) www.gov.uk/government/uploads/system/uploads/attachment_data/file/271231/airports-commission-interim-report.pdf 48. UK Port freight demand forecasts to 2030 webarchive.nationalarchives.gov.uk/http://www.dft.gov.uk/consultations/archive/2006/ppr/ukportdemandforecaststo2030.pdf

GRADE

D-

OBJECTIVES FOR 2018

- Improve decision making capabilities of transport authorities in city regions
- Reduce the maintenance backlog on local roads

LOCAL TRANSPORT NETWORKS

RECOMMENDATIONS

1. **Government should further extend devolved powers and funding through the creation of more powerful, fully integrated transport authorities in city regions**
2. **Government and local authorities should establish a more ambitious joint programme to finally clear the maintenance backlog, and commit to a regime which moves to planned, preventative maintenance**
3. **Enhance sustainable alternatives to the private car; including improved public transport and a greater focus on active travel**

The majority of our journeys use the local network for some or all of their distance – particularly local roads, many of which are in poor condition.

It is in our denser urban areas where most population and recent growth is occurring,⁴⁹ that much of the local network congestion harmful to physical and economic health occurs. This is also where the greatest opportunities for modal shift, demand management and improving the quality of 'place' are to be found.

LOCAL TRANSPORT GOVERNANCE

Local transport governance is often weak and fragmented, with funding inadequate to deliver the system we need. Responsibility for most roads remains with local highways authorities, which in major urban areas are often small with shrinking budgets. Bus services – the most frequently used form of public transport – are deregulated in most of the UK, albeit with major public subsidy. Transport planning is often weakly integrated across modes and with spatial planning and economic development.

ICE believes that city regions are often the most appropriate 'larger than local' scale for understanding and managing travel behaviour, and suggests that the trend towards devolution to English city regions be accelerated. ICE recommends the establishment of fully-integrated transport authorities across the UK with:

- Greater responsibility for all roads in their areas, including network investment, maintenance and demand management
- More effective influence over bus networks (including routes, fares, subsidies, frequencies, ticketing and vehicle standards)

49. 2011 Census Analysis - Comparing Rural and Urban Areas of England and Wales www.ons.gov.uk/ons/dcp171776_337939.pdf 50. Asphalt Industry Alliance (AIA) Annual Local Authorities Road Maintenance (ALARM) survey 2014 www.asphaltindustryalliance.com/alarm-survey 51. Ibid 52. DfT Modal comparisons (TSGB01) www.gov.uk/government/statistical-data-sets/tsgb01-modal-comparisons 53. In their 2012/13 Annual Report, the Independent Investment Programme Advisory Group (IIPAG) described the cost and performance of London's buses as 'among the best in the world' www.tfl.gov.uk/cdn/static/cms/documents/iipag-annual-report-2013.pdf 54. Department for Transport (Table BUS0103) www.gov.uk/government/statistical-data-sets/bus01-



- Greater influence on local rail services
- Enhanced powers and resources to invest in new light rail or other major improvements
- Democratic oversight via Combined Authorities or similar arrangements

LOCAL ROADS

The local road network's physical condition is a cause for concern. The Annual Local Authority Road Maintenance (ALARM) survey found that almost one-fifth of England's roads were in poor structural condition in 2014 and under half were considered to be in good condition.⁵⁰

In 2013, Government announced £6 billion over the next Parliament for local road maintenance in England; however, the estimate for a one-time maintenance 'catch-up' cost has increased from £10.5 billion last year to £12 billion this year⁵¹ leaving a gap in Local Authorities' maintenance budgets. Local authorities can improve efficiency and delivery of services by working with central Government and each other to embed the principles of good asset management in all areas through the Highways Maintenance Efficiency Programme (HMEP); however, Government may have to accept measures, such as reduced speed limits on local roads, if it does not provide sufficient maintenance investment.

PUBLIC TRANSPORT

Public transport's share of distance travelled rose from 12% in the mid-1990s to 17% in 2012 – mostly due to rail, and commuter and leisure journeys in London.⁵² In contrast, local bus trips outside London fell by 15% over the same period and have halved in England's major provincial centres since deregulation in the 1980s. Nevertheless, more people still use buses than trains and in many areas they are often the only option for those without cars.

