

'Building our Industrial Strategy' Green Paper

Submission of evidence by the Association of Project Management



Building our Industrial Strategy: Call for evidence

Response by Association for Project Management

The Association for Project Management (APM) is a registered charity with 21,650 individual and 570 corporate members making it the largest professional body its kind in Europe. APM is committed to developing and promoting project and programme management and has recently been awarded a Royal Charter as part of its strategy to raise awareness and standards in the profession.

This call for evidence draws upon APM's recent online member surveys around technology, future infrastructure needs and a specific survey on the Industrial strategy held from March to April 2017.

We wish to offer the following key observations:

- **The Green Paper sets out an ambitious agenda - rightly so – of transformational change and major project activity. It is important that many of the key projects which underpin the Green Paper's ambition are properly planned and executed. As the Chartered body for the project management profession we are pledged to support the Government's ambition via the Infrastructure and Projects Authority (IPA) as well as individual departments in delivering this agenda successfully.**
- **The forthcoming challenge of Brexit from 2019 onwards will provide a formidable transformational challenge – but it is important that the effort to build a more competitive economy, envisaged by the Green Paper, remains a central focus for activity and that both the public and private sectors are not deflected from the central challenges contained in the Green Paper.**
- **Specifically on skills we advocate that a proper skills audit of skills shortages or gaps is carried out and maintained to help plan future mitigation to support efforts to deliver the long term ambition of this Green Paper (see page 9).**
- **On infrastructure, we believe that it is important that legacy learning becomes a key part of infrastructure projects to help create a virtuous circle for future success (see page 12).**
- **Driving up productivity as a means of powering the UK economy. Over 2017-18 APM will be conducting research will ascertain the relationship between project management and productivity and how it might be used to play an important part in improving the current low levels.**

Overall Comments

A survey run by Ipsos MORI amongst leading C-suite executives (*Source - Ipsos MORI Captains of Industry Study November 2016*) noted that the most important policies for inclusion in the Industrial Strategy Green Paper would be infrastructure (19%) and skills (16%) [Source 2016]. APM echoes these sentiments so our submission particularly focuses on these two of the ten pillars of the Industrial Strategy along with some additional comments on the rest.



We welcome the publication of the Green Paper on Industrial strategy. We believe that it is important commitment by Government to have an industrial plan around a number of pillars of competitiveness for the future. Combined with the intention following the 2016 Referendum to withdraw from the EU, the Green paper takes on an increased importance to help turbo-charge the UK through what will undoubtedly be a period of uncertainty and change.

All ten areas identified are, in their own way, significant and important and obviously inter-related but two have particular importance. The first is infrastructure and the other is skills. Whilst we make a number of points about some of the other pillars we focus mostly on these two. We would concur with three themes of particular importance:

1. The need to build on existing strengths by improving excellence
2. Identify and close the gaps identified to ensure there is increased productivity
3. Finally, reinforce the competitiveness of the UK and improving global competitiveness for the wider public benefit.

As the Chartered body for the Project profession – one of the newest professional bodies in the UK – we believe that our profession has a particular focus and expertise to bear on many of the issues identified in the White Paper. Indeed our members are central to such projects as Hinckley Point C, Crossrail Heathrow or HS2 or indeed many other private and public transformational projects.

The project management profession has a good vantage point on this agenda. Many of our practitioners are at the epicentre of making many of these transformational changes and that projects deliver – on time and on budget – as efficiently as possible. We would identify four major themes by which its progress should be benchmarked against:

First, how change is managed against the context of increasingly complex operational environments, often pan-national in nature.

Secondly, how collaboration is achieved via multi-disciplinary and interdependent projects.

Thirdly, the world is being digitised at pace – over time the industrial strategy needs to not only address but also anticipate these changes; and

Finally, having the widest, most diverse and appropriately skilled pool of talent to draw from in ensure the capacity challenges are met.

However a recent National Audit Office report (*Capability in the civil service*; HC 910 March 2017) has identified a specific public sector requirement to improve capability and skills to ensure this does not undermine the government's ability to achieve its objectives. Whilst considerable progress is being made the NAO states that: "Government projects too often go ahead without the government knowing whether departments have the skills to deliver them".

Industrial Strategy overarching questions

1. Does this document identity the right areas of focus: extending our strengths; closing the gaps; and making the UK one of the most competitive places to start or grow a business?



