

Engineering the future of Scotland

Our vision

IET calls on all parties in Scotland to recognise the role of engineering in: providing jobs; creating opportunities and; shaping the future of Scotland.

Engineering, whether in manufacturing industry, Information Technology, construction or energy, underpins vital sectors of the Scottish economy and provides the platform for innovation in which the Scottish economy can grow and create jobs to compete with the rest of the world.

Key points

1. Engineering is important to Scottish economy and for the future of the country. It needs support.
2. Education which includes early encouragement in Science, Technology, Engineering and Mathematics (STEM) is a key battleground. We need to assist pupils particularly girls and promote training for their teachers.
3. Engineering is a wide discipline with opportunities not just for graduates but also at technician level. Flexible training and apprenticeships can maximise opportunities in an area which has many skills shortages.
4. The office of Chief Scientific Officer for Scotland is still vacant. This role must be filled soon so that Government can avail of independent evidence-based scientific advice in formulating policy.
5. Funding for research and the encouragement of links between the research bodies and commercial businesses is a priority.
6. Energy is a vital sector for the Scottish economy but Scotland needs a mix of power generation sources. The extension of the lifespan of the Torness nuclear plant to 2030 is wise but vulnerabilities remain due to the intermittent nature of some sources of renewable energy (e.g. wind).
7. Investment is needed to provide resilient infrastructure. The recognition that many types of infrastructure are inter-dependent also needs to be recognised.
8. There has to be a major education campaign to alert business, particularly small businesses to the cyber security threats.

The technology and engineering sector is a [key driver of the Scottish economy](#). Currently, engineering, electronics and information technology businesses employ nearly 150,000 people, contributing over £10 billion a year to Scotland's economy. That's almost 10% of national output.

Advanced engineering provides the infrastructure foundation for the success of key sectors such as energy, telecoms, construction and manufacturing where thousands more skilled engineers and technicians are employed. All businesses in all sectors have an ever increasing reliance on the products and skills of technologists and engineers. Many Scottish technology and engineering companies also have a strong international outlook, exporting around £6.5 billion of products and services to international markets each year.

Yet engineering as a sector has persistent skills shortages. When surveyed in October 2015 for the IET Skills survey, 59% of Scottish companies who responded said that a skills shortage represents a threat to their business.

To achieve growth and jobs within the Scottish economy, engineering and technology need to be promoted in several different ways.

Education

Support for engineering is needed at many levels. Educating the engineers and technicians of tomorrow requires sustained commitment to Science, Technology, Engineering and Mathematics (STEM) from an early age. Children need support but parents too need to understand that engineering and science are good career pathways for both girls and boys.

[HMIE](#) should monitor the performance of Science, Technology, Engineering and Maths teaching in schools and colleges to ensure it includes practical activities, industry engagement and exposure to real-world problems.

Case study

[FIRST® LEGO® League \(FLL\)](#) is an international, robotics-based programme which ignites the imagination and problem solving abilities of children through engineering, computing, creativity and teamwork. It is designed to inspire the next generation of tech-savvy inventors! [Lambda Jam](#) work in partnership with the [Young Academy of Scotland](#) to bring this exciting programme to Scottish children with support coming from the [Institution of Engineering and Technology](#), (which oversees FLL in the UK), [Skills Development Scotland](#), and many other [generous organisations and volunteers](#).