ICE would like to see reforms to metropolitan bus networks such that they become a more attractive alternative to the private car through:

- Review of the effectiveness of the system of Quality Partnerships and Quality Contracts, learning particularly from the experience of London's successful regulated system⁵³ and Tyne and Wear (where a bus Quality Contract is being investigated)
- Reviewing bus operator and passenger subsidies against clear transport, social and economic objectives
- Mandating simple and attractive smart-ticketing and real-time information standards

High service frequencies and recent investment in new London buses, coupled with the benefits of real time running information, low, flat-rate fares and integrated ticketing, have seen ridership rise significantly in the capital while subsidy has fallen. Like London, Northern Ireland also was not deregulated in the 1980s, and Belfast's metro network has seen ridership increase at a similar level to London – around 30% since 2004/05. Over the same period, patronage in England's provincial metropolitan areas fell by 6%.⁵⁴

ACTIVE TRAVEL

Both walking and cycling have an important role in shorter trips for joining up public transport journeys, alongside associated health and well-being benefits. Traditionally most of the benefits of transport infrastructure projects have been associated with reductions in travel time; however, studies suggest that active travel should be considered as a positive aspect in infrastructure appraisals.⁵⁵

Walking is often neglected in transport debates yet still accounts for around one-quarter of trips and is the second most common mode of commuting.⁵⁶ Environments that are attractive to pedestrians are often also attractive places to live, work, shop and socialise. ICE would like to see walking promoted through better streetscape management, including wider, better-lit⁵⁷ and better-maintained pavements and public realm. There should also be a reduction in unnecessary street furniture, traffic-calming and other measures to make existing environments more pedestrian-friendly.

The UK ranks 24th in the EU for the percentage of its population cycling daily,⁵⁸ yet cycling could make a much greater contribution to our travel. It reduces pressure on road space and the need for parking, and improves public health; but despite a relatively high public profile and encouraging words from Government, there has been much less meaningful action. ICE recommends that transport policy should embrace cycling as a mainstream travel choice and address the barriers to achieving this by:

- Committing to clear national objectives and targets
- Increasing funding to ensure development of high quality networks in major urban areas
- Taking action to improve cycle safety and perceptions of safety

local-bus-passenger-journeys Department for Regional Development Northern Ireland www.drni.gov.uk/index/statistics/stats-categories/ni_transport_statistics.htm 55. Department of Health, An Economic Assessment of Investment in Walking and Cycling (2010) www.apho.org.uk/resource/item.aspx?RID=91553 56. Census of Population 2011 www.ons.gov.uk/ons/dcp171766_299766.pdf 57. Particularly through use of energy efficient LEDs 58. Special Eurobarometer 406 (2013) 'Attitudes of Europeans towards urban mobility'. The UK's 4% of population cycling daily compared with 43% in the Netherlands and 19% in Germany and Sweden ec.europa.eu/public_opinion/archives/ebs/ebs_406_en.pdf



GRADE

C-

OBJECTIVES FOR 2018

- Capital and maintenance investment in flood management should increase to meet the pressures of climate change and property development
- Flood assets that protect other infrastructure networks are being made resilient to severe weather events

FLOOD MANAGEMENT

RECOMMENDATIONS

- The Environment Agency (EA) and Lead Local Flood Authorities should fully implement a holistic approach to flood management, which includes land use planning, upstream catchment measures, flood defences and increased infrastructure and buildings flood resilience**
- EA should work with other infrastructure owners to agree standards of resilience required to maintain and operate infrastructure networks. This should include agreed levels of service during severe weather events**
- Government should provide the longer-term certainty needed to improve flood resilience by committing to a long-term capital and maintenance programme for Flood Management which protects funding beyond the current six-year plan**

The autumn and winter of 2013/14 saw extreme coastal surges, storms and rainfall, causing extensive and prolonged flooding and other damage.

Although this was a season of particular intensity, such events have occurred in different locations for a number of years and may occur more frequently in the future.

Despite the severe impacts of the 2013/14 weather, the collaboration and communication among the Environment Agency (EA), the Met Office and emergency responders should be praised. The National Severe Weather Warning Service (NSWWS) managed by the Met Office provided early warning for those operating infrastructure. Collaboration between the EA and the Met Office in the Flood Forecasting Centre enabled the EA and emergency responders to plan and manage these extreme events effectively.⁵⁹

DELIVERING FLOOD MANAGEMENT

In his review of the 2007 summer floods, Sir Michael Pitt called for 'urgent and fundamental changes in the way the country is adapting to the likelihood of more frequent and intense periods of heavy rainfall' and recommended that 'local authorities should lead on the management of local flood risk'.⁶⁰ While the latter of these recommendations has been enacted through the Flood and Water Management Act (2010), the former remains an issue and requires sustained attention if we are to build resilience into our infrastructure networks. The delayed implementation of sustainable urban drainage systems legislation is a significant concern.

