

VOLUME 5 · ISSUE 01



BALSILLIE
PAPERS

Age of Disruption: How Ecological Breakdown Could Alter Globalization

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March 21, 2022

The ecological consequences of globalization have long been of concern to scholars of international political economy. Some rang alarm bells of impending ecological crisis decades ago, brought about by the growth in material consumption facilitated by accelerating globalization. Others countered that globalization has offered an ecological silver lining, since trade liberalization brought rising national incomes which have enabled governments and non-state actors to pay for environmental remediation and green infrastructure. While debates about the true impact of globalization on the global environment continue, some scholars have come to ask about the inverse relationship: How might ecological breakdown influence globalization?

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We argue that the world is likely to see an increase in ecologically-induced disruptions to globalization – namely, disruptions caused by climate breakdown, biodiversity decline, degraded landscapes, increasing scarcity in some critical materials, and even increases in zoonotic diseases tied to animal habitat loss. We identify five main ways that ecological breakdown – and efforts to mitigate it – could disrupt the processes which have come to characterize contemporary neoliberal globalization. Finally, we urge Canadian policymakers to improve resilience by better understanding future risks, planning for a range of possible disruptions, and building domestic capacity to deal with such problems as they arise.

Another driver of globalization

Before enumerating our five forces of disruption, we note how ecological change has increasingly been identified as an important driver of contemporary globalization. Early scholarship on globalization referred to technological innovations, market capitalism, and ideology as its three main driving forces.⁵ While scholars do not agree on *when* globalization really started, or even whether it has influenced the fundamental powers and interests of nation states,⁶ there does appear to be general agreement that globalization represents some level of growing “interconnectedness” between people in different parts of the world, and that this process has intensified in recent years. In terms of technological drivers, innovations in transport, communications, and financial technologies have played the essential role of making it easier and quicker to move people, goods, information, and capital, across borders.⁷ Market

¹ Jennifer Clapp and Eric Helleiner, “International Political Economy and the Environment: Back to the Basics?,” *International Affairs* 88, no. 3 (May 1, 2012): 485–501, <https://doi.org/10.1111/j.1468-2346.2012.01085.x>.

² Narindar Singh, “Economics and the Crisis of Ecology” (Oxford University Press, 1976), https://scholar.google.com/scholar_lookup?title=Economics+and+the+crisis+of+ecology&author=Singh%2C+Narindar.&publication_year=1976.

³ Shunsuke Managi, Akira Hibiki, and Tetsuya Tsurumi, “Does Trade Openness Improve Environmental Quality?,” *Journal of Environmental Economics and Management* 58, no. 3 (November 1, 2009): 346–63, <https://doi.org/10.1016/j.jeem.2009.04.008>.

⁴ Ryan Katz-Rosene and Matthew Paterson, *Thinking Ecologically About the Global Political Economy*, First edition., RIPE Series in Global Political Economy (London: Taylor and Francis, 2018), <https://doi.org/10.4324/9781315677835>.

⁵ John Baylis, Steve Smith, and Patricia Owens, *The Globalization of World Politics: An Introduction to International Relations*, Eighth edition. (Oxford: University Press, 2020).

⁶ David Held and Anthony McGrew, *Globalization / Anti-Globalization: Beyond the Great Divide* (Polity, 2007).

⁷ Jan Aart Scholte, *Globalization a Critical Introduction* (London, Basingstoke : New York: Macmillan, Macmillan ; StMartin’s Press, 2000), <https://login.proxy.bib.uottawa.ca/login?url=http://books.scholarsportal.info/viewdoc.html?id=/ebooks/ebooks2>

capitalism has created the impetus for entrepreneurs and corporate interests to expand markets in the search for profit. Political ideologies have served as a driver as well, though working in both directions – with pro-globalist institutions and intellectuals advocating for further integration within the global marketplace, and anti-globalists across the political spectrum (including labour and environmental movements on the left, and nationalist neo-mercantilist factions on the right) seeking protectionist policies or other shields from the forces of globalization. For the purposes of this article, we therefore define globalization simply as the intensification of consequential social, political, and economic relations across space and time. We see disruption occurring in many ways – through, for instance, the slowing or acceleration of the driving forces of globalization, or the reconfiguration of established spatial flows of goods, information, people and capital with significant consequence for various communities of people.