- 2. Are the 10 pillars suggested the right ones to tackle low productivity and unbalanced growth? If not, which areas are missing?**
- 3. Are the right central government and local institutions in place to deliver an effective industrial strategy? If not, how should they be reformed? Are the types of measures to strengthen local institutions set out here and below the right ones?**
- 4. Are there important lessons we can learn from the industrial policies of other countries which are not reflected in these ten pillars?**

1. Science, Research and Innovation

- 5. What should be the priority areas for science, research and innovation investment?**
- 6. Which challenge areas should the Industrial Challenge Strategy Fund focus on to drive maximum economic impact?**
- 7. What else can the UK do to create an environment that supports the commercialisation of ideas?**
- 8. How can we best support the next generation of research leaders and entrepreneurs?**
- 9. How can we best support research and innovation strengths in local areas?**

We wish to stress the importance of vocational learning alongside cutting edge research as a means of generating world class skills, products, services and processes. We support a number of the proposals put forward by HEFCE for the Research Excellence Framework (REF) 2020 which include: increased focus on open access, greater emphasis on research impact and encouragement of collaboration between academia and industry to aid theory and practice interfaces. Much of the discussion pre and post Green Paper has rightly focused on the capacity of the UK to deliver on inventive capability (more focus and drive to increase the D in R&D).

One example of large scale research being used to inform practice is the Infrastructure and Projects Authority's (IPA) major research initiative Project X. The Public Accounts Committee record a poor historical track record of major project delivery performance with the Government's Major Project Portfolio (GMPP) currently worth circa £500 billion but with 34% of the projects currently "in doubt" or "appear unachievable." Project X responds to and addresses the National Audit Office's concerns and recommendations to the Public Accounts Committee for delivering major projects.

Through bespoke research based on unique data and expertise, Project X will identify and deliver key learnings and management techniques to increase the efficient delivery of major projects. It seeks to generate unique insights into the performance of major projects and programmes in Government that can be used to drive improvement in performance and delivery confidence.

It is hoped that the project will create a collaborative environment for the civil service, academia, external project professionals and professional bodies coming together to share best practice and generating new knowledge in aiding improved project and programme delivery. The work of Project X is not in isolation and is further influenced by other activity including: IPA Annual Report, National Infrastructure Plan, the Government Construction Strategy and the research agendas of the participations universities, research councils and professional bodies. In addition to a range of practical research studies which are already underway the initiative has started to bring together academics and practitioners to work on other research activities.



APM action – in addition to supporting the Project X initiative and providing funding for subsequent research studies we are launching two pieces of work which we believe are germane to this set of questions. One on productivity and the other on the contribution of projects to the UK economy.

“The relationship between project management and productivity”

This research will ascertain the relationship between project management and productivity demonstrating the importance of project management to the economy. In addition the research will examine whether project management and project based activity could be used as a means to improving productivity whilst devising a potential methodology for measuring this relationship as part of a future study.

“The contribution of projects and project management to the UK economy”

This research will identify in measurable terms the impact of the project profession on the UK economy. It will do this by analysing the total Gross Value Added (GVA) and total employment which is managed by projects in the UK along (direct) and the GVA and employment attributable to project, programme and portfolio management in the UK (indirect).

2. Developing skills

10. What more can we do to improve basic skills? How can we make a success of the new transition year? Should we change the way that those resitting basic qualifications study, to focus more on basic skills excellence?

11. Do you agree with the different elements of the vision for the new technical education system set out here? Are there further lessons from other countries’ systems?

12. How can we make the application process for further education colleges and apprenticeships clearer and simpler, drawing lessons from the higher education sector?

13. What skills shortages do we have or expect to have, in particular sectors or local areas, and how can we link the skills needs of industry to skills provision by educational institutions in local areas?

14. How can we enable and encourage people to retrain and upskill throughout their working lives, particularly in places where industries are changing or declining?

Are there particular sectors where this could be appropriate?