⁵⁹. Met Office 2014 written evidence to ICE ⁶⁰. The Pitt Review (2008) Learning lessons from the 2007 floods. London, Cabinet Office ⁶². Report by the Comptroller and Auditor General, Department for Environment, Food and Rural Affairs and Environment Agency, Flood Risk Management in England, HC 1521, October 2011 ⁶¹. Report by the Comptroller and Auditor General, Department for Environment, Food and Rural Affairs and Environment Agency, Flood Risk Management in England, HC 1521, October 2011 ⁶². Committee on Climate Change (2014) Policy note: flood and coastal erosion risk management spending www.theccc.org.uk/wp-content/uploads/2014/01/2014-01-21-ASC-Policy-Note-flood-defence-spending-FINAL.pdf ⁶³. More than 5.5 million (one in six) properties in England and Wales are at risk of flooding from all water sources www.publications.parliament.uk/pa/cm201314/cmselect/



In 2013/14 flooding severely disrupted both the transport and energy networks and prevented the removal of sewage. On previous occasions it has also prevented the supply of water to communities. The impact of flooding on economic infrastructure is evident, yet it does not factor in the EA's High Level Reporting for targeting investment in flood risk management. The EA should be more proactive in its work with infrastructure operators to manage the flood risk to infrastructure assets.

INVESTMENT

The economic case for investment in new infrastructure to reduce flood risk is extremely strong compared to many other infrastructure investments, with capital flood management schemes frequently returning cost to benefit ratios better than 1:8.⁶¹ The long-term implications of flooding require a longer term planning period which should be matched by a long-term funding settlement.

Through its Long Term Investment Strategy, the EA previously estimated that an extra £50 million annual investment would be required⁶² to reduce the number of properties at risk⁶³ over time.⁶⁴ Committee on Climate Change (CCC) has reported that despite the 5 year investment settlement for flood risk management, actual funding from Defra will still be £1.4 billion less between 2015 and 2021 than the EA's estimate of the amount of funding that would be needed to avoid flood risk increasing.⁶⁵ Current levels of planned investment will lead to flood risk increasing.

The decline in recent maintenance investment in England is of concern to ICE. In 2014/15 maintenance grants from the EA will be 22% lower than they were in 2010/11.⁶⁶ This has an impact on the range of maintenance activities that EA, LLFAs and Internal Drainage Boards can undertake, such as dredging, clearing culverts and inspecting flood and coastal defences.

The EA maintains both their own and third party assets.⁶⁷ After the winter of 2013/14 flood defences have been exposed to severe weather conditions, often for a prolonged period of time, meaning that more maintenance will be required. The Royal Engineers recently completed an intense maintenance audit of flood infrastructure which will provide a new condition baseline for the EA.

A WHOLE SYSTEM APPROACH

The strategic approach to flood management which has been established over the last two decades needs to be reinforced. This combines flood defences with a holistic management of fluvial and surface water flood risk, and upstream catchment measures to improve building and infrastructure resilience to floods. Flood risk management can be achieved with active measures (physical defences), passive measures (planting of grass and trees to increase water infiltration to soil), emergency management measures (flood warnings and emergency management plans), and improved resilience to speed recovery after flood events occur.

Flood management requires a multi organisational and multi-disciplinary approach. For example, the Metropolitan Glasgow Strategic Drainage Partnership (MGSDP) is a collaborative venture between local authorities, the Scottish Environment Protection Agency (SEPA), Scottish Water and Scottish Enterprise.⁶⁸ The MGSDP is successfully modernising the drainage and sewerage network, reducing flooding and supporting urban development requirements while improving water quality and the environment at a number of locations in Glasgow.

Catchment-wide green infrastructure solutions, especially upstream, offer the opportunity to reduce or delay runoff from catchments. These measures can also provide other benefits such as creating/restoring habitats, enhancing biodiversity, capturing carbon, reducing sedimentation and improving water quality.⁶⁹ This type of joined-up, longer-term thinking can make a big difference to our flood resilience and has further benefits as indicated in the Water section of this report.

cmenvfru/330/33005.htm#n33 ⁶⁴. Figure based on 2010/11 flood defence budget of £679 million, as set by the previous government in 2007 ⁶⁵. Committee on Climate Change (2014) www.theccc.org.uk/publication/policy-note-flood-and-coastal-erosion-risk-management-spending/ ⁶⁶. Committee on Climate Change (2014) Policy note: flood and coastal erosion risk management spending www.theccc.org.uk/wp-content/uploads/2014/01/2014-01-21-ASC-Policy-Note-flood-defence-spending-FINAL.pdf ⁶⁷. EA 2013 written evidence to ICE ⁶⁸. The Metropolitan Glasgow Strategic Drainage Partnership (2013) Briefing Note No.10 www.mgsdp.org/CHttpHandler.ashx?id=15703&p=0 ⁶⁹. British Hydrological Society 2013 written evidence to ICE

GRADE

B

OBJECTIVES FOR 2018

- Implementation of soft engineering techniques for surface water drainage and catchment management
- There should be a reduction in the volume of water flowing into the sewerage network
- A more determined approach to reducing demand for water would yield cost savings for consumers and benefits to the environment

