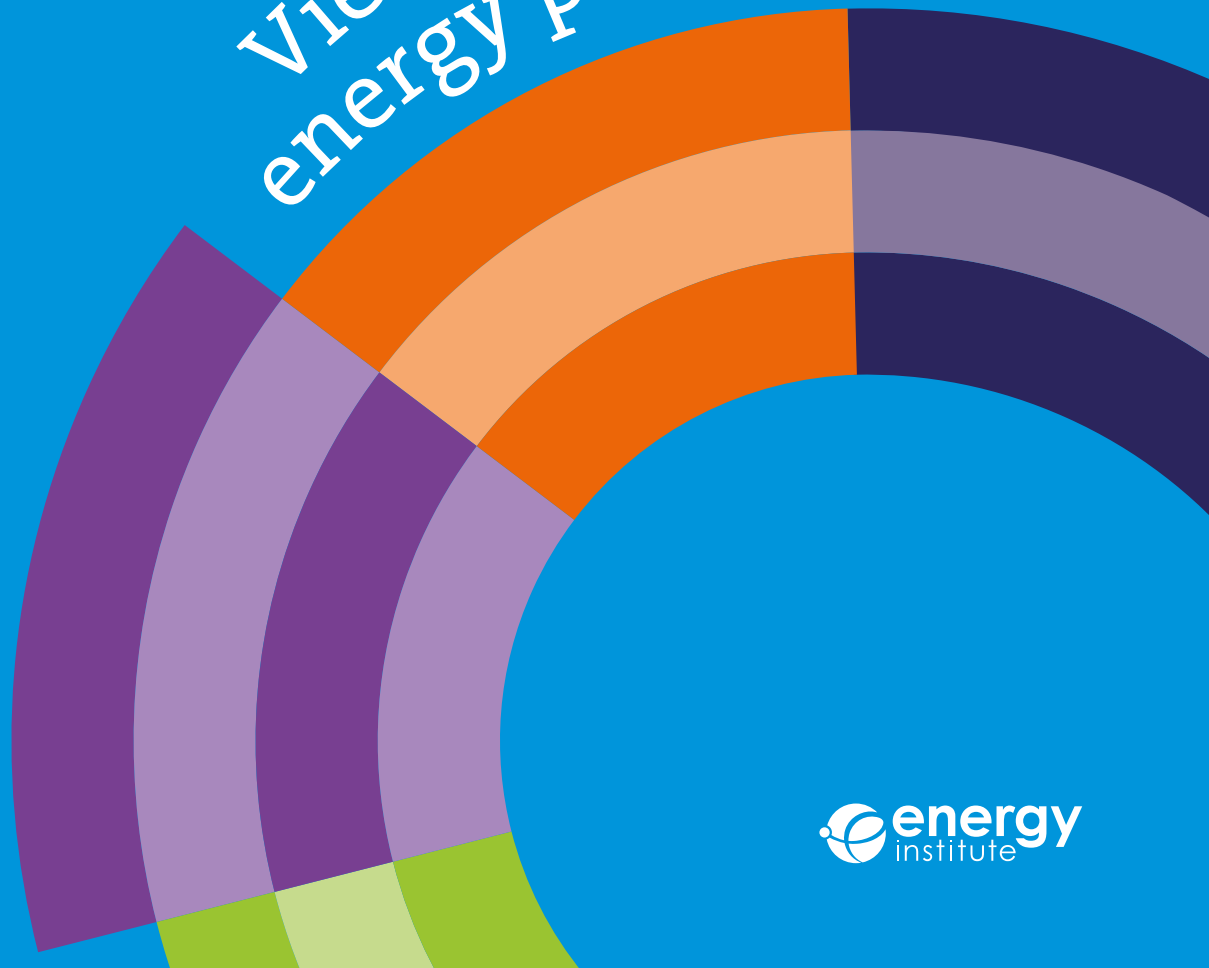


Views from UK energy professionals



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Table of contents

Presidential remarks 4

Executive summary 5

Ten key messages from energy professionals 6–9

Section 1: Brexit 10–15

Main impacts

People and skills

Policy going forward

Section 2: Policy, investment and prices 16–21

UK energy policy and industrial strategy

Cost and investment

Prices

Section 3: Energy transition 22–29

Climate change action

Future energy system

Heat

Future business models

Section 4: Energy in society 30–35

Acceptance and trust

Future energy leaders

The role of the EI 36

Method 37

Presidential remarks



Professor Jim Skea
CBE FRSA FEI

Today's energy system is undergoing a quiet revolution, driven by an ever-changing global political landscape, climate change challenges and a range of innovations influencing energy consumption. Energy professionals, better than anyone else, can identify opportunities of this transformation and caution about potential pitfalls. This year's Energy Barometer provides views from these professionals on a wide range of factors impacting the energy sector and moulding the energy transition.

In the political arena, there has been a renewed focus on affordability, with an ongoing push to increase UK productivity and competitiveness. Brexit brings that challenge to the fore, but also introduces uncertainty around future UK-EU relations, including energy markets. The overriding message to the UK Government from Energy Institute (EI) College members surveyed in 2017 is the need for clear energy policy that is not eclipsed by Brexit, change of government or other emergent factors. In the face of imminent withdrawal from the EU, EI members strongly support the retention of EU energy legislation in UK law and call for continued cooperation with the EU.

Political uncertainty also may jeopardize the progress of the UK's transition to a low carbon economy. Electricity has been decarbonised substantially, but there is a growing need for action in decarbonising heat and transport. However, EI members warn that current energy policies seem insufficient to meet the UK's legally binding emissions reduction targets. The message from EI members is clear: energy efficiency and renewables are the most effective approaches to meet emissions targets and secure the benefits of the low carbon transition, but to reach their potential, policy support in these areas needs strengthening.

Overall, EI members believe that the UK energy system must become more flexible, decentralised and connected, able to integrate increasing intermittent renewable sources. These systemic changes will drive the development of new business models, characterised by a focus on service provision and increased customer engagement.

The 2017 Energy Barometer was a joint initiative and I wish to express my gratitude to all those who contributed to the publication of the report. I extend my sincere thanks to the Energy Advisory Panel, chaired by Dr Joanne Wade FEI, for their support and guidance throughout the process, and the EI Knowledge Service for their role in designing and conducting the survey, as well as preparing the report. The greatest debt, however, is owed to members of the EI College who generously shared their insight and knowledge. Their ideas, expertise and commitment have been crucial not only for the successful completion of this project, but also to define and direct the UK energy debate. I recommend the Energy Barometer as an indispensable tool to all those building and shaping the future of energy.

Professor Jim Skea CBE FEI FRSA
President, Energy Institute

Executive summary

Energy policy, the investment environment and the need for energy system change are the main challenges for the energy industry in 2017 identified by EI members. Uncertainty around Brexit and wider geopolitics could negatively impact efforts to develop a clear strategy, to update infrastructure, and to meet demand and climate targets at least cost to end users.

Brexit



EI members see Brexit as a material concern to the sector. They urge those negotiating the UK's exit from the EU to

pay particular attention to energy policy, regulation and trade agreements, energy costs, and security of supply. If free movement of labour is restricted, they anticipate a fall in the number of engineers and labourers, and a rise in wages. Industry training and apprenticeships are seen as key to addressing potential labour shortages. UK regulations should, in most cases, be informed by existing EU legislation, and continued cooperation with the EU is still considered a desirable complement to UK policy decisions.

Policy, investment and prices



While four in ten EI members are positive about the effect of UK energy policy, over half think it has no effect or a negative effect. New

nuclear is seen as most positively impacted by policy, while fuel poverty is considered the least positively affected. The suite of Electricity Market Reform measures is viewed positively overall.

Uncertain energy policy is still contributing to a risky investment climate, with immature low carbon technologies most affected. Technology readiness and market conditions

are also seen as significant limitations to investment across low carbon technologies. Government can boost productivity and innovation by supporting links between business and academia, and helping to commercialise new technologies. EI members expect moderate price rises across primary and retail energy markets in 2017, with exchange rates expected to have a greater influence than in previous years.

Energy transition



While members are confident that the low carbon transition is underway, given current policies the majority expect the UK to fall short of its carbon targets through to 2050. Additional support for energy efficiency and renewables could help close the perceived carbon policy gap, and also represent the best opportunity to reap economic benefits from the low carbon transition. In addition to emissions targets, EI members feel the low carbon economy is fuelled by wider environmental concerns, falling technology costs, and rising energy costs, making efficiency more attractive.

The future energy system will be more flexible and will involve system-level strategies and new business models. EI members believe system flexibility can be achieved through infrastructural and societal changes, especially updates to the electricity grid, energy storage, adoption of new technologies, earning consumer trust and changing behaviours to shift demand.

While EI members foresee the UK heat mix in 2030 will include more low carbon sources, the biggest emissions reductions are expected through energy efficiency improvements, such as better insulation of buildings and

heating system upgrades. On the policy side, financial incentives, mandatory standards and community engagement are seen as the best measures for reducing emissions.