APM welcomes that the Government has put skills at the heart of its industrial strategy. Government has set out several new commitments under this pillar:



Skills Gaps:

Key new commitments:

- Create a proper system of technical education, to benefit the half of young people who do not go to university and provide new, better options for those already in the workforce.
- Commit £170 million of capital funding to the creation of new Institutes of Technology to deliver higher technical education in STEM subjects and meet the skills needs of employers in local areas.
- Work towards a joined-up, authoritative view of the sector-specific skills gaps that the UK faces now and in the future.
- Publish a comprehensive careers strategy later this year.
- Take further actions to address differences in skill levels between different areas to help drive economic growth and opportunity throughout the country.

With an estimated 2 million additional jobs required for higher-level skills by 2022, and seven out of ten employers stating that they are *not confident* of being able to recruit sufficient high-skill employees in coming years, the UK's skills challenge remains a threat to productivity. The most recent labour market research from the UK Commission for Employment and Skills (March 2016) found that demand for highly skilled workers continues to rise across the UK – and is particularly strong in sectors critical to the rebalancing of the economy such as engineering, science and high-tech, and construction.

Investment in skills is responsible for up to a fifth of productivity growth, and a highly skilled workforce is therefore key to creating what is often called a “virtuous cycle” – where productivity improvement spurs increased skills investment, which in turn drives productivity growth.

Ensuring that businesses have access to the talent they need must be a foundational element of the Government's Industrial strategy – and the utilisation of third sector bodies in monitoring and addressing sector-specific skills gaps could prove to be transformative.

Traditionally project management competence and technical skills have been used in the recruitment of project professionals, but increasingly behavioural characteristics and emotional and social intelligence have been sought as another means of aiding selection. For example APM surveyed nearly 5,000 respondents in its '2016 Salary and Market Trends Report'. The report found that whilst the profession is well served from technical skills it, like the wider STEM environment, lacks the necessary 'soft skills' such as communications, creativity, management and being able to embed projects as part of organisation strategy which can only serve to boost UK productivity. Project management as both a profession and discipline is well placed to bridge that gap as it is one of the few subjects in UK Higher Education that appears in both Business and Engineering Schools.

What skills/competences do you look for in project professionals?

Stakeholder management and communications

67%

Budgeting/Cost control and financial management

53%

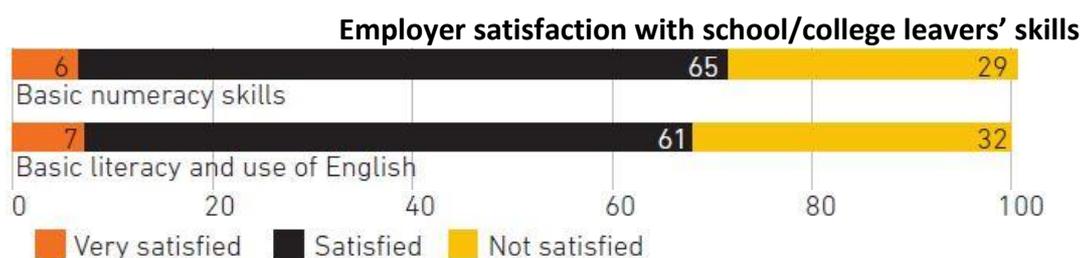


Planning	53%
Risk/issue and opportunity management	51%
Leadership and management (line management)	39%
What skills/competences are lacking in project professionals?	
Leadership and management (line management)	28%
Coaching and mentoring	26%
Strategic management	26%
Breadth/diversity of thinking (going beyond Project Management)	25%
Risk/issue and opportunity management	24%

Source: APM 2016 Salary and Market Trends Report

Basic Skills:

Of employers surveyed by the CBI/Pearson Education and Skills Survey 2016, 29% stated that they were *not satisfied* with school leavers' basic numeracy skills, with 32% *not satisfied* with school leavers' basic literacy and use of English.



More work is clearly still required – with Department for Education data showing that in England, one child in five (20%) still leaves primary school without reaching expected standards in reading, writing, and maths combined. This is particularly concerning as the evidence demonstrates that young people do not catch up once attainment gaps exist.

APM welcomed the government's assurance that following the introduction of the apprenticeship levy, funding will be available if an apprentice needs additional training to meet Level 2 in English and maths.

