



BIS | Department for Business
Innovation & Skills

RESEARCH REPORT

Infrastructure supply chains:
barriers and opportunities

AUGUST 2011

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Executive Summary

1. This report fulfils a commitment made in the National Infrastructure Plan 2010. It sets out the findings of a supply chain study covering five infrastructure sectors: transport, energy, digital communications, water and waste. The remit was to identify issues affecting the delivery of UK infrastructure, including barriers to innovation and the efficient operation of supply chains, and identify opportunities to remove those barriers and learn from good practice. The report presents evidence and views from respondents; it is not a statement of Government policy.
2. Section 1 describes the remit and scope of the work, together with the methodology that was used. This was based on direct engagement with business, so as to gain an unfiltered perspective of the influences and incentives that companies face. These interviews were supplemented by published sources.
3. It became clear from interviews with supply chain companies that barriers to infrastructure delivery occur to a different extent and with different consequences in each of the five sectors. They typically arise from the interaction of several factors – for example, an innovation may be technically excellent but if lenders will only finance projects using established technology, then it will not be deployed.
4. The study identified five key issues that potentially affect supply chain performance. These are analysed in Section 2 and the extent to which they constrain each sector is summarised below. Planning, which was cited as a factor by many respondents, is included as part of policy risk.

Figure 1: Potential constraints on supply chain performance

	Innovation	Finance	Policy risk	Procurement	Skills
Transport (Road, rail, ports, aviation)	●	◐	●	●	◐
Energy (Renewables, nuclear, transmission)	◐	●	◐	◐	●
Communications (Fixed, mobile, satellite)	○	◐	◐	○	○
Water (Supply and waste water treatment)	◐	○	○	○	◐
Waste (Including energy from waste)	◐	●	◐	◐	◐

5. Section 3 contains short profiles of each sector, their strengths and weaknesses and the extent to which they are affected by the factors mentioned above. The findings in each case seek to identify the key issues and opportunities to be addressed by future policy – as well as the potential to transfer good practice to other areas.
6. The study found that businesses face a complex mix of sometimes contradictory incentives. Adding to this complexity without understanding the environment in which supply chains currently operate is unlikely to produce the desired response. In seeking to introduce new policy initiatives, it is important to take a holistic view of the barriers and opportunities faced by companies and to assess the potential impact of changes already underway.
7. The findings of this report will inform Government policy including the next phase of the Growth Review announced in June 2011.

Summary of findings

8. The design, construction and operation of infrastructure networks is a complex task that depends upon a network of public and private sector clients, funders, suppliers, economic regulators and infrastructure users. This network is currently subject to change across the board, from reform of public procurement to reviews of economic regulators, the electricity market and the planning framework. The policy landscape by the end of the study was markedly different from the position at the start.
9. With a few exceptions, the supply chains involved are capable of delivering the UK's infrastructure needs. Specific areas of concern include:
 - high-voltage subsea cables (lack of production capacity)
 - nuclear power station construction and commissioning (timing issues)
 - marine energy (immature technology)
10. The primary economic benefits of infrastructure accrue to users over the life of the assets. However there are also opportunities to build long-term UK capability and achieve growth of UK supply chains in certain sectors, notably the rail industry, nuclear and renewable energy sectors, both onshore and offshore.
11. The study found both cross-cutting and sector-specific barriers to innovation and efficient operation. Many of these are being addressed by the measures identified above. Respondents were cautious about the introduction of new measures until existing initiatives had been delivered.
12. The priority cross-cutting barriers were identified as policy risk and finance, plus public procurement where relevant (primarily roads, rail, flood defences and waste). On policy risk, the proposal to publish a forward pipeline of infrastructure projects was welcomed and respondents called for a clearer long-term vision and timely decision-making as additional measures.

13. On finance, the Green Investment Bank was cited as an essential element that was not yet in place. The role of government in de-risking projects so as to allow private finance to participate was repeatedly emphasised, with the risks involved ranging from technology to regulation to scaling-up from demonstrator facilities to commercial scale. Taxation of long-life assets and making the investment case to overseas funds were also seen as areas to address.
14. Sector-specific issues that were identified included:
 - Better integration and communications between clients, Tier 1 contractors and suppliers in the civil engineering and construction sector;
 - Successful and timely completion of the Electricity Market Reform¹ to provide the necessary certainty for investors;
 - Further reforms to procurement in the road and rail sectors, building on good practice introduced by the Highways Agency;
 - Better demand management and more selective use of technical standards in the procurement of railway rolling stock;
 - Bridging the funding gap for marine energy technologies;
 - Incentives for collaboration and innovation in the water sector;
 - Specialist funding provision for innovative waste treatment technologies that were unable to obtain bank lending;
 - Coordination between industry providers and the community to ensure that ICT infrastructure installed for the Olympic Games has lasting benefits.
 - Encouraging industry engagement with Government through the Offshore Transmission Coordination Group to address the challenges of building the offshore grid.
15. The Charter commitments² agreed as part of the Infrastructure Cost Review address many of the behavioural and cultural aspects of the change that is needed. The emphasis on transparency and certainty as well as whole life outcomes and earlier supply chain involvement go to the heart of what is required. It is important to note that the Charter is even-handed as between government and industry; it was clear from this project that many of the barriers identified would require joint action from both private and public sector if they were to be overcome.

¹ The reforms were published in a White Paper on 12 July 2011

² See http://www.hm-treasury.gov.uk/d/iuk_charter.pdf

Section 1: Scope and methodology

16. This paper meets the Government's commitment in the National Infrastructure Plan³ to identify barriers and opportunities in infrastructure supply chains and to publish the findings. The purpose of the study was to identify barriers to growth and innovation through analysing the evolution of supply chains in infrastructure and the business environment in which they operate.
17. This was a research study and the findings are therefore a statement of evidence rather than Government policy. The conclusions will feed into government policy decisions, including the next phase of the Growth Review. The findings support the importance of delivering measures that have already been identified, including the forward pipeline of projects and other measures to offer forward visibility and reduce policy risk.
18. The National Infrastructure Plan identifies five sectors: transport, energy, digital communications, water and waste. As work progressed, three points became apparent:
 - a great many actions were already underway across these five sectors, ranging from policy reviews in waste and the role of economic regulators to a comprehensive review of the electricity market;
 - while several Tier 1 firms had a presence across the infrastructure sectors, particularly in construction and civil engineering, their sub-suppliers were more specialised and hence less able to transfer expertise and good practice;
 - all five sectors faced common issues and barriers to growth, of which the two that were cited consistently were finance and policy risk.

How the research was carried out

19. The findings of this report are based on desk research, evidence from infrastructure funders and operators, and finally conversations with the suppliers who will actually deliver the infrastructure assets described in the National Infrastructure Plan. These conversations informed an analysis, for each sector, of barriers to innovation and also of the strengths and opportunities for growth. They gave an invaluable industry perspective on the policy options open to government and the practical impact of the current business environment.
20. Given the size and complexity of the sectors in question, these analyses are not exhaustive but they do enable an assessment of barriers and an answer to the question: is the supply chain for this sector able to deliver against expectations? More thorough analyses of each sector are referenced in the text and include assessments by economic regulators, academic research and government policy reviews.

³ www.hm-treasury.gov.uk/d/nationalinfrastructureplan251010.pdf

21. As the importance of cross-cutting issues became apparent, research was extended to include evidence in each of the five areas identified. The overall picture that emerged was of a complex business environment in which seemingly minor changes can have far-reaching impacts on confidence and hence investment decisions.
22. A consultative group gave generously of their time to assist the project and provide a business and engineering perspective. The group included representatives from the EEF, CBI and from three engineering institutions, the IET, IMechE and ICE. All of these bodies have expertise in their own right and have made important contributions to the policy debate, particularly on the possible engineering responses to climate change. Collectively, they provided an invaluable sounding-board for the findings of this work.

Cross-cutting issues

23. From conversations with supply chain companies, it soon became clear that they faced common barriers to growth and innovation as well as sector-specific issues. While the existence of these barriers was not a surprise, engagement with suppliers offered new insights into their nature and how they might be overcome. Discussions with supply chain companies highlighted five cross-cutting issues, further described in Section 2:
 - how the business environment affects the availability of finance for infrastructure and how to remove barriers in this area;
 - how to offer investors better forward visibility of policy direction to underpin investment decisions and reduce policy risk;
 - linked to this, the impact of Government procurement on suppliers and whether current arrangements produce the best outcomes for infrastructure users;
 - the availability of people with the right skills to deliver the UK's infrastructure needs and how demand for skills is signalled to the labour market;
 - measures in addition to those above that would stimulate innovation in infrastructure provision – both technological innovation and changes in the operation of infrastructure assets and the behaviour of end-users.
24. While these barriers may seem to be somewhat remote and non-specific, supply chain companies put forward a clear view that action was needed in parallel on cross-cutting and sector-specific issues in order to unblock investment and innovation. In particular, the question of forward visibility was highlighted time and again as a factor that held back investment, because companies were not well-placed to understand or manage policy risk.

Barriers and opportunities

25. Factors affecting individual supply chains were influenced by their sources of funding, whether or not the sector was regulated and finally the level of certainty with which companies could assess the future direction of their sector. The water sector is at one end of the spectrum with stable regulation, predictable cash flows and well-understood long-term goals. This stability has delivered a doubling of capital investment since privatisation with improved environmental standards.

26. The road and rail sectors have not yet achieved the same level of stability and companies provided extensive evidence of the impact of unpredictable work flow, an over-prescriptive procurement culture and investment plans that are called into question even when the work has been put out to tender. The impact of these factors and the steps being taken to remedy them are described in Section 3.

Supply chain collaboration

27. As this report was being prepared, measures were already underway to address the culture of public sector procurement and seek a more appropriate use of standards and frameworks. A new quality of dialogue between public sector clients and the construction industry is being sought following the infrastructure cost review⁴, which found worrying discrepancies in the capital cost of UK infrastructure projects when benchmarked against our main competitors. Putting this right is not a task for industry or government alone, nor can the cost discrepancy be pinned to a single factor as the cost study made clear.
28. The high-level objectives and behavioural changes needed to reduce the costs of infrastructure delivery are set out in a Charter⁵, whose creation was one of the outcomes of the cost review. Developed jointly by government and industry, the Charter includes commitments that address many of the barriers identified in this report, including from government:
- provide improved transparency and certainty around the infrastructure forward programme;
 - group projects into more efficient longer-term programmes with clear outcome based objectives;
 - seek the best whole life outcome rather than seeking the lowest cost for a given specification.

The Charter places responsibility on industry to:

- be proactive in supporting Government and infrastructure clients to develop and implement new models of procurement and other means to reduce costs and remove wastage;
 - develop long-term strategies to invest in innovation, training and improve safety, productivity and skills; and
 - promote industry collaboration and joint venturing as a means to improving efficiency and growth.
29. Taken together, these pledges address many of the issues and barriers identified in this study. The Charter is therefore an important summary of the behavioural changes that need to take place. It states that *Government will embed these objectives and behavioural changes into the public sector* – a necessary but challenging ambition, given the extent of culture change that this implies. As the Charter itself recognises, publication of the pledges is only the beginning and government has undertaken to report annually on progress.

⁴ www.hm-treasury.gov.uk/d/cost_review_main211210.pdf

⁵ http://www.hm-treasury.gov.uk/d/iuk_charter.pdf

Next steps

30. Across the five infrastructure sectors and cross-cutting issues, many of the findings of this report are already being addressed by policymakers, industry and regulators. There was little evidence that new institutional arrangements were needed, but rather that existing mechanisms needed time to bed down and gain the confidence of all stakeholders. Collaborative groups such as those described above will play a key role in assessing the business environment as it relates to infrastructure. The revised planning framework and operation of the Major Infrastructure Planning Unit is just one example of a major reform whose effectiveness will take months if not years to assess.

31. On the key question of forward visibility and policy risk, the Government committed in the Plan for Growth in March 2011 to publish a long term forward view of infrastructure projects and programmes in the National Infrastructure Plan 2011. This initiative was universally welcomed by Tier 1 suppliers in particular, who noted that their more enlightened private sector clients went to some lengths to share forward strategy and work plans, knowing that it would be to their benefit in securing the necessary supply chain capacity when those plans were realised.

Section 2: Cross-cutting issues

Innovation

32. A number of reports⁶ have highlighted innovation as a major issue for the UK's infrastructure. Innovation here can refer to the implementation of novel forms of infrastructure. But it also relates to the ease with which businesses in the supply chain create and develop new ideas or products, and how easy it is for these to be integrated into existing systems.
33. It would be incorrect to suggest that there was no innovation whatsoever across the infrastructure supply chains. Levels of innovation differ between sector and sub-sector, and some of these are especially innovative. However, it is evident that, despite the excellence of the UK's research base, the ideas and technologies generated here are not being developed and integrated into the infrastructure networks to the full extent that they could be. This is predominantly due to the incentives (regulated and non-regulated) that govern the infrastructure networks, which promote low-risk behaviour, and which impact on procurement practices and interaction within the supply chain.
34. Improving innovation within the supply chains will be particularly important over the next 20-30 years, as the UK looks to modernise and 'green' its infrastructure. Removing barriers to innovation is imperative to achieving these goals and will lead to a better outcome for the UK.

Evidence

35. Given the diversity across sectors, it is unsurprising to see different barriers to innovation in different sectors. For example, in the rail sector the over-specification of national standards is an inhibitor of innovation there.
36. Levels of innovation are driven by the overall objectives and incentive frameworks of that sector. Business comment that short-term, cost-saving, well-tested innovations are encouraged over innovations that are longer-term, not purely focussed on reducing costs and deviate significantly from the status quo. This approach, whilst producing effective and reliable networks does restrict innovations that could improve the quality of the service.
37. This incentive structure exists for good reason: to improve productivity and efficiency in UK infrastructure. Furthermore, as knock-on effects of failure in the infrastructure network to the rest of the economy are extremely severe, it is unsurprising that low-risk options are disproportionately favoured by managers of infrastructure networks. Creating the right incentives (regulatory or non-

⁶ Committee on Climate Change Council (2010) Building a low-carbon economy – the UK's innovation challenge; Council for Science and Technology (2009) A national infrastructure for the 21st century; UK Government (2010) National Infrastructure Plan

regulatory) that are able to manage this risk will be instrumental to 'pulling through' alternative types of innovation.

38. Whilst these incentives are often cited in relation to the economically regulated sectors (as discussed below), these frameworks are by no means confined to these specific supply chains. Even where infrastructure is not technically subject to economic regulation (such as the rail network), its modus operandi for scheme evaluation and prioritisation, operated through a single agency, can often lead to practice comparable to the regulated industries⁷.
39. The following issues were raised in discussions with industry, and are discussed in more detail below:
- Policy Consistency
 - Regulatory Incentives
 - Procurement
 - Investment
 - Demonstration Facilities
 - Data Quality and Distribution

Policy Consistency

40. As development in infrastructure is inherently long term, certainty and security for all parts of the supply chain is necessary to give confidence for innovation. Where a policy has been given time to bed in (for example, on the Landfill Tax), and industry has had time to prepare, adjust and plan for the changes, business has been able to respond accordingly.
41. Conversely, respondents stated that the Electricity Market Reform process had added uncertainty to industry planning⁸. Relevant supply chains agreed that the reforms were necessary, but inevitably business and investors would need time to adjust to the new system. So long as it was unclear what the reforms would mean and how they would work in practice, there would be uncertainty in the marketplace leading to a pause in investment. Respondents pointed to the need to balance opportunities for consultation and engagement with forward visibility and timely decision-making.
42. Looking ahead, the proposed publication of the pipeline of infrastructure projects was welcomed as a measure that would help give industry the confidence to invest in innovation.

⁷ Innovation and Growth Team (2010) *Low Carbon Construction*, HM Government

⁸ The reforms were published in a White Paper on 12 July 2011

Regulatory Incentives

43. In their 2009 report on the national infrastructure⁹, the Council for Science and Technology stated that:
- The current regulatory framework has lasted well over 20 years, and was designed for particular purposes, separately for the individual sectors within the NI. We are not convinced that as it currently stands the regulatory system is optimally designed to meet 21st century challenges e.g. to address the pressing challenges for increased resilience; for reducing carbon footprints; or for encouraging longer-term investments in innovative solutions by business.*
44. The current regulatory system has in some instances been very effective at incentivising innovation. For instance, the introduction of the RPI-X regulatory framework challenged industry to increase its productivity. This formula encouraged efficiency and lower network investment costs by taking the retail price index and then subtracting an efficiency factor (X) from it. However, by continually seeking to force down the rate of return to financing costs, this regulatory structure has inevitably made both longer-term and riskier investment and innovation unattractive.
45. Other examples illustrate the way that regulators can both incentivise or reduce the incentives for certain types of innovation. The regulatory investment structure in the water sector, it is sometimes argued, encourages short term protection of customers at the expense of long-term industry performance. In digital communications, the UK imposes tighter constraints than other countries in license-free spectrum, thus restricting the free development of networks including commercial high speed internet services. However Ofcom also has a statutory duty to promote innovation, which requires it to take a longer term perspective on developments in business.
46. Regulators have recognised that they need to encourage more innovative approaches. Ofgem's Low Carbon Network fund sets a framework in place to encourage network operators to engage in funding large-scale demonstration projects. Their new 'RIIO' (Revenue = Incentives + Innovation + Outputs) model also encourages companies to take a more innovative approach to network management and sets a long-term framework to encourage a more flexible and forward looking approach from network companies..
47. Regulators have also recognised that they need to provide more certainty and forward visibility of infrastructure plans to encourage longer term investment, beyond the fixed-term price control period. Both Ofwat and Ofgem have developed policies for this purpose: water companies were asked to create 25 year 'Strategic Direction Statements', setting out the vision for the future of water and sewerage services; Ofgem has lengthened the price control period for Transmission Operators. Greater collaboration with industry has helped this. Through the creation of the UK Water Industry Research (a collaborative industry forum), Ofwat has worked with the water companies to facilitate innovation.

⁹ A national infrastructure for the 21st century CST, June 2009 available at <http://www.bis.gov.uk/cst/cst-reports#Infrastructure>

Procurement

48. In some procuring organisations, there is insufficient expertise to undertake the effective procurement of innovative products and services, which inevitably results in a low-risk approach or continual engagement with the incumbent businesses. Even where there is expertise, procuring organisations will tend to opt for the low-risk option, thereby choosing recognised or existing suppliers and hindering the emergence of more innovative ideas.
49. The way contracts are structured can also inhibit innovation, due to the fact they are often only short-term and there is little visibility of the future pipeline. Often the contracts themselves include overly detailed specification, which can also inhibit innovation. Greater flexibility through the use of outcome-based specification in contracts could allow for more innovation, or allow suppliers to adapt to unexpected challenges over the course of the project.
50. There is evidence that industry collaboration could lead to greater innovation. For example, the National Grid have taken an 'alliance' approach to contracting, sharing risk and costs in exploring innovative solutions. The Rail Alliance, an industry trade body, works with the rail sector (notably Network Rail) to widen choice of suppliers and to ensure new and innovative goods and services are not neglected.

Investment

51. Small businesses comment that it is particularly difficult for them to commercialise innovative ideas or technologies in infrastructure sectors. There is low appetite for risk from investors when initial funding (including the contractors' own balance sheet) is reaching its risk limit and banks are not ready to lend. This predominantly affects SMEs in the supply chain, rather than large businesses, whose balance sheets are more able to support the investment required.
52. Infrastructure investment is still recovering from the effects of the credit crunch, which has affected the availability of project finance in non-regulated sectors (though there are early signs of recovery) and led to the collapse of the bond insurance market, thus reducing access to capital markets. The EU Solvency II Directive is also set to impose tighter risk management on insurance funds (and potentially pension funds) from 2013. Respondents noted that this has made it extremely difficult to secure finance for novel infrastructure or for more innovative (and inherently more risky) forms of infrastructure.
53. The Green Investment Bank could be critical in helping socialise the risk for that short period whilst bank finance is sought. Local finance solutions may also be able to catalyse the implementation of novel infrastructure. The London Waste and Recycling Board (LWARB), a statutory public body, operating on a commercial basis, has found a solution to the problem in the waste sector, but is yet to operate on scale. They operate as a statutory public body (funded by DEFRA and LDA) but operate on a commercial basis, issuing loans rather than grants. This means that they are able to act as a 'first mover' to lever in additional funding from other sources.

Demonstration Facilities

54. When developing new products, the ability to test it and decrease the risk associated to it is particularly important. However, given the potential impact of failure in infrastructure and difficulties in accessing the network for testing, it can be very difficult for SMEs or new entrants to successfully test novel ideas.
55. For example, it is extremely costly to replace failed components in offshore wind turbines. As a result, there is no appetite from the major manufacturers to include components that do not come from companies with a suitable pedigree of supplying into the market. This issue has been recognised by the industry, with turbine test and demonstration facilities in place and planned.
56. In the marine sector, for example, this problem has been solved through public intervention and the building of marine testing facilities. Now the UK is considered to have the most advanced testing facilities for marine energy across five sites across the country.

Data Quality and Distribution

57. Innovation would be facilitated by up-to-date information on different infrastructure types and other smarter infrastructure features including interconnection and real-time condition monitoring. Currently these data are of variable quality and typically not shared between sectors. This includes the location and condition of infrastructure assets, demand patterns and interdependencies. The potential benefits of better-quality information include resilience, optimisation and public engagement. Government has a role to facilitate data collection and use, both as a customer and in the interests of private sector growth.

Conclusions

58. Simply put, innovation requires idea generation and a motivation or incentive for those ideas to be adopted. The UK should continue to maintain funding in R&D, whilst encouraging an overall framework, in collaboration with industry, which is open to new ideas and technologies and can effectively manage the risk that comes with these innovations.
59. Economic regulators are taking steps to shift incentives to encourage more innovation. The evidence suggests that other publicly driven supply chains (for example, rail and road) could usefully review the frameworks that govern their industry, ensuring they are able to adjust to the long-term challenges ahead – the independent review of the Strategic Road Network (Cook Review) is an example.
60. Government plays a crucial role, working with industry, to set its objectives for infrastructure investment. This should enable the UK to make long-term investment decisions based on a shared analysis of needs and priorities, which can then act as a framework for the private sector, regulators and Government to operate within.
61. Taking steps towards more consistent policy and regulatory frameworks for each sector would provide more confidence for investors and innovators alike. Maintaining regulators' independence is vital, and this is one way of creating stability for business, but there are other ways to recognise the value of long term stability in infrastructure and the effect that uncertain or delayed decision-making can have on this.

Finance

62. The National Infrastructure Plan 2010 noted that *trends all point towards a need for a step change in both the level and type of investment* in infrastructure. The plan listed the key drivers as:
- Obsolescence
 - Globalisation
 - Growing demand
 - Climate change
 - Interdependence
63. These drivers do not apply equally to all types of infrastructure, not least because some sectors have a head start in meeting the investment challenge. For this reason, overall spend on water and communications infrastructure is expected to remain broadly stable over the five years to 2015 as compared to the previous five-year period.
64. The energy sector meanwhile will see the largest absolute increase as existing power stations are taken out of service and a new zero-carbon electricity infrastructure takes shape, with not only new generating plants but storage facilities, offshore substations, interconnectors and carbon capture technology all required in order to meet the UK's greenhouse gas reduction commitment. Continued growth in demand and the need to update ageing and overcrowded networks are the main drivers that expected to maintain the transport sector's position as a key focus for public investment during this period.
65. The total investment over five years to 2015 is assessed at £200 billion, of which the private sector is expected to contribute some 70%. Direct government investment is focused on the transport sector, with targeted interventions in energy from waste, high-speed broadband and carbon capture and storage. Indirectly, government incentives will play an essential role in the projected doubling of private-sector investment in the energy sector.
66. These forward projections do not include investment in the production facilities required to support this new infrastructure, items ranging from wind turbine blades and hubs to railway rolling stock to components for nuclear power stations to process plant for carbon capture and storage. Depending on the sector, this type of investment represents a significant opportunity to build lasting UK capability over and above the growth impact of the infrastructure assets themselves.