EI members envisage business models of the future to be more decentralised, with increased customer engagement and more focus on service provision than assets. Technological changes are likely to drive the development of new business models, which in turn will drive further innovation, with renewables expected to play a major role.

Energy in society



EI members aspire to earn the trust of the public and develop a more positive perception of the industry. It is generally felt that gas and electricity distribution and renewables are the most trusted sectors. Public trust could be earned by greater price transparency, better communication and stronger regulation. Trust between Government and industry could be improved through greater accountability and transparency of policy processes.

Those early in their energy careers were motivated to join the industry by a desire to contribute to climate change action and be part of a multidisciplinary sector. The renewables and energy efficiency sectors are considered to offer the greatest potential for new starters, with roles in engineering viewed as most attractive. These new starters believe that graduate programmes, trainee roles, and opportunities for progression are the best ways to encourage young people to pursue careers in energy. They expect that decarbonisation of the energy system will be the greatest change they witness over their careers.

Ten key messages from energy professionals

1

EI members were asked to identify the biggest challenge facing the energy industry in 2017. The top ten challenges span the energy system, highlighting the broad range of members' concerns.

Energy policy

EI members seek stability and a long-term, strategic approach to energy by Government, whereas current policy is perceived as uncertain, inconsistent and short-term. A clear framework and future system direction would encourage investment, facilitate the transition to a low carbon economy and underpin energy security.

“Progressing the energy transition for the long-term in the context of short-term political uncertainty.”

2

Low carbon energy

The industry faces a challenge to reduce dependency on energy sources that release greenhouse gases across the whole system, in electricity generation, heat and transport. EI members state this should be done at least cost, with emerging technologies supported towards commercialisation and away from subsidy. They believe progress towards renewables and decarbonisation goals should be at least maintained, and ideally scaled up.

“A transition to a low carbon world requires a stable and sustainable environment whereby all actors orchestrate and maintain balance.”

3

Security of supply

The need to secure supplies of electricity, gas and primary energy continues to be a concern for EI members. Targeted investment could provide the flexible capacity needed to manage peak demand and help reduce dependence on fossil fuels. Challenges to future security of supply include impending loss of generating capacity, increases in demand, current dependence on imports and uncertainty stemming from geopolitics.

“Removing barriers to technology and infrastructure that will enable a more flexible system able to cope with the renewable penetration set out by our targets.”

4

Investment and cost

Assuring investment and managing cost are key to security of supply and the transition to a low carbon energy system. Specific areas identified for investment include efficiency improvements, research and innovation, and oil and gas production. Challenges to securing investment include policy uncertainty, long payback periods linked to high capital costs, and competition for limited funding.

“Making long-term investment decisions when the direction of energy policy is unclear.”

5

Brexit

EI members emphasise the need to maintain clarity and commitment on energy policy, both during the Brexit negotiation process and within future strategy. Maintaining momentum on decarbonisation and continued UK compliance with EU directives or participation in research projects are often cited as desirable. There are further concerns about price fluctuation, free movement of people and investment uncertainty.

“The Brexit factor impacting and clouding the UK Government’s long-term energy policies and strategies.”

Ten key messages from energy professionals

6

Grid and infrastructure

Grid and wider infrastructure upgrades are needed to ensure security of supply and meet decarbonisation targets. The focus is primarily on electricity but heat, transport and primary sources are acknowledged as important. These upgrades should help replace and increase capacity while enabling a more flexible, decentralised system, particularly as more renewables come on stream.

“To develop a decentralised energy infrastructure for electricity, heat, transport that includes energy efficiency, with policy commitments to renewable energy.”

7

International factors

There is a general concern about geopolitical instability and the energy policies of other countries. The challenge is to ensure security of supply and progress towards decarbonisation within a complex global system. The US is a common example, with many citing a potential for policy change (now a reality) or reversal of climate agreements. The actions of oil and gas producers, such as OPEC and Russia, are also seen as challenging.

“Ensuring future security of supply amidst global political uncertainties.”

8

Public engagement and acceptance

EI members appreciate the importance of the trust, perceptions and expectations of consumers and members of the public. Particular emphasis is placed on consumer responses to prices, energy system changes and new technologies. Individuals and communities should be informed and involved in decisions.

“Dissemination of the right information at the right time to the public and empowering them to reach out to feel they can make a difference.”

9

Price volatility

Prices in the UK are expected to remain volatile or rise, due in part to uncertainty around Brexit and fluctuating exchange rates. EI members consider volatile oil prices to be a source of uncertainty for investment, as well as potentially delaying decarbonisation efforts.

“Shifting the way people think about energy, and making people accept that change is necessary.”

10

Sustainability and climate change

Climate change and wider environmental concerns will require intensified, balanced efforts across the energy system to decarbonise supply and meet growing demand. The impact of Brexit and uncertainty about US commitment to climate targets were both cited as potential barriers to environmental sustainability.

“Getting domestic end-users motivated to invest in energy efficiency improvements and industrial and commercial end-users to accept longer payback periods.”

How do they compare to last year?

2016 vs 2017

Biggest challenges

?

What do you think is the biggest challenge for the energy industry in 2017? N=335 (number of respondents). Free responses coded and summed.

1 st	Energy policy	
2 nd	Low carbon energy	+ 3
3 rd	Security of supply	+ 1
4 th	Investment and cost	- 2
5 th	Brexit	New
6 th	Grid and infrastructure	New
7 th	International factors	
8 th	Public engagement	- 2
9 th	Price volatility	- 6
10 th	Sustainability and climate change	- 2



Brexit

Both before and after the 2016 EU referendum the EI engaged with its members about the potential consequences of Brexit for the energy industry. Members continue to see Brexit as a material concern and in this year's survey, with the approach of Brexit negotiations, have provided greater detail on their priorities for negotiators. Members expressed concern about the clarity of process and timing, future security, sustainability and affordability of supply, access to the integrated energy market and movement of labour. The overarching message from these consultations was that Brexit should not affect existing policies if those policies are sound and built on solid evidence.

Main impacts

EI members were asked about Brexit's likely effect on the energy industry. There is a clear message for those negotiating the UK's withdrawal from the EU: Brexit must not undermine effective energy policy in the UK. Most EI members are concerned about uncertainty, specifically around energy policies, future trade agreements, energy costs, security of supply, investment climate or availability of skilled labour. Additionally, respondents mention that potential consequences of leaving the EU could include reneging on climate change commitments, as well as decreases in: global influence and international cooperation; support for decarbonisation policies; and support for energy research and innovation.

Expected impact o



What will be the most significant impact of Brexit on the energy industry? N=314. Free responses coded and summed.

