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The globalization of artificial intelligence: consequences for the politics of environmentalism

Peter Dauvergne

Department of Political Science, University of British Columbia, Vancouver, Canada

ABSTRACT
The globalization of artificial intelligence is supercharging the technological base of the world order. What are the consequences of the rising power of AI for environmentalism? Machine learning and intelligent robotics can advance environmental knowledge and conservation. Yet other AI technologies – from facial recognition to automated online surveillance – can enhance the power of states and corporations to suppress activism. The consequences of AI for environmentalism are highly variable, empowering some campaigns and depowering others. Still, a broad pattern is discernible. Going forward, AI technologies would seem set to advance technocratic, incremental, and moderate forms of environmentalism while hampering confrontational tactics and grassroots resistance, especially in authoritarian states. At the same time, AI is going to spur wasteful consumption, natural resource extraction, and the production of electronic waste. The globalization of AI, as these findings reveal, is set to unsettle the politics of environmentalism, doing some good, but bringing many dangers.

KEYWORDS
Environmental politics; artificial intelligence; activism; technology; surveillance; state power

The ability of machines to learn, think, and act independently is rising quickly. The list of products and services enhanced by artificial intelligence – and especially machine learning – could fill a book. Virtual assistants, such as Alexa and Siri, rely on AI. So does Google Translate. And so do smart homes and smart cities. AI is diagnosing diseases, trading stocks, and lending money. And AI is the brain for driverless cars, smart tractors, and autonomous weapons. AI systems are writing novels and poems; others are authoring fake news; still others are working to eliminate hate speech and pornography on social media. Retailers and brand manufacturers are turning to AI to automate services and target advertising. Oil and mining companies, meanwhile, are embracing AI to increase the speed – and reduce the costs – of drilling and transportation.

Artificial intelligence is a general-purpose technology amplifying vast numbers of technologies, akin to electricity. This may well lead to a machine equalling or exceeding human intelligence by the end of this century. But, for now anyway, the political and economic value of AI is coming from specific, limited applications, where it outperforms a human at a defined cognitive task, such as playing chess or finding patterns in big data: what many describe as narrow AI. PricewaterhouseCoopers (2017, p. 5) is projecting narrow AI technologies will add nearly US$16 trillion to the annual value of the world economy by 2030 (PricewaterhouseCoopers, 2017, p. 5): roughly equal to the combined gross domestic products of China and India in 2018.

CONTACT Peter Dauvergne peter.dauvergne@ubc.ca

Some of these AI technologies have the potential to empower environmentalists. Machine learning, where computers gain proficiency by analysing data and running simulations, is already starting to deepen the scientific understanding of climate change, biodiversity loss, and deforestation. AI technologies are offering new tools to conserve ecosystems, spot poachers, and detect illegal logging and mining. There is also a potential for AI software to help hone, target, and automate the online messaging of advocacy organizations. At the same time, however, other AI technologies – such as facial recognition cameras, automated internet surveillance, and autonomous drones – are set to enhance the ability of states and corporations to suppress social movements and dissenting voices.

Going forward, the consequences of AI for the power of specific environmental campaigns are going to be highly variable. Still, it is already possible to discern a general pattern. Broadly, as I argue in this essay, the globalization of AI technologies looks set to advance technocratic, moderate forms of environmentalism while hampering confrontational movements and grassroots resistance, especially in authoritarian states. On top of this, even as some AI technologies enhance the efficiency of the world economy, others are going to propel unsustainable production and consumption, creating new – and sometimes even greater – challenges for global environmental governance.

To develop this argument, I start by surveying the critically-oriented environmental literature to highlight some of the known risks of the globalization of technology. The remainder of the article builds on this survey to explore the consequences of the globalization of AI for societal efforts to reduce harms to natural environments and improve the eco-efficiency of built environments: what, in shorthand, I refer to as 'environmentalism'. I turn first to examine the potential of AI to advance environmental research, conservation, and the fight against illegal fishing, destructive logging, and the poaching of endangered species. Next, I analyse the potential of AI to increase the power of states and corporations to monitor and suppress environmental activism, both online and offline. After that, I examine the ways that the globalization of AI, even as it advances the eco-efficiency of some aspects of the world economy, can end up accelerating the very forces of unsustainable production and consumption that so many environmentalists are trying to slow down.

This article, as a search of the Scopus and Web of Science databases confirms, is the first to investigate the consequences of the globalization of artificial intelligence for the politics of environmentalism. These consequences are still emerging, and my conclusions are in no way meant to suggest a foregone fate for environmentalists. Identifying the shoals of AI could well help environmentalists avoid them – at least that is my hope.

The environmental dangers of the globalization of technology

Historically, the environmental consequences of the globalization of commercial technology have tended to be highly uncertain and unpredictable, especially over the long term. Who in 1920 could have imagined that over the next hundred years traffic accidents would kill more than 80 million people? Or, when Thomas Midgley Jr. created chlorofluorocarbons (CFCs) in 1928, who could have imagined that a half-century later these substances would be destroying the ozone layer?

There has also been considerable variation in the long-term threat levels of different types of technologies. Small-scale, alternative technologies have posed less immediate risks to ecosystems and, even when something has gone wrong, far less of an environmental threat as the underlying political and corporate groups profiting from production have not been strong enough to disrupt scientific consensus or resist calls for reforms. Technologies such as automobiles or airliners or oil platforms have been very different, with global-scale consequences and politically-connected industries able to oppose state regulation and social movements. General-purpose technologies such as electricity, engines, and computers have had especially far-reaching consequences by amplifying the power of all technology.

Over the past century, the globalization of commercial technologies has brought both costs and benefits, sometimes at an exponential rate, at least in the early stages of development (Kurzweil, 2005). This has certainly helped humans live longer and more comfortably (Broers, 2005); and, as ecomodernists (Symons, 2019) and ecological modernization theorists have shown (Mol et al., 2009), many technological advances (e.g. smokestack scrubbers and catalytic converters) have reduced the environmental impacts of production and consumption. Yet, as critically-oriented scholars have shown, the globalization of just about every commercial technology – including environmental ones such as solar panels, wind energy, and electric cars – generally entail at least some costs for the global environment (Bolwell, 2019; Newell, 2020; Wright & Nyberg, 2015).

