UCL

AI for People & Planet

Policy Commentary: Climate Change

AI for People and Planet - Climate Change

The **Artificial Intelligence (AI) and Climate Change** discussion was organised as part of the UCL roundtable series 'AI for People and Planet'. The roundtable brought together leading minds from academia and the UK's climate sector to explore how AI can assist in the transformational changes needed to decarbonise systems, infrastructure and societies.

The roundtable sought to address two key areas:

1. How do we best leverage the transformational power of AI to reduce the impacts of climate change?
2. What is needed to foster more interactions and knowledge sharing between climate experts and AI researchers?

Executive Summary

The key points highlighted during the discussion include:

- Many technology solutions to achieve decarbonisation in energy systems already exist. AI can play a role as the 'software' solution that manages this complexity and makes it feasible to adopt the hardware into the system.
- The predictive ability of AI can play a role in forecasting, modelling and managing supply and demand for renewable energy sources.
- Digital twins are virtual models of physical energy infrastructure, energy markets and market actors (i.e., people and businesses). They have the potential to explore different policy and weather scenarios, manage resources and monitor the health of equipment.
- Decarbonising the energy system and achieving net zero by 2050 will require behaviour change in people's everyday lives. AI has the potential to identify synergies & trade-offs of solutions as well as interventions that have the greatest likelihood of public acceptance.
- Addressing the talent and skills gap is key, and it is vital that employment pathways are provided at the intersection of data science and climate change.
- Creating small community-based demonstrators could offer one way to introduce new concepts and technologies, while also enabling decision-makers to explore how such technologies could be rolled out across the country and building public acceptance.
- Greater collaboration and sharing of data and metadata between energy companies is needed, as well as improved access to nationally held data.

These areas are presented in more detail below.

What are the applications of AI that could have the greatest impact? What do we need to know to increase such impact?

Forecasting, modelling and managing energy supply and demand

As the energy grid grows in complexity due to an increase in the number of fuels, actors, and components, AI becomes an important mean to monitor, optimize and plan energy supply and demand. For example, as weather-dependent renewable energy sources such as wind and solar increase, the prediction of energy generation becomes as challenge. Using AI technologies to predict how weather scenarios might affect renewable energy generation would help to show where there might be significant drops or surplus in energy supply across the energy network.

AI can help to manage energy supply (i.e., forecasting the number of sunny days or windy periods) and demand (i.e., temperature changes that would affect heat usage).

While the potential of AI in forecasting applications has long been understood, a less developed application area of AI is in supporting faster roll-out of sustainable technologies or data-driven scenario development. Moreover, solutions depend on the acceptance by citizens. AI can play a role here by intelligent optimisation of limited resources or displaying costs of alternative options - for example, a targeted installation programme can be developed that makes best use of the limited workforce of installation technicians in the UK by identifying homes that would most benefit from a heat pump.

Innovation

Digital twins are a virtual representation of a system that spans its lifecycle, is updated from real-time data, and uses simulation, machine learning and reasoning to help decision-making. These models have enormous potential in smart cities and the energy sector. For example, Carson City, Nevada, has used a digital twin to manage the city's water supply, and has subsequently reduced the number of human hours needed to operate the system by 15 percent while maintaining the same level of supply. Additionally, GE Renewable Energy is developing a software platform to create a virtual version of GE's gas, steam and wind turbines to test different scenarios and monitor a turbine's performance. The energy sector is highly fragmented, geographically dispersed and greatly influenced by human behaviour. Therefore, being able to develop simulations that attend to these challenges could support scenario planning and big picture thinking.

Having innovative information management frameworks are also needed to optimise the potential of AI technologies and promote wider sharing of data between companies and prosumers. Open banking models (i.e., the financial ecosystem where transaction data can be anonymously shared with financial institutions and FinTechs to access better financial products and services) have opened up the banking sector and could offer an example for the climate sector.

Access to data

Data science and AI technologies, such as digital twins, could be used to help identify opportunities for decarbonising. However, efforts to incorporate AI into the energy sector are fragmented. While organisations such as the Open Data Institute are developing standards for data sharing, and the Modernising Energy Data programme at the Department of Business, Energy and Industrial Strategy (BEIS) is implementing the recommendations from the Data Task Force, a central AI and climate change position statement is needed to create a cohesive policy framework.

With increased competition for energy providers to offer green energy solutions, companies are less likely to be willing to share their data and metadata with their competitors. A mandate, possibly paired with financial incentives, is needed for companies to build-up capacities for data stewardship and to share data and models to foster greater collaboration and coordination across the industry.

Federated learning (sometimes referred to as collaborative learning) is a machine learning technique that trains models across multiple decentralised servers that hold local datasets, without exchanging them with the other servers. While industries such as defence and pharmaceutics use these techniques, federated learning is not currently widely used in the energy industry. However, given that federated learning enables multiple stakeholders to build a common, robust machine learning model without sharing data, these techniques present a solution to critical issues such as data privacy, data security, data access rights and access to heterogeneous data.