Digital Skills:

A 2016 report by the House of Commons Science and Technology Committee *Digital Skills Crisis* highlighted that skills gaps in digital cost the economy around £63bn a year in lost income and that basic digital skills are a powerful social enabler – opening up opportunities for improvements in education, better health care services, connecting people to their communities more effectively and helping adults to find work. The report also cited the Tinder Foundation – who reported that already almost 90% of new jobs require digital skills, with 72% of employers stating that they are unwilling to interview candidates who do not have basic IT skills. The Government itself has identified it needs an extra 2,000 digital staff over the next five years (NAO Report, March 2016) against the backdrop of a declining overall civil service size. It is not clear there is a clear pipeline of talent to meet this requirement, given the private sector requirement for those very same skills and people.



APM welcomed the publication of the government's *Digital Strategy* which aims to support everyone to *develop* the skills they need to participate in the digital economy, helping businesses to harness the productivity benefits of digital innovation. The establishment of a Digital Skills Partnership is another welcome policy development. Furthermore, the introduction of coding into the National Curriculum from Key Stage One onwards is an important development for the project management profession, and APM looks forward to government implementing the recommendations of the Shadbolt Review to ensure that computer science students have the real-world, up to date skills needed in the digital economy. However, given the pace of change it is important that the current workforce is also updating its digital skills as they constitute the bulk of the workforce skills set for the immediate future!

Technical education

APM welcomes the development of technical education pathways. Over the next 10 years, we believe there will be a large demand for project managers (as well as project management skills for those who do not classify themselves as project managers but who are undertaking some element of project management), initially as a result of the transformational change of Brexit but also as part of the huge scope of change reflected in the industrial strategy – not least through digital transformation.

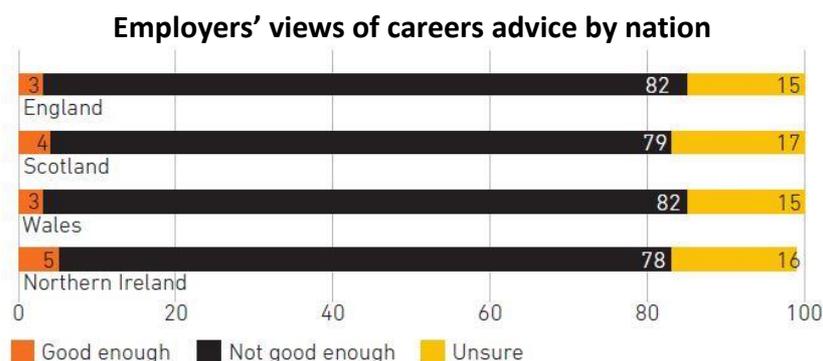
As a result, we need to be training and employing far more project managers at an early age. Furthermore, technological projects in construction or infrastructure cannot be completed successfully without adequate project management. This needs to be recognised in the new IoTs, through integrated training pathways that acknowledge the central role of project management in many technological careers.

Careers advice

It is imperative that across the UK the provision of careers advice keeps abreast of the changing world of work. Sadly, this is not the case – and employers lack confidence in existing provision, with respondents to the CBI/Pearson Education and Skills Survey 2016 stating unequivocally that they saw current careers advice as not good enough.

That Ofsted now considers the quality of careers education in its evaluation of schools in England is a welcome step, but the long awaited careers strategy – setting out a vision to 2020 and focusing on careers education throughout the school and college system – particularly in England where there is a clear weakness – must be published as soon as possible. This new strategy must acknowledge the role of project management in increasing productivity in the UK.





Apprenticeships

APM welcomes the overall approach of the investment in apprenticeships and the attempt to build in more esteem to the vocation route. The recent introduction of the apprenticeship levy (6 April 2017) as a means to induce further employer investment in skills is a powerful intervention although it is a blunt tool. Furthermore, it is clear that details of this policy were not universally understood, with a City and Guilds [report](#) showing that just months before the introduction of the apprenticeship levy, two in five employers were unaware whether they would even be paying the levy. Hopefully this will settle down as it comes better understood.