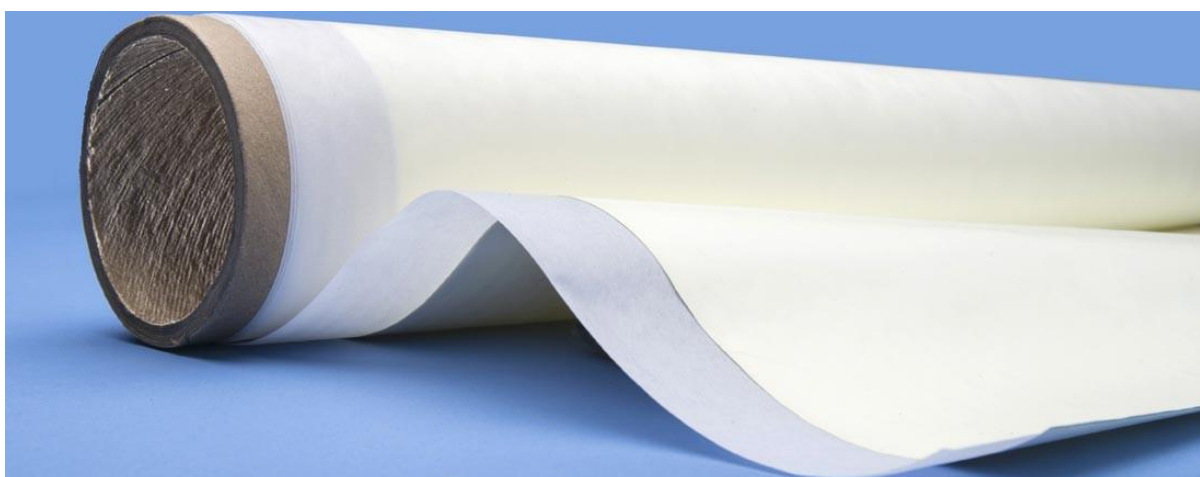
To encourage the new generation of boys and girls who are excited by science and technology, STEM teachers also need more direct experience of STEM-related careers through contact and collaboration with local employers. Without clear evidence of these things a school should not be judged as outstanding.

Training and development is a life-time process. Engineering needs people at a wide variety of levels. Qualifications such as Eng Tech can provide Engineering Technicians with qualifications which enhance employability and which they can then develop further. Flexible training options and the encouragement of part-time working will encourage diversity in engineering and retention of female engineering workers who form only 12% of the engineering and technology profession in Scotland at the moment.

Research and innovation

Advances in engineering to create the jobs of the future depend on research and the funding to support this research. Figures from the [Department of Business Innovation and Skills](#) show that the UK has 31 institutions in the world's top 200 universities, with five (16 per cent of the UK's representation), located in Scotland. There are more research professionals per capita in Scotland than in the rest of the UK, with around 32,000 in Scotland (1.3 per cent of all employment in Scotland) and 279,000 in the rest of the UK (1.1 per cent of all employment). The expansion of funding in respect to research must be continued. Also important is the application and commercialisation of this research. In today's technical world, innovative products are often the result of successful collaboration between commercial enterprises and research institutions.

Case Study



Earlier this year, a tie-up between the University of Strathclyde, the Oil & Gas Innovation Centre (OGIC) and US company Blueshift has helped accelerate the [development of a new product](#) that aims to reduce the cost of pipeline installation.

This product, a new “polymer aerogel” technology should improve the insulation for deep-sea oil and gas pipelines, reducing the amount of steel used in construction while increasing the rate of flow. Aerogels are the world's lightest solid materials, composed of up to 99.98 per cent air by volume.

Blueshift was founded in 2013 to focus on the commercialisation of polymer aerogels for application in oil and gas, aerospace, radar, automotive and building materials. These new gels are 500 times stronger than conventional silica aerogels.

The firm linked up with OGIC to support the development of the polymer aerogel blanket, and selected Strathclyde as its academic partner. Blueshift required fast track delivery and Strathclyde's multi-disciplinary, integrated approach accelerated the project. Blueshift is continuing to work with the University of Strathclyde as they take this project onto the next phase of development.

Scotland needs not just the commitment and funding for innovation but also a structure which can provide it and encourage participation. New catapult centres such as the [centre for precision medicine](#) in Glasgow are an example of targeted funding which offers the potential for future growth.