Our main contention in this paper is that ecological breakdown could become an increasingly central determinant of how globalization takes shape for the remainder of this century. In this sense, ecological change should be added to the list of drivers of globalization. Some have made the case that material ecological realities have *always* played a key role in determining the flows and spatial layout of globalization, largely in terms of determining the spaces of commodity extraction and the directional flow of global supply chains dating back to the era of European imperialism.⁸ Now, however, with the emergence of the Anthropocene, human-caused ecological changes are profoundly reshaping the geography of globalization.⁹ Moreover, human efforts to mitigate the risks posed by such ecological changes – especially climate change and biodiversity decline – are also having an influence on globalization. Further, as with other drivers of globalization, ecological change is producing uneven social outcomes, with the world's most vulnerable populations within and between nations experiencing the most pronounced impacts. We now turn to our five forces of disruption.

i) Tapping the brakes while pushing the gas pedal

First, ecological breakdown might impact the velocity of globalization. On one hand, it could slow globalization through periodic disruptions to supply chains in various parts of the world. On the other hand, efforts to tackle ecological breakdown might accelerate the processes of globalization in various ways (for instance, if trade in nascent clean energy technologies increases). We do not mean to imply that globalization would come to a halt or speed up uncontrollably, but rather that ecological breakdown (and efforts to mitigate it) could have a spasmodic effect on the velocity of globalization, in the same way tapping the brakes and then pushing on the gas pedal causes a vehicle to erratically slow and then speed up.

/pda/2011-12-01/1/5372.0333660218; Frederick Cooper, "What Is the Concept of Globalization Good for? An African Historians Perspective," *African Affairs* 100, no. 399 (2001): 189–213, <https://doi.org/10.1093/afraf/100.399.189>.

⁸ Ryan M. Katz-Rosene and Matthew Paterson, "Imperialism and Environment," in *The Palgrave Encyclopedia of Imperialism and Anti-Imperialism*, ed. Immanuel Ness and Zak Cope (Cham: Springer International Publishing, 2019), 1–11, https://doi.org/10.1007/978-3-319-91206-6_129-2.

⁹ P. J. Crutzen, "The 'Anthropocene,'" *Journal de Physique IV (Proceedings)* 12, no. 10 (2002): 1–5, <https://doi.org/10.1051/jp4:20020447>.

This could occur in a number of ways: from climate-related weather events that temporarily knock out critical infrastructures necessary for transborder (or even domestic) commerce, to the despoliation of important extraction sites for key commodities through environmental accidents requiring urgent attention, as well as an increase in zoonotic diseases caused by human incursions into natural areas associated with expanded global consumption, leading to more frequent global disease outbreaks and the related impacts this may have on global transport flows of both people and goods.¹⁰

For example, in the last year alone the Western half of North America has seen just how disruptive climate change can be to ‘business as usual’ relations in the economy: An unprecedented heat dome in July, and an associated surge in wildfires driven by drought, created a haze of pollution which profoundly influenced the continent’s tourism sector and caused significant delays and backlogs to freight delivery systems.¹¹ More recently, three successive atmospheric rivers dumped so much rain in British Columbia, Canada, that roads and rail lines were washed out. This left Canada’s largest port, Vancouver, disconnected from the rest of the country, leading to supply chain issues, gas rationing and grocery store shortages.¹² As severe weather tied to climate change is only expected to intensify and increase, these types of supply chain disruptions are likely to also become more common around the world.