Evidence

67. The extent to which finance was seen as a barrier varied according the sector and size of company. Respondents identified a number of influences on funding availability:
- global competition for investors' funds, from fast-growing economies in Asia and the Middle East as well as established competitors in Europe and North America

- bank de-leveraging, encouraged by financial regulators, leading to reduced debt availability and an increased role for equity in the funding mix
 - regulations affecting the investment able to be held by insurers, notably the Solvency II Directive, and by pension funds
 - the rise of sovereign wealth funds and other state-backed entities and the differences in investment culture between these and traditional investors
 - the treatment of long-life assets in the UK tax system as compared to other jurisdictions, notably the withdrawal of Industrial Buildings Allowance in 2008
 - perceived short-termism in the investment approach of UK institutions as compared to investors from continental Europe and Asia.
68. While there is no global shortage of liquidity¹⁰, UK projects will increasingly be competing for the attention of overseas investors and infrastructure funds with a remit to invest wherever the balance of risk and long-term returns looks most attractive. The National Infrastructure Plan set out a number of steps to ensure that this balance remains competitive and the Infrastructure Growth Review will consider what additional measures may be required.
69. On the question of short-termism, Professor John Kay has been asked to examine investment in UK equity markets¹¹ and specifically *whether the timescales considered by boards and senior management in evaluating corporate risks and opportunities, and by institutional shareholders and fund managers in making investment and governance decisions, match the time horizons of the underlying beneficiaries.*

Conclusions

70. Looking specifically at barriers to innovation in the supply chain, respondents identified three specific issues:
- risk aversion on the part of funders that leads to proven technology being mandated as a condition of investment (as one technology manager put it, “innovation is not just discouraged, it is banned”)
 - the impact of policy risk not only on investment in infrastructure assets themselves, but in supporting facilities and skills
 - innovation in funding itself - the opportunity to extend proven models to new areas of infrastructure.

¹⁰ For example, specialist consultancy Ecofin estimates that the necessary rise of £40bn over 10 years in institutionally managed funds allocated to the UK energy sector would represent a shift of less than 0.2 per cent of global assets under management

¹¹ Professor Kay’s review was announced on 22 June 2011 and its terms of reference may be found at <http://www.bis.gov.uk/assets/biscore/business-law/docs/k/11-1015-kay-review-terms-of-reference.pdf>

Funders and innovation

71. Because innovation is fundamentally risky and infrastructure assets are large, long term commitments, it should not be surprising that lenders typically mandate the use of proven technology in projects that they are requested to fund. The extent to which this issue inhibits innovation varies across sectors. In the water industry, suppliers felt that water companies were receptive to innovative proposals because they were well-placed to assess the risk and did not rely on project-specific funding. This was especially interesting given the criticism that is sometimes voiced that the regulatory regime for the water industry incentivises spend on new assets rather than innovation in how existing assets are used.
72. Where bank lending is tied to a specific project, lenders will seek to limit the technology and execution risk by satisfying themselves that equipment and processes used are robust and proven. Technology demonstrators do not fully eliminate this risk, since the technical challenge of scaling-up a demonstration facility remains. Companies therefore need to use other sources of finance, which may include bonds (if the firm is large enough) or their own equity.
73. The role of the Green Investment Bank (GIB) is to de-risk such investments sufficiently to allow commercial lenders to take part. Although the energy sector is likely to represent the largest proportion of GIB investments, of those firms interviewed for this study it was those in the waste management sector for whom project funding appeared to be the most significant barrier, perhaps reflecting the smaller deal size and greater commercial uncertainty as compared to (say) wind generation. The London Waste and Recycling Board (LWARB) is close to the GIB in concept and received the endorsement of companies in the sector as an effective body that had enabled projects to proceed that would not otherwise have gone ahead, leveraging significant private funds in the process.

Investment in supporting facilities

74. While the funding requirements of infrastructure asserts preoccupy clients, for their suppliers it is the need to invest in production plant. This varies across sectors, with particular opportunities in energy, waste management, rail and airports where there is significant manufacturing content alongside the construction element of the work.
75. In new sectors such as wind and other renewable technologies, suppliers underlined the scale of the opportunity for the UK. Clear policy direction and the natural advantages of UK geography have led to a ramp-up in projected investment that equals the most optimistic scenarios presented at the start of the process. Suppliers noted however that there was uncertainty around the timing of the next round of procurement for offshore wind, which risked damaging investment plans (these interviews took place before the outcomes of the Electricity Market Reform were known). A senior executive with a Tier 1 supplier to the offshore wind sector wrote:

The supply chain is ready to invest in the UK and bring down the cost of offshore wind, but we are very nervous about whether there is a sufficient market here. The 7 year plus lead time for offshore wind means changes in signals over that whole timescale will affect what finally gets built. At the very time when we need to make large, one-off investment decisions to meet potential demand from Round 3 we are in the middle of a 2-year famine in new orders in the UK.

Innovative funding mechanisms

76. Although most suppliers have little direct involvement in the funding of infrastructure projects, they have an interest not only in the potential business but in a stable and predictable funding environment. The roads sector at local level was described as being particularly prone to funding uncertainty, owing to the number of different funding streams that would typically come together to allow such projects to go ahead.
77. The Regulated Asset Base model has been conspicuously successful at providing incentives to investment, notably in the water sector. One construction company with clients in the water, transport and local authority sectors, suggested extending this model to assets such as flood defences, arguing that the existing regulated utilities were well-placed to play a leading role:
- Their equity and debt providers are familiar with the concept too, so raising additional capital for RAB-based projects is likely to be more straightforward than for newcomers to the field. Furthermore, they have established contracting relationships with the designers, builders and operators of infrastructure, thus lowering the operational risk in bringing any project to fruition. Nor are the synergies purely intellectual. By expanding into infrastructure provision there may be additional economies of scale that flow through to the procurement of materials and services for their existing businesses.*
78. For the majority of suppliers however, the general business environment including the ability to finance their own working capital needs at an acceptable cost was a more relevant consideration.

Public procurement

79. Where government purchasing represents a significant share of the total market, public procurement can have a significant impact on:
- supporting robust supply chains
 - stimulating innovation in new technologies and markets
 - enabling competition in infrastructure markets
80. Of the five infrastructure sectors, transport has the highest level of public capital expenditure through procurement at £8.7bn in 2009/10¹². Overall public procurement of transport (both capital and current) has been steadily increasing over the last 5 years from £12.4bn in 2005/6 to £15.7bn in 2009/10¹³.
81. The other significant areas of expenditure are flood defences and waste management. Defra spending during the previous four years on flood defences was £2.36 billion¹⁴ although this is expected to be reduced by 8% over the next

¹² PESA National Statistics Release 2011 available at http://www.hm-treasury.gov.uk/pesa2011_section2.htm

¹³ PESA National Statistics Release 2011 as above

¹⁴ Source: Defra <http://www.defra.gov.uk/news/2011/01/17/mythbusters-flood-spend/>

four year period. Total public expenditure on waste management has increased from £5.1bn in 2005/6 to £6.6bn in 2009/10, possibly reflecting the rise in landfill tax over that period¹⁵.

Evidence

82. Evidence has been gathered from industry through workshops, stakeholder interviews and through a literature review. In both, businesses have argued public procurement practices can create barriers to growth and innovation.

Evidence from industry highlighted the following procurement practices and recommended actions which, if taken forward could have a positive impact on delivery and investment down the supply chain	
Communication	<ul style="list-style-type: none"> • Improvements in consistency to give degree of certainty that procurement contracts will not alter substantially during the contractual period • A constructive dialogue with industry throughout the full procurement process, particularly at the pre-procurement stage • Clear, consistent goals articulated throughout the procurement period • Effective communication and dialogue between the procurer and the provider(s) during the contract phase
Contractual Incentives	<ul style="list-style-type: none"> • Key Performance Indicators (KPIs) and payments structures should align with the outcomes to be achieved to prevent perverse incentives • Over-detailed and prescriptive specifications and can create barriers to market entry • Tender documents should be incentivise competition on quality as well as price • Risk should be appropriately managed and passed down supply chains
Attracting New Market Entrants	<ul style="list-style-type: none"> • Industry engagement is primarily with incumbents, this should go wider to stimulate competition and innovation from new market entrants and SMEs • High barriers for SMEs in understanding how to participate in major procurement programmes.

¹⁵ PESA National Statistics Release 2011 *as previously*

<p>Long-term Planning and Strategy</p>	<ul style="list-style-type: none"> • Long-term planning by contracting authorities is needed with as much information as possible shared with industry to enable investment, innovation and risk assessment • Reduce the practice of procuring projects to fast delivery times where possible, as this increases costs to the supplier and to the purchaser • Lifecycle costing and a systems approach should inform strategic procurement. Current practices are too focused on unit cost on a project by project basis, this can lead to a higher total cost
<p>Capability and Skills</p>	<ul style="list-style-type: none"> • ‘Up-skilling’ of procurement officials to better understand incentives, business impact and business engagement and address the seniority at which decisions are taken about complex trade-offs

International Comparisons

83. The most recent detailed study in this area is the Infrastructure Cost Review¹⁶, which uncovered some stark comparisons:
- Benchmarking of eight roads projects between the UK and the Netherlands indicated that the UK examples are on average 10% higher, based on the unit costs per lane kilometre.
 - When compared to the four most directly comparable EU projects, the Channel Tunnel Rail Link (CTRL) 1 construction cost was at least 23% higher.
84. The Lean Review (2011)¹⁷ also looked at a smaller sample of projects and concluded that complex procurements took an average of 77 weeks in the UK compared to just 44 weeks in Germany. Whilst these statistics are concerning, the Infrastructure Cost Review does point to the greater density of population, higher land costs and the ageing asset base in the UK as a contributing factor.

¹⁶ HM Treasury ‘*The Infrastructure UK Cost Review*’ (2010) as previously

¹⁷ Cabinet Office ‘*The Lean Review*’(2011) available at <http://tinyurl.com/6as77h6>

Capability and Skills

85. The Infrastructure Cost Review revealed an industry perception that the UK had less in-house technical knowledge than other EU countries. This resulted in a limited capability to negotiate and challenge as part of the procurement process (with the notable exception of pockets of good practice). The recent House of Lords Science and Technology Committee report also highlighted the lack of seniority of decision-making on procurement, which was confirmed by Francis Maude (the Minister for the Cabinet Office with responsibility for procurement) who stated that once a policy had been agreed responsibility for the procurement defaults to a relatively junior level¹⁸.
86. The Lean Review pointed to a lack of market understanding, which made procurers unlikely to effectively run a process based on future and current demands; in addition to a lack of legal and commercial capability and an over-reliance on external expertise to plug these gaps. The NAO again pointed to a lack of knowledge of the supply market amongst procurers across all types of public procurement¹⁹ suggesting this is endemic and difficult to resolve.
87. The barriers to changing public procurement culture were perhaps best summarised by Dr Charles Wessner of the US National Academy of Sciences, who stated that “changing the incentives in [public] procurement to accept greater risk is more difficult than commonly believes... career incentives for procurement officers tend to support the selection of established products rather than promising prototypes whose production at scale, timely delivery and quality assurance may be problematic.”²⁰

Access for SMEs

88. Across the public procurement landscape there is significant published evidence about the barriers faced by SMEs in accessing, competing for and winning public contracts. The Industry-led report *'Evaluating SME Experiences of Government Procurement'* (2008) and the independent *Glover Review* (2008) found that small and medium sized enterprises (SMEs) were deterred from selling their services to the public sector owing to a whole range of barriers, including:
- lack of awareness of opportunities
 - excessive bureaucracy
 - risk aversion from Government procurers
 - increased contract sizes
 - prime contractors & managed service providers lacking transparency
 - unsophisticated financial management knowledge among procurers
 - varied and onerous Pre-Qualification Questionnaires (PQQs)

¹⁸ House of Lords Science and Technology Committee 'Public Procurement as a tool to Stimulate Innovation' Report May 2011

¹⁹ NAO report: 'A Review of Collaborative Procurement across the Public Sector' (2010)

²⁰ Evidence to the House of Lords Science and Technology Committee quoted in 'Public Procurement as a tool to Stimulate Innovation' Report May 2011

89. A systematic review and analysis of SMEs' experience of infrastructure procurement was beyond the scope of this review. Nonetheless it seems clear that good procurement practice can ensure the Tier 1 supplier has the necessary experience and capacity, while at the same time providing assurance that it will nurture smaller, specialist suppliers down the supply chain.
90. Evidence provided to the House of Lords Science and Technology Committee by Andrew Wolstenholme an Executive at Balfour Beatty, CEO of Cross Rail and formerly responsible for Heathrow Terminal 5, demonstrates the potential for SMEs engaged in infrastructure delivery:
- Delivery partners [contracts] are normally awarded to large organisations able to draw on resources from large pools and with a depth and breadth that would be able to demonstrate experience of projects of a similar scale and nature...it is still possible to design a procurement strategy that accommodates both large and small companies to deliver innovation—even on large transport projects... if you go down into the layers of supply chain then you'll come across companies of all different shapes and sizes. You'll be surprised by how many SME organisations are there to support with good ideas, innovation and value. I think the constraint here is to create a project environment where you have open innovation through the vertical slots of the supply chain and to create the opportunity where those companies with good ideas can get to the surface.*
91. The Infrastructure Cost Review noted the opportunities for greater supply chain integration to drive cost savings and stimulate innovation and that this could be led by the development of a common procurement approach (in appropriate circumstances) in the public sector.

Short-termism

92. Literature on procurement of infrastructure highlights the problems associated with short-termism such as increased transaction costs for the public and private sector; low investment in skills and R&D amongst suppliers that are uncertain about the project pipeline and less well-integrated supply chains (Infrastructure Cost Review 2010). The UK economy is dependent on a modern infrastructure base that attracts inward investment and supports domestic firms. Infrastructure also needs to be able to respond to the challenges of the future such as climate change by offering low carbon solutions (mitigation) and adapting to threat of global warming (adaptation and resilience). Evidence on this was received by the House of Lords Select Committee on Science and Technology which set out that a long-term view of the pipeline was imperative to secure private sector investment and technological capability necessary to meet future demand²¹

²¹ *Public Procurement as a tool to Stimulate Innovation* House of Lords Science and Technology Committee, May 2011 - evidence from Invensys Rail and the Royal Academy of Engineering

Fragmented Public Sector Buying Environment

93. Although infrastructure procurement, particularly where major construction projects are involved, tends to be concentrated in a handful of spending departments and arms length bodies; issues relating to the fragmentation of the public sector buying environment have emerged through the literature review. The Lean Review pointed to a system in which there exists little sharing of best practice in procurement between government departments, agencies and the wider public sector. The House of Lords Report²² issued a recommendation for best practice to be more widely adopted and for a single Minister to have responsibility for innovation and procurement in order to create a strategic approach to procurement across the public sector. The Government are currently considering the recommendations of the Committee.

Increased Bid Costs

94. The findings of the Lean Review 2011, Infrastructure Cost Review 2010 and CBI Business Survey 2007 point to increased bid costs for business driven by excessive bureaucracy, pipeline uncertainty and over-detailed specifications. This has potentially deterred industry from a more strategic approach to investment in skills, technology and innovation. The Lean Review also found that public procurement using the competitive dialogue procedure cost suppliers on average £1.6m more than in equivalent private sector procurements. However this procedure can offer the best route to delivery, to value for money and to effective dialogue throughout the procurement process.

Analysis of Evidence

95. Evidence from industry and from the literature review is consistent. Although in some cases evidence of good practice was identified, on the whole public procurement was characterised by low levels or ineffective industry engagement, poor and inconsistent communication of goals, short-termism, perverse contractual incentives, over-specification in tender requirements and a lack of seniority and capability of procurers. The cumulative effect of these practices has been increased costs to industry and public contracting authorities. The evidence from the literature includes evidence of procurement practice in general, which may apply to varying degrees to the procurement of infrastructure. Furthermore whilst a number of the data sources in the literature are dated, the issues they raise were mirrored by those raised by industry in 2010/11.

Evidence of good practice

96. There is another side to this story and there are examples of good practice in infrastructure procurement. Both the Infrastructure Cost Review and the House of Lords Select Committee report found that the Highways Agency (an Executive Agency of the Department for Transport) had demonstrated a more sophisticated approach to managing their £2.5bn annual spend more effectively through procurements. The House of Lords Report pointed to a strategic approach which had delivered efficiency gains through incentivising innovation through the supply chain. The Infrastructure Cost Review stated that through making use of data intelligence systems and cost benchmarking the Highways Agency (HA) was able to save £70m of tax payers' money over three infrastructure projects.

²² House of Lords Science and Technology Committee *as above*

Furthermore that the HA uses early contractor involvement (ECI) which has lowered prices and led to quicker completion times.

97. The Government remains committed to supporting innovation and the development of new technologies. The Small Business Research Initiative (SBRI) procurement programme supports technology development in companies at an earlier stage than, or in parallel with, commercial venture capital. It provides a route to market for new ideas, R&D contracts to progress the idea, and new business opportunities for technology companies.
98. Evidence from industry and available literature does not yet reflect the recent procurement reforms described below. Issues raised by industry should continue to be taken into account in the development of government policy on procurement.

Government action underway

99. The Government has embarked on a major procurement reform programme in order to enable fair access to public procurement contracts to SMEs, reduce unnecessary bureaucracy and delays and to improve the skills level of procurement staff. Relevant measures include:
 - a. Publication of the findings of the Cabinet Office's LEAN Review into reducing waste and tackling bureaucracy in the procurement process.
 - b. The creation of the Major Projects Authority with a mandate to scrutinise major projects.
 - c. The development of a centralised approach to the procurement of commonly bought goods and services.
 - d. An aspiration that SMEs access 25% of central government procurement spend and the appointment of Stephen Allott as a new Crown Commercial Representative (CCR) for SMEs. His task will be to build a more strategic dialogue between HM Government and smaller suppliers – giving those suppliers a strong voice at the top table.
 - e. The launch of a Contracts Finder website. The new online facility²³ is available to find public sector contracting opportunities over £10,000 and will make the Government's procurement process totally transparent
 - f. The Cabinet Office 'licence to source' programme, developed with industry and professional bodies, aims to increase the capability of procurement professionals on the use of lean techniques. If the pilot stage is successful Government intends to award a 'licence to practice'. Those with a licence would be eligible to lead on major public procurement.
 - g. The launch of the Cabinet Office interchange pilot programme to get secondees from business into public sector procurement teams and to get civil servants out into the commercial world, to facilitate two way commercial skills and knowledge exchange.

²³ Available at <http://contractsfinder.businesslink.gov.uk>

- h. In recognition of the need for a bespoke set of solutions in construction, the government has also created a single Government Construction Board which will ensure future procurements are joined-up across government, are more strategic and improve transparency on the future pipeline of procurements. The Government Construction Board will provide a forum for on-going dialogue to improve government's relationship with suppliers and bring about continuous improvement. It will also fulfil the role of the Crown Commercial Representative for construction.
 - i. European markets are a major trading partner and the Government is committed to realising the single market through simplification of existing EU rules and promoting best practice across the EU.
100. These reforms taken together will improve the procurement landscape for businesses seeking to deliver infrastructure contracts.

Policy risk

101. The issue of policy risk, also described as certainty, forward visibility and 'direction of travel' was a recurring theme in discussions with infrastructure companies. The issue can arise on specific projects (Will the contract be let as advertised? Will the funding be in place?) or it may be a background concern, for example development of the planning framework or adequacy of the UK's electricity supply.
102. During the course of this study, the CBI published a report on UK growth and investment²⁴ based on interviews and workshops with business leaders. The report echoed views from infrastructure clients and Tier 1 suppliers who participated in this study:

Investment decision makers often look ahead 5-10 years when planning R&D, market expansion or other investment, but the return on investment in some sectors may take much longer to realise. To have any traction with business, a vision for the UK economy must look ahead at least 20 years, but also establish key milestones for progress. The overall vision needs to be high level, allowing for innovative solutions to be delivered, but also specific enough to create the certainty that will galvanise investment. [. . .] Businesses need to know that incentives will not suddenly disappear, procurement contracts will not alter substantially, and that extreme shifts in policy or direction of travel will not occur at each general election.

Evidence

103. Suppliers highlighted a number of examples of good forward visibility underpinning investment:
- The Landfill Tax was cited by waste management firms as an example of good regulation, with a clear rationale and consistent long-term direction. This

²⁴ *Making the UK the best place to invest* CBI, April 2011

was factored in to the business case for investment in waste treatment facilities.

- Economic regulation of the water sector has delivered the investment required to meet water quality and environmental standards. Although the regulatory cycle introduced a five-yearly dip in activity, suppliers had confidence in the long-term direction and priorities for the storage and distribution network.
 - Good procurement practice, where the client had clear, consistent goals and communicated them effectively, gave confidence at the project level. The Olympic Delivery Authority was cited as an exemplar.
 - The transitional approach to building the offshore transmission grid has been successful in securing investment. In the first round of bids to operate the offshore grid there were £4bn worth of bids for £1.1bn worth of assets.
104. The creation of Infrastructure UK and publication of the National Infrastructure Plan were widely welcomed, as was the undertaking to publish a forward pipeline of infrastructure projects and update this in future. Suppliers made the point however that the private sector is vulnerable to sudden policy shifts over which it has no control. Publication of the forward pipeline of work was just one element in reducing policy risk.
105. Lack of forward visibility has had a particularly significant effect on the construction sector. The Infrastructure Cost Review²⁵ published at the end of 2010 notes that:
- Sustained uncertainty and the cyclical nature of infrastructure investment in the UK has contributed, over several decades, to a significant shift from fixed to variable resources, relative to many European contractors, i.e. there is a greater use of subcontracting and less direct investment in construction, the former driven in part by a move to greater specialisation within the supply chain. Measures of relative capital intensity also show that the UK construction industry is investing less in its operations than France or Germany.*
106. Suppliers noted the following cases where confidence to invest was lacking:
- There was a complex interaction between carbon taxes and incentives, including the Climate Change Levy, EU Emissions Trading Scheme and Carbon Reduction Commitment on the demand side, together with Renewables Obligation Certificates and feed-in tariffs. This complexity, coupled with recent changes to feed-in tariffs for larger solar photovoltaic projects, had undermined confidence in the business case for investment.
 - Delays and uncertainty in the timing of investments in the rail sector had affected the UK supply base, leaving it potentially less able to respond to customer needs.
 - At the project level, uncertainty around timing and the allocation of risk between client and contractor led to increased costs and encouraged

²⁵ Infrastructure Cost Review HM Treasury, December 2010

fragmentation of the construction sector. Tier 1 firms typically relied on a network of subcontractors, which could reduce the capacity of the supply chain as a whole to collaborate and innovate, because of the number of contractual boundaries involved and the lack of certainty around the relationship.

107. While suppliers agreed that the forward pipeline would help with this last point, they were sceptical of the extent to which such information was reliable. Experience led them to believe that even plans that were contracted were subject to change and delay, typically because of public sector funding constraints that became evident during the design and build phases.