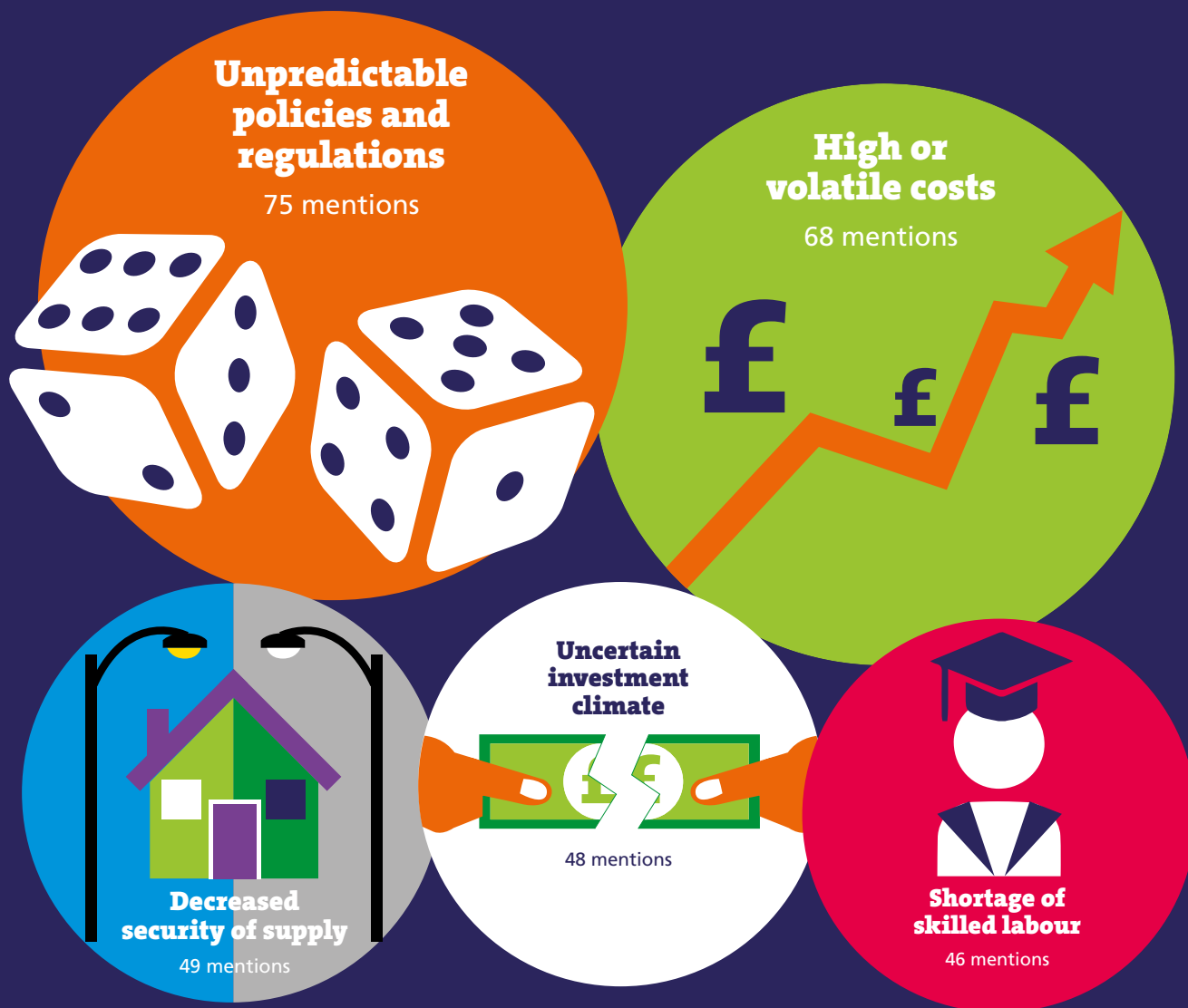


Simon Virley CB FEI
Partner and Head of Power & Utilities, KPMG UK LLP



This year's Barometer indicates broad support for keeping the current EU energy and climate change legislation in place, once the UK leaves the EU. It also highlights concerns in the energy industry about the uncertainty in the regulatory environment created by Brexit and worries about the availability of skilled labour going forwards.

f Brexit on energy





People and skills

A majority of EI members expressed concern about the availability of qualified workers if free movement of labour is restricted post-Brexit. Nearly 60% of respondents anticipate a fall in the number of skilled workers and over 40% foresee a drop in qualification levels. On the other hand, EI members think that such changes may contribute to a rise in wage levels.

Given they identify a risk of a post-Brexit shortfall in skilled labour, respondents recognise the need for support to ensure sufficient supply of workers, prioritising engineers and qualified manual labour. Additionally, if freedom of movement is curtailed, energy professionals prioritise supporting the supply of unskilled manual labour over the supply of other professionals such as project managers, IT or business administrators.

Measures to ensure sufficient supply of labour should be implemented by Government, academia and the industry itself. For Government, these measures should include supporting industry training and apprenticeships and encouraging immigration of skilled labour. Additionally, nearly 40% of respondents think that Government should support vocational and retraining programmes for workers coming to energy from other industries and also encourage cooperation between academia and industry. Considerable support for a range of skills-related policy mechanisms indicates that a package of measures is needed rather than a single solution.

EI members think cooperation between academia and industry should focus on apprenticeships and skills training as well as on providing work placements and internships. Their preference for industry training and apprenticeships corresponds with Government's Spring Budget 2017 promise to expand technical training for young people through new technical education that includes high-quality industry work placements.



If free movement of labour is restricted post-Brexit, which of the following disciplines will need the most additional support to ensure sufficient supply of labour?

	Disciplines	% of respondents
1	Engineering	66
2	Skilled manual labour	62
3	Unskilled manual labour	38



In your view, which of the following is the MOST effective form of cooperation between industry and academia to address skills shortages?

	Forms of cooperation	% of respondents
1	Apprenticeships and training	39
2	Work placements	29
3	Graduate schemes	13
4	Funding research	10



Impact of restricted movement of labour

?

If free movement of labour is restricted post-Brexit, how will the following be impacted within your sector of the energy industry?

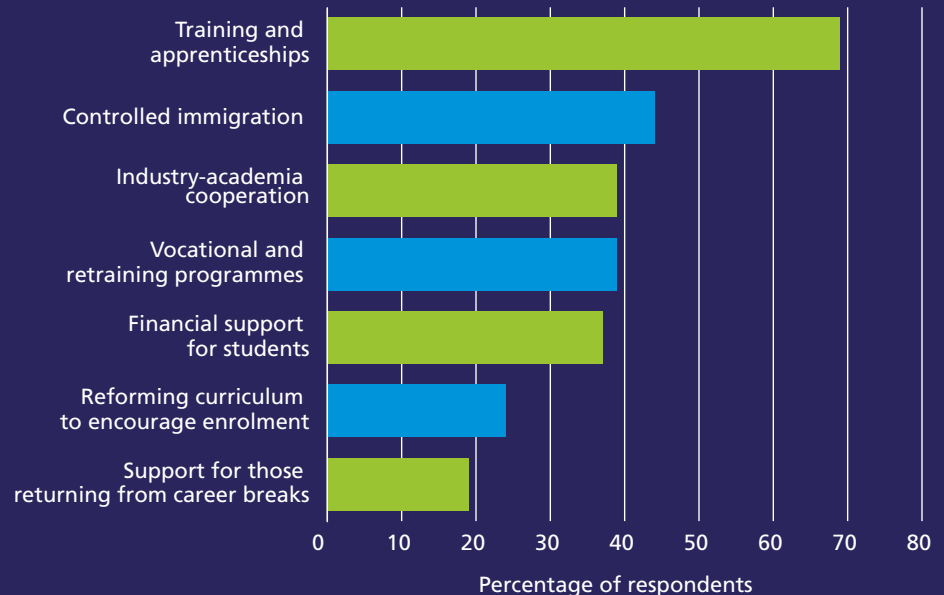
- Fall
- Neutral
- Rise
- Not sure



Government measures to address skill shortages

?

What would be the best way for Government to address future labour shortages in key energy disciplines?

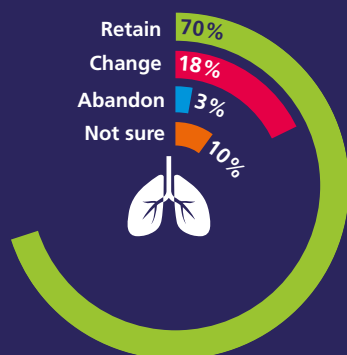




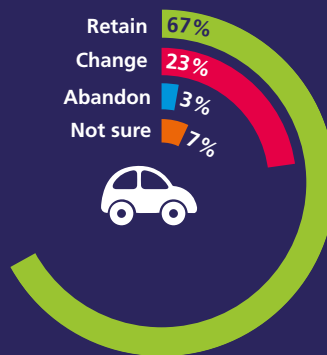
The Great Repeal Bill

?

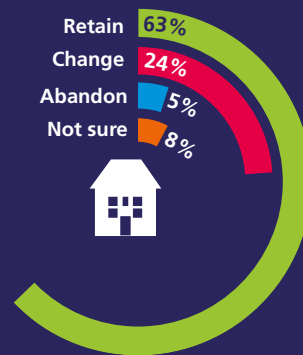
The UK Government has proposed the Great Repeal Bill, which will give the UK Parliament the power to decide how existing EU law should be translated into the UK law. When the UK leaves the EU, how should the following EU energy legislation and resulting mechanisms be treated?



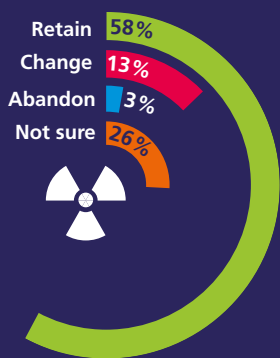
AIR QUALITY
DIRECTIVE



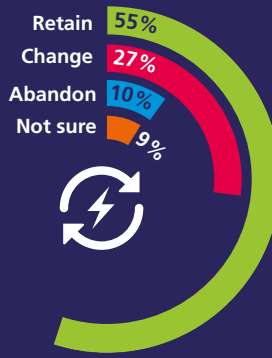
VEHICLE EMISSIONS
REGULATIONS



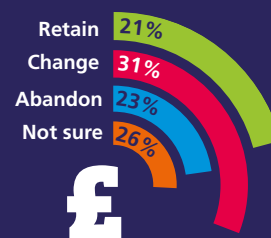
ENERGY PERFORMANCE
OF BUILDINGS DIRECTIVE



RADIOACTIVE WASTE AND
SPENT FUEL MANAGEMENT DIRECTIVE



RENEWABLE ENERGY
DIRECTIVE



STATE AID
RULES



Policy going forward

The majority of EI members want to keep EU directives enshrined in UK law. This preference is strongest for: the Air Quality Directive, vehicle emissions regulations, the OSH Framework Directive on Safety and Health Work, the Energy Performance of Buildings Directive, the Energy Efficiency Directive, the Industrial Emissions Directive, the Radioactive Waste and Spent Fuel Management Directive, the Ecodesign and Energy Labelling Directives and the Renewable Energy Directive. Only in the case of state aid rules do the majority of EI members (54%) prefer to change or abandon the legislation. Opinion was divided on whether to retain British involvement in the EU Emissions Trading System (EU ETS).

As in the 2016 Barometer, when asked which level of governance was the most appropriate for areas of the energy system, EI members prefer the national level, particularly for energy security and efficiency. Nearly a year after the EU referendum, a significant proportion of respondents still refer to the EU as an appropriate level of governance for energy issues, second to the national level in most areas, perhaps reflecting benefits of continued cooperation and resource sharing.

