The Institution of Engineering and Technology

Engineering priorities for delivering net-zero

The UK is facing the most significant challenge it has ever encountered. The responsibility to drastically reduce our impact on the climate falls on all areas, industries and sections of society.

Decarbonising quickly and effectively to hit our net-zero target by 2050 requires urgent, clear and decisive leadership. It will require large-scale political and policy action and it will need a great number of actions to be taken simultaneously.

Combine this with the increasing interconnectedness and complexity of infrastructure, and it is vital that a joined up, "whole-system" approach is prioritised. The impact of the growth in electric transport for example, must be considered in conjunction with the future of heat, the decentralisation of energy and upgrades required to electricity infrastructure.

Engineers have the skills, insights and ingenuity to help tackle these challenges in ways that optimise efficiency, economy, safety and reliability. As engineers, we are problem solvers and innovators, with a unique perspective on the world. Most of these challenges are significant, long-term and require cross-government action. Engineering is central to delivering them.

Here we set out the Institution of Engineering and Technology's (IET) priorities for upcoming policy decisions for the UK to achieve net-zero. We will continue to work to ensure that the scale of the task is well understood, and that the UK has the vital engineering skills necessary to deliver change for generations to come. The understanding and articulation of these challenges will change over time, but the IET and the engineering profession stands ready to support delivering solutions to these challenges and ensuring a safer and more sustainable future for us all.

Transport

Bring down costs, embrace technology and accelerate the mass roll out of clean transport solutions.

1 **Roll out of charging infrastructure for electric vehicles** in urban and rural areas to encourage their uptake and meet consumer demand, subsidising where the private sector is less likely to deliver.

Why?
There has only been a 2% reduction in UK carbon emissions in transport between 1990 and 2017, compared to 60% in electricity supply[1].

2 **Greater clarity from government on how net-zero targets for aviation will be achieved** as part of the Aviation 2050 Strategy and in the light of realistic technology progress towards zero-carbon commercial aviation.

Why?
The UK has the largest aviation network in Europe and the third largest in the world. Aviation directly contributes at least £22bn to the economy and supports around half a million jobs but contributes 7% to the UK's total CO_2 emissions[2].

3 **Encourage further investment in transport technology** to improve the efficiency of moving people, goods and services[3].

Why?
Technological advancements such as Mobility as a Service, autonomous vehicles and efficiency improvements in last mile logistics can make the most of precious resources and reduce the number of inefficient or unnecessary journeys[4].

4 **Greater government support is required for the development and deployment of alternative fuels for heavy-duty freight, aviation and shipping** that may include hydrogen fuel cells, bio fuels, decarbonised gas and combined pantograph and battery technology.

Why?
Heavy Goods Vehicles (HGVs) make up a large proportion of the greenhouse gas (GHG) emissions of the transport sector, but also contribute considerably to poor air quality through nitrogen oxide (NOx) emissions. However, there remain challenges to the electrification of larger HGVs[5].

Why?

The transport sector in the UK accounts for large amounts of CO_2 emissions, but also other pollutants which cause extensive air quality issues, particularly in large towns and cities. Targets have been set in the UK for the roll out of electric vehicles, but more needs to be done to support their take-up.

23%
UK GHG emissions from surface transport, the largest single contributor[6].

7%
Total UK CO_2 emissions from international aviation, more than double 1990 levels[7].

5.8%
Total UK market share of Electric Vehicles in 2018[8].

Systems and Infrastructure

Eliminate silos imposed through current departmental, industry and regulatory structures to ensure the energy transformation is governed in a coherent and resilient way.

1 **Adopt an agile change and governance approach for the UK power system** to ensure it is accessible, flexible and fit for purpose to coordinate increasingly dynamic disruption in the sector.

Why?
The current regulatory framework is becoming increasingly unfit for purpose. It is structured around the transmission and distribution networks that can no longer be regarded as "the system"[9].

2 **Draw departments and agencies together to initiate a detailed work programme for policy development around complex systems of systems.**

Why?
This is needed to develop the necessary new thinking and new mechanisms to provide real transformational change for consumers, and to place the UK at the forefront internationally[10].