Understanding policy risk

108. Respondents noted that the issue of policy risk applied at several levels and on different timescales. They recognised the need for policy to adapt to changing conditions and the legitimate need for elected governments to implement policies in accordance with their mandate, which would lead to changes of direction.
109. The consultative group²⁶ noted that reducing policy risk need not mean reducing flexibility or tying the hands of future administrations. They suggested that risk could be reduced by offering:
- A long-term vision that was sufficiently stable and widely-accepted to need reviewing no more than once each Parliament. For some infrastructure types even this was too short a timescale and cross-party consensus would be necessary to offer the required level of confidence.
 - An effective policy framework within which businesses could operate and which offered clarity on how medium-term goals would be set. Economic regulation provides this type of framework, with well-understood processes for review.
 - Clear and timely short-term decisions, so that industry could understand whether a particular announcement represented an option to be considered, a provisional outcome or a clear decision that would be implemented.
110. On the last point, the consultative group noted that in their experience government policy advisers were not well-placed to understand the full cost of postponing a decision. The 'do-nothing' option was rightly included as part of the decision-making process, but it was often not appreciated that this seemingly safe course of action could be both expensive and risky. This was especially the case where doing nothing meant that the time available for delivery was compressed, leading to a 'feast or famine' demand profile for the supply chain.
111. This view of policy risk as consisting of long-term vision, policy framework and short-term decisions offers a useful model for considering how to offer greater certainty to investors. It also illustrates how the goals of better forward visibility and reduced risk can be compatible with a responsive and flexible approach to meeting policy challenges as new evidence becomes available.

²⁶ The group included representatives from CBI, EEF and three engineering institutions. Please see *How the research was carried out* in Section 1

112. During the study, it became clear that policy risk is a key factor affecting the availability of project finance. Opaque or poorly-understood risks may be compensated for through a risk premium and through measures to reduce the funder's exposure, such as requiring a greater part of the project to be funded by the client's own balance sheet. In extreme cases funding may evaporate altogether following a change of policy, as in this feedback from an inward investor providing photovoltaic systems:

Because of [a government policy announcement] on 7 February 2011, the funding banks of our projects have withdrawn their commitments to fund our projects, for which we already have planning permissions. In consequence, we will be required to write off our UK investments. This is not a potential risk, this is reality today. ... To our business, this is the worst case scenario and will probably lead to insolvency of [the company]

113. The table below gives some examples of potential policy risks from the perspective of a potential investor in infrastructure.

Business driver	Short-term or project issues	Long-term issues
Is there a market?	<p>Some markets (waste management, renewables) are underpinned by regulation or incentives. Are these secure during the life of the project?</p> <p>For new markets (e.g. Carbon Capture and Storage) are the first projects realistic? Do all parties have a common view of the constraints?</p>	<p>Are the long-term market rules predictable? Long-term may mean 20-30 years depending on infrastructure type.</p> <p>Does the market structure suit our investor profile? This may mean size and regularity of contracts or overall market size and security.</p>
Do we have the capability?	<p>Are the specifications or operating conditions liable to change, for example as the result of regulatory action by a third party?</p> <p>Does the project rely on unique specifications or technology that are not proven elsewhere?</p>	<p>Do we have the capability to navigate the business environment (e.g. planning constraints) and is the opportunity cost worthwhile?</p> <p>Will the skills to service the market be available in future (directly or through sub-contractors)?</p>

<p>Are the risks acceptable?</p>	<p>Where there is a monopoly customer, do contractual remedies apply or is the relationship so important that the supplier may have to bear the costs of delay or changed specifications? What is the probability of these?</p> <p>Does the contract allocate risks to those best placed to manage them?</p>	<p>What is our confidence in the stability of factors outside our control? These include tax, regulatory and policy changes.</p> <p>Is there evidence that a stable business environment is a cross-party goal, with effective coordination across government?</p>
<p>Can we make a return?</p>	<p>At the project level, this will typically be a function of the issues above leading to added costs that are outside the investor's control.</p>	<p>Long-term, a decision to invest in the UK will be influenced by the scale of the opportunities available elsewhere and the associated risks.</p>

Conclusions

114. The proposed publication of the forward pipeline of infrastructure projects is welcome but will be insufficient on its own to reduce policy risk and unlock investment. Businesses also need greater confidence that these projects will be contracted as planned and that the regulatory environment will allow them to make an acceptable return.
115. When evaluating the potential impact of policy options, policy makers should specifically consider the effect on investment intentions and policy certainty. This will require a greater degree of business engagement, earlier in the policy-making process, than is currently the norm. Early business engagement can also reduce risk by improving business understanding of the policy framework and long-term objectives.
116. Policy makers can underestimate the lead time required to provide certainty for investment, the cost to industry of delayed policy decisions and most of all the unintended consequences for the supply chain of policy changes. Business engagement as suggested above is one route to improved understanding; consideration should also be given to updating the guidance for Regulatory Impact Assessments to ensure that these factors are adequately addressed.

Skills

117. The delivery of the UK's infrastructure needs over the next 30 years will require an increase in workforce capacity across most economic infrastructure types. For example, over the full life of the programme Crossrail will employ up to 70,000 people²⁷ and conservative estimates of future employment for wind power in the UK predict 36,000 people by 2020²⁸.
118. Businesses in the supply chain have a robust assessment of the skills they are likely to need particularly in terms of the immediate pipeline of work. A large proportion of the skills are in civil engineering and related consultancy and advisory functions. There are also significant predicted needs in terms of advanced manufacturing, design and high level electrical engineering roles such as those required in electrical grid connection and maintenance. There are well-documented skills shortages in high-voltage electrical engineering and in the nuclear industry that are being addressed by the relevant engineering institutions, companies and the HE and FE sectors.
119. Supply chain respondents in this study recognised that responsibility for ensuring availability of the right skills in the right numbers is shared between employers, skills providers and government. Overall they felt that previous attempts to quantify skills needs and seek to provide them on a predictive basis had been ineffective in meeting the needs of industry or individual learners. A demand-led system was the right approach and we found no appetite for further structural reform. There was a general recognition that the respective stakeholders needed to collaborate to ensure that the skills pipeline worked as intended and a period of stability – coupled with simplification where possible – was the main 'ask' from industry.

Reputation of the UK skills base

120. The UK's civil engineering and consultancy businesses are respected across the world. They are generally large multinational, market leaders that develop knowledge and skills in-house which can be easily transferred to across infrastructure projects. They are considered highly competent with good project management skills and strong technical experience. More broadly it is evident that UK engineers themselves have a good global reputation.

Skills Shortages

121. Current and future skills shortages were raised as being of real significance. Across more than one infrastructure type business continues to raise concerns about the lack of supply of a range of engineering and technical skills and an ageing workforce. These issues were particularly marked in nuclear power, rail and road construction.
122. In the longer term the likelihood of skills shortages having an impact is increased by the fact that demand for specific skills in the UK economy is expected to

²⁷ <http://www.crossrail.co.uk/delivering/skills-employment/>

²⁸ <http://www.renewableenergyjobs.com/content/BWEASkillsReport>

increase. This is anticipated particularly in areas where an upturn in major infrastructure is expected to be delivered e.g. power generation and transmission. Here the retirement peak for workers is in 2023 and the expected upturn in demand will begin in 2014-15. In electricity transmission there is a shortage now “from line engineers to PhD level systems analysts” according to one respondent and this is expected to get worse.

Pipeline of STEM Skills

123. There is a general recognition that a long-term approach is an important part of avoiding skills shortages and meeting future infrastructure skills demand in the UK. This includes ensuring that school pupils develop STEM skills and are well supported through careers advice. Businesses reported that engineering suffered from an image problem and could benefit from an enhanced perception of its professional status. This accorded well with a recent GE survey of engineering technology students and lecturers which identified an improved status for engineering as the number one way of encouraging young people into the engineering profession.²⁹
124. The number of young people studying engineering at university has been in decline for some years although recent figures on candidates taking STEM subjects at GCSE and A Level show a welcome rise³⁰. However this is against a general backdrop of firms believing that they will not be able to meet their future STEM skills needs and this echoes the perception from a 2010 CBI survey of employers³¹.

Competition for Skills

125. The issues of a relatively low throughput of graduates and an ageing workforce are even more challenging in the context of the likely increase in demand for skills from other parts of the world. Countries in the Far East and Middle East also have ambitious agendas for infrastructure development. More than one senior executive reported concern at signs of overheating of the market in some roles adding significant costs to delivery of infrastructure. The UK already has one of the highest numbers of expatriate skilled workers³² and there is a worry that the UK could lose out to other countries if the combination of sufficient opportunities and competitive remuneration are not available in the right balance and at the right time. Talent management and succession planning are therefore becoming key priorities for business.
126. Another reported element to the issue of competition for skills is the number of engineers moving to other sectors, particularly financial services, reportedly because of the greater remuneration available. Respondents suggested that this was linked to the relatively low esteem in which engineering is held in the UK.

²⁹ <http://www.genewscenter.com/ImageLibrary/DownloadMedia.ashx?MediaDetailsID=3892>

³⁰ *Engineering UK 2011: The state of engineering* available from <http://www.engineeringuk.com>

³¹ <http://tinyurl.com/39wuxq4>

³² <http://www.oecd.org/dataoecd/55/3/41362303.pdf>

Policy risk

127. The recession clearly has had an impact in some sectors where a reduction in infrastructure projects has led to downsizing. A more long term concern however is the 'feast and famine' experience in infrastructure supply chains. Uncertainty in terms of the policy direction and work pipeline for key infrastructure sectors can negatively affect investment decisions throughout their supply chains. Whereas multinationals such as the larger civil engineering companies and Tier 1 suppliers are better able to cope, SMEs have shorter investment timescales. Their ability to invest in future skills is more constrained if it is not clear when those skills will be needed.

Skills and migration

128. Many infrastructure sectors have a track record of extensive use of mobile labour. The IET estimates that about 20 per cent of science-related professional jobs in the UK are filled by immigrants to the country.³³ This study encountered a perception in supply chains that the risk of skills shortage is being heightened by current Government policy on immigration and the introduction of limits on the number of workers employers can recruit from outside the EU. Changes to the immigration system introduced in April 2011 are designed to allow companies to continue to recruit the skilled workers they need and benefit from their skills and experience. The limit mechanism prioritises shortage occupations, including many engineering jobs, and has been undersubscribed during the first three months of its operation.

129. There was also recognition that companies themselves have a responsibility to do more to develop UK talent. There have been a number of recent collaborative initiatives involving employers, education institutions and government designed to address skills shortages. Examples include the Power and Tunnelling Academies³⁴ are welcomed and firms reported they were putting more effort into recruiting and training new entrants into the industry.

Perceptions of the apprenticeships system

130. Apprenticeships are generally recognised as a mutually beneficial route for career development and ensuring workforce skills meet the business needs of companies that provide them. Smaller firms reported that they had not followed up their interest in apprenticeships. This seems in part because they feel they do not have the resources to spend time understanding how the skills system works.

131. Some felt there was not enough tailored and easy accessible information to raise their awareness of the potential benefits of apprenticeships and what to expect. During the time of this study the BCC has published a report on Infrastructure which has a section focused on skills. This also reports business views that their experience is that the apprenticeship system can be overly bureaucratic³⁵.

³³ <http://eandt.theiet.org/magazine/2011/05/high-demand.cfm>

³⁴ UK's only Tunnelling and Underground Construction Academy 'topped out' <http://tinyurl.com/6j4kbj2>

³⁵ Government must rise to the challenge on infrastructure, say business chiefs <http://tinyurl.com/5tznaf>

Conclusions

Managing Policy Risk

132. The need to better manage policy risk in the context of the future plans for infrastructure is a major finding of this report and the evidence on skills issues supports this conclusion. The National Infrastructure Plan does not address skills directly but nevertheless was seen as a positive development in helping to define the scale of likely demand for particular skills. Respondents were clear that action was needed to give greater certainty and forward visibility on the UK's long-term infrastructure programme and that this certainty would encourage future investment in skills.

Addressing Skills Issues

133. We were told that the issues around skills shortages and other issues raised above are generally well understood and that there was a well-developed set of responses to respond to demand for skills delivery. These include:
- sector skills councils articulating the needs of relevant industries
 - increased Government investment in apprenticeships
 - increased investment by Government and businesses in collaborative academies and other centre of excellence
 - sector-led activity such as the Technician Council which aims to promote increased recognition of skilled technical roles
 - changes to migration policy and ongoing work by Government to ensure businesses can continue to benefit from immigration to meet the balance of their skills needs
134. Respondents generally agreed that government should not seek to predict skills demand and set top-down targets. It is for industry to define the need and specify occupational standards. The skills system needed to be responsive to demand and engage with industry to provide good outcomes for learners. Businesses themselves should continue to respond positively to government signals such as apprenticeship investment and University Technical Colleges and sector-specific initiatives such as the IET's Faraday Challenges, designed to interest students in electrical engineering as a career.³⁶
135. As this report was reaching a conclusion, it was announced that a Growth Review of the UK skills system would be taken forward to address barriers to growth in this area. This offers an opportunity to seek to address employer concerns around the complexity of funding streams and other issues highlighted by infrastructure providers. As part of this review, the Government will examine the 'end to end' process that SMEs face in engaging with apprenticeships and will seek to simplify the process so that more SMEs can realise the benefits that apprenticeships bring.

³⁶ <http://eandt.theiet.org/magazine/2011/05/high-demand.cfm>

Section 3: Sector profiles

Renewable energy roadmap

136. Government recognises that most renewable energy technologies face some degree of supply chain constraint, whether for equipment, installers or infrastructure. The severity of these constraints will vary by technology. They will be particularly important, for example, in developing markets such as land based renewable energy technologies (onshore wind and biomass); offshore wind, marine energy and heat pumps. For this study, it was decided to cover marine and wind energy generation from the renewable technologies as well as nuclear energy and electricity transmission.
137. The Government has recently published the UK Renewable Energy Roadmap.³⁷ This sets out a comprehensive suite of targeted, practical actions to help overcome deployment issues and accelerate renewable energy in the UK. The Roadmap focuses on eight technologies that between them are assessed as being capable of delivering more than 90% of the renewable energy needed for the UK to meet the target³⁸ set for 2020:
- onshore wind
 - offshore wind
 - marine energy
 - biomass electricity
 - biomass heat
 - ground source heat pumps
 - air source heat pumps
 - renewable transport
138. The Government's financial incentives for renewable energy will provide greater market confidence about future deployment levels, helping to stimulate supply chain development. In addition, the Government is taking specific measures to:
- reform the planning system in England and Wales;
 - introduce better certification and assessment of installers for small scale technologies including domestic heat; and
 - encourage the development of port and manufacturing facilities for offshore wind, Marine Energy Parks and charging infrastructure for plug-in vehicles.

³⁷ UK Renewable Energy Roadmap DECC, July 2011 available at http://www.decc.gov.uk/en/content/cms/meeting_energy/renewable_ener/re_roadmap/re_roadmap.aspx

³⁸ The target is for 15% of electricity to be generated from renewable sources. The central projection quoted in the roadmap is for 234 TWh of renewable generation capacity to be in place by 2020, representing 15% of the forecast demand of 1557 TWh.

139. Biomass is likely to be a significant contributor to meeting the UK's 15% renewable energy target by 2020. The Government will publish a UK Bio-energy Strategy later this year which will articulate a clear vision for the growth of sustainable biomass energy. The biomass supply chain was not considered as one of the sectors in this study, so as to avoid duplication with this work.
140. The Government's Electricity Market Reform White Paper³⁹ was published alongside the Roadmap and set out reforms to the separate Great Britain and Northern Ireland markets for all forms of electricity generation.

Wind energy

Introduction

141. This chapter covers both onshore and offshore wind. The UK currently has 4GW of installed onshore capacity, which in capacity terms, is the single most deployed renewable electricity technology. The existing onshore pipeline contains an additional 11GW of proposed capacity. When taken together with the existing operational capacity, we expect onshore wind to contribute a significant proportion of the UK's renewable energy target by 2020.
142. Offshore wind has around 1.3GW of offshore capacity from 13 farms with 436 turbines⁴⁰, plus another 2.2GW under construction (making the UK offshore wind industry the largest in the world). Offshore turbines have rated capacities of between 3-5MW, although designers are hoping to double this capacity within the next decade.
143. In January 2010, The Crown Estate announced the successful bidders for each of the nine new Round 3 offshore wind zones, potentially totalling 32GW in capacity. This is in addition to the 8GW already planned from Rounds 1 and 2. The combined total of all leasing rounds is over 49GW (including sites in Scottish Territorial Waters and Round 1/2 extensions).
144. The sector currently relies on the Renewables Obligation (RO) to achieve cost competitiveness with fossil fuel generation.⁴¹ The Electricity Market Reform published in July 2011 provides a new framework including stable financial incentives to invest in all forms of low-carbon electricity generation.
145. There is a range of forecasts for the UK market, ranging from 10GW to 33GW by 2020. The Renewables Roadmap establishes an industry-led Task Force to set out a path and action plan to reduce the costs of offshore wind to £100 MW/h by 2020. That level of cost reduction would make it possible to deliver up to 18GW by 2020 and open up the 30-40GW of low carbon generation that will be necessary in the 2020s to keep the UK on track to deliver the 4th Carbon Budget.

³⁹ *Planning our electric future: a White Paper for secure, affordable and low-carbon electricity* DECC, July 2011 available at <http://tinyurl.com/6jynjine>

⁴⁰ <http://www.bwea.com/ukwed/offshore.asp>

⁴¹ Ofgem, which administers the RO, issues one Renewables Obligation Certificate (ROC) for each MWh produced by a qualifying renewables generator. Onshore wind attracts 1 ROC per MWh. Offshore wind will attract 2 ROCs for arrays commissioned up to 31st March 2014, after which it will attract 1.5 ROCs.

The European market has potential to grow to around 40-50GW by 2020, with the UK maintaining its 40% share of the European market thereafter.

The wind energy supply chain

146. The UK wind supply chain currently employs around 5,000, but this is expected to increase towards 50,000 as the industry pushes towards 30GW of installed capacity. The wind supply chain can be split into five segments:
- Wind farm design, development and consenting - Involves the processes up to financial close, which specifically involves the design of the entire farm (location of the turbines to maximise efficiency); environmental, seabed and meteorological survey work; analysis of site viability; and survey vessel operation.
 - Turbine manufacture - Includes the design of the turbines; blades (which form around 20% of the turbine cost and are mostly manufactured in-house by the turbine suppliers); castings and forgings; gearbox, large bearings, and direct drive generators; and towers.
 - Balance of Plant - Includes manufacturing of subsea cables (export and array); foundations; and electrical substations.
 - Installing and commissioning - Includes seabed preparation, foundations laid at sea, final assembly of turbines at ports, installation of turbines on site, laying cables and installing substations.
 - Operation, maintenance and services - Includes operational support and maintenance.
147. There are currently only four turbine manufacturers with offshore models, although recent announcements should push this in excess of 12 products by 2015. However respondents suggested there would be some consolidation as the industry matured and performance data became more widely available.
148. Whilst the current machines are around 3MW, the predicted size of machines for Round 3 will average at least 5-6MW, with some designs increasing to at least 10MW within Round 3 timescales. Both gearless direct drive and traditional gearbox designs are being developed.
149. There is a major drive to invest in UK assembly plants (including significant proposals announced by GE, Gamesa, Siemens, Mitsubishi, and Vestas). This private sector led investment in port side manufacturing is essential for the major suppliers to push their capacity towards the level of demand created by Round 3, although significant technical and logistical risks remain.
150. There is still uncertainty as to the level of UK input into these new manufacturing plants, with some respondents suggesting that would assemble mainly imported components, at least initially. However UK firms at Tier 2 and 3 have the required capabilities and, in some cases, existing customer relationships. For the Tier 1 turbine manufacturers there are clear advantages in logistics and flexibility from building local supply chains.
151. There are weaknesses in the European supply chain, which imply significant risks to delivery. These are explored in the SWOT analysis below.

SWOT analysis

Strengths

- UK Research and Development facilities, including contract research organisations and universities
- The UK has recognised expertise in design, consultancy and environmental survey and assessment.
- Significant expertise in existing sectors (North Sea oil and gas; aerospace, defence) capable of addressing the needs of customers in offshore wind manufacturing and in offshore renewable operations and maintenance.

Weaknesses

- Cable manufacture - The number one supply chain pinch point for the offshore industry is the limited manufacturing capacity for high voltage (HV) subsea cables. There are only four companies offering this product (ABB, Nexans, KNT, and Prysmian), and there are significant barriers for new entrants in terms of demonstrating sufficient capability in this highly technically demanding market. Some investment has taken place, but considering that cabling takes around 4 years to fully develop and deliver, analysis suggests that there could be insufficient capacity to meet demand when Round 3 reaches its peak.
- Substations - There is limited supply of substation transformers. With only two active companies (ABB and Siemens) and significant barriers to entry in the short-run, there is a risk that capacity will be unable to meet demand as with HV cables.
- Vessels - Analysts believe that the number of specialised installation vessels on order should satisfy most Round 3 demand. There is some risk that the oil and gas sector, a higher margin industry, could out-bid the offshore wind industry when booking access to these new vessels.
- Ports - The scale of Round 3 developments will require more ports with larger lay-down areas and facilities to build, lift and transport heavy equipment. In most cases this involves the ports having to undergo major construction alterations, but port operators have yet to receive enough firm orders from the offshore manufacturers to justify the investments. There's a risk that enough facilities will not be available.
- Components - Limited UK-based supply of large scale casing and forging, gearboxes and bearings. Reliability of some key components, such as gear boxes, is still a risk.
- Skills – Shortage of skilled staff, particularly marine engineers, maintenance technicians, HSE experts, and electrical engineers.
- Cable laying – There is frequent damage to export cables, a lack of available cable-laying vessels and experienced personnel, and problems in attaching array cables to foundations. However, whilst these issues remain a risk, they are considered “teething” problems. The situation is expected to improve as the extensive experience of the offshore oil and gas industry is made available (subject to a reduction in the cost base).

Opportunities

- The UK has strong onshore wind speeds in Scotland, Northern Ireland and Wales, but less so in England, particularly the South East. It also has the World's greatest offshore resource, as a result of strong winds and shallow waters stretching far out in the North Sea.
- The EU has a target of 20% renewable energy by 2020 and the European sector will offer export opportunities to credible UK firms. Because the UK sector is more advanced than in other European countries this offers opportunities for UK firms who have established a successful track record to win orders from outside of the UK.
- The Crown Estate has declared its intention to facilitate up to 33GW of offshore capacity in UK waters by 2020. After this date, offshore wind activity outside of Europe is likely to become an important consideration.
- Provisions in the Marine and Coastal Access Act 2009 and Marine (Scotland) Act 2010 led to the introduction of marine planning and a streamlined consenting process which will address developer risks through providing certainty and a simplified regulatory framework for marine energy.
- Marine Management Organisation (MMO) has responsibility for marine planning. It has established an offshore renewables regulators group which will address strategic issues. The group includes all the relevant statutory advisors and met for the first time in June 2011.
- With German contracts starting to progress, there is an industry expectation of a "beauty contest" between UK and German markets in the lead-up to 2020 EU target date. This will potentially give UK companies an export opportunity and (by virtue of making a bigger European sector) could be a factor in driving down costs. On the other hand, this rapid expansion could exacerbate the weaknesses already identified in cabling, substation and vessel supply.

Threats

- Some developers point to consenting delays on land to get on-shore substation and electrical grid infrastructure developed. The current average lead time for obtaining consent is two years. This will be addressed through the New Marine Act and the new Major Infrastructure Project Unit which has a target of granting consents within 12 months.
- Development of the Marine Conservation Zone has introduced some uncertainty into the planning process.

