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UCL INSIGHTS: RESEARCH BRIEFING

Artificial Intelligence for the energy system: ethical and social impacts

In February 2018, academics from UCL and researchers at DeepMind, an artificial intelligence research company, and the Hoffmann Centre and the Energy, Environment and Resources Department based within Chatham House, held an exploratory roundtable to discuss the uses of Artificial Intelligence (AI) within the energy sector.

At the event, participants discussed questions including:

- In what areas can AI have the greatest impact on improving energy efficiency and tackling climate change?
- What new opportunities can AI create to enhance energy efficiency?
- What responses are needed to ensure positive economic effects, inclusivity and equal access to benefits?
- What are the possible social, economic and environmental impacts of the use of AI in addressing energy efficiency and climate change (both positive and negative)?
- What policies, tools or regulations are required to ensure public benefit is realised from the use of AI in the energy system?

KEY THEMES

- The **energy system is becoming more complex and fractured** as renewable sources form a greater part of the energy mix
- These changes **increase the risk of the energy system becoming less equal**, increasing the risk of fuel poverty
- Using **Artificial Intelligence could deliver significant efficiency improvements** in the energy system.
- This area of research can offer valuable insights to address two of the **Grand Challenges identified in the UK Industrial Strategy: AI and the Data Economy, and Clean Growth.**
- **Data security and privacy**, particularly of personal data, must be considered if AI is to be used more widely to address challenges for the energy sector.

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What problems are the energy sector facing?

Energy systems are rapidly becoming more complex. Due to the inherent volatility of weather-dependent renewable energy on the supply side, and the use of electric vehicles on the demand side, our energy systems are becoming increasingly unpredictable. Moreover, the number of energy generating units in the UK's power grid will increase from several hundred to several thousand in the coming decades due to the advent of small-scale renewable energy sources.

Improving energy efficiency is a key factor in tackling climate change. It will require a range of data inputs to be successfully managed, and will only be achieved by complex, interdisciplinary decision making.

Consumers are becoming producers of personal energy data. The rollout of smart meters is creating a vast amount of data on the energy usage habits of households. Ownership of energy data is thus shifting from utilities to consumers.

While this information could provide a valuable resource for AI to make efficiency improvements, it raises pertinent questions over data privacy and security. Work currently being undertaken through the EPSRC-funded Smart Meter Research Portal project[1], led by the UCL Energy Institute, is investigating how to manage data from the nation's smart meter infrastructure.

There are both technical and political challenges to be overcome in order to find ways to make use of this valuable data while upholding the rights of consumers, as well as in addressing customers' ability to access, understand and make use of this data.

Energy systems are at risk of becoming more unequal. The availability of premium energy services risks widening equality gaps with societies. Distributed renewable generation has allowed some sections of populations to leave national energy grids, at the expense of those who remain on-grid.

The 'Thousand Flowers'[2] transition pathway, one path by which the UK energy system may move to a more sustainable future by 2050, envisages that 50% of electricity would be generated by local community energy schemes. However, the ability to finance such projects may constrain them spatially, making them less likely to receive approval in more economically deprived areas, and restrict

1 https://www.ucl.ac.uk/bartlett/energy/smart-meter-research-portal-smrp
2 Community energy and equity: The distributional implications of a transition to a decentralised electricity system. People, Place and Policy Volume 8 - Issue 3; Dec 19, 2014; Victoria C.A. Johnson and Stephen Hall.

private access to technology to more affluent members of society. This would in effect trap those on the lower end of the socio-economic scale in an energy system where they bear an increasing share of the burden of cost of national infrastructure and are excluded from accessing the most economic means of energy supply. Furthermore, AI-driven subscription services can help consumers to navigate complex tariffs and fluctuating energy prices, but are not universally available.

Financial resources, availability of data, and the ability to manage data securely are all potential obstacles to emerging data-driven services and the use of AI to improve the energy system. More broadly, AI has the capacity to make significant efficiency improvements to entire energy systems, but this is likely to be dependent on both capital investment for the infrastructure that is required to extract maximum value from the potential of AI, for example smart heat pumps, data centre infrastructure that allows for smart control, as well as the quality of existing infrastructure.

Careful planning is required to ensure that improvements facilitated by AI are made widely accessible.

Research recommendations

Active research is needed to inform policy decisions and to anticipate future problems to which AI could be applied. Moreover, open publishing of research is essential as a means of ensuring equal access to AI benefits and understanding challenges in developing economies.

There is a need for interdisciplinary research that considers the technical, economic and social challenges of integrating AI into energy systems. Key research topics are:

- **Develop frameworks for secure sharing of consumer energy data.** More localised, higher resolution data could improve the effectiveness of AI in the energy sector. Data encryption could mitigate privacy concerns regarding the use of highly disaggregated data which may otherwise hinder the development of such applications. Policy development may also have a role to facilitate regulated access to energy data that is appropriately aggregated or anonymised for research purposes, in order to further develop beneficial applications of AI.
- **Investigate the impact of AI on inequality and fuel poverty.** AI has the capacity to both intensify and reduce fuel poverty and inequality. Some applications, such as improvements to system operation, are likely to be universally beneficial. However, paid consumer services, such as those using smart meter data may inadvertently widen existing energy inequality gaps. Moreover, some economies may benefit disproportionately for several reasons including data availability and the capital investment required to implement AI in the energy sector.
- **Investigate safe and ethical applications of AI.** In the context of a rapidly developing energy system, the use of AI models that have been trained on historical data, should be rigorously investigated for bias and carefully thought through to avoid exacerbating inequality. There should also be active research in the area of safe and ethical AI applications which can assure effective implementation in the real world.
- **Test new regulatory structures for the energy market.** As OFGEM is actively looking to reduce mainly to reduce energy bills through increased competition, agent based modelling and AI could allow for new market regulations and structures to be tested. This could assess the impact of introducing new competitors, whether this would be beneficial to customers, where it may emerge first, as well as an assessment of public policy options and responses.
- **Investigate new infrastructure development.** Through the Industrial Strategy, UK policy could also play a role in supporting the development and delivery of necessary infrastructure, both physical and virtual, to increase the use of AI in the energy system.

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