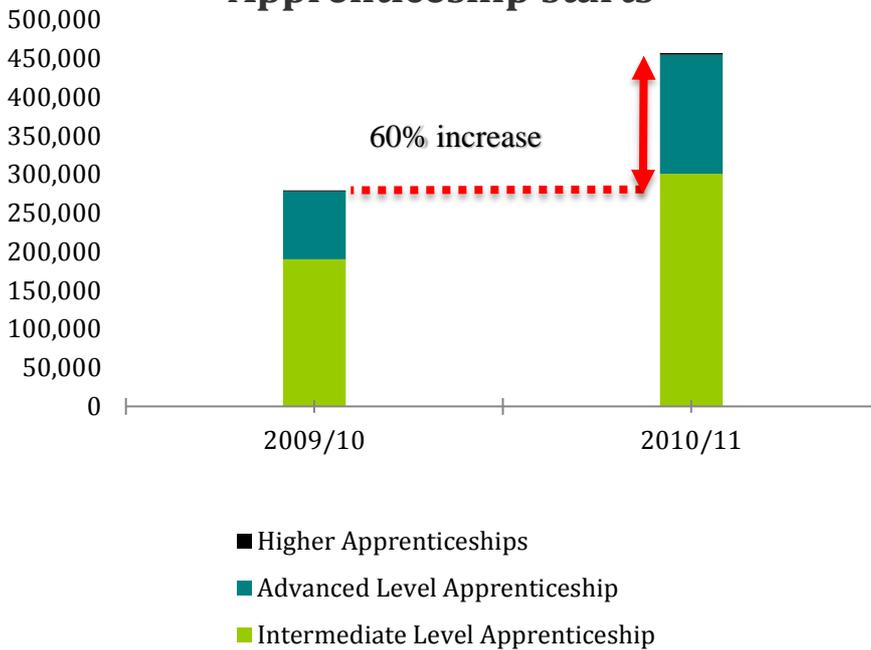
At their best, apprenticeships are a valuable way to up-skill and re-skill those already in the workforce and can provide a route to a good career with higher pay for those entering the workforce. If they are to fulfil their potential however, then apprenticeships must ensure *progression* for the learner. The government's numerical target of 3 million new apprenticeships by 2020 was focussed on apprenticeship *starts* and the risk remains that *quantum* will take priority over *quality*. The fear endures that this intervention may do little to address the UK's skills challenge and address specific skills shortages, for example in STEM sectors. The increase in apprenticeship starts in the year immediately following the 2010 general election provides evidence enough of this concern – with a 60% increase in starts doing little to narrow skills gaps owing to the fact that the majority increase was in apprenticeship starts at level 2, in retail.

APM recommendation

We recommend that as part of the follow up to the White Paper that BEIS, in combination with the Department for Education (or the Institute for Apprenticeships?) monitor quality as well as quantity of apprenticeships and there is a specific and regularly updated audit of key skills required and current gaps and performance against those identified skill deficits.



Apprenticeship starts



Apprenticeships undoubtedly have a vital role to play in addressing the UK's skills challenge but that they continue to suffer from a *disparity* of esteem vis-à-vis a more mainstream 'A-levels followed by university' route suggests that there is still work to be done.

The Government's promise that businesses will now have more input and ownership (via an account with the [digital] apprenticeship service) following the transfer of the cost burden to employers was greeted with coolly following past bad experience (Employer Ownership Pilots).

As skills policy has been devolved, governments in each of the devolved nations will receive a 'population share' of the apprenticeship levy. The Office for Budget Responsibility's latest apprenticeship levy forecast (Published in March 2016) is as follows:

Population share of levy funding (£m)	2017-18	2018-19	2019-20
Scottish Government	221	230	239
Welsh Government	128	133	138
Northern Ireland Executive	76	79	82

If the apprenticeship levy is to prove to be effective as a policy for UK plc, the devolved administrations must use these revenues to invest in skills in the devolved nations.

APM has been involved in the development of the Trailblazer Associate Project Manager Apprenticeship and the Higher Apprenticeship in Project Management – which we believe is an excellent way for



businesses to recruit new project managers and to also achieve the aims of the Industrial Strategy by improving non-academic routes into employment.

The APM believes that skills are crucial to the successful implementation of a whole range of major infrastructure challenges over the next few years. This includes a proper overview of the need for 1) the client skills capability and 2) future skills required for both specific projects and the national infrastructure as a whole. We believe that as the 'pipeline' develops there is a need to anticipate future skills requirements both for major projects and at a systemic level. The APM and its membership is well placed to view this and we have major concerns that current and future 'bottlenecks' in project management and related skills could have a major constraint on the successful delivery of these projects. We believe it is essential that the skills required – both in Higher and Further Education but also at a vocational level within the current workforce is assessed and built into the National Assessment process.