Can the Supply Chain Deliver?

152. The supply chain is currently on course to deliver a significant offshore wind generation capacity over the coming two decades and beyond. The central projection in the Renewables Roadmap of 18GW by 2020 should be achievable. Supply chain bottlenecks in HV cabling, vessels and substations and the timelines of planned port and manufacturing investment will also need to be resolved in order to meet this projection.

Barriers to Innovation

153. There are significant barriers to the adoption of new technologies, especially for offshore. It is extremely costly to replace failed components in offshore installations and as such there is no appetite from the major manufacturers to include components that do not come from companies with a suitable pedigree of supplying into the market. Onshore turbine manufacturers are more willing to take risks in this respect because repairs are quicker and less costly.
154. Therefore, the process of seeking acceptance by the offshore manufacturers is lengthy and relies on extremely close relationship development with the turbine manufacturers. Demonstration and test facilities such as those at NAREC, the National Renewable Energy Centre, are essential to overcoming these barriers.

Electricity Market Reform

155. Electricity Market Reform (EMR) was the major issue for respondents at the time of this study. Most respondents were broadly supportive of the principles of EMR, while remaining concerned about the detail. Some companies stated that they were holding back investment decisions until the outcomes of this major reform were known. *Planning our electric future: a White Paper for secure, affordable and low-carbon electricity* was published on 12 July 2011.

Supply Chain Development

156. As already described, there are a number of threats to the efficient and effective delivery of Round 3. The Government is focused on mitigating these threats by removing barriers to enable the efficient delivery of market driven solutions.
157. In pursuit of these objectives DECC has committed up to £60m to support investment in major offshore wind manufacturing (including tower, foundation and cable companies, as well as wind turbine manufacturers and associated infrastructure at port locations) in Assisted Areas in England. In addition, the Scottish Government has announced up to £70million to support the sector.
158. Cost reduction is key to increasing the size of the sector. So as to ensure this occurs the Government announced in the Renewable Energy Roadmap that it had asked an industry Task Force to set out a path and action plan to reduce the costs of offshore wind, from development, construction and operations to £100/MWh by 2020.
159. In direct response to requests from the supply chain DECC and BIS are also developing a joint action plan for the offshore wind supply chain. The key focus is the supply of high quality data (which will assist the market in delivering more efficient outcomes), including:
 - Offering the supply chain assurances that the Government is removing barriers in the planning system, ensuring grid access is available in a timely fashion and providing support for technology development and innovation.
 - Improving the supply of non-confidential market information from developers and manufacturers to send clear signals to the supply chain.
 - Ensuring developers use good procurement practice.

Marine energy

Introduction

160. The Marine energy sector includes three product areas – wave, tidal stream (energy generation from the force of the current) and tidal range (energy generation from the varying height of the tides). This is a nascent industry and there is currently no commercial generation, although a few technologies, in particular Pelamis (wave) and SeaGen (tidal stream), have reached full-scale prototype stage.
161. 2.4MW of demonstration technology is currently installed. Another 1.2GW of development leases have been agreed, making the UK the prime European location for marine energy. The UK has a high concentration of developers – as many as 150 different designs now being developed. RenewableUK (the renewable energy trade association) forecast that the marine energy industry could grow to produce 1.5GW by 2020 and 36GW by 2050 (20% of UK electricity demand) if the regulatory environment is sufficiently developed. Under such growth forecasts, by 2035 sales would reach £6.1bn and employ as many as 19,000.
162. Marine energy is still far from being financially viable and is therefore completely reliant on subsidies, in the form of development grants and ROCs (to be replaced by feed-in tariffs). As the industry innovates towards more financially attractive technologies access to development finance has, and will continue to be, the dominant issue for the industry.

The marine energy supply chain

163. The marine energy industry is likely to remain uncompetitive with wind for some time to come. The case for its development includes the benefit of maintaining an option to diversify the future energy mix, the predictable nature of the tides and the long-term benefits to the UK economy if UK is successful in consolidating its lead in these technologies.
164. The supply chain can be divided into seven major segments, with a number of sub-divisions. These are:
 - Technological development
 - Testing facilities and services
 - Manufacturing
 - Site Development and Project Consent
 - Installation
 - Operation & Maintenance
 - Decommissioning
165. Currently, only the development segment of the supply chain has formed into a definable structure. It covers the owners and developers of the “devices” (devices in this respect means the different types / makes of the machines, such as Pelamis). The other segments of the supply chain have yet to be formed into areas of industrial activity that can be identified as being primarily marine energy.

166. Most developers (the exceptions are large engineering firms such as Alstom and Rolls Royce) appear to concentrate on one, occasionally two, devices and are completely focused on developing that technology. Few have other activities or opportunities for revenue generation.
167. The technology development process is divided along the lines of technology readiness levels (TRLs). Group 1 (TRL 1-3) is the concept development stage (which includes applied research and concept engineering). This group will be composed of small development companies, universities, and spin-out companies. Group 2 (TRL 4-5) is the prototype development stage (laboratory testing, computer-based analysis, and tank testing). This stage is where funded companies are formed and where intellectual property is managed. Group 3 (6-7) is the prototype demonstration stage (prototype manufacturing, with full-scale, at sea prototype testing and certification – up to 1MW). Finally, Group 4 (TRL 8-9) is full-scale pre-commercial arrays – 2-10MW.
168. Eight devices are currently in Group 3, with many more in Group 2 and none in Group 4. Access to the finance for further testing will be a key driver in pushing more firms into Group 3 and on to full-scale arrays.
169. The major marine-focused testing facilities are too expensive to be built by individual developers and therefore separate facilities have been constructed using public funds (with the exception of WaveGen's tank). There are five testing facilities which have a combined investment expenditure of around £20m. The main facilities include the European Marine Energy Centre (EMEC) in Orkney; the National Renewable Energy Centre (NAREC) in Northumberland; QinetiQ's Ocean Basin and Towing Tank in Gosport; test tanks at Edinburgh and Plymouth Universities; Wave Hub, Devon; and WaveGen's advanced tank testing facility.
170. Industry contacts suggest that there is the possibility for UK manufacturers to provide around 80% of the content for the latest devices. In general, little is known about the current state and potential ability of the UK supply chain beyond the developers.
171. The market is expected to develop along similar lines to wind, with developers selling designs / expertise etc to multinational technology giants, such as GE. At that point, SMEs will find it harder to enter the market for devices directly although they may still be able to develop their designs before being bought out by larger multinationals. Any devices not considered to have the potential to compete will no longer receive funding, leaving only a few key technologies.

SWOT Analysis

Strengths

- The UK is currently considered the global leader in technological development, with more than half of the world's devices under serious development.
- The UK is considered to have the most advanced testing facilities for marine energy. At the development stage this is proving to be a major advantage over other nations' development activities. However, NAREC's (and possibly the others') facilities are open to foreign developers.
- The UK has many green investors.

Weaknesses

- Currently, no major industrial multinational has made a commitment to fully enter the sector. This means that development is reliant upon independent developers who have limited resources. This is slowing down development and increasing the perceived risk of the entire industry.
- There is a major gap in finance at the later demonstration stage. This is where development takes a step up in capital requirement, because there's a requirement for full-scale prototype manufacturing (which is extremely costly because of the bespoke nature of the product), and there's deployment costs, which may be high due to the novelty of deploying a unique product. This is a significant barrier to further development of the entire UK marine energy industry.

Opportunities

- The UK has some of the best coastline and waters in the world for marine energy deployment. Analysis suggests the available UK resource could be up to 22TWh per year.
- The intermittent and unpredictable nature of wind energy generation suggests that the more predictable generating capabilities of the marine technologies will find favour as the energy mix leans more towards renewables.

Threats

- If the finance gap at the full-scale demonstration stage is not tackled sufficiently then there are worries that other countries will overtake the UK should they pursue more aggressive subsidy packages.

Can the Supply Chain Deliver?

172. The supply chain cannot deliver electricity to the grid at the moment and is not expected to contribute meaningfully until at least 2020 and possibly even until the late 2020s. Current investment is focused on maintaining a credible long-term, UK-based alternative for wind generation.
173. The Marine Energy Programme is the chief conduit between Government and Industry. It held its first committee meeting in January 2011 and RenewableUK, the main trade association for the marine energy industry, has reported that there was agreement about the vision for the industry. RenewableUK has since published (in March 2011) a position paper *Sea Power – Funding the Marine Energy Industry 2011 – 2015* which makes a series of focused recommendations⁴².
174. One potential outcome is that the sector is well-placed to win a share of the Low Carbon Innovation Fund⁴³, a necessary step to enable further investment. Further actions are dependent on the development of the technologies.

⁴² http://www.bwea.com/pdf/marine/SeaPower_Fund_Paper.pdf

⁴³ <https://www.lowcarbonfund.co.uk/LCIF>

Nuclear energy

Introduction

175. There are currently 10 operating nuclear power stations in the UK providing c15% (11GWe) (63TWh) of the UK's total supplied electricity⁴⁴. The last station built in the UK was Sizewell B, which was built 1988-1995.
176. Many of the UK's operational reactors are now reaching the end of their life and are due for decommissioning. By 2023, if none of the reactors have their lives extended, all reactors will be retired, except Sizewell B. It is possible, however, that the lives of the existing nuclear power stations could be extended (this decision depends on the state of individual reactors and is usually for no more than 15 years).
177. The Government's energy strategy confirms its intention to take the actions required to facilitate private sector investment in new nuclear power with nuclear energy free to contribute as much of the 18GW required from non-renewables by 2025 as possible. Developers have already announced plans to construct 16GW of new capacity: EDF has announced plans to build four new reactors – two at Hinkley Point in Somerset and two at Sizewell in Suffolk⁴⁵. Horizon Nuclear Power has stated it intends to build at least 6GW at Wylfa on Anglesey and Oldbury in Gloucestershire⁴⁶. Nugen, a joint venture between Iberdrola, GDF Suez and Scottish and Southern Energy, has acquired land for 3.6GW of new capacity at Sellafield⁴⁷.
178. Nuclear is considered a desirable energy option because it has a unique combination of being low carbon, secure (energy is domestically produced and its fuel is widely available), financially competitive, and has a steady output rate (making it ideal for base-load supply).

The nuclear energy supply chain

179. The last nuclear unit was completed in 1995. However, the UK has maintained strong capabilities especially in its technical engineering and civil infrastructure industries, through an active domestic decommissioning programme and participation in global nuclear new builds and maintenance programmes. This provides solid foundations for domestic UK suppliers to rise to the challenge of building modern nuclear plants in the UK.
180. About 80% of a nuclear new build is actually not nuclear specific, but is similar to other large-scale construction.

⁴⁴ Source: <http://www.world-nuclear.org/info/inf84.html>

⁴⁵ Source: <http://newnuclearopportunities.edfenergy.com/>

⁴⁶ Source: <http://www.horizonnuclearpower.com/>

⁴⁷ Source: http://www.nugeneration.com/our_plan.html

181. The supply chain can be divided into five major segments, with a number of sub-divisions. These include:
- Pre-build (design) - This includes design and engineering specialists, legal and planning specialists, and technical consultancy. Together they account for around 8-10% of the entire value and employment of the construction process.
 - Civil Engineering and Construction - This includes project management (which also features heavily in pre-build), civil construction, on-site erection of the equipment (mechanicals), and commissioning.
 - Plant & Equipment - This includes manufacturing of plant and equipment.
 - Operation - This includes operation and site management, nuclear fuel supply, engineering / technical services, waste management and disposal.
 - Decommissioning - Planning and licensing, decommissioning.
182. Each new build consortium will have its own approach to the design and construction of new nuclear, some taking on responsibility for the project direct and others looking to turnkey solutions. The reactor technology will be provided by a nuclear vendor, with the overall site being managed by an architect engineer who is likely to have significant sub-contracts for areas of construction and manufacture. The owner of the site will form the Site Licence Company and be held responsible by the regulator.
183. Extremely high levels of quality assurance has made nuclear an enormously complex industry, where even standard technologies, such as welding, have become technically difficult to produce consistently at the required quality levels. Many existing UK suppliers are capable of delivering products and services to these levels of accuracy, but lack recent experience and therefore need to improve their reputation. As such, the story of the UK nuclear industry is one of building on existing expertise in order to establish experience and credibility.
184. Analysts suggest that UK suppliers are currently capable of supplying around 50% of plant & equipment requirements, mainly for equipment that has multi-industry applications. This could be pushed to 70% with timely investment.

SWOT Analysis

Strengths

- Fuel fabrication and reprocessing .
- The UK radioactive waste management supply chain has extensive experience, including waste segregation, categorisation, handling, encapsulation, minimisation, stabilisation, packaging, storage and disposal for all types of radioactive wastes.
- Beyond the generic designs, UK-based companies are currently capable of providing all aspects of the 'Pre-Build' (Design) phase of a nuclear new build programme. This is the area where the UK excels internationally and it is highly likely that UK companies will provide most of this activity for its domestic new build programme.

- The UK has a strong civil construction industry with a proven track record in successfully delivering high profile projects. All elements of the civil construction (i.e., Building & Construction of the nuclear and turbine islands, balance of plant and supporting infrastructure) and on-site fabrication could be competently undertaken by UK companies. Analysts believe the full nuclear programme would only draw on 5% of UK civil engineering capacity, suggesting that there would be no resourcing problems.
- UK suppliers have an excellent reputation in many non-nuclear island technology areas, such as main coolant pumps, specialised inspection equipment and services, and precision mechanical components.
- A long-track record of operating nuclear plants.
- The privatised energy industry has enabled the major financiers in the City to gain experience of working with major energy projects, creating good understanding of risk in the industry.

Weaknesses

- The UK has no nuclear reactor vendor, however some believe this is a strength as the UK nuclear industry has experience with a wide range of civil nuclear reactors, but no bias or limitation towards one design.
- The UK lacks capability in some equipment areas. The UK would be able to produce around 50% of the engineered parts required, rising to 70% with investment.
- The UK has reduced its R&D activity since 1980's. This is to be expected considering the lack of activity and emergence of global solutions to energy issues, but there are concerns that it has led to shortages in some areas and it is generally agreed that the UK has on the whole lost ground to the leading nuclear nations (US, Japan, France). However, there has been an improvement in recent years, with the establishment of the National Nuclear Laboratory, the Nuclear Advanced Manufacturing Research Centre, sitting alongside the established Sellafield Technology Centre.
- Many specialists residing within the UK will be due to retire over the next 5-10 years – hence a positive commitment to a nuclear new build programme is required to encourage investment in (and by) a new generation of nuclear specialists to provide continuity of support for a new build programme.

Opportunities

- The scale of the latest UK new build programme will open up a entry routes into numerous technology areas. Analysts believe many of the gaps identified in the UK supply chain (described in the weaknesses section) are capable of being filled by UK suppliers if they invest quickly and heavily. Some of these technology areas will prove much harder to penetrate than others, especially those in the nuclear island.
- Plant life extensions will generate further opportunities in asset management.

Threats

- A major nuclear incident which could undermine future investment.
- Some analysts worry that the Government and in some cases the Regulator may not complete the facilitative actions required to time.
- Global pinch points - Increasing new build activity in other markets could displace global resource from the UK market. Key areas of concern (where global capacity may be stretched, resulting in delay of key components) include super-large forgings, induction bending machines for the pipe work, pumps and valves, high quality steel alloys, and large capacity super-lift cranes.
- Growing skills gap, resulting from an aging workforce.

Can the supply chain deliver?

185. The global supply chain is well placed to deliver the UK's nuclear infrastructure requirements. There are some niggling concerns regarding capacity constraints against exceptional global demand, but with good planning these concerns should not significantly delay delivery.

Electricity Market Reform

186. Electricity Market Reform was a major issue for respondents at the time of this study. In common with other low-carbon energy sectors, respondents in the nuclear sector welcomed the reform in principle and were waiting for the detailed measures that would influence the scale of investment into the nuclear industry. *Planning our electric future: a White Paper for secure, affordable and low-carbon electricity* was published on 12 July 2011.

Supply Chain Development

187. There is a role for government to continue to support the business opportunities in this market area, building on the work already conducted with the industry delivered by the Nuclear Advanced Manufacturing Research Centre, the Manufacturing Advisory Service and the Nuclear Industry Association.

Electricity transmission

Introduction

188. The demands placed on the UK's electricity transmission networks are set to increase and change over the next decades. This is the result of three main challenges for the electricity sector:
- the need to replace existing generation capacity that is reaching the end of its natural life;
 - the rapid increase to 2020 in the installation of renewable energy generation to meet commitments to achieving 15% of energy use from renewable heat transport and electricity by 2020⁴⁸ and
 - a potentially significant increase in demand for electricity as sectors such as heating and road transport shift to electricity to reduce emissions.
189. The electricity transmission grid will be crucial to enabling the change to renewable generation but was constructed to work with a different energy mix. New renewable generation and in particular onshore and offshore wind presents a different challenge. The onshore transmission system will need to be reinforced and extended to coastal areas to connect offshore wind and other low carbon generation such as new nuclear which is located in more peripheral areas and offshore grids need to be built from scratch.
190. There is also an ongoing need to replace existing assets which are coming to the end of their natural life. The intermittency of wind power will also mean the grid will need to be able to cope with fluctuating supply. In 2009 an industry group jointly chaired by DECC and Ofgem assessed the requirements to reinforce and extend the existing onshore network to meet the challenge and concluded that reinforcements of approximately £4.7 billion would be required to 2020⁴⁹. Taking into account the need to develop an offshore grid Ofgem estimates that overall £32bn of investment is required.⁵⁰

Onshore Transmission Networks

191. The onshore transmission system in England and Wales is owned and maintained by National Grid, under a regulatory regime managed by Ofgem. National Grid (as National Electricity Transmission System Operator) also has the responsibility for managing the flow of electricity across GB including in Scotland where the network is owned by two other transmission companies (Scottish Power Transmission and Scottish Hydro Electric Transmission Limited). The network is designed to ensure no supply interruptions at peak demand even with the two worst case outages. Much of the grid was built in the 1950s and 60s and is in need of renewal, as well as accommodating a new generation of generating facilities. National Grid is devoting £3.6bn to updating the power network in 2011 alone.

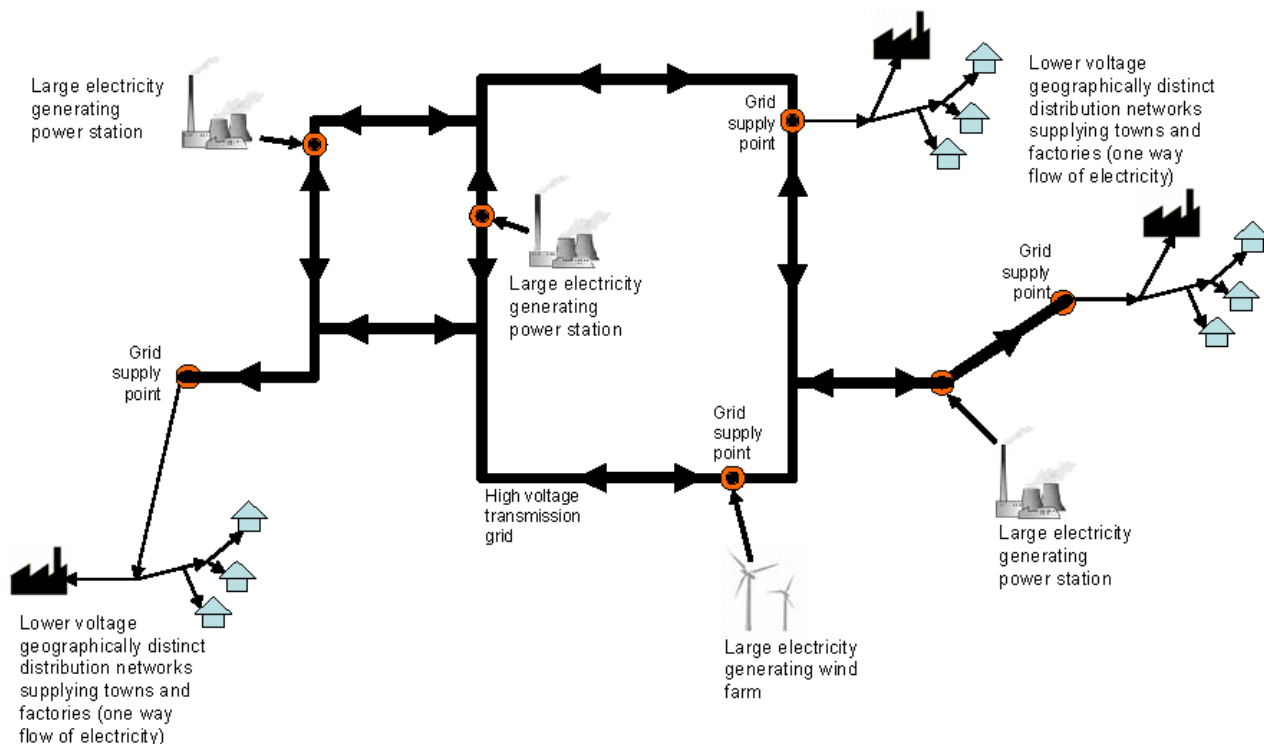
⁴⁸ DECC 2010, National Renewable Energy Plan - the 2009 figure was 3%.

⁴⁹ Electricity Networks Strategy Group (2009) Our Electricity Transmission Network, a Vision for 2020

⁵⁰ <http://www.OfGEM.gov.uk/Media/PressRel/Documents1/RIIO%20Oct%20Press%20notice.pdf>

192. This report does not cover distribution networks which take electricity from the transmission networks and carry it to homes and businesses.

Figure 2: The physical electricity system



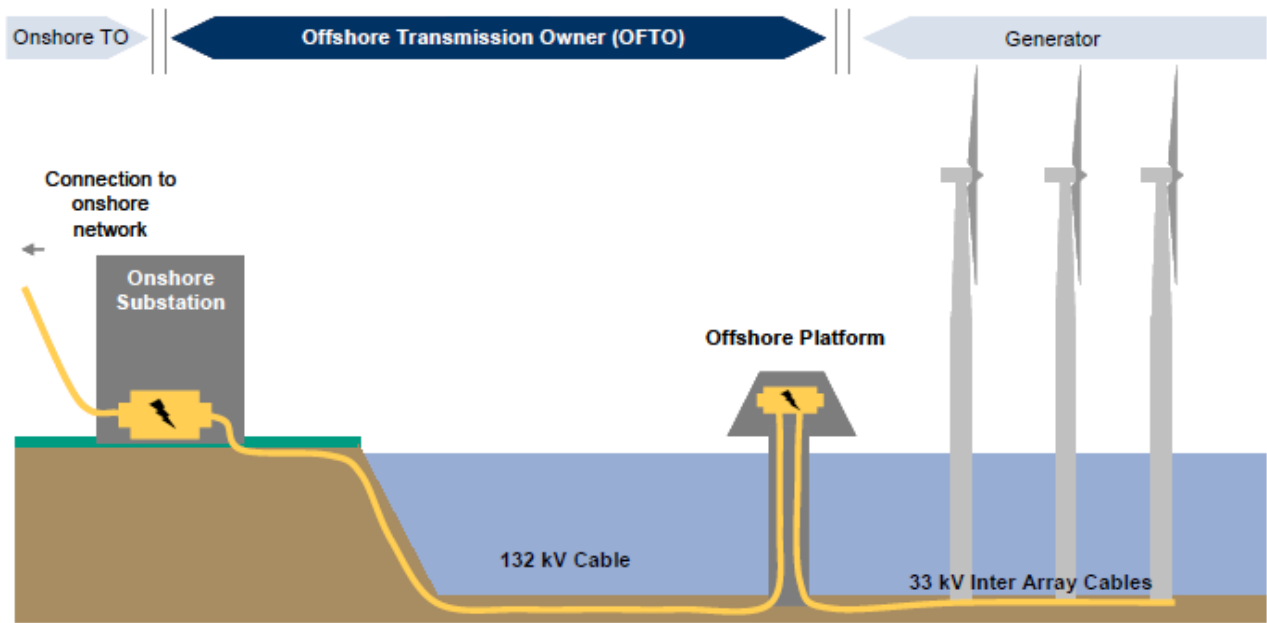
Source: National Audit Office, 2010

Offshore Transmission Networks

193. There is a separate regulatory regime and ownership structure for offshore transmission networks. Ofgem and the Government have developed a competitive tender process to encourage the investment to deliver the offshore grid. The process involves companies called Offshore Transmission Owners (OFTOs) that own and operate the transmission links between offshore wind farms and Britain's onshore grid. This structure is illustrated in Figure 3 overleaf.
194. The first phase of this new regime involves two OFTO transitional tender rounds to own and operate assets already built or under construction by generators. The first transfer of assets from the generator to an OFTO took place in March this year⁵¹. Under the enduring regulatory regime, generators can also choose to opt for an OFTO to be appointed to design and/or construct the transmission assets (as well as own and operate them).