3 **Embed resilience into the planning and design of infrastructure from its inception.** This requires a body that has clear ownership and responsibility for managing the resilience of complex systems and promoting dialogue and continuous dynamic cross-sectoral planning.

Why?
Government focus on resilience and contingency planning has been on the cause of major incidents, rather than the consequences. This doesn't recognise interdependencies and potential cascade effects, some of which may not be anticipated. A potential "fix" for a cause may go on to create a host of more subtle vulnerabilities with different, but equally disruptive, consequences[11].

4 **Drive the establishment of world-class digital connectivity and infrastructure** that is fast, secure and resilient across both urban and rural areas of the UK, through investments such as the National Productivity Investment Fund.

Why?
Connectivity is an essential prerequisite for an advanced digital economy and to make the most of new technology, since the fast, resilient and secure transfer of data is required for many data-driven systems, such as smart grids[12].

Why?

Innovative policy-making that supports a "whole-system approach", working to break down silos and driving large-scale deployment of existing low-carbon solutions is urgently needed if we are to create flexible, clean and resilient infrastructure that is fit for the future.

1980s
The decade the current electricity governance structures were put in place[13].

23.6%
Record share of UK electricity generation from wind and solar in Q1 2019[14].

1.1 million
Estimated number of customers without power during the outage on 9 August 2019[15].

3

Sustainable Manufacturing

Reduce the impact of industry through proactive resource productivity and efficiency measures to reduce environmental impact and save money.

1 **Declare a national state of industrial emergency** to help bring non-labour resource (energy, water, raw materials etc) productivity issues to the attention of business and industry[16].

Why?
Global industry CO_2 emissions are currently around 37 billion tonnes per year[17]. Securing resource efficiencies within industry makes sound financial as well as environmental sense, resulting in higher productivity and greater economic prosperity.

2 **Target the delivery of lean, efficient and effective systems as an urgent priority for all industries.** Process and production systems used to design and make goods and services need to be as resource efficient as possible and should be a priority.

Why?
If 100% of large companies, 50% of SMEs and 10% of micro companies could achieve an 8% reduction in resource consumption each year, it would reduce the UK total resource consumption by around 5% a year. This would mean we would only need 75% of our current energy needs by 2025[18].

3 **Encourage greater cross-industry collaboration through peer-to-peer learning.** Government and business leaders must play a part in helping to create a national network of industrial sustainability champions.

Why?
Creating sustainability champions in each business, who are willing and able to share good practice with their neighbours, their supply chain and customers can increase economic prosperity and position the UK as a leader in industrial sustainability[19].

4 **Invest in skills, as well as capital equipment,** to encourage behavioural change and inspire greater sustainability across industry.

Why?
Investing in skills, data and processes can deliver long-term organisational and behavioural change. This is what industry and society needs and is likely to be more cost-effective and achieve better results at scale than simply buying more energy-efficient equipment[20].

Why?

Focussing on resource productivity will help us deliver on the government commitment to reduce GHG emissions to net-zero. We have been working to encourage manufacturing engineers to come together with environmental and sustainability managers to identify and drive reductions in energy, water, materials and other consumables.

21%
UK GHG emissions from industry[21].

60%
of the UK's GHG emissions from industry come from manufacturing[22].

52%
Fall in industry emissions since 1990, largely through energy efficiency improvements and fuel-switching[23].

Efficiency and Heat

Roll out a nationwide programme of retrofit and establish a clear transition plan for the decarbonisation of heat.

1 **Set up a nationwide deep retrofit programme to upgrade the existing housing stock.** With an initial focus on social housing, a programme to boost the energy efficiency of existing buildings is the only way to deliver the required carbon savings.

Why?
80% of the homes we will be living in by 2050 have already been built[24].

2 **Invest in large-scale demonstration for heat technologies such** as district heat networks, heat pumps and heat recovery to support their scale-up.

Why?
There is no one single technology that will be able to solve the issue of space heating, currently dominated by natural gas. The electrification of heat will require a significant expansion of the electricity system, especially peaking capacity[25].