Furthermore, the globalization of technology has tended to boost natural resource extraction, industrial production, energy needs, and individual consumption (Golding, 2017; Mazzucato, 2018; Wiedmann et al., 2015). This has occurred in part because technologies such as oilrigs, bulldozers, and trawlers have created opportunities to extract natural resources more profitably and at greater scale. Partly this has happened because technologies such as automation, robotics, and container ships have increased corporate productivity, enhancing the capacity of firms to produce low-cost goods for more consumers in more places. And partly this has arisen because firms design products for rapid obsolescence, advertisers accelerate turnover rates for consumer goods, and consumers upgrade in response to fast-improving technologies.

More efficient technology has allowed some businesses to produce 'more' goods 'from less' natural resources (McAfee, 2019). Some argue this has the capacity to 'dematerialize' the world economy and 'decouple' economic growth from resource degradation (UNEP, 2014). The efficiency gains from newer technologies, however, commonly rebound into more consumption, with the global environment under even greater, rather than less, ecological pressure (Fletcher & Rammelt, 2017; Hickel & Kallis, 2020). Many call this the Jevons paradox after William Stanley Jevons (1865) who first noticed that the engineering of more efficient steam engines was pushing up coal consumption in England, as uses and demand for engines rose, and as engines made coal mining easier, cheaper, and faster. Paradoxically, as he showed, rising technological efficiency was not conserving coal for future generations, but rather accelerating the 'exhaustion' of England's coal mines (and, as others would later note, worsening air pollution).

The costs and benefits from the globalization of technology, moreover, have been highly unequal within countries, between states, and across generations. Those with power and money have tended to benefit far more, with the ecological costs snowballing into spaces and places with less power, such as into poor communities, fragile ecosystems, and the future (Dauvergne, 2008). We see this, for instance, as microplastics pollute the oceans, persistent organic pollutants accumulate in the Arctic, and used fast-fashion clothing piles up in Africa.

This inequity of costs and benefits has arisen for many reasons. Those with expertise and financial resources have tended to control advanced technologies, as we see with the dominance of companies such as Bayer (which acquired Monsanto in 2018) over genetically modified seeds, chemical fertilizers, and fungicides (McKeon, 2017). Wealthy states and neighbourhoods have tended to have more capacity to deflect the costs of technology, as we see with the location of garbage dumps, incinerators, and chemical plants in poor, racialized communities in the United States (Pellow, 2004). And those with less financial and educational resources have tended to have less ability to adapt to new technologies as well as less capacity to take advantage of the benefits (Biermann & Möller, 2019). Further aggravating inequalities, regulations and precautionary standards have tended to be weaker in poorer regions, with legal implementation more likely to be erratic and inconsistent.

At the same time, states and firms frequently exaggerate the benefits and downplay the inequality of consequences of a new technology diffusing through the global marketplace. Startups hype technological 'breakthroughs' to entice investors. So do transnational corporations, since claiming to be at the cutting-edge of technology helps inspire confidence in a company's long-term growth prospects. Governments have strong incentives as well to embellish the technological capacity of their companies and militaries, as perception of strength is a vital component of state power (Dauvergne, 2020; Frischmann & Selinger, 2018).

Meanwhile, firms have strong incentives to downplay (or simply ignore) the potential of a new technology to cause long-term harm, especially when potential profits are high. Over the past century, for instance, manufacturers have routinely introduced new chemicals into consumer goods, with very little understanding of the long-term consequences for food systems, biodiversity, or human health (Clapp & Scrinis, 2017). If concerns have arisen, firms and industry associations have then tended to fight hard to deflect critics, lobbying governments, attacking scientists, and disseminating misinformation (Oreskes & Conway, 2011). Historically, this was case for the leaded gasoline and CFC industries; today, it is the case for consumer goods, plastics, and fast-food industries.

Levels of precaution around commercializing a new technology do vary across political cultures. In recent years, for instance, jurisdictions in Western Europe have tended to be more cautious than those in North America, as with the European Union's stricter regulation of genetically modified seeds. Still, in most of the world the environmental bar for commercializing a new technology has been very low: essentially, a firm only needs to verify that it will not pose a direct and immediate threat (e.g. poison consumers). This explains why the commercialization of so many technologies – from sugar-free gum to Teflon pans – have in effect been 'experiments' to see if harm will occur to people and the planet (Markowitz & Rosner, 2013).

Firms have frequently repeated these experiments when regulators require the phaseout of a technology or when demand falls as evidence of harm emerges. The substitute technology has generally improved some environmental conditions, as with replacing coal-fired power plants with solar and wind energy. Often, though, these technological fixes have brought new, unexpected problems (Jarrige & Le Roux, 2020), as when replacing ozone-depleting CFCs with climate-warming hydrofluorocarbons (HFCs).

The globalization of technology has also brought both opportunities and risks for environmental advocacy organizations. The internet, for instance, has enabled environmentalists to communicate quickly and cheaply, coordinate social media campaigns, and bypass the filters of mainstream media. Online activism can ignite strong resistance in the offline world, as has been occurring with the school strikes for climate action since 2018. The internet can empower relatively weak actors, too, such as those working to expose the reliance of brand corporations on forced labour, conflict minerals, and unsustainable commodities. But the internet simultaneously poses serious dangers for environmental advocacy, as states and corporations use cyber tools to sabotage campaigns, ramp up business as usual, and track activists (and perhaps later arrest or murder them) (Bridle, 2018; Choucri & Clark, 2018).

The critically-oriented literature on the globalization of technology, then, offers a stark warning for those hoping technological 'progress' will one day halt today's escalating global environmental crisis. Turbocharging the technological base of the world order with artificial intelligence has the potential to bring especially big dangers, not only for the prospects of global sustainability, but also for environmental activists themselves. These dangers, however, are not spread equally. Moderate environmentalists face far fewer threats and, as I discuss next, the globalization of artificial intelligence is helping some environmental researchers and advocacy campaigns to achieve their goals.