⁵¹ Between E.ON and Transmission Capital Partners: a consortium of International Public Partnerships Ltd, Amber Infrastructure Group and Transmission Capital Ltd

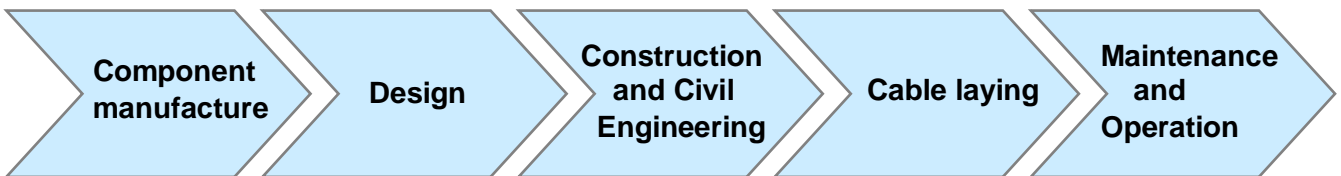
Figure 3: Offshore generation networks



Source: Ofgem

The electricity transmission supply chain

195. The key roles in the supply chain are shown below. National Grid is the main client and has significant in-house capability for design, maintenance and operation.



<ul style="list-style-type: none"> • Wires and cables (inter array and export) • Steel towers and cross-arms • Transformers and other sub-station components • Switchgear • Insulators 	<ul style="list-style-type: none"> • Design of transmission systems • Power systems modelling • Grid connection and power system studies • Software tools 	<ul style="list-style-type: none"> • Converter and transformer station buildings • Offshore substations • Piles, foundations and footings • Tower installation and connection 	<ul style="list-style-type: none"> • Onshore – trenching and laying of underground cables • Offshore – operation of cable laying vessels 	<ul style="list-style-type: none"> • Health and safety • Plant and line maintenance
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SWOT Analysis

Strengths

196. In 2007 National Grid moved to an alliance model to carry out the upgrading and development of its electricity transmission networks in England and Wales. The company has a total of 15 construction partners in 4 regional alliances. The reported benefits of this approach include greater trust and integration between companies in the supply chain; greater levels of innovation and an overall increase in efficiency. Respondents reported that these benefits are less likely to be seen in more traditional commercial relationships in construction supply chains, where companies are separated by a series of bilateral contracts and risk is passed down the chain rather than allocated in the optimal fashion.
197. The policy and regulatory frameworks to stimulate investment in the offshore transmission grid have so far been felt to have been successful. In the first round of bids to operate the offshore grid there were £4bn worth of bids for £1.1bn worth of assets. Ofgem calculate that the competitive approach taken will have saved the consumer around 30%.⁵² The transitional aspect of the start of the regime protected OFTOs from construction risk and this has been helpful in enabling new market entrants.

Weaknesses

198. The time taken to achieve planning consent is a concern to the supply chain which affects primarily onshore but also offshore transmission systems. The Beaully-Denny line upgrade project in Scotland is an example of the network reinforcements required to connect renewable energy to the grid. It took five years to receive planning consent (with conditions). This length of time creates uncertainty in supply chains and can add costs to the overall project.
199. The task of balancing local environmental impact and the need for transforming our networks is also encouraging innovation. Manufacturers and civil engineering firms are responding by developing solutions with smaller footprints and there is a strong track record of power system engineering solutions to enable existing wires to take heavier loads. National Grid and their alliance partners are also investigating the cost benefits of installing more transmission lines underground in part to protect the landscape⁵³.
200. There is also an expectation that the changes to the planning regime that are being introduced by the Planning Act 2008, will lessen the time taken to decide on planning applications for major national infrastructure projects. The marine planning regime, introduced by the Marine and Coastal Access Act 2009 and the Marine (Scotland) Act 2010 will provide a streamlined consenting process. The draft energy National Policy Statements have now been laid before Parliament. Once approved these will set the framework for major planning applications relating to energy infrastructure including transmission.⁵⁴

⁵² <http://tinyurl.com/5uftyymb>

⁵³ <http://www.nationalgrid.com/uk/Electricity/UndergroundingConsultation>

⁵⁴ National Policy Statements are available from <http://tinyurl.com/5wmfv7h>

201. Currently there is little standardisation of the technology for the offshore grid, in particular transmission voltages and control systems. This is a threat to the interoperability, coordinated development and security of the grid. It could also result in inefficiencies through voltage conversion losses and reduced economies of scale and competition.

Opportunities

202. There are significant business opportunities in offshore grid supply chains because of the scale of investment required in the future. In the electrical supply chain for example there will be increased demand for transformers, switchgear, cabling (including inter-array cabling), heavy duty fuse boxes and innovative steel solutions. There is a general belief that in countries where the market gets off the ground more quickly with clear plans for the future employment opportunities will accrue. Furthermore UK companies that can develop a track record in the domestic market will have the significant potential to export solutions to other markets as they develop their renewable generation and accompanying transmission infrastructure.

Threats

203. Skills gaps have emerged in recent years in a number of roles in power transmission, for example project managers, project engineers, power systems engineers and overhead linesmen. Given the investment planned for the transmission system the challenge to meet skills demand will now increase, with a ramp-up from around 2017.
204. For example in terms of overhead linesmen National Grid currently have around 600 and will need approximately 1,200 in 2017. The impact of this rise in demand is compounded by the fact a large percentage of the current skilled workforce entered the industry in the 1960s and 1970s and the industry is close to a peak in terms of numbers of people retiring. This can have particular consequences, for example in terms of the role of Senior Authorised Person. These are key roles that have responsibilities such as signing off on new asset connections to the live network and they tend to be experienced members of staff.
205. Developing new staff to take up these roles is a huge challenge. The Energy and Utilities sector skills council estimates that up to 26,000 new workers are required in the wider electricity transmission and distribution sector by 2024⁵⁵. The ENSG in 2009 raised concerns around the limits to training new staff because of the length of time it can take to develop full competency for many of the roles.
206. There is also competition for skills with the oil and gas industry, where the remuneration can often be greater. Competition for skills also arises from that fact the UK is not the only country planning significant investment in transmission. There are consequently already signs reported that the emerging skills shortage is leading to overheating of salaries which in turn is adding to the overall cost.

⁵⁵ <http://www.euskills.co.uk/download.php?id=776>

207. There is also a perception in the industry that current government priorities in migration policy are indirectly hampering the ability of the industry to respond to skills challenges. It is felt this is particularly true in power transmission where there is a tradition of using migrant labour that moves around the world coupled with the global shortage in some specialist roles.
208. The industry however continues to respond to the challenge of meeting skills gaps by investing in development of the workforce within this country e.g. through National Grid's 'Grow Our Own' initiative. Industry and Government are also collaborating to address skills needs most notably through the UK Power Academy⁵⁶
209. The most significant threat to the ability of the supply chain to deliver is in terms of the supply of High Voltage sub-sea cables. Although the UK is currently the largest market globally there is high and increasing demand elsewhere. There are currently three main manufacturers and existing capacity can be tied up quickly. Competition does not just come from export cabling in other wind farm projects but also from potential sub-sea connections such as the 'bootstraps' projects that would connect the main onshore transmission network between Scotland and Northern England/Wales. New market entrants are emerging but owing to the lead-in times for building new plant and testing new cables there is a real risk of a bottleneck that would impact on the rest of the supply chain. It was reported that given the lead-in times key investment decisions on new capacity need to be made now to avoid potential bottlenecks.
210. Alongside cable supply there is an issue around the capacity in the specialised ships required to lay subsea cable and to a lesser extent for other aspects of grid installation at sea. A number of new ships are currently under construction but it is not clear that ship capacity will increase sufficiently to avoid delays in some projects.

Policy developments

211. The challenge of decarbonising the economy has presented new demands on UK energy policy and regulation. This study was undertaken as Government was consulting on Electricity Market Reform (EMR), a fundamental review of energy markets designed to attract investment, reduce the impact on consumer bills and create a secure mix of electricity sources including gas, new nuclear, renewables, and carbon capture and storage. *Planning our electric future: a White Paper for secure, affordable and low-carbon electricity* was published on 12 July 2011 and this policy framework will have a major influence on the future development of the Grid as it is upgraded in response to higher demand and a new generating mix.
212. Reforms have recently been introduced to the regulation of transmission networks. In March this year Ofgem introduced the framework for the new RIIO (Revenue = Incentives + Innovation + Output) price control model⁵⁷. These

⁵⁶ <http://www.power.nsacademy.co.uk/investors/our-members>

⁵⁷ http://www.OfGEM.gov.uk/Media/PressRel/Documents1/RIIO_Exec%20Summary.pdf

reforms fundamentally change the balance of incentives and rewards within which transmission owners operate and are designed deliver value for money for consumers, facilitate the transition to a low carbon economy and deliver energy security.

213. The respondents taking part in this study all understood the need for EMR and the changes in RIIO and were broadly happy in terms of the ambition and scope. However it is understandable that any review of this scale will cause nervousness. Investors in offshore and onshore electricity supply chains look to government for clear signals on future intent and will factor these signals into their investment decisions. As the package of related measures in terms of market and regulatory reforms and National Policy Statements emerge it remains to be seen how they combine to impact on the sentiment of investors. Some recent developments have been positively received, for example the announcement by DECC on the new carbon targets to 2027 and the laying before the house of the National Policy Statement for energy.
214. Largely owing to the technology and construction risk in large renewable energy projects the financing packages for investment are difficult to put together and sustain. This has been reported in terms of wind farms in particular. Here a particularly risky phase is as developers are seeking to confirm debt and equity investment to finance the increase in costs driven by the move to full testing and construction. Any delays to planning consents or new construction risks can delay and/or threaten the funding.

Findings

215. There are a number of positive findings with regard to both offshore and onshore transmission grids. A particular strength (as in other infrastructure types) is the excellent reputation and track record of UK civil engineering and related advisory companies and the contribution they make to both networks. There are also strengths in terms of manufacturing investment and capacity within the wider offshore wind industry. Generally the evidence gathered suggests that the supply chains are ready to deliver on planned upgrading and building of the grid. The exception principally is with regard to the supply, and to a lesser extent the installation of sub-sea cables.

Policy risk

216. This profile has noted issues that were reported as having an impact on investors in terms of their impact on policy risk and certainty i.e. the experience of the planning regime and current review of relevant policy and regulatory frameworks. No specific recommendations are warranted by the evidence gathered for this study and indeed the processes of EMR, RIIO and other reviews all include ample opportunity for stakeholder engagement. The issues reported do however add to the stock of evidence for why the issue of managing policy risk is so important for investors. As such it therefore supports the proposals in the cross-cutting section that the current infrastructure growth review should examine where it can promote improved management of policy risk for infrastructure sectors.

Collaboration

217. The immediate and long term demands of reconfiguring our transmission networks are hugely challenging. They cannot be met solely by one or two players but require the insight and resources brought by all interested parties. Collaboration therefore is key and there was positive feedback from respondents for the initiative by DECC and Ofgem to set up the Offshore Transmission Coordination Group. This kind of development has the potential to address a number of the risks and threats raised here, including:
- developing and sharing best practice in working with planning regimes;
 - new approaches to sharing risks throughout supply chains;
 - exploring the right balance between innovation and standardisation in equipment
 - developing the skilled workforce required
 - maximising the potential for the supply chain to develop and provide jobs in the UK

Road transport

Introduction

218. The asset value of the UK strategic network is estimated at over £100 billion. (England: £87 billion) The network comprises almost 400,000 kilometres of publically maintained highway. Only 3,500 kilometres of the entire network comprises motorway, which with other principal highways that form the strategic network, carry around one third of all traffic and around two thirds of the freight movements in the country. 83% of goods in the UK travel by road.
219. Over two thirds of the entire network is unclassified but provides access in both rural and urban areas to other parts of the network and access to both residential and commercial properties. Particularly in urban areas it will have a high mixed use of pedestrians, cyclists and other non vehicular as well as vehicles comprising car, commercial and public service vehicles. It also will generally contain many of the utilities on which communities depend and provide a significant part of urban public space. This mixed use means that the network serves a number of competing objectives which have lead to highly developed policies and skills to manage effectively. The size of the local road network means it is the largest and most valuable asset controlled by Local Authorities.
220. Highways policy is set at Governmental level and for the strategic network and is delivered through executive agencies. Flexibility on Local Transport planning, including the highway network, is allowed through the Local Transport Planning (LTP) system although there is clear guidance to link individual authorities polices on highways to national policy. There is therefore no single policy on highways across the UK and individual authorities therefore have some flexibility in defining service levels to fit in with the overall policy direction set by government. This is underpinned by the extent of capability at an institutional level across the sector, both in the public and private sector.

221. Funding is generally obtained from central Government for both Capital and Revenue purposes. At a local level, whilst there is some flexibility to set different standards, in reality there is limitation on this flexibility due to overall budget restraint and the constraints of the local authority funding system. In some specific instances operators receive direct income from user charges for use of highways e.g. M6 Toll motorway and major river crossings. In a local context income is derived from parking charges, including on-highway parking.

SWOT analysis

Strengths and opportunities

222. The UK is recognised as having strengths in a number of areas including; Enhancing Capacity and Reducing Congestion; Safety; Sustainability; Procurement of Highway Services; Asset Management; Technology; Urban Design and Security
223. The market, with well established contractors, sub-contractors and suppliers adapts to changing requirements, contracting (and diversifying) and expanding as necessary. The UK has international recognition in the roads sector, with huge export potential which in itself helps justify investment and Government support, especially to encourage innovative and value for money solutions.
224. The size and complexity of the supply chain offers the potential for significant value for money benefits when different suppliers work together. By aggregating common category requirements across Highways Agency spend, and working more closely with extended tiers of the chain, increased value can be generated through greater efficiencies and lower unit costs.
225. The contracting strategy for individual procurements will include targeted supply chain incentives. These will encourage performance and the delivery of optimum value for the Highways Agency. The HA will continue to promote the benefits of a diverse and competitive supply chain and engage to utilise opportunities for improving capability, capacity and expertise
226. Improvement schemes and new construction of a significant nature (over £50m) are treated as Major Projects in their own right and have a dedicated project team to develop and manage their implementation. This ensures that the suppliers with the right capabilities to deliver the project can be selected. There are a substantial number of contractors engaged across the Highways sector in the UK, all with significant capability from their UK experience that is potentially exportable overseas.
227. On the operational side, the UK has wide experience in using the skills of both the public and private sectors, working in partnership to deliver effective services. There has been increasing focus on ensuring that the risks inherent in each different stage of the sector life cycle are transferred to the party best able to manage them. This understanding has been used to develop a range of different delivery models across the sector. These models ensure that particular objectives pertinent to different parts of the sector are delivered effectively.

228. The experience in developing these models and procuring them in a way which ensures that the right partners are put in place is a key area of capability that the UK has developed and is exportable.

Weaknesses and threats

229. There is still considerable scope for improved efficiency in planning, procurement and project management, recognising the need for in-built flexibility to allow for the inevitable challenges of the unexpected arising over the course of a road building project of several years - and which would (in theory) save costs and free- up further funding for new investment.
230. Infrastructure UK's Infrastructure Cost Review (December 2010), found that pipeline uncertainty and complex procurement approaches has increased transaction costs and deterred industry from a more strategic approach to investment in skills, technology and innovation. There is in fact over-supply in the UK - but this is not reflected in lower costs.
231. A key issue is lack of certainty which has a knock-on effect for contractors, sub-contractors and suppliers, often SMEs and providing local employment. Lack of certainty is being caused across the supply chain, in particular in planning, where there is a need to ensure that planning processes do not delay projects, leading to more uncertainty and higher costs. It also impacts on skills with a "feast and famine" approach to road building leading to skilled people going to other sectors.
232. Other issues for the road building industry include getting value for money which is in part impacted on by the lack of ownership of risks. High costs reflect inherent risks and uncertainties in road building; much depends on who takes on the risks within the supply chain, with a need for those higher up the supply chain to take more ownership of risk. The involvement of players at Tiers 2 and 3 in the supply chain was raised, particularly around the stage at which they are involved in the commissioning process and whether supplier accreditation schemes should be introduced for these suppliers.

Findings

233. There is work already underway by the Highways Agency (HA) and DfT which aims to address some of the concerns and barriers for the road building industry and there may be scope to look at how these can be promoted further to enable the industry to operate more effectively and promote growth in the supply chain. The independent review of the Strategic Road Network (Cook Review) is one of a series of measures aimed at ensuring that the Highways Agency is structured in the best way to deliver effective services. The review is considering whether England's network of motorways and major 'A' roads could be more effectively operated, maintained and enhanced.
234. The Highways Agency (HA) has pioneered the use of Early Contractor Involvement (ECI) in a number of projects which involves the constructor of the scheme at a much earlier stage than traditionally. This has the benefit of identifying issues at an early stage that will potentially have an effect during construction and ensuring they are addressed during the design phase of the project. It also encourages innovation and can achieve savings of up to 50% on

construction times. Early engagement helps dispel objections more quickly and aims to reduce risk to both parties. There could be scope to expand this approach, both within the HA and to other types of infrastructure.

235. On procurement the Highways Agency will continue to make clear what is needed in terms of quality in requirements, scope for innovation, technological solutions and the capabilities of potential providers. Quality Management System requirements will continue as part of assessment processes. To stimulate supply chain best practice and innovation, the HA will support and encourage the introduction of ideas and proposals that deliver project objectives and support standard ways of working.
236. The size and complexity of the supply chain offers the potential for significant value for money benefits when different suppliers work together. By aggregating common category requirements across HA spend, and working more closely with extended tiers of the chain, increased value can be generated through greater efficiencies and lower unit costs. The contracting strategy for each individual procurement will include targeted supply chain incentives to encourage performance and the delivery of optimum value for the HA. The HA will continue to promote the benefits of a diverse and competitive supply chain and engage to utilise opportunities for improving capability, capacity and expertise
237. Under the DfT's October 2010 strategy "Investment in Highways Transport Schemes", the DfT will seek to maximise the number of schemes which it will be able to implement within available funding. This programme is achievable because the Highways Agency will be bearing down hard on its costs and the costs of its supply chain. The DfT will be looking to the construction industry to work with the HA to achieve these savings through a range of measures including certainty of forward work programmes, value engineering and efficiencies in the uses of materials, labour and equipment.
238. For all other schemes, in order to secure value for money, to ensure funding goes as far as possible and to maximise the number of projects that can go ahead, the Government will be challenging scheme promoters to review options for cost reductions, including scope changes that improve value for money, increase local contributions and maximise the opportunities presented by a soft contracting market.
239. The Government is moving from 26 separate local transport grant streams to just four. This approach will give Local Authorities greater flexibility in how they spend their funding, enabling solutions tailored for the specific needs and circumstances of individual communities. The DfT will work in partnership with local communities to develop a new framework for the funding of major local transport schemes over time, one that will have a reduced role for central government and give a proper voice to locally elected representatives and business interests.

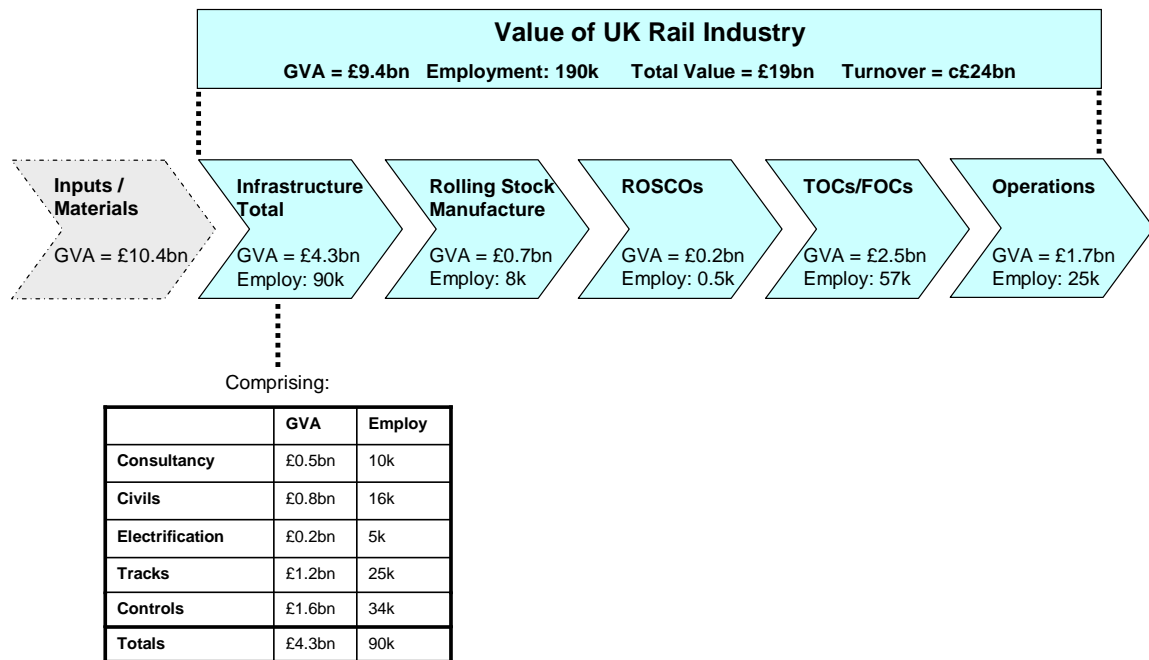
Rail transport

Introduction

240. BIS and DfT conducted a supply chain analysis of the rail industry in 2010. The findings from this work, which sought the views of stakeholders on the barriers to growth and efficiency within the industry, have informed this analysis.
241. In the last thirty years the rail industry has become increasingly globalised, with complex and inter-dependent global supply chains. Today, the UK rail industry is globally competitive, estimated to employ more than 190,000 people and worth at least £9bn annually.
242. The UK has a world-class expertise in research, consultancy and civil engineering and a modest capability in the manufacturing of high-end components. The UK has a strong track record in exporting in these areas.
243. The UK based rail industry is a complex mix of customers and suppliers, some regulated (notably Network Rail) and others unregulated. There are some segments that are easily recognisable as being unique to rail – for example permanent way, signalling and rolling stock. This includes a significant range and diversity of businesses, from multinational manufacturers to small and medium component suppliers and niche technology companies.
244. Other segments of the rail supply chain, particularly on the infrastructure, civil engineering and consultancy segments are dominated by a relatively small number of major civil engineering contractors with business interests and activity across a range of infrastructure types. Rail is often a relatively small part of their business. Finally, businesses operating in the rail consultancy segment offer multidisciplinary services across a range of design, engineering and construction types.