Supply chain disruptions have recently become a defining feature of the COVID-19 pandemic as well. To the extent that the pandemic has potential origins in environmental degradation, then this pandemic too is a marker of potential future disruptions to global supply chains. The risk of additional pandemics tied to zoonosis – the transmission of an infectious disease from an animal to a human – is exacerbated by human incursions into natural areas (facilitated by increased flows of foreign investment and growing global demand for a range of raw materials from timber to palm oil to minerals).¹³ Scientists have thus warned that pandemics are likely to increase in frequency unless global biodiversity loss is addressed.¹⁴

Aside from supply chain disruptions, another important way the COVID-19 pandemic has impacted the pace of globalization is through a decrease in global travel. The International Air Travel Association reports that global air travel decreased by 75.6% from 2019 to 2020 and expects it to take years before pre-pandemic levels of air travel return.¹⁵ Decreases in air travel have been profoundly uneven, with the

¹⁰ Patrick Tonissen, “IPBES #PandemicsReport: Escaping the ‘Era of Pandemics,’” IPBES secretariat, October 19, 2020, <https://ipbes.net/pandemics>.

¹¹ Liz Lasater, “Wildfires Disrupt the U.S. and Canadian Supply Chains,” *Red Arrow Logistics Transportation and Freight Forwarding* (blog), August 2, 2021, <https://redarrowlogistics.com/industry-news/wildfires-disrupt-the-u-s-and-canadian-supply-chains/>.

¹² Claire Parker, “Major Flooding in Canada Leads to Widespread Supply Chain Disruptions,” *Washington Post*, accessed December 27, 2021, <https://www.washingtonpost.com/world/2021/11/18/british-columbia-floods-canada-supply-chain/>.

¹³ Patrick Tonissen, “IPBES #PandemicsReport: Escaping the ‘Era of Pandemics,’” IPBES secretariat, October 19, 2020, <https://ipbes.net/pandemics>.

¹⁴ UNESCO, “Pandemics to Increase in Frequency and Severity Unless Biodiversity Loss Is Addressed,” UNESCO, October 29, 2020, <https://en.unesco.org/news/pandemics-increase-frequency-and-severity-unless-biodiversity-loss-addressed>.

¹⁵ International Air travel Association, “2020 Worst Year in History for Air Travel Demand,” accessed December 27, 2021, <https://www.iata.org/en/pressroom/pr/2021-02-03-02/>.

world's wealthy continuing to make up a great deal of passengers.¹⁶ In contrast, the introduction of new international sustainable transport modes intended to mitigate environmental damage (such as the expansion of both Europe's and Asia's electric-powered high-speed rail networks), might further accelerate travel in those regions. By continuing to tap the brakes and push the gas pedal of globalization, ecological degradation and efforts to mitigate it will likely continue to have a disruptive influence on the kind of business-as-usual patterns of global living and commercial activity the world became accustomed to during the late 20th and early 21st Centuries.

ii) Changing the human map

A second main way ecological breakdown could influence globalization is by reshaping where people live and work (or seek to live and work), and by extension, changing the world map of *where* and *how* the underlying processes of production and consumption fueling globalization occur. This could be in the form of changes in real estate risk profiles in wealthy countries in regions exposed to exceptionally high (or low) climate risk, leading to new push and pull factors as people seek more hospitable living environments. Or, as is the case for hundreds of millions of people in poor countries living in coastal areas threatened by rising sea level, more people will be compelled to move to higher ground.¹⁷ This is a process which has already begun in recent decades, as evidenced by the UNHCR officially recognizing that “climate, environmental degradation and disasters increasingly interact with the drivers of refugee movements,” and a commensurate growth in the number of Internally Displaced Persons globally.¹⁸

This remaking of the human world map will disrupt patterns of production and consumption in the places experiencing declining or increasing populations, respectively, leading to significantly altered patterns of demand, shifting trade routes, and possibly even new forms of consumer demand as the cultural profile of receiving communities changes. These effects – like many produced by globalization – will be felt unevenly, with populations in countries in the Global South that are the most marginalized to begin with, continuing to be hit hardest while facing the most difficulty adapting to new geographies. Increased migratory patterns caused by environmental damage may also speed globalization by bringing peoples from far off places together, reshaping political and cultural communities. It is unclear precisely what the future human map will look like, but it is clear that the millions that have already been displaced will continue to rise in scope and frequency, leading to the disruption of life and commercial activity for hundreds of millions globally.

¹⁶ Milena Büchs and Giulio Mattioli, “Trends in Air Travel Inequality in the UK: From the Few to the Many?,” *Travel Behaviour and Society* 25 (October 1, 2021): 92–101, <https://doi.org/10.1016/j.tbs.2021.05.008>.