WATER

RECOMMENDATIONS

1. **Department for Environment, Food and Rural Affairs (Defra) should task the recently established National Water Resources Group with creating an integrated and strategic roadmap to ensure future water security including both demand and supply side measures**
2. **Economic regulators should ensure that Total Expenditure (TOTEX) approaches and the use of soft engineering, such as catchment management, are fully incentivised through the economic regulatory system. Water and sewerage companies should ensure that they use these new approaches to deliver resilient and sustainable infrastructure**
3. **Devolved governments and regulators should introduce metering, complemented by social and discretionary tariffs, throughout the UK. This will enable water and sewerage companies to monitor leakage more accurately, and more effectively incentivise water conservation, without adversely impacting low income households**

Investment in the privatised water sector in England and Wales since 1989 has now reached £110 billion, and Ofwat expects at least £20 billion to be invested over the next five years.⁷⁰

Investment has been similarly successful in Scotland where the water infrastructure is publicly owned and subject to regulation by the Water Industry Commission for Scotland. In Northern Ireland there continues to be no domestic charging for water and sewerage services, with funding coming from a mixture of regional rates and Government budget. The direct charging of domestic consumers – in addition to industrial and agricultural users – is vital to ensure water is valued and used more efficiently.

EVOLVING REGULATIONS

Ofwat has recognised the need to shift regulatory incentives to encourage a Total Expenditure (TOTEX) approach to investment such that the total costs of delivering a given set of improvements is minimised while providing customers with best value.⁷¹ Assessing costs on a TOTEX basis removes the tendency for water companies to seek capital expenditure-intensive solutions where there may be better alternatives, which deliver more sustainable and more resilient outcomes for customers.

ICE supports the TOTEX approach but recognises that the concept needs to be clarified and driven through the sector and its supply chain. Only by fully incentivising the right behaviour will water companies select the best combination of capital and operational investment, focused on providing the best outcomes for customers.

ABSTRACTION LICENCES

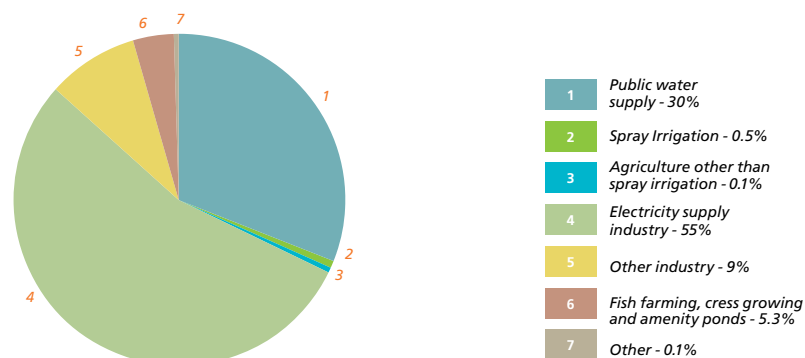
Defra and the Welsh government are currently consulting on changes to abstraction licences in England and Wales. The pressures from climate change and population growth mean that water availability will be less predictable in the future; therefore, the manner in which water is abstracted will have to change. The Environment Agency should ensure that those requiring water are not disproportionately affected. To manage such issues, both long-term demand management and long-term supply measures should be promoted.

70. Ofwat 2013 written evidence to ICE 71. According to Ofwat (2013), 'A total expenditure or TOTEX, approach considers expenditure in a more holistic way. This means looking at a total expenditure requirement rather than separate OPEX and CAPEX allowances.' 72. The Scottish Government www.scotland.gov.uk/Topics/Business-Industry/waterindustry/scotland/theHydroNation 73. Ibid 74. Welsh Government (2014) Water strategy for Wales wales.gov.uk/topics/environment/countryside/epq/waterflooding/publications/water-strategy/?lang=en



FIGURE 5

England and Wales abstraction: all surface and groundwaters



WE NEED TO MANAGE ALL USES OF WATER

Holistic management of water and its interdependencies with food, energy and the environment (including flooding) is vital for future water security. Our current regulatory and institutional structures do not readily accommodate such holistic management. The Scottish Hydro Nation concept⁷² links the importance of water to economic and business growth.⁷³ The Welsh government is currently developing a specific water strategy⁷⁴ to link economic growth to water resource management. ICE welcomes this recognition and recommends that Defra adopts a similar approach for England through the National Water Resources Group.

Figure 5 shows the estimated abstraction by sector in 2010. Although average water abstraction for agriculture is only approximately 1%,⁷⁵ it varies among regions and is as high as 24% in East Anglia during peak irrigation periods. The increased raw water demand from the agricultural sector coupled with reductions in summer flows will thus place increasing pressure on abstraction for public water supply.