The rail supply chain

245. The elements of the UK rail supply chain are shown below, with an approximate breakdown of the £9.4 billion total value added for the sector.



246. The supply chain often operates differently within each segment although there are some common features (e.g. EU procurement, safety standards etc) with often long contractual supply chains including complex contractual relationships where firms switch roles from being the customer/sub-contractor in one contract to being lead contractor in the next.
247. A key feature of the UK based rail sector is the significant number of SMEs in the lower tiers of the supply chain who supply labour, components, good and services to a range of sectors. For example, it is estimated that there are around 1,850 SMEs active in the rail sector, with the average rail related turn-over being around 45%. Of particular note is the range of smaller labour supply contractors that are often a key source of labour to larger businesses in the supply chain, Understanding issues and needs of SMEs in the rail supply chain is a particular challenge.

SWOT analysis

248. The **main opportunities** for the rail supply chain include action on procurement, skills and innovation.
249. On procurement, there is evidence of planning ahead by stakeholders to give clear messages to industry and a commitment to sustainable procurement. On skills, leadership and both action on addressing gaps and increasing access to training have been identified as positives. On innovation, action to identify where innovative new products and services can be developed was noted by respondents.

250. Transport for London (TfL) have planned ahead for procurement, giving clear messages to industry about what to expect and provide an exemplar of sustainable procurement to secure the skills, training and meet social agenda requirements. The Rail Safety and Standards Board have also developed a clear strategy for sustainable procurement in rail. The National Skills Academy for Rail Engineering has demonstrated leadership in seeking solutions to long-term skills gaps and has worked in partnership with Government.
251. Where employers have long term certainty, e.g. ROSCOs (with an interest in the maintenance of assets), they have implemented graduate recruitment and trainee programmes. The planned Crossrail Tunnelling Academy was singled out as a strength. The Technology Strategy Board has established a new Knowledge Transfer Network (KTN) to support the exchange of knowledge, information and ideas across the transport sector, including the rail supply chain, to identify where innovative new products and services can be developed.
252. **Key barriers** for the rail supply chain include policy risk, procurement, communications, skills and training, standardisation, innovation and standards.

Policy risk

253. The consistent theme from respondents was the need for greater certainty to make investment decisions. This was typically caused by either a change in direction or the lack of strategic demand planning.
254. Examples of a change in direction included the decision to announce a major new programme of electrification to reverse the 2007 decision ruling-out further new electrification; and uncertainty over the future of diesel rolling-stock (including the unexpected cancelling of 200 Diesel Multiple Units in July 2009). A lack of demand planning was characterised by big gaps between large orders and the lack of dialogue on how to deliver projects over 5-15 years with a lack of incentive to invest in longer-term improvements which stretch beyond the lifetime of a franchise.
255. A lack of certainty was considered to impact on all other areas contributing to a lack of incentive to innovate, recruit or train people during difficult times (especially SMEs); a talent flight from the UK (especially to Australia) due to the liquid market leading to a shrinking skills base (which increases cost) to deliver more projects; a disincentive to potential new entrants to the industry leading to a concentration of skills in older workers; and a risk that a lack of competition in some parts of the supply chain can lead to monopolistic tendencies amongst suppliers and higher prices.

Procurement

256. Key issues cited by respondents were weaknesses in communication and decision-making in advance of procurement, coupled with the procurement process itself. Companies cited concerns with the contracting approach, including framework contracts and delivery lead times. The cumulative impact of these issues was that clients were not getting the best value, particularly as the rail procurement market in the UK has a few, dominant customers. Some respondents also cited consequences for the UK supply chain's overall ability to access the global market.

257. The UK supply chain is critically dependent upon effective pre-procurement communications with its few customers to help business plan and make investment decisions as well as enhancing the customers' understanding of market capacity and capability.
258. Some perceive an unnecessary secrecy aimed at enhancing competition. There are significant barriers for many SMEs in understanding how to participate in major procurement programmes and concerns that major procurers do not have visibility of the strengths and talent of the UK supply chain. Rail is a global market and there are significant benefits in relation to costs, competition and benefits. However, a consistent view from stakeholders was that the UK was not getting the best from being a 'big buyer' in a global market. In part, this was because the practice of bundling orders into large contracts with bespoke UK specifications was seen to significantly undermine the potential benefits. The chosen contracting approach was seen to have a significant impact on the supply chain, particularly in a market dominated by a few large customers. A key concern was framework contracts offering too little certainty on future work and making investing in capability high risk. Some smaller suppliers suggested that they also made raising finance a challenge. Fast delivery times after contract finalisation for large rolling-stock orders was seen to increase costs and when combined with short lead-in times, requiring suppliers to rapidly up-skill and increase capacity. On some infrastructure projects, labour supply companies gave evidence of very short lead times (sometimes only days and hours) as a result of being at the far end of long subcontracting supply chains.

Communications

259. The need for effective communication between the supply chain, policy makers and major customers is an issue that has cited both as a contributory factor/cause of other issues in this section and also part of an overall solution to easing difficulties.
260. Respondents identified gaps between the development of high-level policy (for example electrification and the future of diesel rolling-stock); strategic demand planning over more than one control period (for example the proposed HS2 network) and programme level demand planning within control periods. There is an appetite in industry for engagement in dialogue at every stage of the process; from long-term strategy and goals for sustainability to pre-procurement and more detailed project planning. More effective communication could ameliorate impacts and reduce the 'unknowns' and with them, the risks and costs. Unpredictability has deterred industry from attempting demand planning. This has led to skills gaps and reluctance to invest in training and development.

Visibility and diversity of the supply chain

261. A key feature of the UK based rail sector is the significant number of SMEs in the lower tiers of the supply chain who supply labour, components, goods and services to a range of sectors. This is coupled with a complex and interchangeable range of supplier-customer relationships. Although major buyers have established relationships with larger tier one suppliers, interviews highlighted a number of issues related to the diversity and visibility of the supply chain below tier one.

262. Major buyers are not sufficiently aware of range of innovative and dynamic range of SMEs in the lower tiers of the supply chain. Quality of dialogue and communication was sighted as a key barrier. While infrastructure and maintenance usually draw on local suppliers, in many cases, the UK supply chains' capability to deliver new investment has declined. This may pose risks to delivery and maintenance of infrastructure and impact on value for money. Where key orders of rolling-stock have been won by multinational businesses, these can favour non-UK supply chains. Maintenance, parts and knowledge are seen as being needed in UK. It is often challenging for SMEs to win business with prime contractors, the costs and efforts involved in multiple registrations being a high barrier to entry. Several respondents questioned the value of this in improving their visibility. Other issues raised include security of supply, resulting in some firms and prime-contractors stock-piling inventory adding to cost

Skills and training

263. The industry faces a significant skills challenge, the main barriers being forward visibility to plan for and fund the required workforce and specific skills gaps in several areas.
264. A general complaint from industry was that they had insufficient financial certainty to plan for and fund training / trainees. This impacted across the supply chain, from engineers to lower-skilled track work. Among the lower-skilled workforce there was reduced capacity and productivity because labour suppliers did not know how many people to keep on their books; Labourers are not getting basic activity-focused training (need to be able to offer an individual at least 6 months' work to pay for the course).
265. The rail supply chain involves a range of skills, from basic track-side construction to complex systems engineering. There are key skill gaps now in areas such as signalling and programme management, which were vital to maintain our infrastructure and rolling-stock and to deliver new major projects such as electrification and the proposed new HS2 network. There were concerns about the quality and quantity of skills training from apprentice to post-graduate level.
266. The rail sector has a shortage in large programme and project management skills and systems engineering skills (an issue more broadly across civil engineering) and the lead time to train rail engineers and technicians is significant. It was repeatedly argued that the UK is not training enough graduate engineers, and that graduates do not have the right complementary skills such as leadership and communications. Some firms are increasingly recruiting graduates from overseas as a preferred recruitment strategy.

Innovation, Standardisation and Exports

267. These were raised as separate issues. However stakeholders consistently noted their interdependencies. Key to this is how we unlock recognised barriers to innovation, consider how we build on our research base, and strike the right balance in relation to standards.
268. Many referred to lengthy accreditation processes. Difficulties with access to test track facilities means UK products cannot attain certification. There was a repeatedly expressed concern that buyers did not appreciate the significance of

having strong saleable brands to provide export platforms. There is a tension inherent in commoditisation, which is designed to assure safety by relying on established technology (thereby limiting the number of parts, ensuring good availability of supplies and familiarising staff those parts) but which can make it progressively more difficult to innovate. There was perceived to be an inconsistent approach to setting either bespoke UK standards, and/or stretching outcome based targets for new rolling-stock when cheaper more generic alternatives were available from a global market.

269. Many concerns were expressed by industry that would require further investigation to 'bottom out' the facts and impacts. Stakeholders identified a risk adverse culture (underlying high standards, inflexible implementation and reluctant participation in development) and lengthy development times as the greatest problems to innovation in the sector. This is consistent with findings of the annual study by the Boston Consulting Group, *Barriers to Innovation*⁵⁸ that looks across several industries.

Standards and accreditation

270. Standards are high in the UK and there are differing views about the merits of this. It can add to costs and some question how far high standards are related to a risk adverse culture and fit for purpose. Particular concerns have been the accreditation processes and track side certification regimes.
271. The Network Rail product accreditation processes were considered difficult to understand and in particular, some SMEs said they deterred them from bringing innovative products to market. Network Rail agrees that there have been problems with the process and that they have been working to reduce a back log, reducing the number by half in the last two years. The Achilles/Link up processes for the accreditation of firms are considered costly for SMEs both to register and be audited. They believe the system works for the benefit of buyers and Tier 1 of the chain more than for Tiers 2-3. Track side certification regime problems were reported by all labour supply interviewees.

Findings

272. Engagement with industry has identified several strong positives around procurement, skills and innovation and that some steps are being made in the right direction to better signal procurement opportunities, to identify and fill skills gaps and to see where new and innovative products can be developed. However, it was recognised that in all these areas and in others there were still significant barriers to businesses within the supply chain, specifically SMEs, that held them back from fully taking advantage of the opportunities that may present themselves for UK businesses both in expanding here and into international markets.

⁵⁸ The Boston Consultancy Group, *Innovation 2009, Making Hard Decisions in the Downturn* (Boston, M.A., 2009) <http://www.bcg.com/documents/file15481.pdf>

273. On 19 May 2011, the Government published the findings and recommendations from an independent study by Sir Roy McNulty⁵⁹ into the opportunities and barriers to improve the value for money of rail for taxpayers, passengers and freight customers. The Government will respond to the McNulty study in November 2011.
274. Relevant recommendations from the McNulty study include:
- **Certainty.** The study recommends that the Department for Transport (DfT) develops a clearer definition of the roles of Government and industry with the former focused primarily on setting the overall vision for the industry, the direction of rail policy, the objectives for the industry and level of funding available. It also recommends that Government provide greater clarity about what Government policy is, how different policy strands are harmonised and clarify the links between different levels of policy, objectives, strategies and implementation.
 - **Procurement.** The study recommends that Government lead on franchising procurement but introduce less prescriptive franchises to allow TOCs more freedom to respond to the market.
 - **Communication.** The study has proposed that industry establish a Rail Delivery Group consisting of the most senior people in Network Rail and the TOCs, partly to both drive a change in the industry culture and to improve the speed and effectiveness of cross-industry bodies. This forum should also provide the certainty that industry is looking for.
 - **Visibility of the supply chain.** The study recommends delivering greater efficiencies through stronger partnership working from inception through to the supply chain including better visibility of forward plans to encourage long term investment by suppliers and earlier involvement of suppliers and contractors.
275. Other possible options were suggested to tackle some of the barriers raised above. These included using the *CompeteFor* website model adopted for the Olympics to give better access for SMEs to business opportunities. On skills and innovation, it was suggested that the pharmaceutical industry's success at linking with Higher Education Institutions should be explored to see if lessons could be learned and transferred to promoting these links in infrastructure in general including rail. Network Rail has been piloting a new approach to innovation that aims to help industry target products for which Network Rail have the greatest business need. Respondents believed this was a well-founded approach that could also serve to improve the accreditation process.
276. The McNulty study strongly emphasised the need for the rail industry to be given and to accept, greater responsibility for its own future. In May 2011 a new Rail Delivery Group was created, comprising the chief executives of the passenger and freight train operating owning groups and Network Rail. This has the potential to provide leadership on cross-industry issues including those identified here.

⁵⁹ *Realising the Potential of GB Rail* - independent report commissioned by DfT and ORR, available at <http://assets.dft.gov.uk/publications/report-of-the-rail-vmf-study/realising-the-potential-of-gb-rail.pdf>

Ports

Introduction

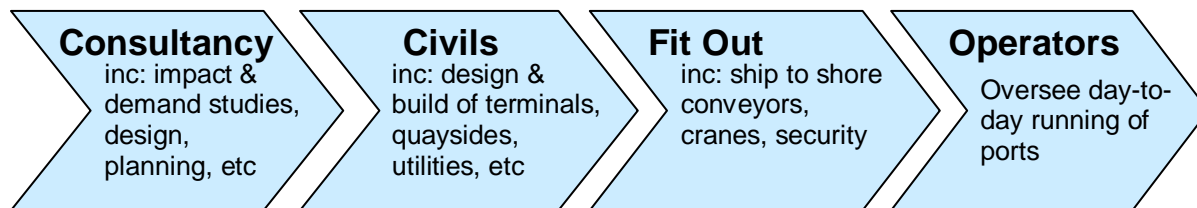
277. The UK has a well established port infrastructure with over 120 ports meeting a variety of capability requirements. These range from roll-on, roll-off (ro-ro) only ports such as Dover, predominantly industry-specific ports (for example Peterhead for fishing), and multi-purpose ports (for example Liverpool and Southampton). Felixstowe is currently the only specialised container port, although the proposed London Gateway will be another, in conjunction with its logistics centre. Port facilities will play a major role in the delivery of offshore wind, as described above in the chapter on wind energy.
278. In 2010 UK ports handled 510 million tonnes of goods which includes around 96% of all UK imports by volume (aviation is the other major transporter of international cargo, carrying lower volume but higher value goods). UK ports are essential for the import, export, and movement of goods around the UK (e.g. via short sea shipping). In addition to facilitating international trade, ports are also major businesses in their own right.
279. Economies experiencing rapid economic growth e.g. China and India are investing heavily in their port infrastructure. Port building is underway on a massive scale as these countries look to improve their economic infrastructure to attract additional inward investment and facilitate international trade.
280. Over the past decades the UK has given sufficient deep sea container terminal development consents to meet aggregate projected demand for the next 25-30 years. These consents will support long-term growth ambitions for the UK, and include London Gateway (by Dubai Ports World) and Felixstowe South (Hutchison Ports); some of these developments are already underway. According to the trade organisation the UK Major Ports Group, annual investment in upgrading and developing port facilities has been running at £200-300m a year to date. This is predicted to increase as the new consents are taken forward.

Workforce

281. According to the most recent DfT statistics⁶⁰, an estimated 118,800 people work in port related activities. This relates to both direct and indirect port operational activities within and outside the port estate as well as induced employment and employment on the port estate partially related to port operational activities. Due to the transferable nature of engineering skills, generally there is flexibility in the labour force as it moves between infrastructure types to meet demand. Overseas developments provide significant opportunity to the UK supply chain to grow revenues. The UK has an excellent global reputation for the design of ports, and for project and programme management for port development. It is also widely accepted within the industry that the UK possesses market leading capability in the financial and professional services required to support port development.

⁶⁰ Transport Statistics Bulletin, Port Employment and Accident Rates 2009/10 (October 2010)

The ports supply chain



SWOT analysis

Strengths and Opportunities

282. Key strengths and opportunities for the sector are global demand, specific skills required and the opportunities for investment in wind technologies.
283. Increasing global demand for port infrastructure (especially new build in high-growth markets) and the number of consents given for UK port infrastructure offers revenue opportunity for the UK supply chain. A specific strength is the growth of suppliers designing turnkey solutions helping to deliver economies of scale.
284. Offshore wind will play an important role in achieving 2020 emissions targets. To achieve the necessary level of turbine deployment there needs to be a step change in the way that turbines are manufactured and deployed. The scale of the turbines and the projects means that road transport is not a viable option and the industry will be predominantly located at or near ports. The infrastructure at UK ports will need to be upgraded to accommodate the manufacturing and installation facilities providing opportunities for those companies involved in civil engineering and construction. In the longer term the supply chain for the construction, operation and maintenance of the offshore wind farms will provide opportunities across numerous sectors.

Weaknesses and threats

285. Key weaknesses and threats exist around skills and demand for expertise, regulatory issues around consents and marine planning.
286. There was a view from business that transferability of skills/expertise between infrastructure types, significant overseas demand for expertise (eg China) and competition between countries for a limited expertise-pool – e.g. dredging capability, encourages talent flight both across projects and abroad. The long-term decline in the skills base was seen as posing a significant risk of irreversible damage to UK capability to take advantage of domestic and overseas opportunities. A further threat perceived was competition for expertise as economies expanding rapidly invest more heavily in port infrastructure.
287. Along with other modes of transport, the complications of the planning process has been raised, particularly the number of different consents required and different ports requiring different consents. This complexity is seen as making investment in infrastructure expensive.

Can the Supply Chain Deliver?

288. UK capability to design, build, and operate domestic port infrastructure is well developed and is capable of meeting the demand that the UK generates, taking into account the fact that the major deep-sea container terminal operators are multinationals and that major equipment such as quayside cranes is often imported. The UK's major consultancy and civil engineering companies tend to be large multinational, market leaders that provide multi-disciplinary services (eg impact studies, design, planning, building). The port operations tend to form only one revenue stream for these companies. Generally the UK is viewed as having strong capability in supply of port design expertise and high expertise of building the physical port infrastructure.
289. In the fit-out segment of the supply chain, the UK is acknowledged as having lower capability relative to overseas competitors. Domestic suppliers tend to offer premium products offering higher quality with greater product life-spans. However, countries with competing manufacturing capability, for example China, have developed similar products at lower cost. This has squeezed UK domestic and overseas sales leading to a decline in domestic manufacturing capability. Procuring organisations for port fit-out equipment are often the consultancies and civil engineering companies that are the prime contractors for port development. These prime contractors rely on existing networks of suppliers and contacts to deliver the required equipment. Where there are gaps in the UK capability, they have the knowledge to access overseas suppliers.
290. As well as the capability issue relative to international businesses mentioned above, there are pinch points within the global supply chain for port development, for example in supply of dredging services. The UK competes globally for the expertise and capability of a handful of suppliers with the scale and capability to deliver the services that UK port development requires.

Findings

291. There is no clear reason to intervene in the supply chain for UK capability to fit-out port infrastructure. The supply chain has adapted to respond to decreased UK capability and is able to source appropriate skills, materials and equipment to meet existing requirements.
292. While the issue of increased investment overseas in port infrastructure may make these more attractive in certain niche markets, ultimately demand for most UK port services is derived from imports and ports in other countries cannot compete away the final importation move. For example, even if at the margin a deep sea container vessel decides not to make a UK call, the vessel's UK-bound cargo will still enter the UK by feeder services.
293. Much of current investment in port infrastructure is in the south east of England. The region is en route for Far East container loops and Dover has a clear advantage for Straits ro-ro services (while needing to compete with the Channel Tunnel). Other ports have their own geographical advantages, e.g. Mersey for transatlantic activity and Hull with major trading links to Europe, the Baltic States and Scandinavia. Ports outside the south east with container consents include Bristol, Teesport and Mersey.

294. The Government has been clear that the geographical rebalancing of the economy is a priority. The setting up of Local Enterprise Partnerships (LEPs) is an example of a mechanism that will give local areas greater control over investment in the local area, assisting with rebalancing. LEPs will be involved in determining the local economic conditions which will encourage investment (including investment in infrastructure) and should be in a position, where appropriate, to work with ports to identify opportunities to build on the geographical advantages for ports outside the south east.
295. Respondents were clear that the planning and consenting regime was a significant concern. Completion and implementation of the Penfold Review of non-planning consents is one example of how Government has sought to address the challenges faced by port operators, including simplifying the range of licences and consents that can be required in parallel with planning permission, harbour orders or development consent. In addition, the Department for Communities and Local Government (CLG) is compiling Planning Performance Agreements setting out performance measurements for how Government and industry can work better on complex investment projects, including infrastructure. Completion of these agreements and simplification of the planning and non-planning consents regime will make a significant contribution to the business case for investment in ports infrastructure.
296. Marine planning will bring efficiencies for industry by bringing stakeholders from all sectors and Government departments together enabling discussions on potential developments to be considered at an early stage. Marine plans will result in greater certainty for developers, thus reducing work and costs that currently arise when conflicts and objections are identified in later stages of the planning process. Marine Plans will also contribute to the economic regeneration on the coast by considering the socio-economic links between what happens at sea and communities on the coast. By placing coastal communities at the interface of two planning systems, marine planning has the potential to contribute to the transformation of coastal towns from geographically peripheral areas to hubs for sustainable economic growth, based on the shared terrestrial and marine evidence bases.
297. Issues with engineering skills and project and programme management experience are common to those in other transport supply chains. There is a need for a coordinated approach to this issue in line with other skills needs as described in Section 2.

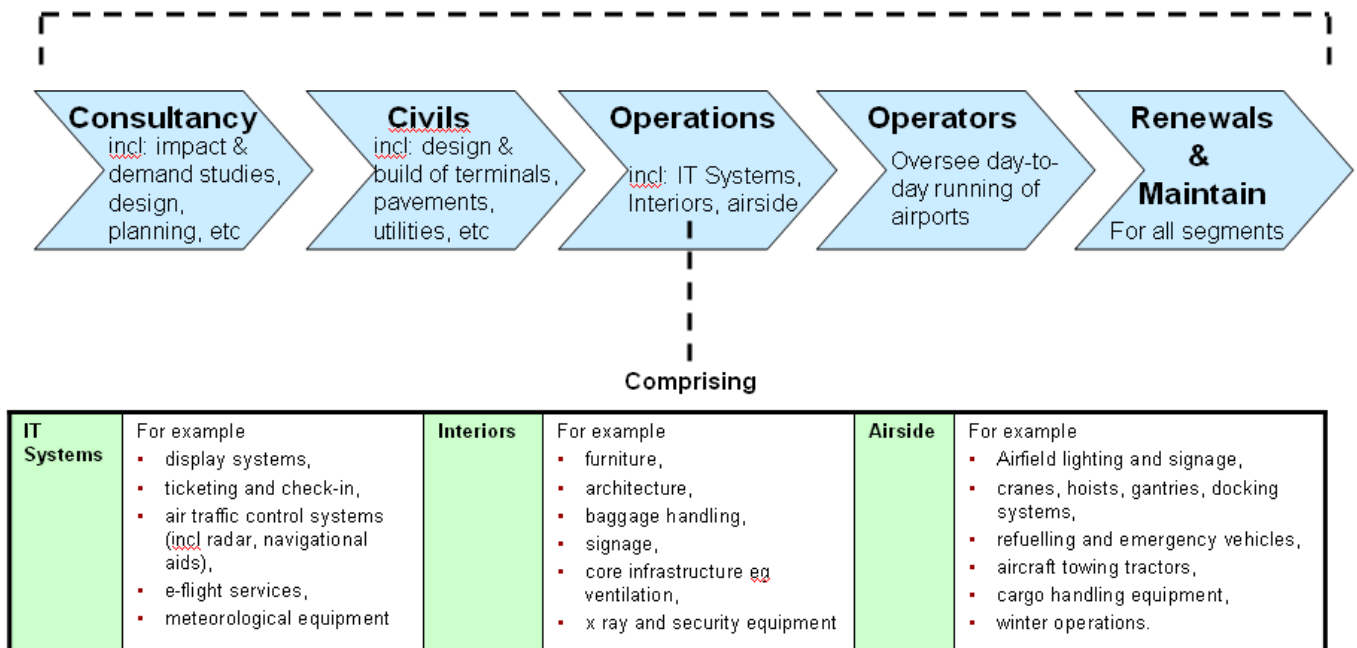
Airports

Introduction

298. Airports are pivotal in enabling the movement of people and goods, in to, out of, and around the UK, supporting both local and national economic growth. Airports are also important businesses in their own right making valuable contributions to regional and local economies. With over 211million passengers passing through UK airports in 2010 alone, our airports are an excellent showcase for the skills, quality and expertise of the UK supply chain. Similarly many countries around the world have used the UK supply chain to construct their airport infrastructure.
299. High economic growth in markets including China, the Middle East, and India offer a wealth of opportunity as they invest in new airport infrastructure to improve access to overseas markets and attract inward investment. These overseas opportunities are increasingly important to the UK supply chain as it grows revenues in new markets and dilutes its reliance on the mature UK airport infrastructure market. Unlike in high growth markets, opportunities for the supply chain in the UK tend to from maintenance and renewal of existing infrastructure rather than development of greenfield airport sites.