Case study - It is important that we draw on international example and innovations and in this regard we draw the Government's intention to an innovative programme conducted in New Zealand. The case study on how New Zealand has successfully implemented a new technical education system can be found in section 11.

3. Upgrading infrastructure

APM have subsequently responded the National Infrastructure Commission's (NIC) National Infrastructure Assessment call for evidence in February 2017 which we hope will help inform the UK's Industrial Strategy infrastructure needs.

15. Are there further actions we could take to support private investment in infrastructure?

16. How can local infrastructure needs be incorporated within national UK infrastructure policy most effectively?

17. What further actions can we take to improve the performance of infrastructure towards international benchmarks? How can government work with industry to ensure we have the skills and supply chain needed to deliver strategic infrastructure in the UK?

Local Enterprise Partnerships (LEPs) are well positioned to best understand the needs of a broad range of stakeholders from local residents to business owners, from skills shortages and challenges in schools and Universities to local infrastructure provision. However, not all LEPs are equal with their resource, capability and experience at different stages of development. The same is true of Growth Hubs which some LEPs have been successful in driving forwards. In order for this approach to work effectively leading LEPs may need to be focussed on first to generate a template benchmark for others to follow. However, it is worth noting that LEPs do things differently and it might be found that what works in one region may not work in another but it is important to understand what does good look like. Leading LEPs already link their own strategic economic growth plans to those of their business community which allows public policy to link into regional industrial strategies if conducted effectively. This in turn could help local infrastructure needs be incorporated into UK infrastructure policy.



In terms of benchmarks and further analysis one of the best places to start is the National Infrastructure System Model (NISMOD) framework which is the UK's first national infrastructure system-of-systems modelling platform and database. The toolset helps examine: long term performance of interdependent infrastructure systems, risks and vulnerability in national infrastructure systems, regional development and how it adapts to infrastructure provision and demand and performance. This framework can be transferred and developed to incorporate other national infrastructure systems so will allow for benchmarking capabilities. The OECD noted in 2012 that 2.5% of global GDP is required to support infrastructure investment through to 2030.

APM wish to stress the importance of robust project management in supporting successful delivery of large scale infrastructure projects. APM have worked with some of the UK's most high profile projects in recent years including most notably the London 2012 Olympic Games and Crossrail to share knowledge and lessons learnt. Working alongside these organisations to develop a 'Learning legacy' has helped document good practice examples and innovations. **For more on this work please visit:**

<https://www.apm.org.uk/resources/learning-legacy> . **We believe that more widespread use of legacy learning would help create a virtuous circle of future success.**

APM were also successful in supporting a largescale Horizon 2020 funded programme entitled 'Being lean and seen' led by Liverpool John Moores University (LJMU) alongside a consortia of EU and Asian partners. The study focuses on the advancement of project management (PM) knowledge and the development of PM capability of people is crucial to the successful delivery of projects including infrastructure. As the overall project-related spending in the EU is assumed to be about € 3.27 trillion per annum there are huge societal and economic challenges of reducing the massive financial and psychological costs of poor project delivery. Especially as about 6% of all projects are believed to be wholly unsuccessful, many of them taxpayer funded. The results of the research hope to provide a framework to successful future project delivery. APM, as the largest professional body of its type in Europe, believe that project management therefore has a key role in driving future infrastructure.

<https://www.ljmu.ac.uk/microsites/being-lean-and-seen>

4. Supporting businesses start and grow

What are the most important causes of lower rates of fixed capital investment in the UK compared to other countries, and how can they be addressed?

19. What are the most important factors which constrain quoted companies and fund managers from making longer term investment decisions, and how can we best address these factors?

20. Given public sector investment already accounts for a large share of equity deals in some regions, how can we best catalyse uptake of equity capital outside the South East?

21. How can we drive the adoption of new funding opportunities like crowdfunding across the country?

22. What are the barriers faced by those businesses that have the potential to scale-up and achieve greater growth, and how can we address these barriers? Where are the outstanding examples of business networks for fast growing firms which we could learn from or spread?



5. Improving procurement

23. Are there further steps that the Government can take to support innovation through public procurement?

24. What further steps can be taken to use public procurement to drive the industrial strategy in areas where government is the main client, such as healthcare and defence? Do we have the right institutions and policies in place in these sectors to exploit government's purchasing power to drive economic growth?