Empowering environmental research and advocacy with AI

The power of artificial intelligence, which broadly encompasses the ability of machines to perform cognitive tasks – such as reasoning, learning, analysing data, recognizing patterns, and making predictions – has been growing steadily over the past half-century. The past decade has seen the pace of progress gather speed as machines become increasingly adept at learning from digital data: what the computational neuroscientist Terrence Sejnowski (2018) calls the 'deep learning revolution', as some of the most impressive progress has come from designing computer systems that resemble the deep neural networks of a brain.

Instead of relying on human knowledge, deep learning networks are processing vast stores of data to 'train' themselves how to play games, earn investment returns, and translate languages. Machines are learning to speak fluently, identify faces in crowds, and drive cars through city streets. They are becoming adept at verifying legal contracts and translating languages. And they are finding patterns in massive datasets, discovering new scientific knowledge, and predicting outcomes with uncanny accuracy (Agrawal et al., 2018; Kelleher, 2019).

The latest machine learning systems are proving highly valuable for advancing environmental research. They are enhancing high-resolution mapping of deforestation, coral reef loss, and soil erosion. They are improving climate modeling as well as the forecasting of poaching, droughts, floods, and wildfires. And they are refining biodiversity calculations (Fei et al., 2019). One example is eBird, an online database of bird sightings and recordings made by volunteers around the world. The observations posted by the birding enthusiasts – what some describe as 'citizen science' (Sullivan et al., 2014) – are incomplete and sometimes inaccurate, and eBird uses learning algorithms to clean up data and predict bird populations, distributions, and migration routes. The resulting data analysis is then supporting targeted conservation campaigns. The Nature Conservancy, for instance, is relying on modeling by eBird to figure out which fallow fields in California might be able to substitute for lost wetlands for migrating shorebirds, and then paying farmers to flood these fields.

Machine learning is proving helpful as well for identifying and tracking illegal extraction of natural resources. Rainforest Connection, with projects in places such as Brazil, Indonesia, and Peru, is one example of the creative ways that environmentalists are drawing on machine learning to protect tropical forests. Launched in 2014, this non-profit upcycles smartphones into solar-powered devices able to pick up the distant sound of a logging truck, bulldozer, chainsaw, or gunshot. Nestled in the trees, these devices relay data through wireless networks to alert rangers of illegal activity. Learning algorithms are now enabling these devices to identify an impressive range of activity in the rainforests, such as the presence of a Jaguar, which is done, not by picking up its stealthy approach, but by analysing the warning sounds of other animals in the forest.

Global Fishing Watch is another example of how activists are turning to machine learning to protect ecosystems against illegal activity. An online, open-access platform founded in 2016 by Google, the non-profit company SkyTruth, and the marine advocacy organization Oceana, Global Fishing Watch tracks commercial fishing vessels by analysing satellite and land-based positioning messages. It then uses machine learning software to try to identify illegal fishing in protected areas, overfishing in particular regions, and the illegal offloading of catch to refrigerated cargo ships.

Machine learning is also creating new tools of conservation. One intriguing example is the RangerBot, a semi-autonomous submersible that is navigating Australia's Great Barrier Reef to locate – and lethally inject with bile salts – crown-of-thorns starfish. Small numbers of these starfish are native to the reef, with occasional population surges performing valuable ecosystem functions by pruning quick-growing coral. But prolonged outbreaks have become increasingly common, as agricultural runoff causes plankton blooms that feed crown-of-thorns larvae, and as overfishing depletes its natural predators. These outbreaks are highly damaging, as crown-of-thorns starfish feed on coral polyps. At least half of the Great Barrier Reef was destroyed between 1985 and 2012, with these starfish accounting for approximately 40% of the loss (De'ath et al., 2012, p. 17995). Conservation divers have long swum the reef to cull these starfish. The RangerBot, however, is a helpful additional management tool. It has no fear of touching the poisonous spines of these resilient starfish. And it is able to hunt for them all day, every day, even in rough weather, through strong currents, and in the pitch dark. Moreover, as the RangerBot continues to learn from experience, it is becoming more skilful, even managing to spot crown-of-thorns starfish curled into the coral.

Artificial intelligence, then, is offering some useful tools to support conservation and environmental protection. Yet a solution like the RangerBot, for all its ingenuity, is never going to do more than temporarily delay the destruction of the Great Barrier Reef – record warming in 2016 and 2017 alone bleached as much as half of the remaining reef (Hughes et al., 2018). The technical advances from machine learning and AI robotics are only tending to improve environmental management at the margins, with net gains for particular ecosystems tending to be incremental and narrow. Moreover, as we'll see next, AI-powered surveillance, both online and offline, pose a grave threat to confrontational, direct-action activism.

Cracking down on activism with AI

Facial recognition technology poses particularly great risks for activists. This technology can help authorities identify protestors, track activists, and monitor citizens without their knowledge or consent. It can also misidentify individuals as well as reinforce racist policing, with false matches especially high for black people (largely because of biases in the training data) (Grother et al., 2019). 'The introduction of facial recognition into cities is a radical and dystopic idea which significantly threatens our freedoms and poses fundamental questions about the kind of societies we want to live in', says Ioannis Kouvakas, a legal analyst at Privacy International (Sánchez Nicolás, 2020). Alvaro Bedoya at Georgetown University goes even further, arguing facial recognition technology 'is the most pervasive and risky surveillance technology of the twenty-first century' (Conger et al., 2019). Similarly, professors Woodrow Hartzog and Evan Selinger (2018) argue the 'technology is the most uniquely dangerous surveillance mechanism ever invented'.

The global market is growing quickly for facial recognition cameras, drones, and police body cameras. So is demand for facial recognition software able to identify individuals from photographs and video footage. One example is the Clearview AI app, which identifies faces by searching through billions of images scraped from social media sites such as Facebook, YouTube, and Instagram. The US Federal Bureau of Investigation (FBI) is now averaging more than 4,000 facial recognition searches a month (Harwell, 2019). Police across the United States are also routinely using facial recognition software to identify faces in surveillance footage (Rector & Queally, 2020).