¹⁷ John Podesta, “The Climate Crisis, Migration, and Refugees,” *Brookings* (blog), July 25, 2019, <https://www.brookings.edu/research/the-climate-crisis-migration-and-refugees/>.

¹⁸ United Nations High Commissioner for Refugees, “Climate Change and Disaster Displacement,” UNHCR, accessed January 21, 2022, <https://www.unhcr.org/climate-change-and-disasters.html>.

iii) Shifting capital flows

Relatedly, efforts to address ecological breakdown will also have a transformational impact on the spatial and directional flow of capital. Existing patterns and flows of goods, cash, and even tourists (along with their hard-earned spending money), will shift because of new policies aiming to address environmental degradation, or even as a result of shifting consumer preferences as people seek ‘greener’ forms of consumption. There are a wide range of ways this could occur: We have already seen major shifts in the spatial layout of mineral extraction and trade as the world has experienced explosive demand for a number of minerals associated with the green economy, including lithium, copper, silicon, and cobalt.¹⁹ As demand accelerates, markets for these minerals will expand and lead to greater flows, opening up new key deposits, while fossil fuels will also start to decline.²⁰ This rise in demand and shifts in global production will be heavily influenced by the \$100 billion in annual climate financing that has been promised by the Global North in order to assist countries in the Global South with climate adaptation and mitigation efforts.²¹

There is also an ongoing shift to new green technologies in transport, including aviation,²² marine,²³ rail, and of course the shift to electric vehicles for both passenger and freight transport.²⁴ While these shifts will be in large part prompted by domestic regulatory changes and international cooperation on multilateral environmental agreements seeking to address climate change, there will also be – increasingly – changes brought about by a more climate-conscious consumer base. This will be particularly pronounced in wealthier economies where higher levels of disposable income drive material consumption, as populations seek to shift to greener forms of consumption; cutting down on meat and dairy consumption, reducing flight travel in markets with viable alternatives, and seeking a range of lower-carbon household appliances from heat pumps to induction stoves. Along with states and consumers, multinational corporations will join the greening spree, marketing new “sustainable” products leading to changes in both production and demand and their associated supply chains and distribution networks.

¹⁹ Andrew Allen, “World Faces Mineral Shortages,” *Supply Management*, accessed December 27, 2021, <https://www.cips.org/supply-management/news/2017/april/world-faces-mineral-shortages/>.

²⁰ Jim Krane, “Climate Change and Fossil Fuel: An Examination of Risks for the Energy Industry and Producer States,” *MRS Energy & Sustainability* 4 (ed 2017), <https://doi.org/10.1557/mre.2017.3>.

²¹ Sarah Bracking, “The Anti-Politics of Climate Finance: The Creation and Performativity of the Green Climate Fund: The Anti-Politics of Climate Finance,” *Antipode* 47, no. 2 (2015): 281–302, <https://doi.org/10.1111/anti.12123>.

²² Emily S. Nelson and D. R. Reddy, *Green Aviation: Reduction of Environmental Impact Through Aircraft Technology and Alternative Fuels* (CRC Press, 2018).

²³ International Congress of the International Maritime Association of the Mediterranean, *Towards Green Marine Technology and Transport: Proceedings of the 16th International Congress of the International Maritime Association of the Mediterranean (IMAM 2015), Pula, Croatia, 21–24 September 2015* (Boca Raton: CRC Press, 2015), <https://doi.org/10.1201/b18855>.

²⁴ Nigel Berkeley et al., “Assessing the Transition towards Battery Electric Vehicles: A Multi-Level Perspective on Drivers of, and Barriers to, Take Up,” *Transportation Research Part A: Policy and Practice* 106 (December 1, 2017): 320–32, <https://doi.org/10.1016/j.tra.2017.10.004>; Kinjal J. Shah et al., “Green Transportation for Sustainability: Review of Current Barriers, Strategies, and Innovative Technologies,” *Journal of Cleaner Production* 326 (December 1, 2021): 129392, <https://doi.org/10.1016/j.jclepro.2021.129392>.