Therefore, we need to be proactive in reducing and managing all water uses. Even in areas where water is perceived as abundant, it is still important for the public, industry and other water users to understand the need for, and means of contributing to, good water management and reducing the energy requirements of supplying, treating and heating water.

Metering, which is now extensive in some areas of the UK, is an effective way to enable both water utility consumers to manage their use, and for water companies to fully understand how water is being used. ICE recommends that metering, complemented by social and discretionary tariffs, should be universally applied throughout the UK, implemented over time and on a regional basis according to the extent of water stress. Smart water bills, which provide customers with clearer information on the nature of their water use, should also be introduced. Universal metering will also enable Water and Sewerage Companies to monitor leakage more accurately and effectively.

Real time data and actual abstraction figures are important as they provide regulators with a better understanding of the nature of water use from all sectors. With increased metering and technological developments, water companies should be able to achieve further reductions in leakage and this should be reflected in their Water Resource Management Plans.

INCREASE SECURITY OF SUPPLIES

ICE believes that new water resources, additional storage and more inter-company transfers will also have to be developed to close the long-term supply and demand imbalance in some regions, as part of an integrated strategy which includes demand management and selected areas of water reuse. Major new resources are expensive and water companies should be encouraged and incentivised to collaborate in order to share both investment costs and risk.

PUBLIC WATER SUPPLY RESILIENCE

The Water Act includes an article to provide Ofwat with a primary duty for resilience. ICE welcomes this proposal as resilience should be at the centre of infrastructure delivery.

Regulators and water companies should establish and agree on the level of resilience required for future scenarios. The 'least cost solution' has often driven the type of infrastructure built. Variables such as environmental costs, energy requirements, carbon emissions, reliability and adaptability to a changing climate should be accounted for in business plans to promote resilience.

REDUCE SEWER FLOWS AND DEPLOY SUSTAINABLE WASTEWATER TREATMENT

Currently most urban surface water flows into sewerage networks and is then treated as waste water before being discharged into water courses. This system has historically functioned well; however, the amount of water now flowing in has increased and the capacity of infrastructure has become overwhelmed. Through catchment management,⁷⁶ sustainable drainage systems, retrofit of small scale storage and careful above ground management of flows that exceed the capacity of existing systems, we should seek to reduce the quantity of water flowing into sewers. In turn this would reduce the quantity of water requiring treatment, reducing costs and carbon emissions and potentially improving water quality.

Conventional solutions to improving wastewater standards to meet the requirements of the Water Framework Directive and related standards often require high energy treatment processes, which are expensive to operate. Water companies and regulators should be encouraged to work collaboratively to devise, pilot and implement novel sustainable solutions that will meet water body objectives without increasing energy bills and carbon emissions.

⁷⁵ Defra (2011) Water Usage in Agriculture and Horticulture Results from the Farm Business Survey 2009/10 and the Irrigation Survey 2010 www.defra.gov.uk/statistics/files/defra-stats-foodfarm-farmmanage-fbs-waterusage20110609.pdf ⁷⁶ In total 87 of 93 catchments in England are being managed through partnerships. These pilots have required collaboration between a number of water abstractors and water managers, including water companies, agriculturalists and NGOs.



GRADE

C+

OBJECTIVES FOR 2018

- England will have a clear waste policy which is overseen by one coherent body
- A circular economy will be in the process of being implemented throughout the UK