In scores of other countries, too, police are using facial recognition technology to identify faces on surveillance video, bodycam footage, and social media postings. Police in Brazil have been using facial recognition cameras and drones to identify fugitives during the annual Carnival, with hundreds arrested in 2019 and 2020 (including one innocent woman misidentified as a criminal already in prison) (Foggin, 2020). Police in the United Arab Emirates are wearing facial recognition smart glasses to watch the streets of Abu Dhabi. Israel security forces are tracking Palestinians and monitoring checkpoints into the West Bank with facial recognition technology. In New Delhi, police have relied on facial recognition technology to identify – and remove – 'rowdy elements' and 'habitual protesters' from rallies for Prime Minister Narendra Modi (Mazoomdaar, 2019). New Delhi officers also used the technology to identify – and arrest – more than a thousand people who took part in 2020 protests against the 'anti-Muslim' amendment to India's Citizenship Act (Singh, 2020).

A glance into the People's Republic of China reveals some of the potential dangers of AI surveillance for the future of global activism. In 2017, the national government of China launched a strategy to assume world leadership in AI by 2030 (Lee, 2018). Chinese companies, under the guidance of the Communist Party of China, are now leading global efforts to develop AI-powered iris scanners, facial recognition cameras, and license plate trackers, installing them at home as well as exporting them to other authoritarian states. Chinese tech startups are also at the cutting-edge of other AI surveillance equipment. In Beijing, police are wearing facial recognition glasses to scan crowds for suspects and dissidents. In Hangzhou, emotion-reading cameras in one high school are watching students to discern who is bored, distracted, or disbelieving. And in the Xinjiang region (home of Uyghur Muslims), a military-tech team has developed a bird-shaped surveillance drone able to soar, flap, and dive like a bird – what the team calls the 'dove'.

China is in the process of establishing 'algorithmic governance', argues Martin Chorzempa of the Peterson Institute for International Economics (Mozur, 2018). Algorithmic governance aims to enhance state controls over citizens by automating the analysis of data from smartphones, internet activity, surveillance cameras, and smart home devices. Cities across China are now competing to implement algorithmic governance, with automated monitoring systems watching for crimes, traffic violations, and jaywalking. In the city of Shenzhen, for instance, facial recognition cameras are autonomously fining jaywalkers, then shaming them by projecting their faces onto a digital billboard. In cities such as Guiyang in southwest China, networks of AI-powered cameras are able to track down suspects in a matter of minutes (Sudworth, 2017).

Under a project translatable as 'sharp eyes', the government of China is working to develop a nationwide surveillance system, relying on machine learning to make sense of the reams of data pouring in from iris scans, surveillance cameras, license-plate trackers, identity cards, medical files, online activity, and banking and credit transactions (Qiang, 2019). Chinese companies, cities, and villages are also piloting various social credit rating systems to reward 'good' citizen conduct (say, paying debts on time, caring for parents, or posting pro-government commentary) and punish 'bad' conduct (say, gambling excessively, defaulting on a loan, committing a traffic violation, or critiquing official policy on social media). Rewards can include upgrades on airline seats, preferential credit, and access to overseas visas; punishments can include borrowing limits, travel restrictions, or loss of employment. To further extend the reach of China's social credit system, the government of President Xi Jinping is currently building upon the pilot projects to develop an AI-powered national rating scheme. Even more ambitiously, as part of its Belt and Road Initiative the government also has plans to extend social credit ratings beyond China (Liang et al., 2018).

Cybersurveillance is intensifying in China, too. The 'Great Firewall' of China has long censored the internet (Roberts, 2018). But advances in artificial intelligence are now extending the state's capacity to monitor and censor online activity. Machine learning software is enabling security agencies to identify dissenting voices across vast stores of text messages, videos, photos, social media commentaries, and audio files. AI systems are notifying authorities of texts and postings that are critical of the government. These systems are also autonomously blocking websites, deleting anti-government remarks, and circulating propaganda. Artificial intelligence, moreover, is extending the power of state cyber units to collect personal data, operate fake accounts, disseminate fake news and videos, and launch malware attacks against activists (Human Right Watch, 2019).

Many other states, too, are starting to deploy AI to intensify offline and online surveillance of their citizens. China has by far the most surveillance cameras, with 200 million in 2018 and plans to double this coverage over the next few years. But the US also has at least 50 million surveillance cameras and the UK has at least 6 million. Over the past few years Russia has been installing cameras at a lightning-quick pace, with 3 million added in 2016 alone, most of which were imported from China. Russia, the UK, the US, and China are all now working to enhance their video surveillance systems with facial recognition technology. China, for instance, has installed tens of millions of AI-powered cameras and since December 2019 the national government has been requiring anyone receiving a new SIM card to submit to a facial scan. Many other countries are embracing facial recognition surveillance, too, with India having one of the most ambitious plans of all, aiming to build a facial recognition surveillance system able to identify every single resident of the country.

More than a hundred countries are now using (or have approved) facial recognition technology for surveillance and policing (Surfshark, 2020). Chinese companies, lenders, and government advisors are playing a leading role in helping developing countries deepen surveillance with facial recognition technology, including Bahrain, Egypt, Iran, Kazakhstan, Kenya, Myanmar, Pakistan, Uzbekistan, and Zambia. 'China is driving the proliferation of AI technology to authoritarian and illiberal regimes', argues Steven Feldstein (2019, p. 41), 'an approach that has become a key component of Chinese geopolitical strategy'. American, Russian, British, and Japanese firms, however, are also profiting from the export of surveillance technologies, including facial recognition technology.

The globalization of AI surveillance technologies is only just beginning, and it is too soon to be able to isolate and assess the consequences for particular environmental groups. From a bird's-eye view, however, the growing surveillance power of states is certainly worrying for the future of environmental advocacy. Worldwide, governments have been cracking down on radical activism since the terrorist attacks in the United States in September 2001. At the same time, public agencies and private businesses have been partnering with more conformist, market-oriented nongovernmental organizations – a process that is moderating the mainstream of environmentalism and further marginalizing confrontational groups (Dauvergne & LeBaron, 2014). The crackdown on direct-action environmentalism, moreover, has been intensifying in recent years (Scheidel et al., 2020), with states all over the world characterizing local environmentalists as subversive agents of foreign interests to justify new laws to restrict activities, sever funding, and revoke charitable status (Matejova et al., 2018).