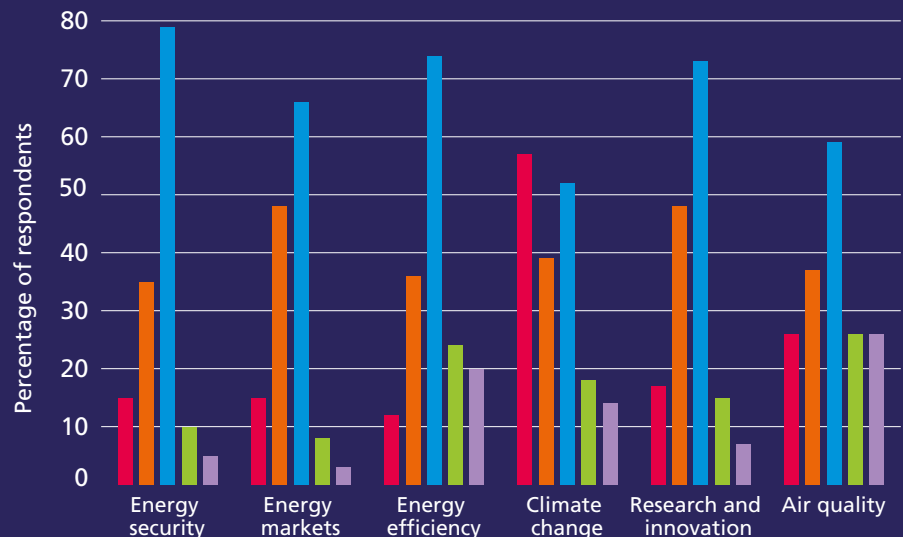
Across energy policy areas, national and international governance are perceived as more appropriate than devolved administration and local councils. Consistent with the 2016 Barometer, EI members identified the UN as the most appropriate forum for climate change policy.

Level of policy decisions

?

At what level should policy decisions be made for the following areas? Please tick all that apply for each of the following areas.

- United Nations
- European Union
- United Kingdom
- Devolved administrations
- Local councils





Policy, investment and prices

UK energy policy and industrial strategy

EI members were asked for their views on the impact of energy policy on a number of areas. Overall, opinion was split on policy effects. Across areas, four out of ten EI members are positive about the effects of UK energy policy, while over half think policy has no effect or a negative effect.

Supporting delivery of new nuclear power generation is perceived as most positively affected by energy policy, followed by supporting demand side response and enabling infrastructure, improving energy efficiency, and supporting research and development for emerging technology. On the other hand, fuel poverty is perceived as the least positively affected, followed by simplifying energy taxation. The high proportion of “no effect” and “negative” perceptions suggest there is still work to do on energy policy. This is in line with previous Barometer results where energy policy has been consistently identified as the biggest challenge facing the industry.

As in 2016, Electricity Market Reform (EMR) is seen to have positive effect overall on low carbon investment, with Emissions Performance Standards and Feed-in Tariffs with Contracts for Difference seen as most effective. However, more impact needs to be demonstrated on the Carbon Price Floor and Capacity Mechanism, as a significant percentage of respondents are uncertain about the effects of these mechanisms.

In the Autumn 2016 Budget, Government introduced a National Productivity Investment Fund (NPIF) for 2017 to 2022 to improve the productivity of the UK economy. The following infrastructure and innovation areas have been earmarked within the fund: new homes (£7.2bn), science and innovation (£4.7bn), transport (£2.6bn), and telecoms (£0.7bn). £7.8bn of this fund remains unallocated.

When asked to prioritise based on maximising economic productivity, EI members would distribute this unallocated portion almost equally between building (heat) energy efficiency, R&D to commercialise innovation, and supporting low carbon transport. Although the £7.8bn will not be entirely devoted to the energy industry, the results demonstrate that EI members place equal importance across sectors, suggesting they support a system-wide approach to industrial strategy investment.

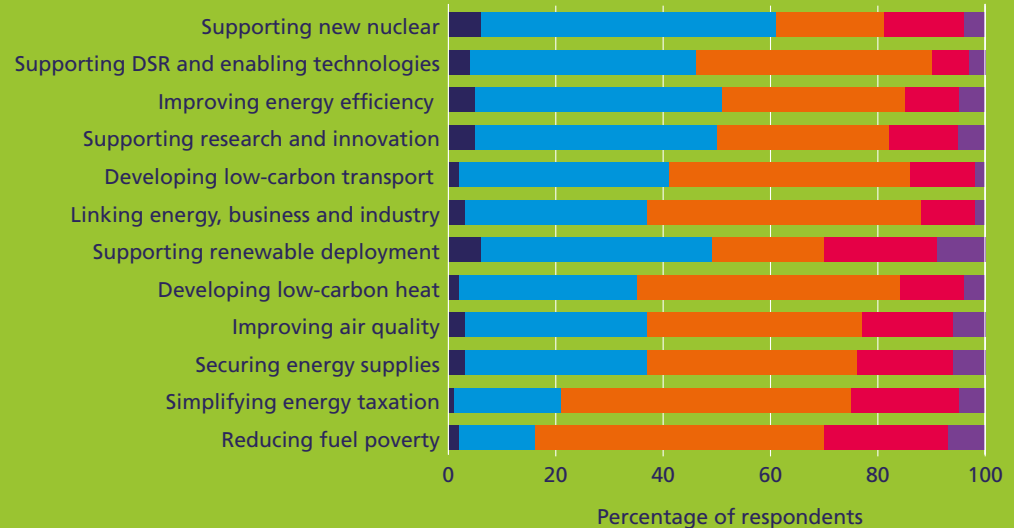
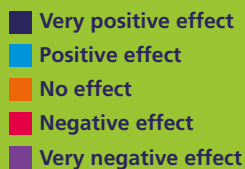
A main pillar of Government's industrial strategy is to become a more innovative economy. Last year's Energy Barometer identified government policy and regulation as the largest barrier to innovation in the UK. EI members believe the top government measures to make the UK more “pro-innovation” are providing tax relief for R&D and supporting collaboration between business and academia. Notably, these

two top measures are part of a broader package of recommended ways to boost innovation, including public procurement and government funding competitions. EI members point to an indirect role for Government in fostering innovation, by prioritising tax breaks for R&D and academia-industry collaboration, over more direct financing from public resources.

UK energy policy effects

?

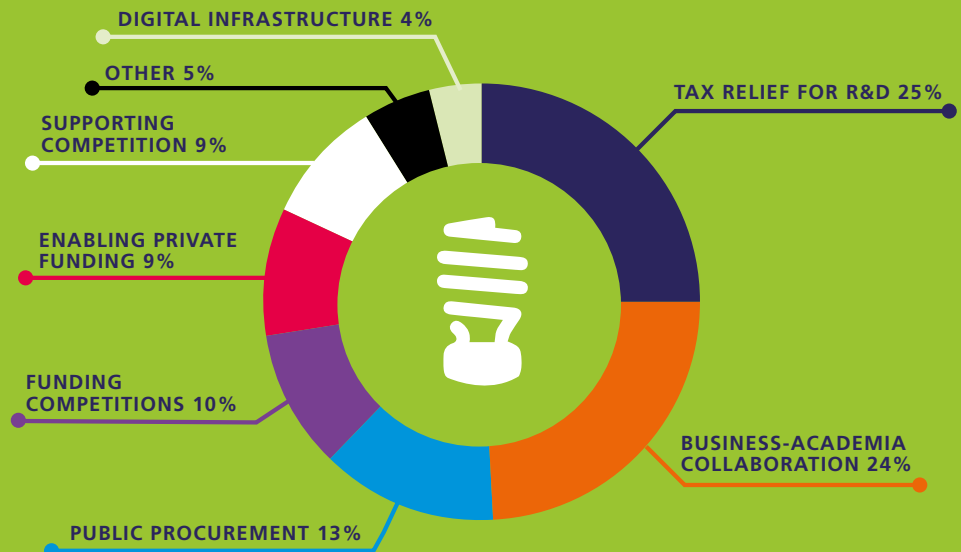
What effect do you think UK energy policy has had on each of the following areas in the last 12 months? "Not sure" responses not shown on this chart. Results ordered by weighted net score.



Government measures for an innovative economy

?

What one measure could UK Government implement to be more pro-innovation?