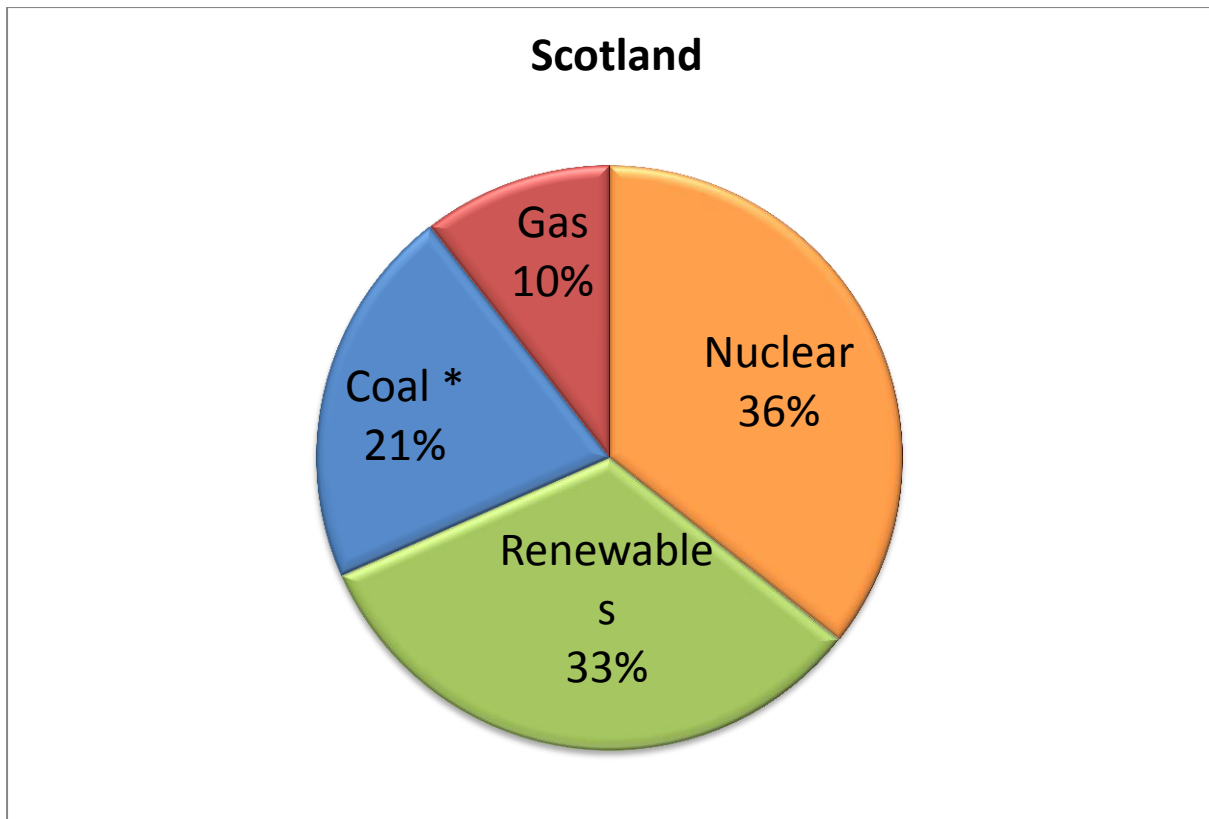
The UK has an excellent science and research base but far too often the output is exploited abroad rather than in the UK. More should be done to help UK businesses – particularly small and medium-sized enterprises (SMEs) – increase investment across the whole development cycle, scale up ideas for commercial success and create new high-value jobs.

SMEs play a major role in innovation but often lack time and knowledge to access government support schemes. To promote productivity and high-value jobs, the creation of more local and [city-based networks](#) which can advise on support available for SMEs are a good way forward.

Energy

Manufacturing has long been a driver of the Scottish economy but so too is energy. The oil and gas sector have driven the Scottish economy forward for the past forty years. Developments in [sub-sea engineering](#) will continue to provide jobs, growth and opportunities even as the oil and gas revenue decline. Scotland is also a leader in relation innovation within the field of renewable energy. Innovative schemes such as the [Islay tidal array](#) show the potential which may lie ahead.

The pie chart on the next page presents the picture of Scottish Energy in 2015. The [December 2015 edition of Energy Trends](#) show that in 2014, some 24% of electricity generated from all sources in Scotland was exported to the rest of the UK. From 31 March 2016, with the closure of Longannet, a major coal fired power station, the picture for Scottish energy changes drastically. This power station is the largest in Scotland and the second largest in the UK, with capacity to supply power to 2,000,000 homes. The impact of this closure has major consequences. While the drive towards low carbon energy is to part of UK law and also an international obligation under the Paris Agreement which was signed in December 2015, the sudden removal of a stable power source must be carefully thought out.



**This is mostly power produced by Longannet station, due to close in March 2016*

In the past, coal (and also gas) fired power stations were useful in that they not only contributed to base load capacity but were also a flexible resource in that outputs could be adjusted relatively easily. This is not possible in relation to nuclear power plants. The rapid closure of many conventional power stations may result in an over-reliance on renewable power generation which has a major disadvantage in that wind power, for instance, is often intermittent. Flexibility can in part be provided by methods such as pumped storage schemes, or the use of inter-connectors assuming that excess power is available elsewhere. Neither of these options is a complete answer to base load deficiencies. Over-reliance on intermittent power sources can also affect the stability of the grid. The resilience of the system must be a major factor in any future energy planning.