With repression rising, the globalization of AI-enhanced surveillance poses a particularly big threat to activists who are fighting for land, forest, and water rights in developing countries. The day may not be far off, moreover, when local politicians and business executives could have access to bird-sized drones able to scan a facial image and independently fly off to seek and assassinate an environmental activist (Payne, 2018; Scharre, 2018). Already, hundreds of environmentalists are murdered every year across the developing world; countless others are 'disappearing', or dying mysteriously, with police dismissing the deaths as suicides or accidents or natural causes. In 2018, the Philippines saw the most reported murders of land and environmental activists, followed by Colombia, India, and Brazil. The governments in all of these countries claim their new facial recognition surveillance systems are going to protect citizens; these systems would seem far more likely, however, to put activists in even greater danger, especially given police and security forces are so often complicit in the killing of activists (Global Witness, 2019).

Equally worrying, the intensification of surveillance is just one of an array of threats that AI poses for the ability of environmentalists to advance global sustainability. As we'll see next, AI technologies are simultaneously reinforcing – and at times revving up – unsustainable production and consumption.

Accelerating production and consumption

Transnational corporations are now embracing intelligent automation and machine learning technologies to enhance the efficiency of resource extraction, supply-chain logistics, and the manufacturing, transportation, and retailing of consumer goods (Agrawal et al., 2018; Davenport, 2018). To some extent, this is helping to save energy, reduce material inputs, and decrease greenhouse gas emissions (Dauvergne, 2020). By using deep learning to automate control systems, for instance, Google was able to decrease the energy needed to cool its datacenters by 30% from mid-2017 to mid-2018 (Gasparik et al., 2018). Mining companies, meanwhile, are analysing equipment sensors with deep learning software to predict maintenance needs, decrease the chances of unexpected breakdowns, and reduce the risk of industrial accidents. These firms are also decreasing fuel consumption by using driverless trucks and relying on AI analytics to improve the efficiency of drilling, excavating, blasting, and hauling (Schilling et al., 2017). Rio Tinto's self-driving trucks for hauling ore, for instance, use 13% less fuel by accelerating, braking, and idling more efficiently than human operators (Marr, 2018).

Yet, as discussed earlier, corporations commonly reinvest the savings from environmental efficiencies to increase sales, expand markets, and grow operations. The deep learning revolution, moreover, is simultaneously intensifying commercial pressures on the natural world. By analysing huge geological datasets with cloud-based AI platforms, transnational corporations are unlocking new sources of oil, natural gas, and minerals. Automated machinery is enabling firms to reach previously inaccessible reserves. The savings from smart technologies are making formerly unprofitable locations financially viable. And intelligent automation is enabling firms to dig and drill around the clock, without worrying about labour costs or the rights of workers (Marr, 2018; Schilling et al., 2017).

This explains why the world's leading oil and gas companies – such as British Petroleum (BP), the China Petrochemical Corporation, ExxonMobil, Gazprom, Royal Dutch Shell, and Total – are now investing heavily in artificial intelligence. The industry is aiming for high returns on these investments. Today's deep learning techniques alone, the McKinsey Global Institute (2018, p. 18) estimates, have the potential to generate as much as US$200 billion annually for the oil and gas industry. Already, automated systems are reducing the industry's labour costs. Algorithms are driving sales by guiding customers through website offerings. Smart aerial drones are inspecting pipelines and wells to maintain production flows. AI platforms are boosting productivity by optimizing data storage, analysing drilling reports, and extending well life. And the efficiencies from AI systems are helping oil and gas companies remain profitable even as the world strives to move beyond fossil fuels (Kimbleton & Matson, 2018).

As the marketing director of the American tech firm NVIDIA notes, artificial intelligence has the capacity to 'dramatically reduce the cost of finding, extracting, processing and delivering oil' (Paikeday, 2018). But the value of AI for the oil and gas industry extends well beyond just enhancing the profitability of current oil fields. Smart submersibles are charting the ocean floor in search of untapped reserves of oil and gas. And AI analytics are proving invaluable as a way of increasing oil and gas production (Dauvergne, 2020).

AI technologies are proving equally effective as a way of increasing retail sales and personal consumption. Over the next few decades, AI is set to bring even more profits for retailers, with the deep learning techniques already on the market having the potential to increase the annual value of global retailing by as much as US$800 billion and the value of packaged consumer products by as much as US$500 billion (McKinsey Global Institute, 2018, p. 18). This extra value is flowing from a great variety of AI applications. Virtual assistants are quickly answering customer questions. Recommendation engines are profiling customers to drive sales. Speech recognition software is allowing customers to use voice activation to navigate websites and order products. Automatic translation is enabling online retailers to reach more markets. AI-powered cameras are tracking customer behaviour to recommend ways to optimize store displays and stimulate impulse purchasing. And the deep learning systems of companies like Google and Facebook are analysing social media activity, online searches, and purchasing habits to target advertising at subgroups of customers with similar profiles (Chavez et al., 2018).

AI is accelerating consumerism in other ways, too. Smart automation is cutting labour costs and allowing retailers like Amazon and Walmart to drive sales by lowering prices. Learning algorithms are enabling online retailers to tailor deals and prices to entice particular customers. And profiling apps are helping instore staff to assess which customers, if offered the option, are most likely to purchase supplementary and additional merchandise (Dauvergne, 2020).

Ultimately, the goal of the corporations investing in AI is the same as for any technology: to gain competitive advantages and grow operations to retain investor confidence. Walmart vice-president Galagher Jeff made this point crystal clear in an interview in 2019. 'We have more data than nearly everyone in the world', he said. 'We're making heavy investments in artificial intelligence and machine learning to grow our business. Why? Because we have to' (O'Brien, 2019).

Conclusion: dangers ahead for environmentalists

Asked in 2018 to reflect on the consequences for sustainability of the rising power of artificial intelligence, machine learning, and digital technologies, Al Gore remarked: 'The world is in the early stages of a sustainability revolution that has the magnitude and scale of the industrial revolution at the speed of the digital revolution' (Nickelsburg, 2018). James Lovelock (2019), who coined the concept of 'Gaia' as a way of conceiving of the earth as a living, adaptive, and self-regulating entity, is equally enthusiastic about the prospects of AI, seeing artificial 'hyperintelligence' as having the potential to end the Anthropocene and launch the 'Novacene', an epoch where 'cyborgs' protect Gaia as a matter of logic.