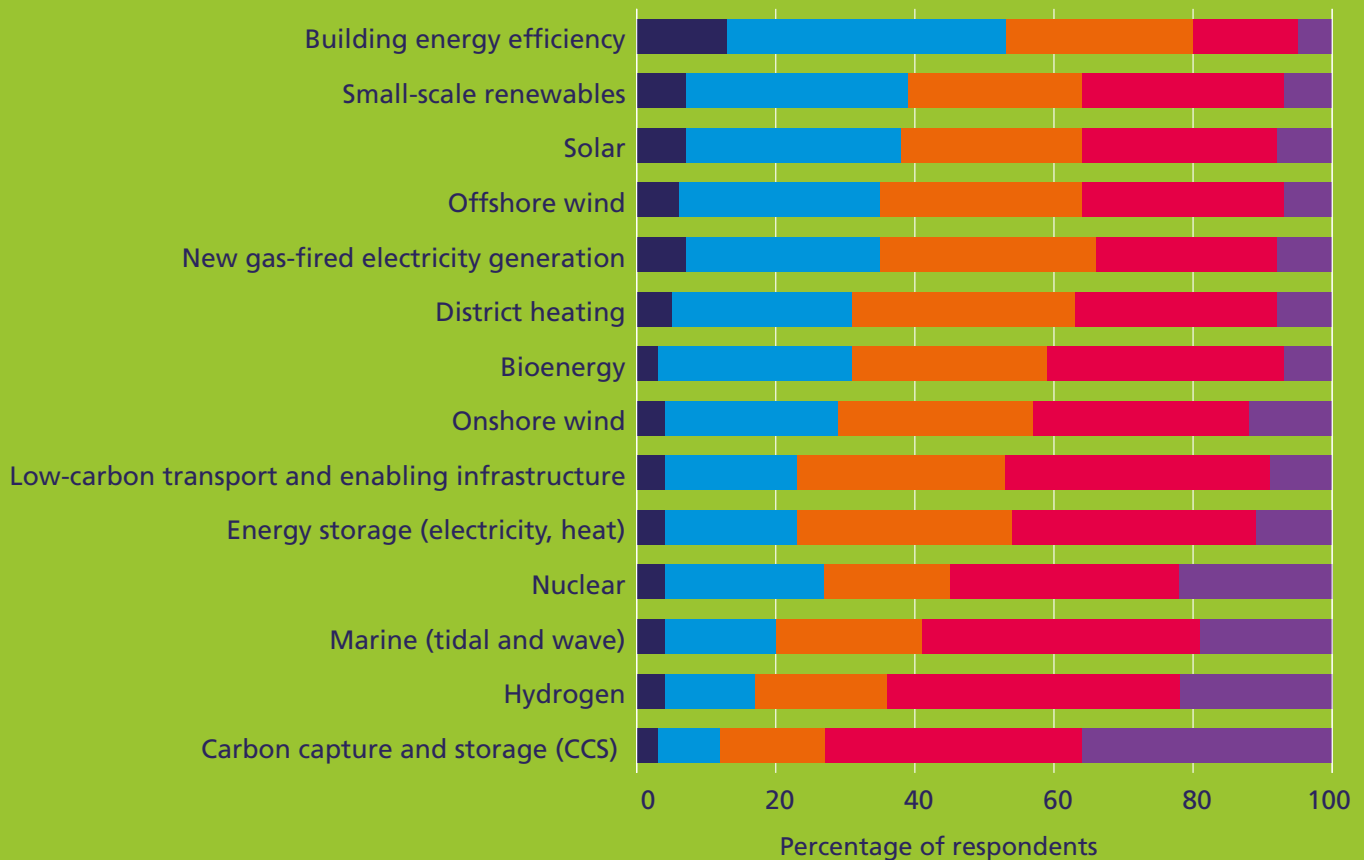


UK investment risk

?

In the UK, what in your view is the level of investment risk due to policy uncertainty in each of the following areas? "Not sure" responses not shown on this chart. Results ordered by weighted net score.

Very Low
Low
Neither low nor high
High
Very high





Cost and investment

EI members perceive many areas of the energy system as risky for investors because of policy uncertainty. This aligns with their identification of policy uncertainty as the biggest challenge to the industry. Carbon capture and storage (CCS), hydrogen and marine are identified as the worst affected, while non-marine renewables and new gas fired electricity generation are more neutral. Nuclear, while seen as most positively affected by UK energy policy, is also perceived to be relatively risky for investors due to policy uncertainty. Improving energy efficiency is seen as the least risky by professionals across sectors, including those working in the buildings or energy demand, management and utilisation sectors. However, there are still calls for more progress to be made in efficiency, as demonstrated by the priority given to this area through the National Productivity Investment Fund allocation (see p. 16).

Overall the perception of risk from policy uncertainty is slightly reduced compared to 2016, with biggest reductions seen across offshore wind, solar and small scale renewables. Immature low carbon technologies continue to be the worst affected by an uncertain policy landscape. Members from the oil and gas sector tend to perceive less investment risk across the industry than members from the renewables sector.

Of the factors limiting low carbon investment, policy uncertainty is the second most common response for most technologies. The exception is onshore wind, where policy uncertainty is considered the greatest limiting factor by the majority (55%). Across hydrogen, energy storage

and CCS, technology readiness is hindering investment the most. For district heating and energy efficiency, current market conditions are seen as the main limiting factor.

Factors limiting low-carbon investment



In the UK, what is the **GREATEST** limiting factor for investment in the following low carbon technologies?



Policy uncertainty

ONSHORE WIND



Market changes

DISTRICT HEATING



Technology readiness

ENERGY STORAGE



Technology readiness

HYDROGEN



Market changes

BUILDING ENERGY EFFICIENCY



Technology readiness

CARBON CAPTURE AND STORAGE



Prices

EI members expect moderate price rises across crude oil, transport fuel, retail gas, and retail electricity markets. Exchange rates are expected to have a greater influence on prices than in 2016, although Brexit negotiations themselves are not expected to have a significant impact in 2017.

For crude oil, the actions and policies of oil producing nations continue to be the dominant factor impacting prices. Geopolitical instability has risen in impact compared to 2016, overtaking production from unconventional and conventional resources, which are still seen to have a significant influence on prices. This echoes the emphasis placed by the respondents on international factors as a top challenge for the energy industry in 2017. Commodity trading, including exchange rates, has greater influence on crude oil compared with 2016, as do demand levels in developing countries.

Crude oil prices continue to be seen as the most important factor influencing retail transport fuel prices, followed by taxation and duties. Although the drivers affecting transport fuel are largely unchanged from 2016, commodity trading, including exchange rates, is expected to have a greater impact than last year.

There is a broad expectation for retail natural gas prices to remain stable or increase slightly in 2017, with 44% of members expecting these to increase up to 5%. The respondents indicate a variety of factors that impact retail natural gas prices. UK and EU natural gas demand and supplier costs are seen as the strongest influences, with UK energy policies and geopolitical factors featuring highly. Supplier costs are seen to

have a significantly greater impact than in previous years, due in part to the influence of commodity prices and exchange rates as a result of Brexit and the changing value of the pound.

A clear majority of members (72%) expect UK retail electricity prices to rise in 2017. This proportion is more pronounced than in 2016, when a price increase was also expected. Specifically, respondents from the energy demand, management and utilisation sector are more likely to predict a price rise than those from other sectors. The cost of primary fuel continues to be the main driver of electricity prices, followed by the need to ensure adequate generation capacity and increase the proportion of low carbon capacity. The growth of low carbon generation and more general network investments are seen to play a bigger role in these price increases than they did last year. This reinforces the message from respondents that security of supply and developing low carbon energy are two of the three most important challenges for the energy system in 2017.



John Pettigrew FEI, FIET
Chief Executive, National Grid



As this report highlights, developments like demand side response and storage have already been able to support renewables and help keep bills down. We now need smart regulations that encourage innovation throughout the industry and engage consumers so that we can deliver the clean energy systems of the future.



Factors influencing energy prices

?

Which of the following factors will have the GREATEST impact on crude oil, gas and electricity prices in the next 12 months?

CRUDE OIL

NATURAL GAS

RETAIL ELECTRICITY

1

Actions and policies of oil producing nations



UK and EU natural gas demand

Cost of primary fuel



2

Geopolitical factors



Supplier costs



Ensuring adequate generation capacity



3

Production from unconventional reserves



Geopolitical factors



Increasing low-carbon generation capacity





Energy transition

Climate change action

The UK has set a legally binding target to reduce greenhouse gas (GHG) emissions by at least 80% from 1990 levels by 2050. The progress to this target is set out by the Committee on Climate Change through a series of intermediate carbon budgets. The fifth carbon budget, adopted in 2016, mandates a 57% reduction of emissions by 2032.

The UK has made significant emissions reductions already through lower energy demand and initial decarbonisation of power supply. Thus far, emissions from heat and transport have not decreased to any great extent (BEIS, UK greenhouse gas emissions statistics, 2017).

EI members were asked how far they expect UK GHG emissions to be reduced given current policies. While seven in ten think there will be a reduction of at least 53% by 2032, only two in ten think the 5th carbon budget's 57% reduction goal will be met. Similarly six out of ten EI members think emissions will be reduced by at least 73% in 2050, but only two in ten predict the 80% target will be achieved given the policies currently in place.


These results send a twofold message: On the one hand EI members are confident that the decarbonisation of the UK economy will continue. On the other hand the majority assess current policies to be insufficient to meet the emission targets. This policy gap

between climate aspirations and concrete energy policies and regulations has been identified by previous Energy Barometers. The forthcoming emissions reduction plan will be an opportunity for Government to lay out how long-term emission targets can be achieved. EI members see the UK on a trajectory to a low carbon economy but also recognise the challenge that lies ahead.