The airports supply chain

300. The UK has an established global reputation for delivering reliable, effective, premium products. The supply chain is well placed to meet the current and future demands of airport operators and policy makers in the UK and overseas. Meeting these needs will draw on the UK’s world-leading consultancy and civil engineering expertise and modest capability in the manufacturing of operational equipment required to fit-out and operate airports.



301. It was reported that there has been a gradual decline in both the availability and quality of the skills base, which has a detrimental impact on the ability of the airports supply chain to meet the demands that are placed upon it, both in the UK

and abroad. The UK's major consultancy and civil engineering companies tend to be large multinational, market leaders that provide multi-disciplinary services (e.g. impact studies, design, planning, building) for which airports typically represent only one revenue stream. They also tend to develop knowledge and skills in-house which can be easily transferred to other infrastructure projects when demand for airport services is subdued, giving the company flexibility to allocate their workforce across infrastructure types.

International comparison

302. The UK has well established airport operators. Heavy passenger demand (both international and domestic) offers the prospect of significant revenue and profits from owning and operating UK airport infrastructure. For this reason, international investors including Ferrovial and Global Infrastructure Partners have taken majority stakes in UK airports and are investing heavily in upgrading existing airport infrastructure. Whilst challenges exist within the supply chain (e.g. skills base), the UK airport infrastructure remains an attractive investment proposition.

SWOT analysis

303. **Strengths and opportunities** lie in product development/rollout, airport design / build/ operation, specific skills and expertise and a variety of advantages within the supply chain. The UK has a proven track record of successful development and rollout of products throughout the supply chain. It also has a reputation for delivering world leading airport design and build – which provides important export potential.
304. The UK is recognised as having expertise in project and programme management and engineering design. Civil engineering companies particularly are considered highly competent. They have good project management skills and strong technical experience. The UK has a good track record of running large international gateway airports.
305. Specific opportunities include the drive for renovation of terminal facilities to upgrade existing infrastructure – e.g. Manchester T1, Gatwick South, Heathrow Terminal 4. A general rising trend in demand for aviation means increasing global demand for airport infrastructure (especially new build in high growth markets). Developed markets such as Australia and Singapore can pay premium prices and offer greater revenue and Intellectual Property security than some emerging markets.
306. **Weakness and threats** in airport infrastructure lie in skills, innovation in security, competition with overseas markets, links with other supply chains and the visibility of the SME role in the supply chain.
307. Threats were reported to smaller firms in particular. There is a perception of SMEs being shut out of UK military contracts and major buyers are considered not to be sufficiently aware of the range of innovative and dynamic range of SMEs in the lower tiers of the supply chain. Quality of dialogue and communication has been cited as a key barrier. It is often challenging for SMEs to win business with prime contractors including major Government contracts. Smaller suppliers can find the costs and efforts involved in multiple registrations a high barrier to entry and are often unaware of existing advisory services.

308. Uneven project demand profiles and increasing overseas demand, for example from China, has led to talent flight. An aging workforce leading to a loss of skills is considered a threat, along with a lack of talent management and succession planning to respond to this. A lack of understanding of how to operate apprenticeship schemes (particularly in SMEs) and a decline in practical engineering skills is decreasing UK capability to actually construct infrastructure, especially in overseas markets with a reliance on others for necessary skills. Long-term decline in the skills base poses significant risk to the UK's capability to take advantage of domestic and overseas opportunities.
309. Technology was seen by some stakeholders as not developing sufficiently quickly to meet security and regulatory requirements e.g. liquid scanners. However, there are several British manufacturers of equipment for liquids screening approved by, or currently being tested for, the Department for Transport. This may be an affordability issue, since the costs of acquiring and installing security equipment fall on the airport operators.
310. Manufacturing premium products often means higher prices which limits the scope to operate in some high growth markets. It was also seen as more difficult for UK technology providers to forge relationships with few global manufacturers than to work within a UK supply chain. Threats cited included the growth of Chinese expertise in construction (through growing the size and operational capability of the skilled workforce) and UK headquartered businesses being attracted to high growth economies in the Middle East and Asia.

Findings

311. SME suppliers requested greater access to Government contracts as a revenue source for their business, with Ministry of Defence contracts being highlighted in particular. The steps being taken across Government to increase access to public sector contracts are set out in Section 2.
312. In common with other sectors, SMEs in the airports supply chain face difficulties in accessing knowledge, funding and skills for research and development. There are examples from other sectors of successful collaboration with the research base that could be transferred to the aviation sector, particularly in technical disciplines such as electrical and mechanical engineering.
313. With the rising costs of input materials, energy prices, etc. stakeholders suggested that the operations segment in particular, with its higher proportion of SMEs, could benefit from greater collaboration between companies. For example where businesses cluster together with similar input materials, the formation of Cooperatives could help to maximise economies of scale and negotiate improved prices, as well as highlighting opportunities for collaboration.
314. Suppliers and airport operators acknowledged that UK Trade and Investment (UKTI) was strong at providing initial support to companies, particularly in finding leads for new business opportunities. However competitor countries, especially France and Germany, were cited as having stronger promotional support from Government (both financial and political), providing greater access to export markets.

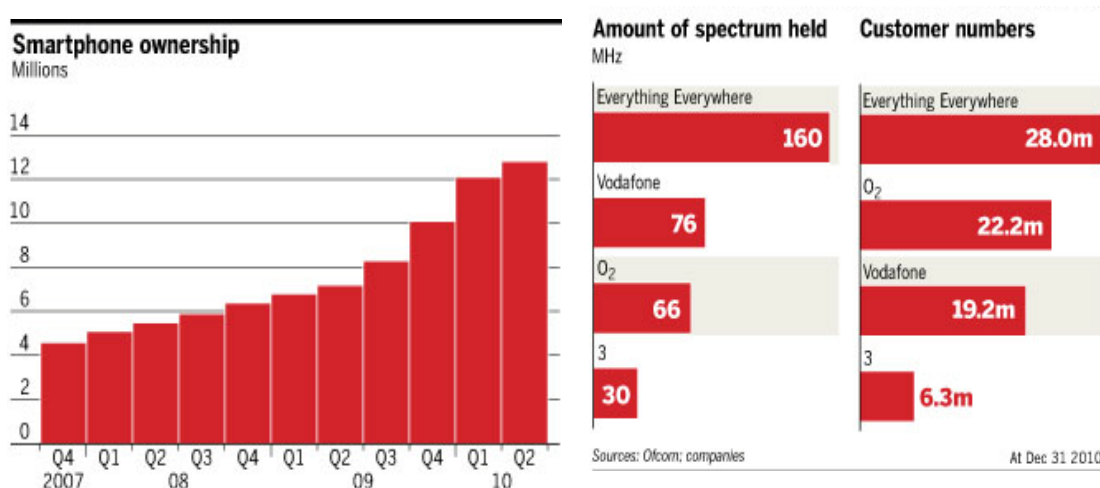
315. The challenge of maintaining both current skills levels (technical and manual) and ensuring a pipeline of new talent in to the airport infrastructure supply chain was cited throughout the supply chain. The issues and proposed actions were in line with the views of respondents from other infrastructure sectors summarised in Section 2.

Telecommunications

Introduction

316. This chapter focuses on the supply chain for infrastructure supporting data services, the key growth area for communications. The future investment challenge is to increasing the coverage, speed and reliability of data networks across all formats: fixed line, mobile and satellite. These are interrelated, since all wireless services rely at some point on fixed lines for the ‘backhaul’ of data to central servers. In some circumstances it is backhaul capacity, rather than wireless bandwidth, that is the limiting factor.
317. The pace of growth is striking: in a recent report⁶¹ the UMTS Forum, an industry body, estimated that total annual traffic on mobile networks globally would reach 127 EB⁶² in 2020. If realised, this would represent a 33x increase compared with the 2010 figure. The same report suggests that in a ‘representative Western European country’ the rate of growth could be double the global average.
318. This growth is being driven by changes in user expectations, for example that video should be available on demand rather than being broadcast at a time fixed by the content provider. Use of mobile data has been driven by the take-up of wireless ‘dongles’ for laptop computers and now by the rapid growth of smartphone ownership.

Figure 4: UK smartphone ownership, spectrum use and customers⁶³



⁶¹ Mobile traffic forecasts 2010-2020 UMTS Forum, May 2011

⁶² An exabyte (EB) equals 10¹⁸ bytes or one billion GB (gigabytes).

⁶³ Source: Ofcom, companies. The chart excludes an EU Commission requirement for Everything Everywhere to divest 15 MHz of spectrum as a condition of merger approval.

319. Broadband in the UK is relatively cheap and widely available, relative to other OECD countries.
- Availability: DSL is available to nearly the entire country and cable available to slightly over half. 3G coverage is estimated as being available to 87% of the population, although some claim higher coverage. Approximately two-thirds of households and 92% of small businesses have a broadband service.⁶⁴ The UK is a leader in deployment of public Wi-Fi hotspots.⁶⁵
 - Cost: mobile and fixed broadband prices are competitive in the UK. Prices have fallen substantially: for example, an 8Mbps fixed-line connection in 2009 cost as little as 20% as the same connection in 2005.⁶⁶ The UK has some of the cheapest broadband subscription prices in the world and has particularly attractive prices for high speed broadband.⁶⁷
 - Reliability: Businesses value reliability and service over speed, according to industry surveys.⁶⁸
320. Comparisons of broadband performance are made more complicated by the range of different metrics available. The EU has developed a basket of measures⁶⁹ including speed, coverage, price and 'socio economic context'. Using this composite 'Broadband Performance Index' the UK was ranked 4th out of 25 EU countries, behind Denmark, the Netherlands and Sweden. Measured on speed alone however the UK was ranked 15th.
321. Since these figures were published, significant public and private investment is being or has been deployed to boost coverage and speed. Government is investing £530m through Broadband Delivery UK to secure 100% UK coverage of a basic 2Mbps service as well as deployment of superfast (25Mbps) broadband to at least 90% of the population in each local authority area. Meanwhile BT is investing a total of £2.5 billion to bring fibre-based broadband to two-thirds of UK homes by 2015.⁷⁰
322. These metrics are not necessarily a guide to the economic value of broadband infrastructure. For example, the UK has outperformed all EU nations in its adoption of online retailing. Nottingham University⁷¹ assessed the online share of retail trade in 2010 as 10.7% with a 2011 forecast of 12%. This was significantly ahead of second-placed Germany, 8% rising to a forecast 9%.

⁶⁴ *Next Generation Connectivity: A review of Broadband Internet transitions and policy from around the world*, Berkman Center for Internet & Society, Harvard University, 2010.

⁶⁵ The Wi-Fi Alliance estimates the *total* number of hotspots in the UK at approximately 28,000, the fourth largest after China, the US and France (verified public Wi-Fi hotspots, January 2011).

⁶⁶ Ofcom, "Impact of the Strategic Review of Telecoms", 2009.

⁶⁷ *Next Generation Connectivity*, *ibid.* Data from speedtest.net tests of actual speed for download, upload and latency statistics.

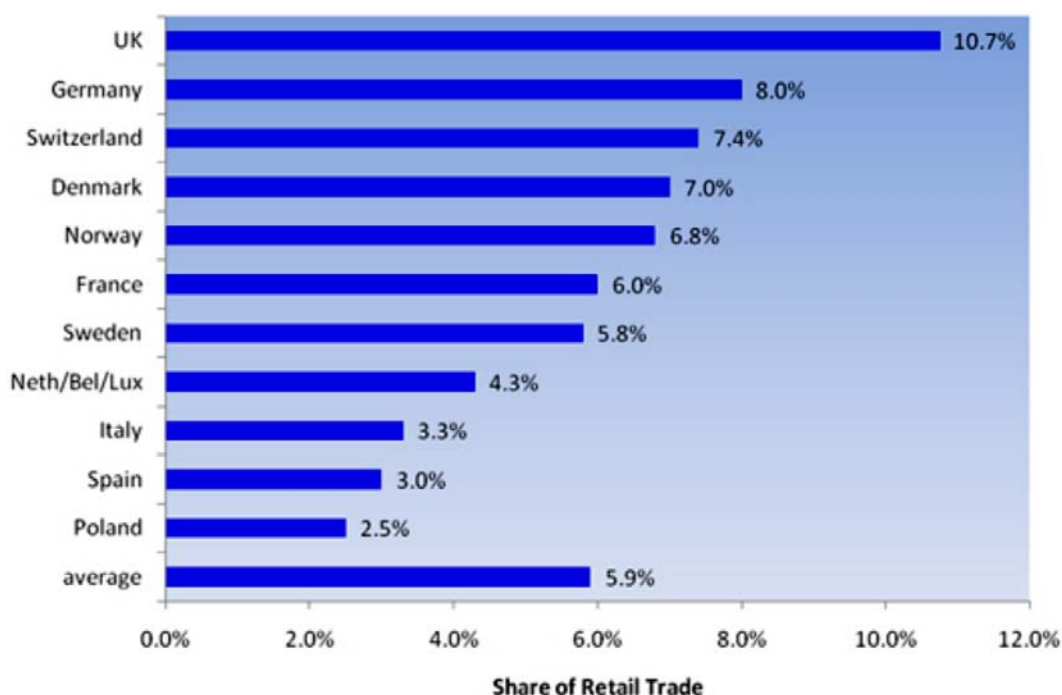
⁶⁸ Source: Ofcom; Powernet reported at <http://tinyurl.com/6csoabm>

⁶⁹ Quoted in the *Digital Competitiveness Report* August 2009

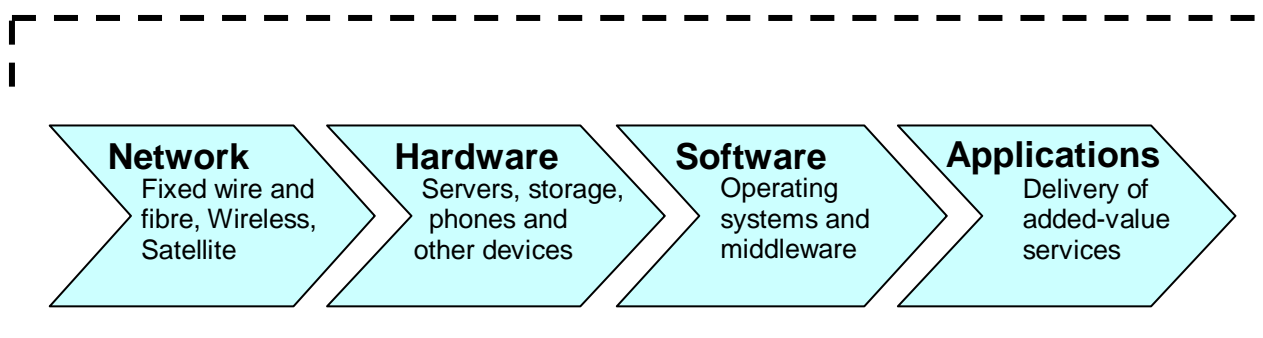
⁷⁰ Source: Company statement, 13 May 2010

⁷¹ *Online Retailing: Britain and Europe* Centre for Retail Research, January 2011

Figure 5: Online share of retail trade for selected EU countries, 2010

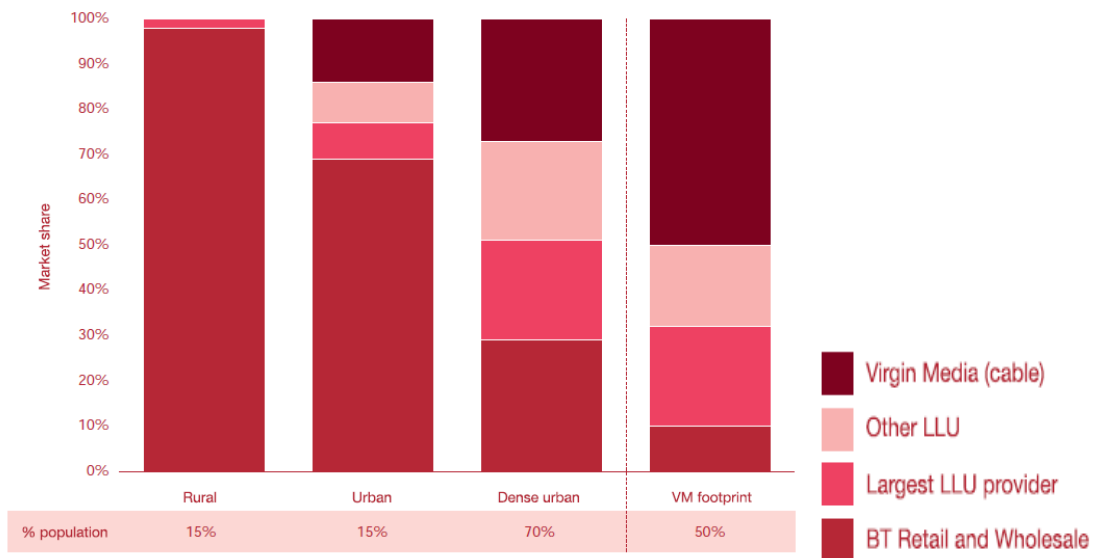


The digital communications supply chain



323. Regulation has played a significant role in (re)structuring the supply chain for fixed broadband. Competition has increased significantly since Ofcom required BT to “unbundle” the local loop, allowing other operators to use connections from the telephone exchange to the customer's premises. This led to the separation of BT network services under the Openreach banner, providing wholesale services to all operators on an equal basis.
324. A period of intense competition followed, though this has subsided in recent years with the consolidation of several of the larger competitors. The connection share of the top five broadband providers was 73% in 2005 but is now over 90%. BT provides 65% of fixed connections but its retail arm holds just over a quarter of the market, with Virgin Media and TalkTalk as the next largest providers.

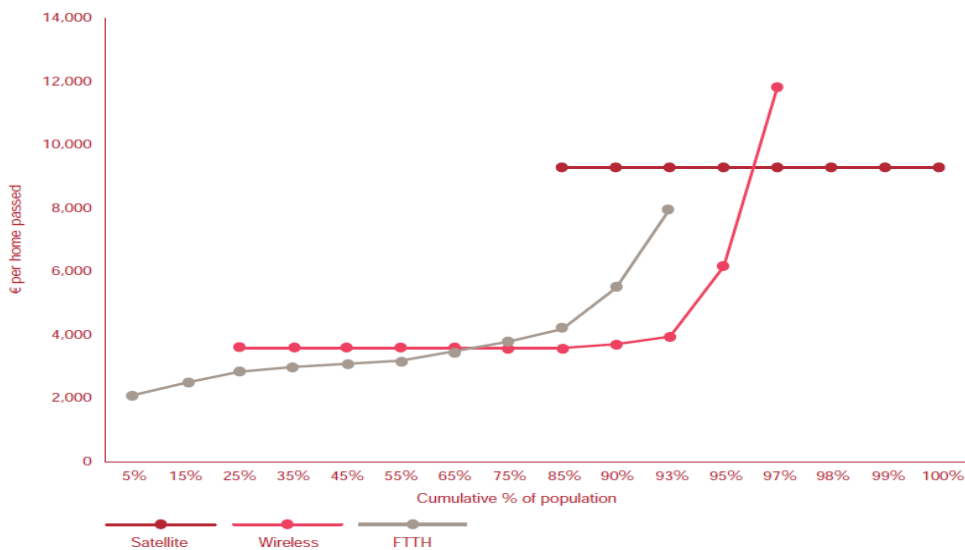
Figure 6: UK market shares by geography



325. The mobile market is dominated by four network operators, O2, Vodafone, 3 and Everything Everywhere (trading as Orange / T-Mobile). Figure 4 gives an overview of the market shares for these firms. Network capacity is leased to second tier operators including Virgin, Tesco and Asda, known as Mobile Virtual Network Operators.

326. Although costs to the consumer are typically two to three times as great as a fixed-line or mobile solution, satellite services have an essential role to play in securing universal broadband access because their footprint covers the entire country, subject to being able to achieve the correct alignment of a receiving dish with the relevant satellite. Figure 7 shows how the comparative costs of three broadband technologies change with increasing coverage of the UK population. Satellite is an essential option for the hardest to reach 1-2% of the population.

Figure 7: Broadband technology cost vs. UK population coverage

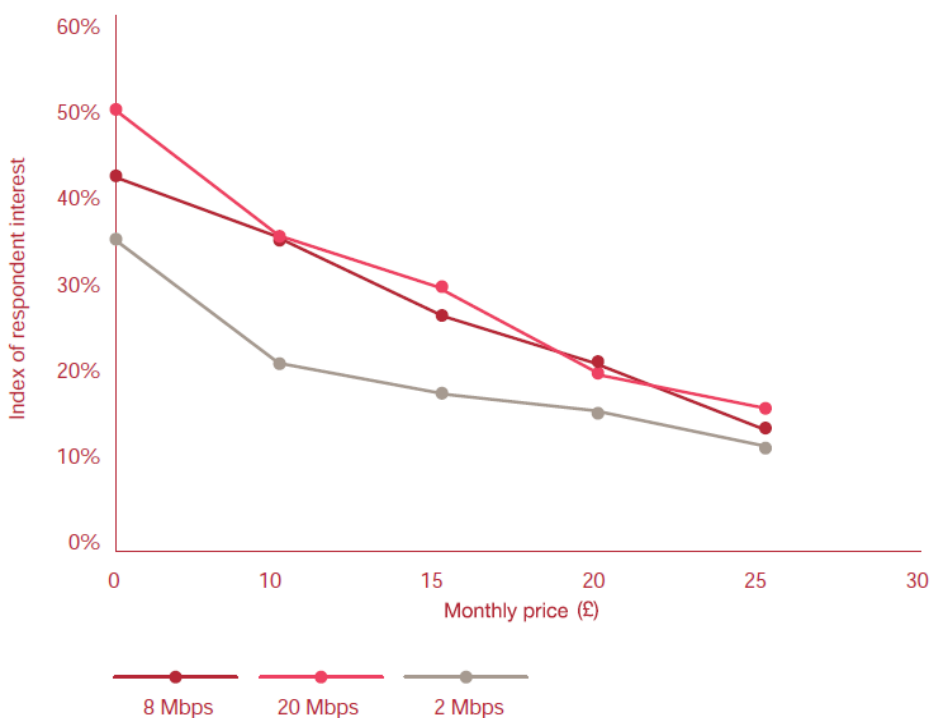


Source: PricewaterhouseCoopers (NB non-linear scale on x-axis)

Can the supply chain deliver?