The optimism of Gore and Lovelock come in part from seeing all of the exciting ways that deep learning, robotics, and AI analytics are advancing the tools of environmental management. It is hard not to feel some sense of awe at the thought of submersibles able to swim the Great Barrier Reef to eradicate destructive species, or software able to map biodiversity using the data of millions of citizen scientists. It is also reasonable to feel some optimism when considering how machine learning is helping businesses to save energy, reduce waste, and improve the efficiency of manufacturing, supply-chain governance, and retail operations.

But, as this article underscores, although artificial intelligence is improving environmental management on some measures, the optimism of Gore and Lovelock is unwarranted. The consequences of the globalization of AI are going to be far more diverse, crosscutting, and negative than their sanguine predictions. In theory, as Skene (2020) argues, it might be possible to turn AI into a force of environmental sustainability by rebooting 'human-centric' AI with 'ecosystem intelligence'. But, given the political and commercial powers driving today's AI revolution, this would seem exceedingly unlikely. As the critically-oriented environmental literature on the globalization of technology suggests, it is far more likely that AI is going to bring a few positive, and many negative, consequences for environmentalism.

States and firms, as this literature shows, tend to exaggerate the benefits and downplay the risks of the globalization of technology. The long-term costs and benefits are almost always far more uncertain and unpredictable than techno-optimists suggest. This is true even for a new technology marketed as a way of mitigating the harm of an old technology. Moreover, the globalization of technology has tended to spur natural resource exploitation, overconsumption, and unsustainable production, while the eco-efficiency gains from more advanced technology have tended to rebound into even more energy and material usage as firms reinvest the savings to expand manufacturing and sales. In addition, the distribution of the costs and benefits of new technologies has been highly uneven across time, geography, and political jurisdictions. Those with power and money have tended to benefit the most; marginalized peoples and ecosystems far from the hubs of power have tended to absorb a disproportionate share of the costs. Over time, these costs have then tended to accumulate in regions with relatively weak regulations, with the negative consequences gathering force with each passing generation.

The globalization of artificial intelligence looks set to follow a similar environmental trajectory. AI is enhancing the fortunes of big business, with industries in China and the United States on track to capture 70% of the financial value of AI over the next decade (PricewaterhouseCoopers, 2017, p. 7). Most of the costs, meanwhile, would seem to be heading elsewhere. Increasing the financial value of AI is going to necessitate more electronics, batteries, and datacenters, pushing up demand for plastics, metals, and energy. It is going to require ramping up the sales of consumer goods, from driverless cars to smartphones to smart refrigerators. It is going to demand more coltan, cobalt, lithium, and rare earth elements to build these products, with multinational miners looking to expand operations in countries with weak human rights and environmental protections, such as the Democratic Republic of the Congo. And it is going to generate more electronic waste in the poorest regions of Africa, Asia, and Latin America as middleclass consumers upgrade gadgets, replace batteries, and outfit smart homes, and as wealthier states look to export their hazardous waste.

Moreover, the globalization of AI is likely to do far more to empower states and firms than nongovernmental organizations and grassroots movements. High-tech companies are on track to be the big winners – ones like Google, Apple, Microsoft, Amazon, and Facebook in the United States, and ones like Baidu, Alibaba, Tencent, and Huawei in China. But other transnational corporations are likely to benefit greatly, too. Automakers look set to become even more profitable as the market for driverless cars expands. Brand manufacturers and big-box retailers look set to sell even more products as AI becomes increasingly adept at targeting online ads, as machine learning advances operational efficiencies, and as smart automation slashes labour costs. And oil and mining companies look set to extract even more profits as deep learning systems cut costs and discover untapped reserves of fossil fuels and minerals. AI is on a trajectory as well to empower the world's military-industrial complexes, especially the US, China, and Russia, as these three states race each other to integrate machine learning into self-guiding submarines, crewless aircraft, driverless tanks, and autonomous armed drones.

Furthermore, the globalization of AI is set to extend state surveillance of environmental activists. Intelligence agencies and police departments around the world are embracing AI-powered iris scanners, license plate trackers, and facial recognition cameras, as well as deploying machine learning software to extend their online powers. Some governments, as in the European Union, are working toward stronger privacy and data protections for the use of AI technologies for surveillance and policing (European Commission, 2020). Following the police murder of George Floyd in 2020, some companies, such as Amazon, imposed temporary moratoriums on the sale of facial recognition software to US police departments. A handful of jurisdictions have even gone as far as banning the use of facial recognition technology by municipal officials, as in San Francisco and Oakland in California and Cambridge and Somerville in Massachusetts. But these cases are outliers. The use of artificial intelligence for surveillance and policing is continuing to spread around the world. And, as we saw, China is leading a global charge to enhance state controls with artificial intelligence. At home, the Chinese Communist Party, working closely with the high-tech industry, is building an AI surveillance infrastructure with a reach and scale never seen before. Abroad, Chinese firms and government officials are helping other authoritarian states build surveillance systems.

Environmental activists already face grave risks, especially those opposing mining, plantations, logging, oil and gas production, and hydroelectric dams (Scheidel et al., 2020). Every year, security officers, corporate henchmen, and illegal operators murder hundreds of environmentalists advocating for land and water rights in the developing world. Going forward, grassroots environmentalists will certainly keep fighting against the forces of exploitation, overconsumption, and inequality. This resistance may well produce some notable victories, such as when El Salvador formally banned metal mining in 2017. Yet, as this article reveals, in the coming years the politics of environmentalism is set to become even more dangerous for grassroots activists, as AI technologies deepen offline and online surveillance, and as corporations and military-industrial complexes compete to extract even more natural resources to fuel the deep learning revolution.