WASTE

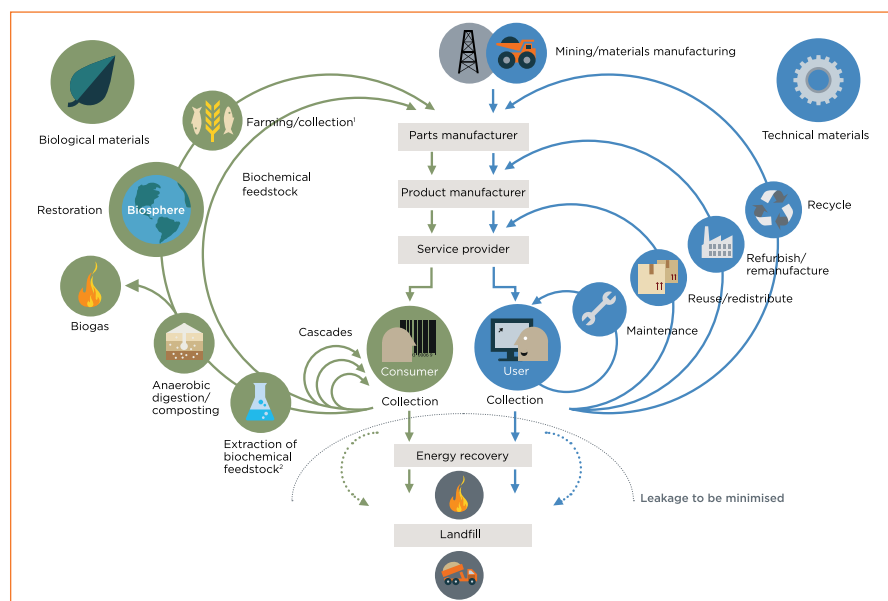
RECOMMENDATIONS

1. **A move from waste to resource management and a circular economy should be at the centre of government policy across the UK**
2. **An Office for Resource Management located in the Department for Business, Innovation and Skills should be established to provide strategic leadership over resource management policy across government in England**
3. **Central Government and the devolved administrations must now focus on creating a policy, regulatory and commercial environment that encourages private investment in infrastructure serving all of the UK's waste streams. At the centre of this should be improved waste data in the commercial and industrial (C&I) sector**

ICE considers a circular economy is central to the future of resource management. Through design, it aims to shift from the 'take-make-dispose' model, to one that extends products' usage; extracting maximum value, reducing waste and also increasing reuse and up-cycling (see Figure 6).

Although waste cannot be eliminated, through thinking in circular rather than linear terms at all stages it can be better managed and become a resource. The establishment of a circular economy will require leadership from policymakers, embedding the idea across government, for example through broadening the ban on sending materials to either landfill or Energy from Waste (EfW) and developing minimum reuse/recycling targets similar to under End of Life Vehicles regulations. As such, it needs a co-ordination that would best be implemented by an Office for Resource Management (ORM).

FIGURE 6 Circular economy⁷⁷



1 Hunting and fishing

2 Can take both post-harvest and post-consumer waste as an input

Source: Ellen MacArthur Foundation (2013) 'Towards the Circular Economy'

⁷⁷ Ellen MacArthur Foundation (2013) 'Towards the Circular Economy': www.ellenmacarthurfoundation.org/business/reports/ce2012 ⁷⁸ ICE (2011) 'State of the Nation Waste and Resource Management' www.ice.org.uk/getattachment/7ef32912-12e4-4e98-9615-976dc8915587/State-of-the-Nation--Waste-and-Resource-Management ⁷⁹ The number of landfill sites operating in the UK has decreased from about 3,400 in 1994 to 2,300 in 2001 to 710 in 2013. Source: Waste Management World (2013) 'UK Waste Management: Growing Old or Growing Clean?' www.waste-management-world.com/articles/print/volume-12/issue-5/features/testing-time-for-uk-landfills.html and HMRC (2013) 'List of Registered Landfill Site Operators' customs.hmrc.gov.uk/channelsPortalWebApp/channelsPortalWebApp.portal?_nfpb=true&_pageLabel=pageExcise_ShowContent&id=HMCE_PROD_009941&propertyType=document ⁸⁰ Compiled from sources: England - Defra (2013) 'Management of Local Authority Collected Waste 2000/01 to 2012/13' www.gov.uk/government/uploads/system/uploads/attachment_data/file/310366/2012-13_ANNUAL_publication_WITHOUTLINKS_v1.xls Scotland - Scottish Government (2013) 'Key Scottish Environment Statistics 2013' www.scotland.gov.uk/Publications/2013/08/1634 Wales - StatsWales (2019) 'Municipal Waste Management Report for Wales, 2007-08 - Revised'

THE OFFICE FOR RESOURCE MANAGEMENT (ORM)

ICE has previously called⁷⁸ for the establishment of an ORM in England. By providing strategic leadership, the ORM would ensure the importance of resource management is entrenched across government. The ORM would provide co-ordination, policy development, modelling and research. Where UK-wide action is required the ORM would be responsible for liaison with devolved administrations, both in pursuit of UK targets and in response to EU regulations.

Examples of particular functions include:

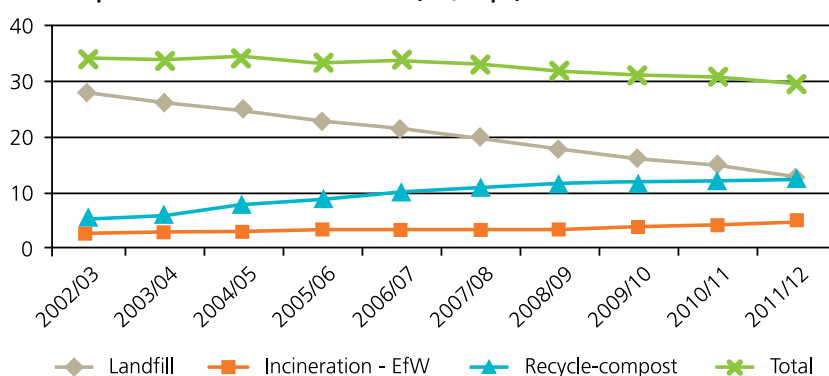
- Review current competencies and vulnerabilities including modelling scenarios to inform policy making and direction across government and in EU negotiations
- Work with stakeholders in developing policy to shift from waste to resource management and create a circular economy
- Lead the setting of national innovation priorities, including future National Waste Planning policy, updates to National Waste Management Plan and National Infrastructure Plans

THE NEED FOR STRATEGIC DIRECTION

Waste policy is fully devolved but the key driver is the EU Landfill Directive, under which the UK is obliged to reduce the levels of Biodegradable Municipal Waste sent to landfill against 1995 levels by 65% by 2020. Scotland, Wales and Northern Ireland provide clear leadership that aligns with European Directives and they should be commended on this foresight.