To reach emissions reduction targets at least cost, members think Government should prioritise support for energy efficiency, renewables and nuclear power. In addition to climate policies they identify several factors driving the decarbonisation of the economy. Chief among these are wider environmental concerns (eg, air quality or land use change), followed by increased competitiveness of low carbon technologies due to falling costs, rising energy costs driving energy efficiency improvements, and consumer pressure. Carbon pricing and increased climate awareness in the investment environment are also seen as drivers, although less significant.

To seize the economic opportunities of the low carbon transition, members think the UK should prioritise support for energy efficiency and renewable technology as well as research and development of emerging technologies. Members support Government's aim, as stated in the recent industrial strategy green paper, to capitalise

on the UK's existing strength in research and academia and apply it to emerging energy technologies such as storage and smart energy systems.



The global economy is moving towards a low-carbon future. What measures should the UK prioritise to seize the economic opportunities of this transition?

	Measures	% of respondents
1	Supporting energy efficiency	64
2	Supporting renewable energy	62
3	Supporting emerging technology research and innovation	60
4	Supporting decarbonising transport	38
5	Supporting nuclear energy	34

Best measures to reach emissions targets

?

What measure should the UK government prioritise to reach its emissions targets (i.e. mitigation) at least cost?



1 ENERGY EFFICIENCY



2 RENEWABLE ENERGY



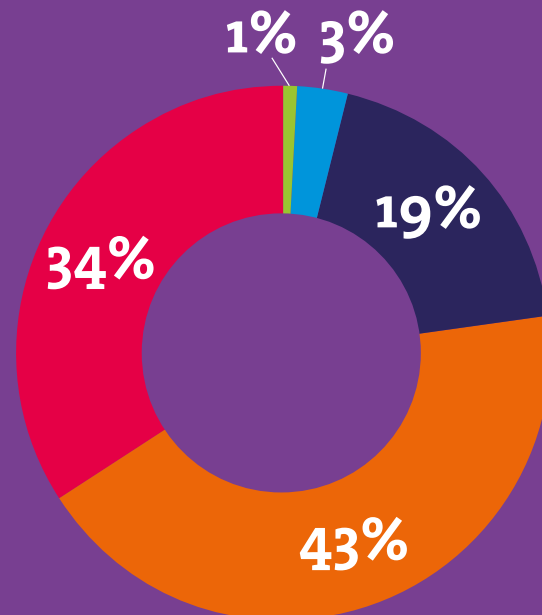
3 NUCLEAR ENERGY

UK 5th carbon budget

?

The 5th carbon budget (2028–2032) requires greenhouse gas (GHG) emissions to fall by 57% (from 1990 levels). By 2032, given current UK emission reduction policies, do you expect emissions reductions to:

- **Significantly exceed the target**
(62% or larger reduction)
- **Exceed the target**
(59–61% reduction)
- **Meet the target**
(56–58% reduction)
- **Fall short of the target**
(53–55% reduction)
- **Fall significantly short of the target**
(52% or smaller reduction)





Future energy system

To accommodate increasing amounts of intermittent renewable energy sources, various means of flexibility are currently debated among energy professionals. The National Infrastructure Commission has estimated that roll-out of flexible grid technologies like storage, demand side response and interconnection to neighbouring electricity markets could save consumers up to £8bn per year by 2030 (2016). When asked which infrastructure changes are needed to make the energy system more flexible, EI members show a clear preference for updating the electricity grid and making it smarter, rolling out energy storage and ensuring a sufficient amount of flexible electricity generation capacity is available.

This is in line with Government's efforts to identify adequate incentives for flexible technologies such as storage and demand side response, as well as regulatory barriers they might face in the current market framework ("A smart, flexible power system" consultation by BEIS and Ofgem, 2016). Furthermore, this result aligns with Government support for interconnection with neighbouring countries and investment in Britain's transmission and distribution grids. EI members share Government's assessment that gas plants play a long-term role in the UK's energy mix to complement intermittent renewable energy sources.

Several other infrastructural changes which could enable a more flexible energy system were widely mentioned by EI members, such as the integration of heat, transport and electricity systems, the roll-out of smart meters and controls, electric vehicle infrastructure and low carbon heat networks.

In line with the long-term role they see for gas in the UK power mix, 70% of members support the development and exploration of shale gas in the UK. However more than half of those who support its development (38%) think stricter regulation is necessary. Opinion on this subject differs between sectors and disciplines, for example, about four in ten of those in the buildings and energy management sectors oppose shale gas, compared to one in ten in the oil and gas sector. Graduate members were less likely to support the development of shale gas.

In addition to the infrastructural changes needed to achieve higher levels of flexibility, wider societal changes will be needed. Members emphasise the need for more engagement of energy consumers in the system. Adopting new technologies and shifting demand through behavioural change are seen as necessary on the consumers' side. At the same time EI members think suppliers need to earn public trust to get consumers more actively involved.

Members were asked to provide examples of how a system-level approach to heat and electricity could enable more efficient decarbonisation strategies. Their responses emphasise the potential of capturing waste heat from power generation in combined heat and power plants (CHP) as well as from industrial sites or other infrastructure for lower temperature applications. Furthermore, proper system planning and providing appropriate grid infrastructure is seen as necessary to ensure cost effective integration of renewable energy sources.



Cordi O'Hara FEI
Director, UK System Operator
at National Grid



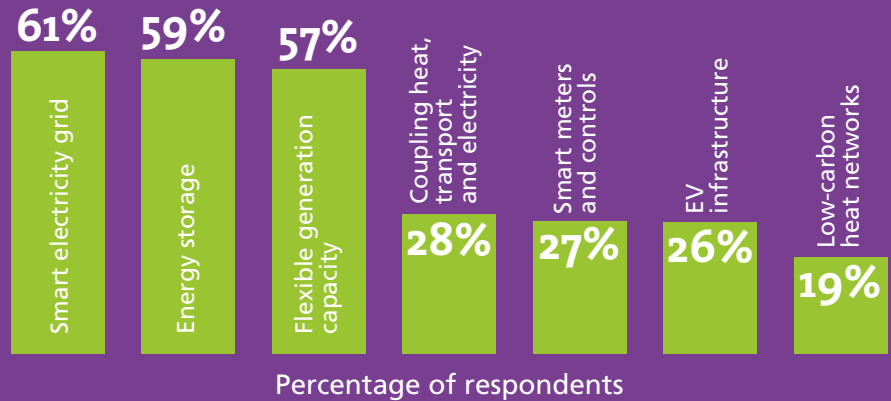
Decarbonisation, decentralisation and digitisation will require a very different energy system in future. That future is here now. The speed of transition means that we are already seeing the need for greater flexibility. We need to act now and develop flexible, agile solutions, including new products and frameworks to deliver future customer needs.



Infrastructural changes for a flexible energy system

?

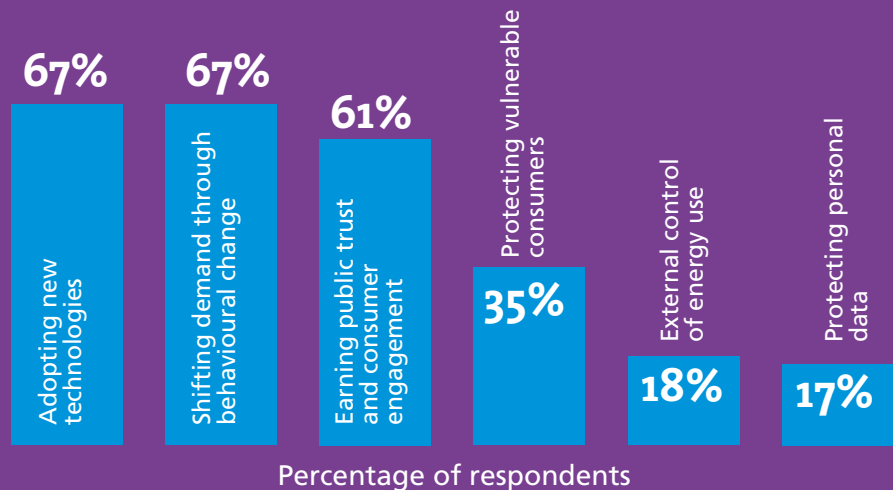
Which of the following infrastructural changes are MOST important to achieve a flexible energy system?



Societal changes for a flexible energy system

?

Which of the following societal changes are MOST important to achieve a flexible energy system?





UK heat mix

?

Thinking of the UK heat mix in 2030, approximately what percentage contribution do you expect each of the following sources to make?



2015

- Gas (70%, actual in 2015, BEIS)
- Electricity (14%)
- Oil (8%)
- Coal (4%)
- Bioenergy & Waste (4%)

2030

- Gas (55%, expected in 2030)
- Electricity (19%)
- Oil (5%)
- Coal (2%)
- Bioenergy & Waste (8%)
- Hydrogen (2%)
- Solar thermal (3%)
- Waste heat (4%)
- Other (1%)



Heat

Heat accounts for about 45% of UK energy consumption (BEIS, Energy Consumption in the UK, 2016) and about 20% of UK GHG emissions (CCC, Progress Report to Parliament, 2016). Over the last five years, Government has launched a series of initiatives reflecting the importance of decarbonised heat for reaching UK emission targets.