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Notes on contributor

Peter Dauvergne is a professor of international relations in the department of political science at the University of British Columbia. A specialist in global environmental politics, his recent books include *AI in the wild: Sustainability in the age of artificial intelligence* (MIT Press, 2020), *Will big business destroy our planet?* (Polity, 2018), and *Environmentalism of the rich* (MIT Press, 2016), which received the 2017 Michael Harrington Book Award from the American Political Science Association.

ORCID

Peter Dauvergne http://orcid.org/0000-0003-2887-8168

References

Agrawal, A. K., Gans, J. S., & Goldfarb, A. (2018). *Prediction machines: The simple economics of artificial intelligence*. Harvard Business Review Press.

Biermann, F., & Möller, I. (2019). Rich man's solution? Climate engineering discourses and the marginalization of the global South. *International Environmental Agreements: Politics, Law and Economics*, *19*(2), 151–167. https://doi.org/10.1007/s10784-019-09431-0

Bolwell, D. (2019). *Governing technology in the quest for sustainability on earth*. Routledge.

Bridle, J. (2018). *New dark age: Technology and the end of the future*. Verso.

Broers, A. (2005). *The triumph of technology: The BBC Reith lectures 2005*. Cambridge University Press.

Chavez, T., O'Hara, C., & Vaidya, V. (2018). *Data driven: Harnessing data and AI to reinvent customer engagement*. McGraw-Hill Education.

Choucri, N., & Clark, D. D. (2018). *Cyberspace and international relations: The co-evolution dilemma*. MIT Press.

Clapp, J., & Scrinis, G. (2017). Big food, nutritionism, and corporate power. *Globalizations*, *14*(4), 578–595. https://doi.org/10.1080/14747731.2016.1239806

Conger, K., Fausset, R., & Kovaleski, S. F. (2019, May 14). San Francisco bans facial recognition technology. *New York Times*.

Dauvergne, P. (2008). *The shadows of consumption: Consequences for the global environment*. MIT Press.

Dauvergne, P. (2020). *AI in the wild: Sustainability in the age of artificial intelligence*. MIT Press.

Dauvergne, P., & LeBaron, G. (2014). *Protest Inc.: The corporatization of activism*. Polity.

Davenport, T. H. (2018). *The AI advantage: How to put the artificial intelligence revolution to work*. MIT Press.

De'ath, G., Fabricius, K. E., Sweatman, H., & Puotinen, M. (2012). The 27-year decline of coral cover on the great barrier reef and its causes. *Proceedings of the National Academy of Sciences*, *109*(44), 17995–17999. https://doi.org/10.1073/pnas.1208909109

European Commission. (2020, February 19). *On artificial intelligence – a European approach to excellence and trust*. COM(2020) 65 final.

Fei, F., Tambe, M., Dilkina, B., & Plumptre, A. J. (Eds.). (2019). *Artificial intelligence and conservation*. Cambridge University Press.

Feldstein, S. (2019). The road to digital unfreedom: How artificial intelligence is reshaping repression. *Journal of Democracy*, *30*(1), 40–52. https://doi.org/10.1353/jod.2019.0003

Fletcher, R., & Rammelt, C. (2017). Decoupling: A key fantasy of the post-2015 sustainable development agenda. *Globalizations*, *14*(3), 450–467. https://doi.org/10.1080/14747731.2016.1263077

Foggin, S. (2020, March 2). Will this be the last time Brazil uses facial recognition technology at carnival? *The Sociable*. https://sociable.co/technology/last-time-brazil-facial-recognition-technology-carnival

Frischmann, B., & Selinger, E. (2018). *Re-engineering humanity*. Cambridge University Press.

Gasparik, A., Gamble, C., & Gao, J. (2018, August 17). Safety-first AI for autonomous data center cooling and industrial control. *Inside Google*. https://deepmind.com/blog/article/safety-first-ai-autonomous-data-centre-cooling-and-industrial-control

Global Witness. (2019). *Enemies of the state: How governments and business silence land and environmental defenders*.

Golding, E. L. (2017). *A history of technology and environment: From stone tools to ecological crisis*. Routledge.

Grother, P., Ngan, M., & Hanaoka, K. (2019, December). *Face recognition vendor test (FRVT) – part III: Demographic effects*. National Institute of Standards and Technology (NIST), US Department of Commerce (NISTIR 8280).

Hartzog, W., & Selinger, E. (2018, August 2). Facial recognition is the perfect tool for oppression. *Medium*.

Harwell, D. (2019, July 7). FBI, ICE find state driver's license photos are a gold mine for facial-recognition searches. *Washington Post*.

Hickel, J., & Kallis, G. (2020). Is green growth possible? *New Political Economy*, *25*(4), 469–486. https://doi.org/10.1080/13563467.2019.1598964

Hughes, T. P., Kerry, J. T., Baird, A. H., Connolly, S. R., Dietzel, A., Eakin, C. M., Heron, S. F., Hoey, A. S., Hoogenboom, M. O., Liu, G., & McWilliam, M. J. (2018). Global warming transforms coral reef assemblages. *Nature*, *556*(7702), 492–496. https://doi.org/10.1038/s41586-018-0041-2