- 327. Communications is a competitive, global industry that is well-placed to supply the needs of the UK market. Although the UK has some highly competitive network operators, the technology leaders in telecommunications hardware are typically based overseas. However the strength of the research base and availability of high-end engineering skills put the UK in a strong competitive as regards product design and development, software and applications design.
- 328. The sector is characterised by rapid innovation, in technology and its application. For example Huawei, the Chinese networking and telecommunications equipment supplier, is undertaking an equipment upgrade for Everything Everywhere in the UK, promising improved coverage while making the network more energy-efficient and reducing the number of base stations.
- 329. Respondents were clear that the speed at which next generation, superfast broadband networks are rolled out is primarily dependent on customer demand, although the availability of staff with the necessary skills is also a limiting factor on the deployment of fixed-line network infrastructure. There are conflicting views in this area, with survey evidence (Figure 8) suggesting that customers place limited value on faster services, or are unwilling to go beyond a set price in return for an improved service, whether this is measured by speed or data allowance.
- 330. On the other hand, as previously noted BT is putting in place a major investment in next-generation broadband on which it clearly expects a return and as Figure 6 shows, where Virgin Media services are available the company's cable broadband offer is attractive to customers. This suggests that once customers experience the benefits of higher-speed services they may change their minds.

Figure 8: Interest in broadband services relative to price and speed



Source: PricewaterhouseCoopers

331. Demand for mobile data has increased which is placing strains on the network to meet the rising demand. The limiting factors are the availability of spectrum at suitable frequencies and the capacity of the backhaul infrastructure that connects wireless base stations to the fixed network. To deal with the demand for additional spectrum Ofcom will be releasing spectrum freed up by the digital switchover of terrestrial television in 2012. Government has also announced plans to release over the next 10 years 500MHz of spectrum below 5 GHz that is currently used by the public sector.
332. Planning was reported as a constraint that introduced a delay in the installation of new base stations and hence made network operators less able to respond to changing demand. Similarly broadband infrastructure delivery relies heavily on being able to secure right of way access to install or upgrade networks. There is also some inconsistency of regulation between infrastructure types, such as the fact that telecoms companies are required to pay compensation and a consideration whereas electricity companies just pay compensation for wayleave access. The Government announced within Phase 1 of its Growth Review that it will address this issue by applying the principle of 'a presumption in favour of sustainable development' for superfast broadband deployment. This will include wayleaves, overhead deployment of infrastructure and rights of access to multi-dwelling units.

SWOT analysis

Strengths

- Widespread availability of broadband (fixed and mobile)
- Competitive pricing (fixed and mobile)
- Competitive market for network equipment
- UK research base; design and engineering skills
- Strong overall position relative to EU competitors, particularly in e-commerce
- World-leading satellite communications sector, covering communications services and satellite design and construction

Weaknesses

- Later roll-out of superfast broadband than some competitors
- Difficulty in securing STEM skills reported by some businesses

Opportunities

- Release of additional spectrum from digital dividend and on-going review of public sector spectrum
- Demand created by public sector investment (through BDUK) in universal broadband service and superfast broadband
- The prospect of applying new technological capabilities to manage demand in electricity generation and storage e.g. installation of smart meters by energy companies.
- New approaches in delivery of infrastructure e.g. the sharing of water and sewage networks to take telecoms cables and innovation in delivery to address challenges presented by planning permission.

Threats

- Robustness of data network, security issues
- Global competition for investment funds
- Network providers unable to justify the scale of investment required to maintain and improve service quality in the face of rapidly rising data volumes
- Consolidation of broadband suppliers could threaten competition within the sector

Findings

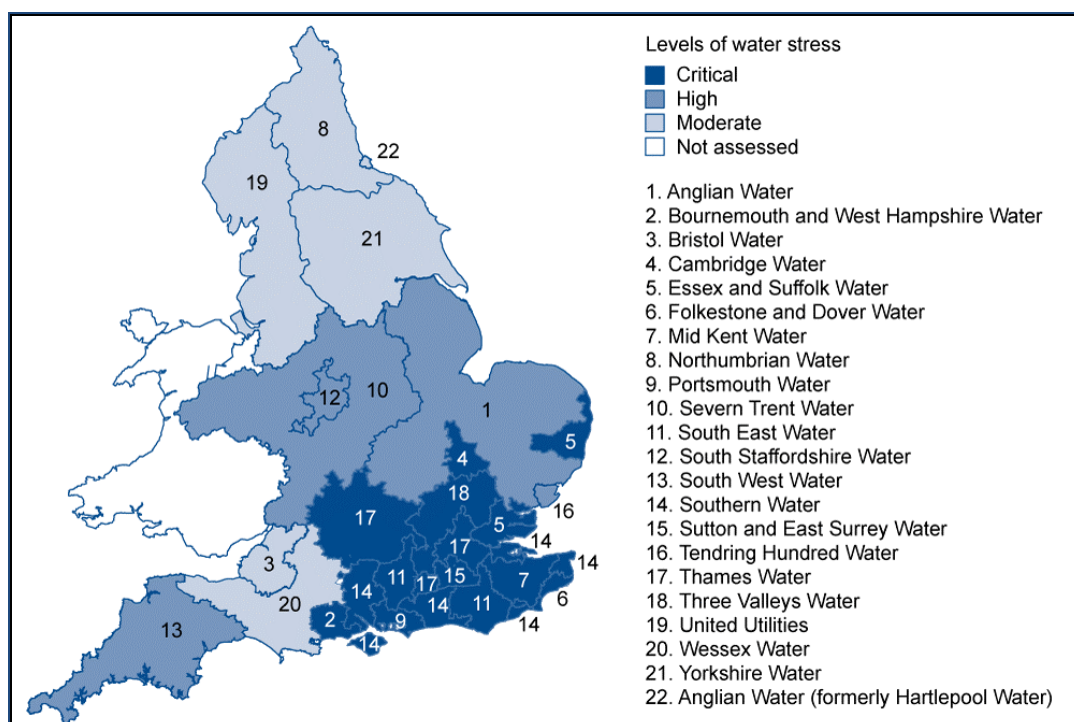
333. The global telecoms supply chain is capable and innovative. UK network providers are able to source competitively without encountering supplier capacity constraints.
334. The scale and speed of growth in data traffic will require significant investment in order to maintain and improve service levels. In the case of mobile data, backhaul capacity and the availability of spectrum are both potential constraints.
335. The UK has inexpensive and widespread broadband access, but has historically lagged other countries in terms of investment in super-fast “next generation” broadband networks. This is now being remedied in both fixed and mobile networks. There is mixed evidence on the implications for UK competitiveness, with the UK demonstrating a strong position in online retailing and e-commerce.
336. Ofcom recently closed a consultation on the release of spectrum that will be made available as a result of the switchover to digital terrestrial television. The Government has also published a call for evidence on the release of public sector spectrum. The timing, structure (size of packages), pricing and licensing restrictions on spectrum release will have a significant impact on market structure and may impact the choice of technology going forward.
337. There are opportunities for collaboration across infrastructure sectors, both in providing innovative data services and in sharing physical connections as a means to deploy fibre networks with reduced disruption and cost.

Water

Introduction

338. There are 21 regional water companies in England and Wales – 10 responsible for both water supply and sewage services, plus 11 water-only companies⁷². All of these are in the private sector, although Welsh Water is a not-for-profit company. Scotland and Northern Ireland each have a single water and sewage service provider. These are in public ownership, but rely upon private companies for delivery of their services.

Figure 9: Water companies in England⁷³ (Source: Environment Agency)



339. The water industry supplies some 17 billion litres (17 million tonnes) of fresh water each day and treats 16 billion litres of waste water before returning it to the environment. The sector is a significant user of energy, accounting for 1% of UK CO₂ emissions. Energy use has doubled since 1990, reflecting capital investment and stringent quality standards for both drinking water and sewage treatment⁷⁴.

340. Collectively the sector has invested some £90bn since privatisation in 1990. It is cash negative, increasing borrowings by an average £1bn annually as new investment continues to outstrip income from water customers. The water supply chain is responsible for the delivery of this investment programme and in some cases for asset operation and maintenance as well.

⁷² Source: Ofwat <http://www.ofwat.gov.uk/industryoverview/today/watercompanies>

⁷³ Water company boundaries follow river catchments rather than administrative borders; hence Severn Trent covers mid-Wales and Welsh Water serves parts of Herefordshire.

⁷⁴ *Improving innovation in the water industry* Council for Science and Technology, March 2009

341. As monopoly providers of a scarce resource, water companies in England and Wales are subject to regulation of their economic activity (by Ofwat), environmental impact (by the Environment Agency) and quality (by the Drinking Water Inspectorate). Scotland and Northern Ireland have analogous arrangements.
342. Economic conditions are set by Ofwat on a five-yearly cycle, which has traditionally dominated investment decisions and supplier contracts. The allowable rise in customer bills and rate of return on capital investment are determined by the Ofwat price review, taking account of the asset base and water scarcity in the area – which varies widely across the UK.
343. So as to look beyond this five-yearly cycle, water companies were asked to create 25-year Strategic Direction Statements setting out their vision for the future of water and sewerage services. These were published for the first time in December 2007.
344. The regulatory regime is said to hamper innovation – the Council for Science and Technology⁷⁵ concluded that *The regulatory regime militates against research and development and provides insufficient rewards for innovative solutions*. However it also noted that *the water industry's performance in terms of investment in technology and application of innovative solutions is highly variable between companies in both clean water delivery and in waste water and sewage treatment*.
345. This more nuanced view was supported by suppliers, who stated that some companies – Anglian and Yorkshire in particular – did have an innovative culture and encouraged innovation from their suppliers. For example, these companies had challenged suppliers to develop infrastructure renewal techniques that minimised customer impact (i.e. no interruption to supply) and reduced or eliminated traditional trenches for pipe laying. Ofwat and the water companies have both sought to facilitate innovation, through specific incentives and the creation of UK Water Industry Research, a collaborative industry forum. Suppliers supported an incremental approach, as recommended by the Cave Review of competition and innovation⁷⁶ commissioned by the UK and Welsh Assembly Governments.

The water supply chain

346. Given that they are subject to a single regulatory regime, water companies are surprisingly variable in their operations, reflecting local conditions (the extent of water scarcity and age of the network) and business strategy. The majority see themselves as asset managers and procurers of services, but some choose to operate and maintain their assets themselves and offer these services to others.

⁷⁵ *Improving innovation in the water industry* as before

⁷⁶ *Independent Review of Competition and Innovation in Water Markets* Professor Martin Cave, April 2009

347. Tier 1 suppliers fall into three groups: civil engineering contractors, suppliers of specialist plant and equipment (pipework, valves, pumps, treatment plant) and service providers offering maintenance, asset management and (if required) operation of water assets.
348. Tier 2 suppliers include drainage and pipe laying subcontractors as well as specialist service providers from laboratory and analytical services to logistics, information systems and environmental consultants.

Can the supply chain deliver?

349. The evidence from suppliers and the water industry's own track record since 1990 both support the view that the sector will be able to raise the necessary funding and deliver the investment that is required. Those concerns that were raised – on innovation, collaboration and long-term water availability – did not call this judgement into question.
350. Because the business environment for the water companies relies on a successful relationship with Ofwat, they have developed an extensive evidence base on their operations. There is not the same imperative for the supply chain, which in consequence is fragmented and has fewer channels to put across policy positions. Interviews with individual suppliers were particularly useful in understanding what lay behind common perceptions on innovation and collaboration.

SWOT analysis

Strengths

- Effective economic and environmental regulation with a 20-year track record
- High investor confidence and sophisticated funding arrangements
- High quality of data and market analysis
- Good forward visibility of infrastructure plans within 5-yearly price reviews
- Established and effective UK supply chain
- Diversity of approaches within a common regulatory framework
- Secure income stream from an essential service

Weaknesses

- Continued reliance on Victorian infrastructure, with consequences for leakage and resilience
- Lack of market incentives limits the consequences of poor performance
- Some evidence that regulatory approach reduces incentives to innovation
- Rising energy consumption, driven by water quality standards
- Lack of long-term planning, beyond 5-year regulatory horizon
- Fall-off in activity at the beginning and end of the cycle (estimated at 40% from the peak)
- Poor collaboration between companies and lack of an integrated UK network

- Lack of resilience to flooding and electricity supply disruption
- Poor visibility of information on stock and condition of infrastructure assets

Opportunities

- Extend collaboration on regulatory issues to cover innovation and skills
- Collect and share data on asset location and condition with Ofwat, other infrastructure providers and stakeholders such as local authorities so as to improve the quality of planning
- Evolve the regulatory regime to address lack of incentives to innovation
- Develop mechanisms to reward collaboration within the water sector and with other infrastructure types
- Develop supplier capability and use the supply base to spread best practice across water company boundaries
- Provide longer-term certainty so as to reduce the impact of 5-yearly cycle – a range of measures is being considered including 7- or 8-year review periods, splitting the review of customer prices from the review of investment or an increased role for companies' 25-year plans

Threats

- Climate change reduces supply at the same time as new household formation increases demand, leading to widespread shortages
- Continuing rise in energy consumption, led in part by the above (Thames Water has opened its first desalination plant, approximately 3x more energy-intensive than conventional treatment)
- More frequent flooding disrupts supplies and requires additional investment to protect pumping stations and install backup power generation
- Increased investment demand from other infrastructure types diverts investment flows and increases the cost of capital

Findings

351. The water sector has been extensively analysed and studied at the level of the water companies, their relationship with the regulator and the operation of the regulatory framework. Less attention has been paid to the role of the supply chain in implementing the desired changes in performance, collaboration and innovation
352. In designing regulatory reforms, the supply chain impact should be assessed so as to model the benefits from a more stable and predictable demand profile. Those benefits will accrue to suppliers (who will be able to deploy their workforce more effectively) and ultimately to consumers, through lower operating costs.
353. There is a specific opportunity to capture the benefits from better sharing of data on water usage and the location and condition of the water infrastructure, giving greater visibility to planners and the general public. Suppliers have the expertise to deliver this information at limited marginal cost, provided the capability is built-in as infrastructure is renewed.

Waste

Introduction

354. The UK's waste management infrastructure relies upon a network of specialist firms and facilities that collect, sort, process and either re-use or safely dispose of some 280 million tonnes of waste generated by UK households and businesses each year. This figure has declined in recent years – the equivalent for 2004 was 325 million tonnes.⁷⁷
355. The decline reflects both a decline in economic activity and the more efficient use of resources and elimination of waste at source. There is some debate as to the balance between these two factors and hence whether waste arisings will increase again as growth resumes, which has been the pattern in past economic cycles, or whether resource efficiency will prevail.
356. Unlike the other infrastructure types considered in this report (water, energy, communications and transport) there is no single 'waste network' to be maintained and the waste management infrastructure is correspondingly resilient. However the sector relies heavily on road transport and when disruption does occur, the consequences for households are highly visible.
357. The sector is often categorised as two parallel supply chains: domestic waste, (representing 10% of the total) the collection of which is contracted by local authorities on behalf of householders, and commercial and industrial (C&I) waste which is a free market. The latter accounts for some 25% of total waste, with the mineral extraction and construction sectors responsible for the balance of 65%.
358. The waste market in the UK accounts for some 0.7% of GDP. In 2009, BIS concluded⁷⁸ that the waste management sector was worth £4.8 billion, with 42,000 employees, with the waste recovery and recycling sector worth an additional £6.5 billion with over 53,000 employees. The sector is heavily regulated, with substantial financial and regulatory incentives to reduce the quantity of waste arising and to re-use, recycle or recover the energy from waste materials.
359. The landfill tax is a key long-term signal, first introduced in 1996 at the rate of £7/tonne⁷⁹ of (active) waste sent to landfill. By 2007 the rate had reached £24/tonne and has increased at £8/tonne annually since then, currently £56/tonne. The predictability of this landfill tax escalator was cited as a key factor in stimulating investment and a good example of government sending a clear and consistent signal to the market.

⁷⁷ Source: Defra <http://www.defra.gov.uk/statistics/environment/waste/wrfg01-annsector>

⁷⁸ *Low Carbon and Environmental Goods and Services: an industry analysis* BERR, 2009

⁷⁹ *Landfill Tax Bulletin* HMRC, January 2011

The waste management supply chain

360. Waste collection and residual waste treatment for domestic waste is dominated by larger firms, with the capacity to invest on the back of long-term local authority contracts. A range of smaller, specialist firms compete in the commercial and industrial market and in the provision of waste treatment technology. These two supply chains are becoming increasingly integrated, with facilities procured by local authorities often having additional capacity available for C&I waste. Similarly some local authorities have elected to send their waste to merchant plants normally associated with C&I waste, either because of the specialist facilities available or simply matching spare capacity with unmet demand.
361. In the recent review of waste policy⁸⁰ the government announced that the Landfill Allowance Trading Scheme (LATS) would be discontinued from 2013. This measure is designed to remove the current disincentive for local authorities to collect trade waste from small businesses. It represents a further step towards an integrated approach to waste, where treatment is best suited to the materials being processed rather than being determined by whether the waste arose from a domestic, industrial or commercial source.
362. The waste policy review also announced a 'Responsibility Deal' between Government and the waste management industry. This deal covers a range of issues, including raising awareness of waste prevention and sustainable waste management; exploring ways to increase take up of recycling services by SMEs and Government and industry working together to promote quality in the way recyclable materials are sorted, particularly at material recovery facilities, through an industry-led Code of Practice.
363. There is an increasing involvement from logistics firms in this market, using distribution networks to remove, sort and recover waste materials for clients in the retail, leisure and food industries. The use of otherwise empty vehicles to return material to distribution centres represents a more efficient use of resources than a separate logistics operation for waste collection.

Can the supply chain deliver?

364. Because there are different options for the treatment and disposal of waste, there is no significant risk of a breakdown in the process such that waste cannot be collected. If the necessary infrastructure is not in place, landfill remains as the fallback option. However in order to meet the ambition of zero (active) waste to landfill, significant investment in new facilities is required, ranging from materials recovery facilities to solid recovered fuel and energy from waste. The investment required was assessed by the Institution of Civil Engineers at £10-20bn over the next decade⁸¹ which represents the highest proportionate increase in investment of the five infrastructure sectors.

⁸⁰ *Government Review of Waste Policy in England 2011* June 2011 available at <http://www.defra.gov.uk/publications/files/pb13540-waste-policy-review110614.pdf>

⁸¹ *State of the Nation: Waste and Resource Management* ICE, January 2011 available at <http://tinyurl.com/5szzoy2>

365. While the technology and capacity exist, we conclude that under current conditions the required facilities are unlikely to secure sufficient funding to allow this investment to take place as planned. The government's current capacity requirement forecasts assume full use of the 2020 landfill allowance of 10.2 million tons. The consequence is that, while waste will continue to be disposed of safely and legally, the cost and environmental impact (CO₂ produced and virgin materials consumed) will be greater than would otherwise have been the case.

SWOT analysis

Strengths

- Clear visibility of policy direction through the 'waste hierarchy' and landfill tax
- Technical capability of the sector in waste collection, sorting and treatment
- High levels of innovation in niche technologies
- Mature, open markets for recovered materials
- Effective standard-setting for fuel and materials recovered from waste
- Transferable expertise in landfill operations
- Commitment to waste minimisation of firms from retail, leisure and distribution sectors

Weaknesses

- Despite significant increases in recycling rates in both households and businesses, the UK still sends more waste to landfill than comparable European countries
- Cost barriers to recycling for smaller firms
- Lack of clear information and communication about the difference in collection systems at local level
- Poor access to finance unless long-term contracts are in place
- Unwillingness of funders to finance relatively unproven new technologies, coupled with the lack of balance sheet strength of innovative technology providers
- Complex and uncertain planning regime
- Poor perception of the UK as an investment location, driven by lack of community acceptance for waste treatment facilities – especially energy from waste

Opportunities

- Local and national leadership to change public perceptions, from 'waste' to 'resource'
- Develop collaborative models for recycling of waste materials from SMEs
- Develop approaches to deliver local benefit from waste management facilities
- Deeper integration between waste producers, logistics firms and their clients
- Elimination of waste at source in target sectors – particularly construction
- Green Investment Bank to target specific funding gaps in demonstrator projects and early adoption of new technologies on a commercial scale

Threats

- Localism enhances resistance of communities to new waste infrastructure
- Public cynicism about new collection proposals, seen as cost-driven
- Lack of finance hampers smaller firms, leading to lack of competition and innovation
- Complexity and uncertainty of ROCs and other low-Carbon measures chokes off investment in Solid Recovered Fuel technology
- Complexity and relatively small size of waste sector means that investment funds are diverted to larger and more attractive opportunities in energy and transport

Policy review

366. A review of waste and resource management policy in England⁸² was published on 14 June 2011 following extensive engagement and consultation with the waste management sector, its customers and other stakeholders. The review covers all of the issues outlined in this chapter, some of which were previously explored in a joint BIS and Defra study of the sector⁸³. The waste review constitutes the definitive statement of Government waste policy in England.

Findings

367. From our discussions with suppliers, the scale of the funding challenge is a key issue. It became clear that lenders perceive waste projects as exhibiting significant technology and execution risk. There is evidence from demonstration projects to support the view that the waste management sector has specific funding requirements that will not be met from purely commercial sources. If the waste infrastructure challenge is to be met, the Green Investment Bank will not only have a part but is likely to need a specific offer geared towards funding waste management facilities, whose risk profile and funding needs are different from those of the transport and energy sectors. There is an opportunity to lead the market in this area and bring private sector capital to bear.
368. The development of markets in recovered materials was another priority for waste management firms, who highlighted glass, plastics and solid recovered waste (SRF) as commodities where markets remained immature. As a consequence, merchants and end-users were not able to have confidence in the quality of recovered materials unless they had an existing relationship with the supplier; these were not true commodity markets. Suppliers highlighted a continuing role for WRAP, the Waste Resources Action Programme, in setting market standards.
369. Supplier concerns on the uncertainty and delays inherent in the planning process were qualified by the knowledge that a new National Planning Framework is in preparation. There was an acknowledgement of the legitimate wish of local communities to control their immediate environment and a strong desire to move

⁸² *Government Review of Waste Policy in England 2011* as before

⁸³ *Less is more: Business Opportunities in Waste & Resource Management* BIS/Defra, March 2010 available at <http://tinyurl.com/68242mt>

away from the adversarial approach and 'planning by appeal' that many felt had characterised the previous arrangements.

370. Several suppliers pointed to the adoption of benefit-sharing and partnership models from other countries as the right long-term solution to public acceptability of waste infrastructure and called for Government involvement in this process.

Case study: public acceptability of waste infrastructure

In Vienna, Austria the words "waste incinerator" do not generate the reaction they would get in the UK. Instead, the use of residual waste for heating and power is seen as a valuable part of the energy mix.

The water and space heating for 4,400 commercial properties in the city is based upon an interconnected network of 10 heating plants with 900 km of pipes, one of the largest in Europe. The Fernwärme Wien is a 460 MW energy from waste facility that doubles up as a city centre tourist attraction.

The plant is designed to burn 250,000 tons of waste per year, generate electricity for its own needs and provide an additional 15 MW to the grid.

Extensive treatment of flue gases removes pollutants down to well below the strict Austrian air quality standards. An electronic display outside the plant shows the level of emissions in real time.



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URN 11/1058