FIGURE 7

MSW disposal methods 2002/03-2011/12 (UK, mtpa)⁸⁰



The lack of C&I waste data is mirrored in the dearth of strategic direction in the sector. While Municipal Solid Waste (MSW) operators have benefitted from government leadership, C&I management has been left largely to the private sector; ministers have provided no clear direction, targets or support. In part, this is due to a lack of government co-ordination with responsibility dispersed across at least nine government departments including Defra, DECC, BIS and the Treasury.

Over the past 10-15 years, the UK has seen significant, local authority-led infrastructure investment to deal with MSW. As Figure 7 shows, there is a shift away from landfill. Other methods, such as recycling and recovery by EfW facilities have become more prevalent, accompanied by a reduction in landfill site numbers.⁷⁹

The other main trend, the overall decrease in MSW, is less certain. The Landfill Tax escalator will be a driver but there will also be other influences, including a decrease in the production/importation of goods caused by the global economic downturn. This suggests that as the economy recovers and population increases the figures could reverse.

WASTE DATA

While data for MSW is reasonably well recorded, in the commercial and industrial sector – estimated to produce around double the annual tonnage of MSW⁸¹ – the available figures are outdated and often inaccurate. Without rigorous data, resource management (and, it follows, a circular economy) become difficult to implement. This not only affects investment in the waste sector but also has negative effects on other sectors, for example by creating uncertainty for EfW and associated combined heat and power operators.

ICE welcomes the 2011 Responsibility Deal⁸² between Defra and the waste sector. The Deal commits a sharing of data on key trends to assess infrastructure need and identify policy priorities. One of the main improvements is electronic duty of care (edoc), a voluntary system to monitor the collection, transportation and disposal of waste across the UK by replacing the current paper-based system. While edoc is in its early days, it has the potential to provide the anonymised data required for C&I forecasting; however, for it to work, ICE believes it needs to be mandatory.

wales.gov.uk/docs/statistics/2009/090522sdr1772008ren.pdf and StatsWales (2013) 'Local Authority Municipal Waste Management Report for Wales, 2012-13' wales.gov.uk/docs/statistics/2013/131114-local-authority-municipal-waste-management-2012-2013-en.pdf **81.** Defra (2013) 'Forecasting 2020 Waste Arisings and Treatment Capacity - Revised February 2013 Report' www.gov.uk/government/uploads/system/uploads/attachment_data/file/251567/pb13883-forecasting-2020-waste-arising-131017.pdf **82.** Defra/ESA (2011) 'Responsibility Deal Between Government and the Waste and Resource Management Sector' www.gov.uk/government/uploads/system/uploads/attachment_data/file/69406/PB13580-responsibility-deal.pdf

CAPABILITY AND CAPACITY

RECOMMENDATIONS

1. **Government should use the National Infrastructure Pipeline to assess and plan for future capability and capacity needs in order to ensure the UK work force fully benefits from infrastructure projects**
2. **Civil engineers should take responsibility for their learning and career development to ensure that they are properly equipped to deliver and manage the transition to a low carbon economy**
3. **The Built Environment sector should continue to improve opportunities and conditions to encourage and develop a diverse workforce by implementing the recommendations from the Perkins Review and support the Royal Academy of Engineering's Diversity Programme**

Engineers and the competencies they possess are in great demand across the UK economy. The demand is increasing in terms of both the number of engineers needed and the breadth of capabilities. Engineers' transferable skills are not only vitally important to economic infrastructure sectors, but their range of competencies – including, numerical modelling, project management and risk analysis – are utilised in other sectors, such as manufacturing and financial services. As multiple sectors return to growth the demand on engineering skills will continue to increase. In a global context engineering vacancies are second on the list of jobs global employers find difficult to fill.⁸³

CAPTURING VALUE

The focus on infrastructure and desire to attract investment provides the UK with a once in a generational opportunity to grow the skills of the domestic workforce to help meet the demand for increased capital and maintenance infrastructure projects. While continuing to encourage imported skills, over the long term the UK should be able to train and equip local populations to compete for these new opportunities. A clear and committed pipeline of infrastructure projects should be used to identify where these opportunities exist and enable government, industry and academic institutions to provide bespoke training to deliver a vast range of infrastructure projects.