Another important and related outcome of the shifts in the spatial and directional flow of capital will be transformations in global agricultural flows resulting from environmental change (and a more environmentally-conscious consumer base). Changes in the production of agri-food staples resulting from changing climates and the greening of consumer preferences will bring about new nodes, networks and flows of food. We might expect, for instance, demand for Brazilian beef shift from OECD nations to China as the E.U. regulates imports of food commodities tied to deforestation and climate change; or we may expect changes in the production of major crop staples to higher latitude nations as crop yields in tropical nations either decline or face increasing pathogenic pressure.²⁵ The precise nature of these disruptions remains unclear: The need for new minerals could accelerate the types of economic integration that facilitated globalization over the past century; alternatively, they could also exacerbate growing rifts within the liberal international order, leading to increased competition, protectionism, and tensions between nations. Either way, shifting flows of capital will redraw the global networks of commodity exchange, resulting in disruptions to ecologies and ancient patterns of life.

iv) Growing the digital divide

Tied in with efforts to mitigate ecological breakdown, we can expect to see social and commercial relations shift increasingly toward virtual formats – a process that has already been underway and which has greatly accelerated with the onset of the pandemic and the commercial race within the corporate sector to control the ‘metaverse’.²⁶ While this process is likely to occur regardless of its potential environmental benefits, environmental motivations are likely to, at least in part, be used as a justification favouring virtual modes of social activity over the much more human in-person alternatives. Similarly, online digitized commercial activities and ‘smart’ systems of digital production and distribution will profoundly reshape supply chains, and these systems will be promoted for reasons of environmental efficiency (though whether or not they mark a genuine environmental improvement is up for debate).

Beyond the shift to online learning,²⁷ virtual conferences,²⁸ the widespread shift to teleworking²⁹ and the rise of e-commerce, non-fungible tokens (NFTs), and other commercial transactions taking place over the internet,³⁰ the parallel development of the ‘metaverse’ may usher in a much deeper transposition of social

²⁵ Thomas M. Chaloner, Sarah J. Gurr, and Daniel P. Bebber, “Plant Pathogen Infection Risk Tracks Global Crop Yields Under Climate Change,” *Nature Climate Change* Vol.11 (August 2021): 710-715, <https://doi.org/10.1038/s41558-021-01104-8>.

²⁶ Richard Saintvilus, “Who Will Win the Battle for the Metaverse? | Nasdaq,” Nasdaq, 2021, <https://www.nasdaq.com/articles/who-will-win-the-battle-for-the-metaverse>.

²⁷ Michael P. A. Murphy, “COVID-19 and Emergency ELearning: Consequences of the Securitization of Higher Education for Post-Pandemic Pedagogy,” *Contemporary Security Policy* 41, no. 3 (July 2, 2020): 492–505, <https://doi.org/10.1080/13523260.2020.1761749>.

²⁸ Denise A. Schmidt-Crawford, Denise L. Lindstrom, and Ann D. Thompson, “Moving Online in 2020: Lessons Learned from Successful Virtual Conferences,” *Journal of Digital Learning in Teacher Education* 37, no. 1 (January 2, 2021): 4–5, <https://doi.org/10.1080/21532974.2020.1855949>.

²⁹ Marta Fana et al., “Telework, Work Organisation and Job Quality during the COVID-19 Crisis: A Qualitative Study,” Working Paper (JRC Working Papers Series on Labour, Education and Technology, 2020), <https://www.econstor.eu/handle/10419/231343>.

³⁰ Usman W. Chohan, “Non-Fungible Tokens: Blockchains, Scarcity, and Value,” SSRN Scholarly Paper (Rochester, NY: Social Science Research Network, March 24, 2021), <https://doi.org/10.2139/ssrn.3822743>.

relations to the digital sphere – with shopping, entertainment, socialization, financial exchange, tourism and even physical exercise increasingly taking place by people logging in from home,³¹ or anywhere in the world they can connect virtually.³² These increasing shifts to the metaverse which are already largely underway will continue to cause substantial disruption to the analogue markets which defined life throughout the Post-War years.