Heat mix in 2030

EI members expect a moderate rather than complete transformation of the UK's heat mix through to 2030. While gas is expected to remain the dominant heat source, its share is predicted to decrease by a noticeable extent (from 70% in 2015, to 55%). The shares of electricity and bioenergy are expected to grow moderately in absolute terms and several low carbon sources are expected to become visible in the mix, such as hydrogen, solar thermal and waste heat.

A wide range of views were expressed across sectors and disciplines about the potential heat mix in 2030. This variation reflects the uncertainty around the future of heat. The current working assumption in the UK is that a multiple technology approach should be followed and the next decade should be used for research into how various technologies (such as hydrogen, heat pumps and heat networks) can be scaled up and combined (CCC, Next Steps for UK Heat Policy, 2016).

Next steps to decarbonise residential heat

The majority of emissions from heat (68%) arise from residential use (CCC, Next Steps for UK Heat Policy, 2016). To reduce this source of emissions EI members strongly agree that proven technologies – particularly those related to efficiency – should be prioritised in the period through to 2030. They emphasise the importance of retrofitting buildings and ensuring high energy efficiency in new buildings through proper wall and loft insulation. Upgrading equipment such as boilers is also among the technological measures believed to enable the greatest emission reductions. Controls and smart systems are an exception in that they are immature technologies but still expected to enable significant emissions reductions in heat.

? Within the residential heating sector, which of the following technological instruments will enable the greatest emissions reduction by 2030?

	Technology measures	% of respondents
1	Retrofitting building fabric	49
2	More efficient new buildings	45
3	Equipment upgrades	45
4	Controls and smart systems	43
5	Heat pumps	27
6	CHP and heat network	26

Financial incentives, like tax credits or capital grant schemes, mandatory standards for buildings, and engaging with communities via new ownership models are seen as the most effective policy measures to decarbonise heat through to 2030.

? Within the residential heating sector, which of the following policy and financial instruments will enable the greatest emissions reduction by 2030?

	Policy measures	% of respondents
1	Financial incentives	68
2	Mandatory standards	63
3	Engaging communities	39
4	Skills, education and training	34
5	Carbon price on heat	24
6	Pilot projects for technologies	23



Future business models

As the UK moves towards a low carbon energy system, changes in technology will lead to changes in business models, and vice versa. Setting out their vision for future business models in the low carbon economy, EI members expect more decentralisation, increased customer engagement, and a greater focus on service provision. This is not surprising given the projection of greater penetration of renewables and a more flexible energy system. The main driver of new business models is thought to be technological innovation, along with policy shifts and commercial factors.

Taking large, vertically-integrated energy companies as an example, nearly half of EI members foresee decentralisation of their assets as most likely in the future. 30% of members think they will provide connected services to externally owned assets, while 18% predict that they will own and aggregate distributed assets, enabling demand side response or distributed storage. At the same time, a significant number of respondents (25%) expect vertically integrated companies to continue to operate large scale assets, but shift to lower carbon sources such as offshore wind or nuclear.

Views on future business models depend to a considerable extent on respondents' sector and discipline. For example, those working in oil and gas are more likely to expect energy companies to remain vertically integrated.

Just as new technologies may necessitate new business models, new business models and market frameworks can foster technological innovation. Members see opportunities for such stimuli in the areas of decentralised renewable energy, energy

efficiency and smart grid infrastructure. Sending the right price signals, and finding new ways to finance infrastructure and to support research and development through commercialisation are examples given by members for structures that encourage innovation. Linking to the recurring theme of policy stability, EI members emphasise the importance of a stable policy framework and long-term support to enable technological innovation.



What are the main drivers for the development of new business models in the energy sector?

	Main drivers	% of respondents
1	Technological innovation	61
2	Governmental policy shifts	52
3	Commercial drivers	49
4	Changing consumer demands	35
5	Climate change concerns	34
6	Enhancing energy system flexibility	34
7	Earning consumer trust	13



Dr Ceri M Powell FEI
Country Chair of Shell
Companies in Brunei



In the coming decades as nations balance energy supplies from diverse sources with commitments to reducing greenhouse gas emissions, fascinating opportunities are emerging for business models driven by technological innovation and intense digital connectivity. Decentralisation, niche customer-focussed solutions and lower carbon value chains are already clear winning trends.



Future business models

?

Which of the following characteristics best describe the most likely future business models within the energy sector?
Percentage of respondents displayed.

Increased customer engagement

56%



Focus on service provision

45%



More decentralised

66%





Energy in society

Acceptance and trust

Public engagement has been consistently identified as a top challenge for the energy sector in past Energy Barometers. Research into public opinion shows the energy sector is among the least trusted industries worldwide alongside financial services and pharmaceuticals (Edelman Trust Barometer, 2016). EI members are mindful that more work needs to be done by the industry to gain public trust.

The role of the consumer is seen as important for achieving energy goals: EI members hope, by earning the trust of the public, to gain a more positive general perception and greater support for industry decisions. Consumer pressure is considered to be among the top drivers of the low carbon transition, in addition to emissions targets. EI members would like to work towards more direct customer involvement in the energy market, and more than half of members expect that business models of the future will involve increased customer engagement. Improving trust, and engaging and educating consumers are seen as important to achieving greater system flexibility and decarbonising residential heat (see p. 26-27).

Renewable companies and those responsible for the gas and electricity grids are thought to be the most trusted, although a significant number of respondents thought that no area of energy was particularly trusted. Reliability, transparent communication and

demonstrating value to society are the main sources of trust in energy companies.

When considering which actions their own sector should prioritise to build trust, most EI members pointed to cost and tariff transparency, helping customers with energy efficiency, and improving communication. Working with Government to strengthen regulation and provide better information to educate and raise awareness are also thought to improve trust. Trust between Government and industry could also be built through greater accountability and transparency of policy processes.



Sinead Obeng BSc(Hons) GradEI
Commercial Analyst, South Hook

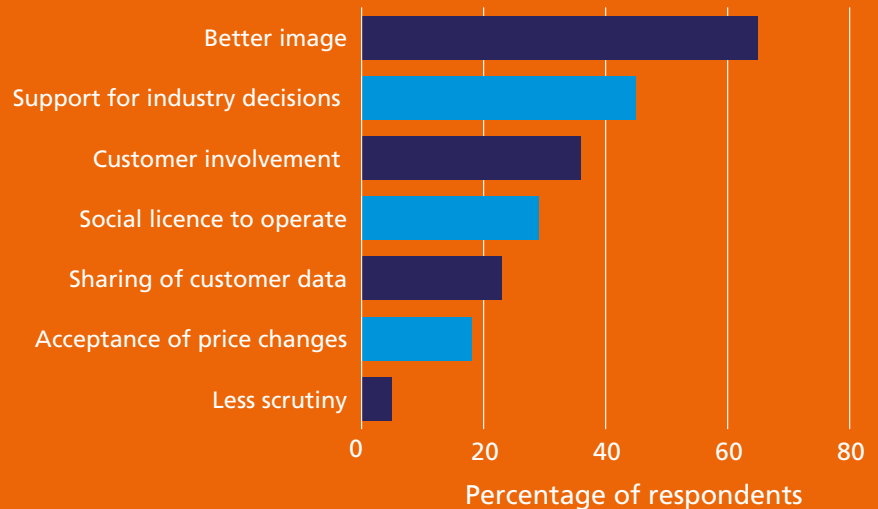


The traditional reputation of our industry is changing. Young professionals from all areas of the industry increasingly have an appetite to serve the energy sector as global citizens. We are more determined to find solutions to current challenges in the industry, particularly in this fascinating time of technological change and disruption.

Benefits of public trust



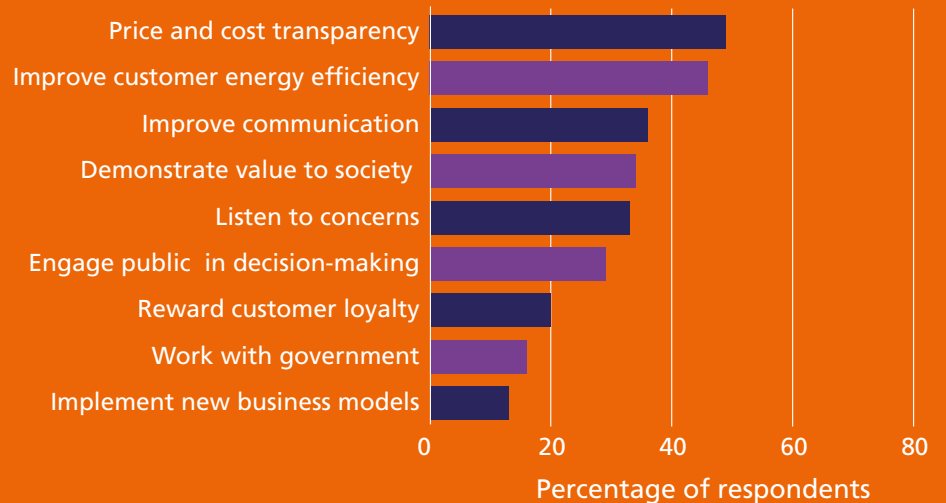
Which of the following would your area of industry hope to gain by earning public trust?