Examples of this approach include the Tunneling and Underground Construction Academy (TUCA) which is a purpose-built facility providing training in the key skills required to work in tunnel excavation and underground construction.⁸⁴ TUCA can help to train and deliver the engineers required to deliver Crossrail, the Thames Tideway Tunnel and High Speed Rail.

ENHANCING CAPABILITY

The civil engineering industry of tomorrow will require a wider range of skills and competencies. Engineers' technical skills should be complemented by professionals who have an understanding of finance, marketing, leadership and management skills and the impact of global influences. From a technological perspective the shifting climatic baseline, the use of Building Information Modelling (BIM), the low carbon agenda, use of off-site construction, globalisation and innovative approaches to improve resilience are all changing the skill sets that engineers and engineering require.⁸⁵

Compliance with environmental regulations and the use of environmentally sensitive materials and practices has also altered the skills required. Innovation and research and development are central to global competitiveness, and demand for service-based products to both the domestic and export markets is likely to increase.⁸⁶ ICE will lead by encouraging civil engineers to take control of their careers.

⁸³. ManpowerGroup (2013) Talent Shortage Survey www.manpowergroup.com/wps/wcm/connect/587d2b45-c47a-4647-a7c1-e7a74f68fb85/2013_Talent_Shortage_Survey_Results_US_high+res.pdf?MOD=AJPERES ⁸⁴. Tunneling and Underground Construction Academy www.citb.co.uk/tuca ⁸⁵. Sector Skills Insights: Construction Evidence Report 50 (2012) www.ukces.org.uk/assets/ukces/docs/publications/evidence-report-50-construction.pdf p.31 ⁸⁶. Ibid p.33 ⁸⁷. Construction Skills oral evidence to ICE ⁸⁸. www.raeng.org.uk/about/diversity ⁸⁹. Royal Academy of Engineering (September 2012) Jobs and Growth, The importance of engineering skills to the UK economy www.raeng.org.uk ⁹⁰. EngTechNow www.EngTechNow.com ⁹¹. Department for Business, Innovation & Skills (2013) Professor John Perkins' Review of Engineering Skills www.gov.uk/government/uploads/system/uploads/attachment_data/file/254885/bis-13-1269-professor-john-perkins-review-of-engineering-skills.pdf



ATTRACTION AND RETENTION

The future demand for engineers requires changes to the education incentives in place to attract students to take science, technology, engineering and mathematics (STEM) subjects; however, the profession as a whole requires changes to attract future engineers.

Female engineers have an average career of five years.⁸⁷ This poor retention rate results in a lack of role models for young females seeking to enter the engineering profession.

The Royal Academy of Engineering runs a Diversity Programme⁸⁸ which receives funding from the Department of Business, Innovation and Skills and works across PEs, industry, education, the Royal Society and other STEM and diversity organisations. The programme aims to improve access to STEM subjects and the engineering profession for ethnic minorities and women. The Construction Leadership Council (CLC) has a programme of work to improve the image of engineering in order to attract a wider range of entrants, delivering key recommendations in Construction 2025. ICE supports both of these initiatives and calls on the wider industry to actively engage in these programmes.

VOCATIONS IN ENGINEERING

It's estimated that by 2020 the UK will require 450,000 more science, engineering and technology (SET) technicians.⁸⁹ There has been a historical lack of attractiveness towards technician occupations, combined with increasing numbers of students progressing to further education this has led to declining numbers of technicians. This issue is being addressed by ICE, the Institution of Mechanical Engineers (IMechE) and the Institution of Engineering and Technology (IET) supported by the Engineering and Science Councils and the Gatsby Charitable Foundation through EngTechNow.⁹⁰

This campaign aims to register 100,000 Engineering Technicians by 2018 and establish technician registration and membership as the norm for those entering the profession. Additionally, ICE supports the Perkins Review recommendation for the engineering community to develop additional Trailblazer Apprenticeships in engineering.⁹¹

THE STATE OF THE NATION INFRASTRUCTURE 2014 CONTRIBUTORS

- AIRPORT OPERATORS ASSOCIATION
- ARUP
- ASSOCIATION OF DIRECTORS OF ENVIRONMENT, ECONOMY, PLANNING AND TRANSPORT
- BRITISH PORTS ASSOCIATION
- CHARTERED INSTITUTION OF WASTES MANAGEMENT
- CONFEDERATION OF BRITISH INDUSTRY
- CONSTRUCTION INDUSTRY TRAINING BOARD
- CONSUMER FUTURES
- CORY ENVIRONMENTAL
- DEPARTMENT FOR BUSINESS, INNOVATION & SKILLS (BIS)
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Image courtesy of Crossrail

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