6. Encouraging trade and investment

25. What can the Government do to improve our support for firms wanting to start exporting? What can the Government do to improve support for firms in increasing their exports?

26. What can we learn from other countries to improve our support for inward investment and how we measure its success? Should we put more emphasis on measuring the impact of Foreign Direct Investment (FDI) on growth?

7. Energy

27. What are the most important steps the Government should take to limit energy costs over the long term?

28. How can we move towards a position in which energy is supplied by competitive markets without the requirement for ongoing subsidy?

29. How can the Government, business and researchers work together to develop the competitive opportunities from innovation in energy and our existing industrial strengths?

30. How can the Government support businesses in realising cost savings through greater resource and energy efficiency?

The following response draws upon previous APM surveys held throughout 2016 on Energy issues which were used to inform our submission to the Energy and Climate Change Select Committee. Responses can largely be broken down to the three following answers: nuclear fusion, energy storage and a combination of renewables and other factors.

i) Nuclear

A number of respondents felt that nuclear fusion as a replacement for fission and fossil based fuels has to be the aim in the short, medium and long term. This in turn could be supplemented by seasonal and diurnal sources of renewable energy such as wind, solar. In addition to nuclear fusion another option might be to utilise micro-generation tesla power wall small modular nuclear reactors.

In order to facilitate this global agreements and international cross funding of the majority of power generation solutions to focus on workable Nuclear Fusion solutions to accelerate technological development will be required. Some respondents noted that the work undertaken through the ITER project for example may prove invaluable in unlocking the potential of nuclear fusion. However, in order for the benefits to be realised this would require broader agreement and more effective project delivery across the multi-national project teams. Respondents felt that this could be achieved by removing short



term politics from the equation and replacing it with long term academic and technical partnerships that reward the investment and enable development.

ii) Energy Storage

Respondents felt that although renewable energy sources have become more efficient and cost effective one of the biggest impediments is affordable energy storage systems for both the home and vehicle. The overall objective is to make more and more homes self-sufficient in electricity by using solar panels and wind turbines and storing the electricity generated in the home, but not required at the time of generation. The cost of solar panels is falling and with developments that will see roofing sheets with integral solar panels many homes should be able to generate their own energy storage.

The storage could be made up of batteries or alternatively manufacturing hydrogen to propel the next generation of vehicles, or to reconvert to electricity to be used later. Alternatively larger houses could be designed to pump water with the excess electricity from basement to roof space and use a turbine to produce electricity at a later time. The advantage of this is that both domestic batteries and central storage by electricity companies would make better use of solar and wind power and so smooth out fluctuations.

This potentially could be achieved through a change in legislation to allow energy generators to store energy which would open up grid level energy storage thus creating domestic energy storage markets and real time domestic pricing.

The main downside of energy storage is that there may need to be massive use of small scale power (solar, wind, + storage batteries), solar hot water and rainwater/grey water capture and use on 'every building' to minimise network distribution costs and energy losses.

iii) Renewable energy and other factors

The majority of respondents acknowledged that first and foremost, revolutionising the energy markets will be a combination of traditional and new technologies, not single solutions.

Amongst renewable energy sources the most popular amongst participants was tidal energy. A number of advantages of tidal energy were cited including: unlike wind and solar energy, tidal energy is a predictable form of alternative energy, tidal energy has a higher efficiency than most other sources, as a source of energy tidal is inexhaustible and there is economy of scale, as tidal water is widely accessible due to the fact that the larger part of the planet is covered with water. All of which in the eyes of respondents makes it viable to generate tidal energy on large scale. In addition no energy is needed to run tidal energy plants although the short-term upfront investment cost would be higher (for now), the longer-term maintenance cost would be relatively low.

A good example of tidal energy cited by respondents was the Wave Hub in Cornwall (<http://www.wavehub.co.uk>), the world's largest site for testing wave energy technology, which could enable up to 20% of the UK's electricity to be sourced from our seas by 2050. The Wave Hub estimates that it could save the energy system between £3-8 billion and create a UK industry that could contribute an estimated £1-4 billion to GDP. The lessons learnt over the past 8 years are also now being applied to a new wave energy demonstration site off the coast of Pembrokeshire.