3 **Large-scale deployment of hydrogen to homes and businesses needs to be implemented over the next 30 years** if it is to make a significant contribution to meeting the UK's GHG target.

Why?
From an engineering perspective there is no reason why repurposing the gas network to hydrogen cannot be achieved, however experience is limited to industrial applications and there are no examples of networks anywhere in the world suppling 100% hydrogen to homes and businesses[26].

4 **Support the large-scale demonstration of carbon capture, utilisation and storage (CCuS),** particularly in energy-intensive industries, and the development of shared infrastructure, market frameworks and regulation.

Why?
CCuS is crucial for achieving net-zero, yet there are currently no large-scale UK CCuS pilots. Without the simultaneous deployment of CCuS infrastructure, hydrogen does not have a future for large-scale retrofit deployment to industry, homes and businesses[27].

Why?

If we are to meet the 2050 targets in the Climate Change Act, then all housing in the UK must have zero carbon emissions from space and water heating, as well as space cooling.

17%

Direct UK emissions from buildings, primarily from the use of fossil fuels for heating[28].

£1.4bn

Estimated annual cost to the NHS in additional treatment from conditions arising from bad housing. Warmer housing could also prevent many of the 35,000 excess winter deaths per year[29].

85%

of UK households and 65% of non-domestic buildings currently use fossil fuel-based natural gas[30].

Generation and Storage

Support the urgent large-scale testing and deployment of existing technologies and improve public engagement.

1 **Deliver an integrated efficient and effective smart power system, which can provide the extensive demand side response** that is critical to much of the innovation that the energy system desperately requires.

Why?
An efficient and effective smart system is needed to facilitate the roll out of electric vehicles, the electrification of heat and increase the resilience and flexibility of the network[31].

2 **Build consumer trust and confidence in technological solutions** such as solar PV, battery storage and smart energy management devices with end-consumers, businesses and investors.

Why?
Misinformation and a lack of consumer engagement risk damaging the relationship with end-consumers, who are increasingly becoming a vital part of the complex energy system.

3 **Provide a clear and consistent policy landscape to incentivise investment** in renewable technology by consumers and businesses, including consistency in incentive/tax schemes, standards and regulations.

Why?
Community ownership and profit-sharing of low-carbon projects, such as joint ventures, split ownership or shared revenue must be encouraged. However, issues such as the delay between the end of the feed-in tariff scheme and the start of the Smart Export Guarantee scheme has caused unnecessary disruption to the smart energy and small-scale generation market[32].

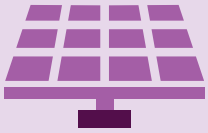
4 **Ensure that public has access to good quality evidence-based information** to encourage greater engagement and give a clear picture of the state of local generation and storage assets.

Why?
Decentralised generation and storage solutions will form a major part of the energy transformation, and whole public support for measures to reduce emissions appears high. This is not always matched with awareness of what actions consumers can take to support it.

Why?

The traditional energy system has changed a huge amount with a dramatic increase in the amount of renewables on the system. More decentralised energy generation, management and storage solutions are needed, which will require vital engagement with a new set of actors in the system.

£6,200
Average cost of a domestic solar PV system[33].



1.8 million
Total number of SMETS2 "smart" meters installed in UK homes[34].

82%
Public support for renewable energy in the UK[35].

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About the IET

As a professional engineering institution and a registered charity, the Institution of Engineering and Technology is working to engineer a better world, inspiring, informing and influencing the global engineering community and supporting technology innovation to meet the needs of society.

On behalf of the profession, the IET strives to inform and influence government on a wide range of engineering and technological issues. The organisation's membership spans a broad range of professional knowledge, and regularly offers unbiased, independent, evidence-based advice to policymakers via several channels. We believe that professional guidance, especially in highly technological areas, is critical to good policy-making.

Our strength is in working collaboratively with Industry, Academia and Government, relying on the expertise of our volunteer-led panels delivering insight, inspiration and influence across many industry sectors:

- Built Environment
- Design and Manufacturing
- Digital
- Education and Skills
- Energy
- Engineering Safety
- Healthcare
- Innovation and Emerging Technologies
- Transport

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