Human Rights Watch. (2019, May). *China's algorithms of repression: Reverse engineering a Xinjiang police mass surveillance app*.
Jarrige, F., & Le Roux, T. (2020). *The contamination of the earth: A history of pollutions in the industrial age* (J. Egan & M. Egan, Trans.) (Original work published 2017). MIT Press.
Jevons, W. S. (1865). *The coal question: An inquiry concerning the progress of the nation, and the probable exhaustion of our coal mines*. Macmillan & Co.
Kelleher, J. D. (2019). *Deep learning*. MIT Press.
Kimbleton, S., & Matson, J. (2018). Cognitive computing: Augmenting human intelligence to improve oil and gas outcomes. *Journal of Petroleum Technology*, *70*(4). https://doi.org/10.2118/0418-0014-JPT
Kurzweil, R. (2005). *The singularity is near: When humans transcend biology*. Penguin.
Lee, K. (2018). *AI superpowers: China, Silicon Valley, and the new world order*. Houghton Mifflin Harcourt.
Liang, F., Das, V., Kostyuk, N., & Hussain, M. M. (2018). Constructing a data-driven society: China's social credit system as a state surveillance infrastructure. *Policy & Internet*, *10*(4), 415–453. https://doi.org/10.1002/poi3.183
Lovelock, J. (2019). *Novacene: The coming age of hyperintelligence*. MIT Press.
Markowitz, G., & Rosner, D. (2013). *Deceit and denial: The deadly politics of industrial pollution*. University of California Press.
Marr, B. (2018, September 7). The 4th industrial revolution: How mining companies are using AI, machine learning and robots. *Forbes*. https://www.forbes.com/sites/bernardmarr/2018/09/07/the-4th-industrial-revolution-how-mining-companies-are-using-ai-machine-learning-and-robots/#1e9a602c497e
Matejova, M., Parker, S., & Dauvergne, P. (2018). The politics of repressing environmentalists as agents of foreign influence. *Australian Journal of International Affairs*, *72*(2), 145–162. https://doi.org/10.1080/10357718.2017.1421141
Mazoomdaar, J. (2019, December 28). Delhi police film protests, run its images through face recognition software to screen crowd. *The Indian Express*.
Mazzucato, M. (2018). *The value of everything: Making and taking in the global economy*. PublicAffairs.
McAfee, A. (2019). *More from less: The surprising story of how we learned to prosper using fewer resources – and what happens next*. Scribner.
McKeon, N. (2017). Transforming global governance in the post-2015 era: Towards an equitable and sustainable world. *Globalizations*, *14*(4), 487–503. https://doi.org/10.1080/14747731.2016.1244757
McKinsey Global Institute. (2018, April). *Notes from the AI frontier: Insights from hundreds of use cases*.
Mol, A. P. J., Sonnenfeld, D. A., & Spaargaren, G. (2009). *The ecological modernisation reader. Environmental reform in theory and practice*. Routledge.
Mozur, P. (2018, July 8). Inside China's dystopian dreams: A.I. shame and lots of cameras. *New York Times*.
Newell, P. (2020). *Global green politics*. Cambridge University Press.
Nickelsburg, M. (2018, May 17). Al Gore predicts machine learning and other tech advances will usher in a 'sustainability revolution'. *GeekWire*. https://www.geekwire.com/2018/al-gore-predicts-machine-learning-tech-advances-will-usher-sustainability-revolution
O'Brien, M. (2019, January 22). How Walmart is going all in on artificial intelligence. *ClickZ*. https://www.clickz.com/walmart-artificial-intelligence/224407
Oreskes, N., & Conway, E. M. (2011). *Merchants of doubt: How a handful of scientists obscured the truth on issues from tobacco smoke to global warming*. Bloomsbury Publishing.
Paikeday, T. (2018, January 29). NVIDIA and Baker Hughes, a GE company, pump AI into oil & gas industry. *NVIDIA Blog*. https://blogs.nvidia.com/blog/2018/01/29/baker-hughes-ge-nvidia-ai0
Payne, K. (2018). *Strategy, evolution, and war: From apes to artificial intelligence*. Georgetown University Press.
Pellow, D. N. (2004). *Garbage wars: The struggle for environmental justice in Chicago*. MIT Press.
PricewaterhouseCoopers. (2017). *Sizing the prize: What's the real value of AI for your business and how can you capitalise?*
Qiang, X. (2019). The road to digital unfreedom: President Xi's surveillance state. *Journal of Democracy*, *30*(1), 53–67. https://doi.org/10.1353/jod.2019.0004
Rector, K., & Queally, J. (2020, June 2). LAPD, FBI collecting protest, looting footage as evidence for future arrests. *Los Angeles Times*.
Roberts, M. E. (2018). *Censored: Distraction and diversion inside China's Great Firewall*. Princeton University Press.

Sánchez Nicolás, E. (2020, May 18). Pandemic speeds calls for ban on facial recognition. *EUobserver*. https://euobserver.com/coronavirus/148387

Scharre, P. (2018). *Army of none: Autonomous weapons and the future of war*. Norton.

Scheidel, A., Del Bene, D., Liu, J., Navas, G., Mingorría, S., Demaria, F., Avila, S., Roy, B., Ertör, I., Temper, L., & Martínez-Alier, J. (2020). Environmental conflicts and defenders: A global overview. *Global Environmental Change*, *63*. https://doi.org/10.1016/j.gloenvcha.2020.102104

Schilling, D., King, J., Wood, R., & Vogt, T. (2017, June 23). Mining value in AI. *Mining Journal*. https://www.bcg.com/en-ca/publications/2017/metals-mining-value-ai.aspx

Sejnowski, T. J. (2018). *The deep learning revolution: Artificial intelligence meets human intelligence*. MIT Press.

Singh, M. (2020, March 11). India used facial recognition to identify 1,100 individuals at a recent riot. *Tech Crunch*.

Skene, K. (2019). *Artificial intelligence and the environmental crisis*. Routledge.

Sudworth, J. (2017, December 10). In your face: China's all-seeing state. *British Broadcasting Corporation Video*. https://www.bbc.com/news/av/world-asia-china-42248056/in-your-face-china-s-all-seeing-state

Sullivan, B. L., Aycrigg, J. L., Barry, J. H., Bonney, R. E., Bruns, N., Cooper, C. B., Damoulas, T., Dhondt, A. A., Dietterich, T., Farnsworth, A., & Fink, D. (2014). The eBird enterprise: An integrated approach to development and application of citizen science. *Biological Conservation*, *169*, 31–40. https://doi.org/10.1016/j.biocon.2013.11.003

Surfshark. (2020). The facial recognition world map. https://surfshark.com/facial-recognition-map

Symons, J. (2019). *Ecomodernism: Technology, politics and the climate crisis*. Polity.

United Nations Environment Programme. (2014). *Decoupling 2: Technologies, opportunities and policy options*.

Wiedmann, T. O., Schandl, H., Lenzen, M., Moran, D., Suh, S., West, J., & Kanemoto, K. (2015). The material footprint of nations. *Proceedings of the National Academy of Sciences*, *112*(20), 6271–6276. https://doi.org/10.1073/pnas.1220362110

Wright, C., & Nyberg, D. (2015). *Climate change, capitalism, and corporations*. Cambridge University Press.