The cost of producing electricity from renewable sources such as solar and wind has dropped significantly over the past five years, narrowing the gap with power generated from fossil fuels and nuclear reactors, according to the International Energy Agency (IEA). The recent IEA Medium Term Energy Market Report 2015 (<http://www.iea.org>) noted that renewable energy will represent the largest single source of electricity growth over the next five years, driven by falling costs and aggressive expansion in emerging economies whilst mitigating climate change and enhancing energy security.

Some respondents felt that the digitisation of the energy market has the greatest potential to revolutionise it. Looking at other sectors such as telecoms and media, participants believed that it is clear that transformation of the market has to come from consumers. Consumers need to engage more in the energy market - not just in terms of being able to switch supplier to save costs but to have a much wider transparency choice about where their energy comes from such as its carbon impact.

It is clear from trends in other sectors that consumers want to understand the social and environmental impact of their choices; in this case their choice of where their energy needs comes from. They also want the power to influence the market place through sharing their views and expressing their choices. There will need to be greater transparency of information from suppliers and others involved in the energy market. There will also need to be greater choice and 2-way engagement with consumers.

Digitalisation of the market place would help change that. Smart metering and the infrastructure to link all these together is only a start - the sector has a long way to go to match the levels of digitisation seen in other sectors.

8. Cultivating world class sectors

31. How can the Government and industry help sectors come together to identify the opportunities for a 'sector deal' to address – especially where industries are fragmented or not well defined?
32. How can the Government ensure that 'sector deals' promote competition and incorporate the interests of new entrants?
33. How can the Government and industry collaborate to enable growth in new sectors of the future that emerge around new technologies and new business models?

9. Driving growth

34. Do you agree the principles set out above are the right ones? If not what is missing?
35. What are the most important new approaches to raising skill levels in areas where they are lower? Where could investments in connectivity or innovation do most to help encourage growth across the country?

10. Creating the right institutions to bring together people and places

36. Recognising the need for local initiative and leadership, how should we best work with local areas to create and strengthen key local institutions?
37. What are the most important institutions which we need to upgrade or support to back growth in particular areas?
38. Are there institutions missing in certain areas which we could help create or strengthen



to support local growth?

11. Other relevant areas for consideration

Below is a summary of a case study by APM Fellow Keith Robinson who was previously Managing Director for Lockheed Martin UKGS and is currently an Honorary Professor at University of Auckland, New Zealand.

This case study summarises the novel work undertaken by Keith Robinson to introduce an “Application Layer” of “Systems Thinking” skills at the University of Auckland’s Faculty of Engineering. Keith wanted to demonstrate that complex multi-disciplinary themes, such as systems engineering, project management, business management, leadership and related people skills, previously reserved for more mature students and experienced practitioners, could be taught successfully at undergraduate level. Keith was keen to improve the emergent capability of young graduates and go well beyond the purely technical, to provide more rounded “big picture” Systems Thinking graduates who could hit the ground running when they joined industry. Such graduates need to be aware of best practice across a number of fields so that they can benefit from accelerated progression.

The course at Auckland therefore was designed to overcome the “classic” university approach where he felt students are taught in narrow, technically specialised “swim lanes”. This “classic”, research led, approach contrasts with the real world where graduates are expected to work on more complex systems in multi-disciplinary project teams. This requires more broadly based engineers who can lead and integrate as well as engineer. The resultant “application led” “Systems Thinking” programme, developed at Auckland, was described as “the biggest change in 30 years” with over 5000 students, in all disciplines, having now passed through the course since it started in 2011.

The New Zealand Government has recently commissioned a study into “New Models of Tertiary Education”. Keith has submitted evidence based on his experience at Auckland and have made major recommendations for change. From a UK perspective the case demonstrates that advanced multi-disciplinary techniques, currently regarded as the preserve of more mature, experienced, engineers, can be successfully taught at undergraduate level. Keith would like to argue that an “application led”, “systems” approach could be made mandatory across all degree courses. Government policy and new funding mechanisms are the only way to bring about the necessary change in Universities. Engineering can play a vital part of the UK’s future and education has a massive part to play in the UKs ability to compete globally. The timing for a new initiative could not be better and BREXIT provides the perfect opportunity to propose a new model of engineering education for the UK.

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