Ways to earn public trust




Below is a list of actions that could be undertaken to earn public trust. Which of these would you prioritise for improvement within your sector?





Future



Attracting people with the right skills is an ongoing challenge for the industry which could potentially be exacerbated by Brexit (see p. 10–13). Graduate members, who are in the first five years of their careers, were asked additional questions to explore the changes they expect over the span of their careers.

These young professionals believe that graduate programmes and trainee roles, along with opportunities for career progression, are the best ways to encourage young people to pursue careers in energy, although a variety of measures should be implemented. These measures echo wider recommendations for addressing potential skills shortages (see p. 12–13).



energy leaders



What is the biggest change you expect to see in the industry over the span of your career?

“I hope to see a world in which energy is more of a tool for good and not one which is vilified”

“Change in mindset from ‘how do we satisfy demand’ to ‘how do we make best use of the energy we have’”

“A shift to a more integrated and low carbon system, with a move away from large scale generation toward smaller, more distributed generation”

“The industry will think outside of the box. The... energy industry [will] also take into account other industries directly affected by energy, i.e. water, food”



Andy Hadland

YPN representative on EI Council
Chief Development Officer, Arenko
Cleantech



To meet many of the challenges highlighted here, we need to continue to learn to ensure our skills stay ahead of the game. In an increasingly digital world, the ability to use code, to solve ever more integrated and complex challenges, will separate those who want to make an impact, and those that will.



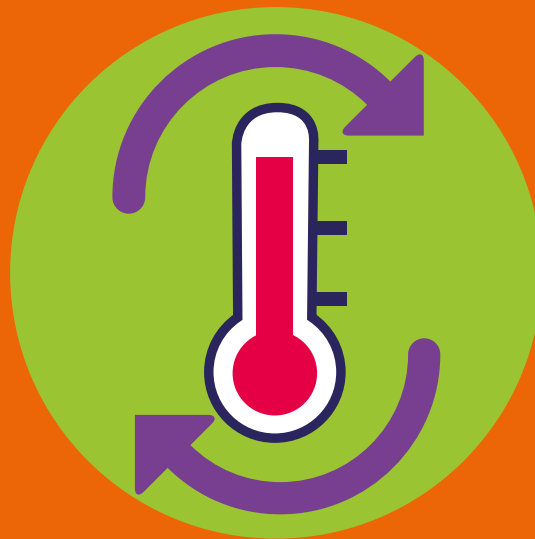
Motivation for working in energy

Graduate members were also asked about what attracted them to work in energy. Decarbonisation emerged as a key theme for this group. Contributing to climate change action was the top motivator for joining the sector and the low carbon transition was the defining change they expect to see by the time they retire. They also expect their jobs to be transformed by IT and digitisation more than by any other technological change.



What was your motivation to pursue a career in the energy industry rather than another industry? N=102

In addition to climate change action, those early in their energy careers were motivated to join the industry by a desire to be part of a multidisciplinary sector, take a responsible role in society and work with new technologies. Renewables, energy efficiency and energy storage are considered to offer the best opportunities for new starters, again showing the significance of the low carbon transition for this generation of energy professionals. Reflecting its continued importance to the industry, a significant number of respondents also identified oil and gas as an advantageous sector.



CONTRIBUTION TO CLIMATE CHANGE ACTION

58 %



**MULTIDISCIPLINARY
SECTOR**
46%



**SOCIAL
RELEVANCE**
38%



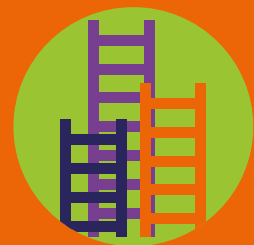
**OPPORTUNITY TO
WORK WITH NEW
TECH**
34%



**WORKING AROUND
THE WORLD**
30%



**STABILITY/FINANCIAL
SECURITY**
28%



**VARIED
OPPORTUNITIES**
26%

The role of the EI



Louise Kingham
OBE FEI

Equipping energy professionals to do vital work and articulating their views are the twin purposes of the EI. Through these activities we bring expertise to bear on the shift towards a safe, reliable and more sustainable energy system and, crucially, on the public debate about this transition.

We achieve our charitable purpose by promoting knowledge, skills and good practice among the people and companies that drive our industry. Our membership is unique, spanning the entire energy system and diverse disciplines, and including seasoned professionals as well as newcomers with fresh perspectives on energy challenges and opportunities. The Energy Barometer brings their voices into the debate, uses their expertise to paint a picture of the current energy landscape, and suggests paths for reaching our collective goals. The results provide evidence for policy and industry decision-making.

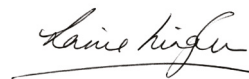
That role doesn't stop with this report. We are working tirelessly with our members and partner organisations to respond to policy consultations, and provide information and a trusted environment for policymakers to ask questions. It is our ambition to provide a reliable and balanced resource to Government to inform energy strategy and policy decisions. By sharing their views, our members make this important work possible.

Through the Energy Barometer, EI members from all sectors have consistently made it clear that the transition to a low carbon energy system is both necessary and desirable. The largest sectors represented within the EI College are oil and gas, and energy demand, utilisation and management; we are making sure our work reflects this diverse energy landscape, and balances supply-side with demand-side, emerging with mature technologies. Our partnership with the G+ Offshore Wind Health and Safety organisation is a prime example, improving good practice in this burgeoning sector by drawing on decades of

experience in offshore oil and gas health and safety.

The complex challenges identified by EI members, especially the low carbon transition and assuring the UK's security of supply, are going to require a growing number of capable, motivated people. That's why so much of our work focusses on professionalism and skills, making sure knowledge is transferred between generations and sectors, and recognising excellence. We're also helping to communicate the benefits of a career in energy, and supporting those who want to pursue one through multiple routes to the workplace. In this report, EI members stress the importance of vocational roles as well as professional ones, and call for support for apprenticeships and training schemes. We also believe in promoting diversity in the sector, and are working with POWERful Women to enable more women to reach senior-level roles.

I would like to extend my sincere thanks to members of the EI College for sharing your views through this report. Your expertise enables us to fulfil our charitable aims and work towards a better energy system, and we will continue to provide you with a platform for sharing your voices.

A handwritten signature in black ink, reading 'Louise Kingham'.

Louise Kingham OBE FEI
Chief Executive, Energy Institute

Method

The 2017 Energy Barometer is the third in a series of annual surveys of the EI College, a group of EI professional and pre-professional members. The survey was sent to the 939 College members, of which 157 were respondents to the 2016 survey and 782 were participating for the first time this year. The College includes three EI member grades: Fellow (FEI, N = 158), Member (MEI, N = 374) and Graduate (GradEI, N = 407). This process was designed to ensure a diverse range of sectors, disciplines, and seniority levels were included in the sample.

The survey questions were established by the EI Knowledge Service (EIKS), under the guidance of the EI's Energy Advisory Panel (EAP) and industry experts. Some questions are repeated annually to form trends over time; others cover topical subjects that change year-to-year.

The survey focusses on the UK energy system, and encompasses a wide range of topics including implications of the UK leaving the European Union for the energy sector, skills and knowledge retention, the UK's Industrial Strategy, investment and prices, emission targets and the energy transition, and public trust in the energy sector. The questions were refined with the help of Dr Dimitrios Xenias at Cardiff University, with input from Dr Melanie Smallman at UCL. For the first time, this year's survey included a section exclusive to Graduate members.

A total of 466 College members fully completed the survey online in February 2017. The responses were analysed by EIKS to assess key findings and identify themes from the results. The survey included

multiple choice (N=466) as well as free response questions (optional). The number of answers received for each free response question is indicated in the report. The answers to free response questions were coded and mentions of codes were counted across responses. In the report, responses to both types of questions are presented as percentages of respondents, unless stated otherwise. This can lead to percentages adding up to more than 100%, in the case of multiple choice questions where respondents were allowed to choose more than one option or in the case of a free response question where a single response may have been assigned more than one code.

The findings represent the views of the EI's members in the UK. Where there were prominent differences across sectors and disciplines, this has been singled out in the report. While naturally there are topics where opinions differ among subgroups, a surprising feature of the survey was a high degree of consensus on most energy issues. This report constitutes a step towards creating an informative, useful account of the energy sector based on the views of those working within it.

The complete set of data used in this report is available online at knowledge.energyinst.org/barometer. Data for questions not included in the report is also available upon request. An additional survey on energy issues and suggestions presented in party manifestos for the 2017 UK general election was carried out in early June 2017. The results of this survey will be published by the EI later this year.

	Top respondent sectors	% of respondents
1	Natural gas and oil	35
2	Demand management	21
3	Academia and research	21
4	Renewable technology	21
5	Buildings	20
6	Heat and power generation	16

Notes

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