

Could Artificial Intelligence deliver a green transition?

*Can AI boost current efforts and innovation to move towards a clean energy model? This is the question addressed by recent research aiming to further our understanding of AI's role in the transition to low-carbon technologies. **Marion Dumas**, one of the authors of this research, discusses some of the key – and sometimes surprising – findings.*

“AI for the planet” is an oft-heard phrase in clean tech and AI circles alike. The idea that AI can catalyse breakthroughs to tackle climate change is an alluring prospect, especially as the world is now waking up, with some anxiety, to how deeply and broadly AI may transform economic sectors and social life. Is it just hype and greenwashing, or a fundamental development?

Our [research](#), carried out with Eugenie Dugoua (LSE Department of Geography) and Pia Andres (LSE Centre for Economic Performance), seeks to address this question. The study focuses on the impact of AI and ICT on low-carbon innovation because innovation is so central to the transition to a net-zero economy. Much like updating an old house with modern fixtures, every core segment of our economy – electricity, transport, heating, and manufacturing – needs a renovation. They all require new technologies that can radically reduce greenhouse gas emissions, turning an old, polluting system into an eco-friendly one.

Help or hindrance?

AI is a bit like a Swiss Army Knife. Economists call it a “General Purpose Technology” (GPT), a tool so versatile it can transform virtually any sector of the economy. Historical examples of GPTs include electricity and the internet.

Since a GPT can be applied to anything, it can be applied as well to increase the productivity of... fossil-fuel based technologies! Indeed, several research programmes are currently developing AI-enabled robots to increase exploration of fossil fuel reserves, or to enable easier monitoring and maintenance of offshore installations. Hence, a priori, there is no reason why AI should particularly help the planet – it can harm it as well by

boosting dirty technologies.

However, there is good news. Using economic theory and an extensive database of patents, our findings show that AI, so far, seems to help more than hurt the transition to a low-carbon economy.

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The ideas behind the theory are simple but go a long way in illuminating what is going on. The first idea is that clean technologies such as renewable energy or electric vehicles need to catch up (in terms of productivity and affordability) with dirty technologies. In the early phases, when they are still immature, the private sector's incentives to improve these technologies tend to be weak, as the rewards are too far into the future. This is a barrier to the transition.

Thankfully, this dynamic can change if clean technology can take advantage of advances in other fast-improving technologies such as AI. Indeed, the second idea in the theory is that new technology's success depends a lot on it taking advantage of advances in other technologies. This is what economists call technological spillovers. By creating new opportunities for clean technologies, spillovers from AI boost the incentives for companies to work on clean technologies. This effect is especially strong if inventors working on cleaner technologies are better able to use AI than those working on their dirtier counterparts.

Mapping flows of innovation

We then turned to a global database of patents (PATSTAT) and extract all patents relating to both clean and dirty transport and electricity technologies, as well as all patents relating to AI and ICT. Think of patents like a family tree, with citations tracing the lineage of ideas. If Patent A cites Patent B, it's as if Patent B is the parent, having contributed to or directly influenced the creation of Patent A. This is one way in which researchers map the flow of knowledge.

Using this data, we estimated the likelihood that a clean energy patent cites – that is, builds on – an AI or ICT patent. We found a very consistent pattern: clean energy patents draw on AI and ICT patents 2 to 3 times more on average than do dirty patents.

Moreover, when clean energy patents incorporate AI, they themselves subsequently generate more citations, that is more new ideas, and to a much greater extent than dirty patents.

The application of AI to clean energy is driven in large part by companies with extensive experience in AI and who seem to find applications in clean energy more appealing than applications in dirty energy.

We considered several reasons why clean technologies have such an advantage. One reason could be intrinsic to the technologies. For example, a lot of data and information processing is needed to smooth intermittent energy from renewables. Another reason could be that companies working on clean tech have more access to knowledge about AI, perhaps because of co-location. A third reason could be that older technologies, particularly those based on fossil fuels, may not be as adept at incorporating fresh ideas and technologies. Their maturity can often equate to a loss of adaptability. In the last part of the study, we linked the patents to the companies that filed them and find evidence that all three reasons are at play. The application of AI to clean energy is driven in large part by companies with extensive experience in AI and who seem to find applications in clean energy more appealing than applications in dirty energy.

An opportunity to grasp

What does this all mean for the transition? It is important to remind ourselves that innovation is central to the net-zero transition. Many commentators claim that the technical solutions exist, and that we are only missing political will. It is true that renewables have become cost-competitive in some markets and that affordable electric vehicles are within reach. However, we are still missing many key elements of a zero-carbon economy: ultra-high-density batteries, affordable hydrogen, smart grid solutions that can smooth intermittent renewables, advanced clean fuels for aviation etc... Overall, the International Energy Agency estimates that 50 per cent of the technologies we need to achieve net-zero by 2050 are still in prototype phase. This is why accelerating the pace of innovation in low-carbon technologies is very important.

This study shows that AI and ICT have been enabling low-carbon innovation. Thus, the idea that AI can enable a faster transition is not wishful thinking – evidence from the recent past supports this vision. As we move forward, there's a significant opportunity to

boost clean innovation if we can deliberately steer AI and ICT towards the greener technologies of the future.

This post draws on research by Pia Andres, Eugenie Dugoua and Marion Dumas contained in the [working paper](#) “Directed technological change and general purpose technologies: can AI accelerate clean energy innovation?” (September 2022) published by the Centre for Climate Change Economics and Grantham Research Institute on Climate Change and the Environment.

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