Domestic decarbonisation

The key to reducing emissions is to decarbonise the energy and material systems, including the built environment (i.e., the human environment including homes, buildings, zoning, streets, etc.), transportation system and electricity system. AI has the potential to reduce the costs involved with these changes and identify interventions that have the greatest likelihood of public acceptance.

While behavioural aspects are beginning to shift and more households are installing smart meters, many of these still only take monthly data captures. Having more frequent readings, for example, would provide valuable, granular data to help gain an accurate understanding of energy usage patterns and ways to maximise existing technologies. AI technology in homes could help to identify how behavioural aspects and technologies interplay and help to prevent potential loading problems that cause interruptions to energy supply across the network.

What changes are needed? What are the barriers to successful deployment of AI technologies?

Employment pathways

While data stewardship (i.e., implementing data governance policies and procedures in an organisation) and data science are becoming more recognised fields, the pathways to careers at the intersection of data stewardship, data science and climate change are not clearly established. There has been an increase in Hackathons and data science events with climate focused problems being put to the AI community, such as the Ofgem climate emergency hackathon or the 'Learning to Run A Power Network' challenge at the Neural Information Processing Systems (NeurIPS) meeting in December 2020. However, more long-term solutions are needed to enable AI researchers to build careers that positively impact the climate change emergency. The pathways from academia into graduate training programmes and placements in industry that are beginning to be established in the AI and drug discovery sector (explored in more detail in the AI and Discovering New Medicines commentary) offer a complementary model on which the energy sector could base its own career pathways.

Public acceptance for AI and climate change

A lack of public trust in AI technologies and acceptance for the use of personalised data, regardless of whether it is anonymised or unidentifiable, is a major barrier to the uptake of new AI technologies in the energy sector. Regardless of the technological innovations made, lack of public acceptance will result in new technologies not being adopted. The use of AI and large-scale data analysis to develop climate services (i.e., products that enhance users' knowledge and understanding about the impacts of climate on their decisions and actions) could leverage the enthusiasm of citizen scientists (members of the public who collect and analyse data), facilitate sustainable development in low- and middle-income countries, and increase transparency of decision-making. Climate services represent a way to bring greater individual involvement and engagement to the global decarbonisation movement.

Mobile phone-based climate services

In Ghana, the Climate Change, Agriculture and Food Security research program delivered tailored seasonal forecast information to farmers via their mobile phones. This information enabled farmers to adapt their farm management decision-making to seasonal variabilities due to climate change.

Gaining a critical mass of people who are willing to switch to sustainable energy sources is essential; efforts are needed to increase the uptake of, and acceptance for, green energy technologies. Creating small community-based demonstrators could offer one way to introduce new concepts and technologies to wider populations, while also enabling decision-makers to explore how such technologies could be rolled out across the country.

SGN's H100 Fife pioneering project

In November 2020, Ofgem announced funding for a scheme to demonstrate hydrogen distribution and in-home heating performance in Levenmouth, Fife, Scotland. By 2022, approximately 300 homes will be part of the 100% hydrogen demonstration network, with the hydrogen being produced by a local offshore wind turbine. This project will contribute toward understanding decarbonisation options for heating and provide evidence of hydrogen's performance in a real-world domestic setting as a carbon-free energy source.

Conclusion

The AI and Climate Change roundtable explored how AI can assist in the transformational changes needed to decarbonise systems, infrastructure and societies. Innovations such as digital twins, community-based demonstrators, scenario explorers and innovative information management structures could facilitate the deployment of sustainable technologies and creation of smart cities. Additionally, if open and sharable data agendas are progressed rapidly, AI can play a role in transitioning to net zero through identifying the most cost-effective and interventions with the greatest potential for return. Underscoring all of these innovations and agendas is the need for strong leadership to drive the successful uptake and implementation.

Participants

UCL Participants

Dr Aidan O'Sullivan (UCL Energy Institute, *chair*)
Dr David Barber (UCL Centre for Artificial Intelligence)
Professor Tadj Oreszczn (UCL Energy Institute)

External Participants

Mr Jay Ashton-Butler (Office for AI)
Mr Rafi Cohen (Quadrature Climate Foundation)
Professor Olga Fink (ETH Zürich)
Mr Alex Howard (Centre for Net Zero)
Dr Lynn Kaack (ETH Zürich)
Ms Catherine Newman (Limejump)
Mr Simon Pearson (Energy Systems Catapult)
Ms Laura Sandys (Energy Systems Catapult)
Professor Valeria Jana Schwanitz (Western University of Applied Sciences)
Dr Emily Shuckburgh (University of Cambridge)

This document was prepared under the *Chatham House* rule by Ms Audrey Tan and Dr Aidan O'Sullivan. Please get in touch if you would like to know more or contribute to this discussion on Climate Change.

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