It is therefore important that there is a policy in Scotland to ensure a mix of power generation sources coupled with renewed drive towards energy efficiency. Insulating homes gives people greater comfort, lower bills and energy savings. In urban areas, community heating schemes using Combined Heat and Power can benefit from waste heat from offices, for example, and this shows great potential to help us move away from reliance on gas for heating. Achieving a balanced energy policy will be probably the single most important element in the programme of the next Scottish Government.

Infrastructure

Major investment in power generation will be needed in the coming decades but the transport network also requires considerable sums of money. Scotland is distant from many major markets and also has many small communities scattered over a large area. Therefore it needs a good transport network. Early suggestions that HS2, the proposed high speed rail network [should extend northwards](#) have yet to be taken forward. The length of time taken to decide on choosing a new UK airport hub is also detrimental to Scottish interests.

Planning large transport investments requires joined up thinking to ensure that projects are part of an efficient and fit-for-purpose national infrastructure strategy. Otherwise we risk wasted investment, lost opportunities and a dysfunctional transport system.

Investment in infrastructure is vital but so too is a realisation many forms of infrastructure are inter-dependent. Planning for infrastructure needs must take into account the interdependence of various types of infrastructure. For instance, water and transport (both devolved matters) both interdepend with UK national electricity infrastructure and its design. Resilience needs to be built into the system at all levels to ensure that there is no domino effect when the failure of one asset impacts on the performance of other systems.

Cyber Security

Infrastructure investment is required not only in the built environment but also in relation to broadband capacity which drives the new digital economy. Data security underpins the development of this economy and this is an area of technology which has dramatically increased in profile recently. Government too has now backed rhetoric with action as the plans announced in the 2015 Autumn Statement to spend £1.9 bn in this area indicate. At an EU level too, the new [General Data Protection Regulation](#) will impose duties to proactively carry out risk assessments, appoint a data protection officer and provide national authorities of early notification of data breaches. After long negotiations, the newly agreed EU [Network and Information Security Directive](#) is another initiative which imposes new duties on those deemed to be essential services and which underlines the message on data security.

While high profile companies like Talk Talk achieve publicity when data breaches occur, small and medium sized enterprises (SMEs) are increasingly finding themselves in the line of fire. Indeed the [Scottish Business Resilience Centre](#) warns that particularly when an SME is part of a supply chain, the scale and cost of the cyber-attack is magnified. The supply chain also includes operations involving information and communication technologies, software distribution and operations

within the “cloud”. Given the extent of the threat, businesses in Scotland (particularly small businesses) need to be made aware of the risks and ought to receive comprehensive training on counter measures. New technological developments such as drones and driverless technology serve to emphasise the diversity and the increase in the potential threat of cyber security.

Harnessing expertise

The Office of Chief Scientific Officer for Scotland has been vacant since December 2014. It is very useful for Government to have someone who can provide independent expert advice on any aspect of science, technology and innovation so that scientific advice informs Government policy.

Professional organisations such as IET and the other professional bodies in the Engineering Policy Group Scotland have a wealth of professional expertise, which can be used in the development of evidence based policy. Regular events are held in Holyrood and submissions made to parliamentary inquiries both in Edinburgh and in London.

Looking forward

On June 23 2016, the referendum on the place of the UK within the EU will be held. Whatever the outcome, support for engineering and technology in Scotland will be needed to provide the foundations for a vibrant economy and jobs in the future.

The [Institution of Engineering and Technology](#) (IET) is an international organisation with over 160,000 members which acts as a voice for the engineering and technology professions. Our primary aim is to provide a global knowledge network between business, academia, governments and professional bodies, promoting ideas which enhance the positive role of science, engineering and technology for the society and the economy of the future.

With an active membership of 10,216 in Scotland, the IET has offices in Glasgow and a dedicated IET Engineering Policy Panel (composed of a panel of experts drawn from academia, professional bodies and industry). IET Scotland is one of 100 communities world-wide that deliver activities designed to share knowledge between engineers and technologists and promote science to young people.