An additional form of disruption stemming from increasing virtual social relations stems from the highly uneven access to the virtual world. This uneven access to the digital realm will not only be expressed across regions of the world (with impoverished communities being unable to connect to the new globalization), but also within and between wealthy economies based on location and socioeconomic status (for instance, in Canada, as has been widely acknowledged with the lack of broadband access for rural, northern, and particularly Indigenous communities across the country).³³ Moreover, manual labourers and other service workers in cities will continue to participate in a parallel material economy, potentially excluded from the metaverse during work hours while those in the knowledge economy will live *and* work in the virtual realm.

v) Bracing for transition

Finally, new transformative technologies developed with the intention of mitigating environmental degradation or improving efficiency will reach far corners of the Earth, and this will cause profound disruptions to select communities of workers. Everything from AI, electric vehicles, 3D printing, laboratory meat, biotech and genetically modified organisms, advanced nuclear, carbon capture and storage (and associated markets for offsets) – these technologies are all being developed with the aim of addressing ecological breakdown by reducing humanity’s environmental footprint. However, they will inevitably bring about winners (i.e. Silicon Valley, software and IT, investors, etc.) and losers (sector-specific workers, artisans, peasants, unskilled labourers, etc.). This will likely be most pronounced within fossil fuel industries and communities of workers oriented around fossil fuel infrastructures, as they experience profound disruption in the coming decades as the international community seeks to wean itself from oil, gas, and coal, and pursue new low carbon energy technologies instead.³⁴

To expand on just one of the examples listed above, while the shift to laboratory grown meat is often proposed as a way to curb greenhouse gases produced from traditional beef farming, the high capital intensity of this market means that the production of cell-cultured foods would be concentrated in the

³¹ Subspace Team, “Peloton Interactive’s Gaming and Fitness in the Metaverse,” Subspace, 2021, <https://subspace.com/resources/peloton-interactive-gaming-and-fitness-in-the-metaverse>.

³² Matthew Sparkes, “What Is a Metaverse,” *New Scientist* 251, no. 3348 (August 21, 2021): 18, [https://doi.org/10.1016/S0262-4079\(21\)01450-0](https://doi.org/10.1016/S0262-4079(21)01450-0).

³³ Katharina Koch, “Infrastructure Policy Trends: The Digital Divide and the Lack of Broadband Access During COVID-19,” *The School of Public Policy Publications (SPPP)* 13 (2020), <https://doi.org/10.11575/sppp.v13i0.70382>.

³⁴ Matthias J. Pickl, “The Renewable Energy Strategies of Oil Majors – From Oil to Energy?,” *Energy Strategy Reviews* 26 (November 1, 2019): 100370, <https://doi.org/10.1016/j.esr.2019.100370>.

hands of very few large multinational corporations.³⁵ If these companies realize their stated goals of eliminating animal-based meat products within the coming years, this could mean that global meat production is controlled by the very few, which could greatly threaten access to important protein-rich foods for much of the global population.³⁶ Moreover, the rural economies of dozens of beef producing nations would be completely transformed, with beef and dairy producers struggling to compete with their synthetic alternatives. The global trade in animal products and animal feeds, worth hundreds of billions of dollars, would be realigned as meat production shifts from large tracts of land to advanced laboratories closer to urban markets. While we are not predicting that animal-based meat will be pushed out of the market anytime soon (in fact, there is reason to be skeptical of the extent of the market for meat which might be obtained by lab meat³⁷), this is but one example of the types of disruptions that new technologies seeking to tackle ecological disruption could have on production, places, and people.

Conclusion

The world is in the midst of both a climate crisis and a biodiversity crisis, not to mention a global health crisis (which, as we note above, may have linkages to the biodiversity crisis). These crises, along with other anthropogenic forms of ecosystems degradation, are not just a result of contemporary patterns of globalization; they will profoundly alter it in turn.

In this paper we have argued that ecological breakdown and collective responses to it will serve as an important determinant of how globalization takes shape for the remainder of this century. Moreover, we have identified five key ways that the interplay of ecological breakdown and globalization will be socially disruptive. While it is likely that many of these ongoing disruptions will continue to have socially deleterious effects in a number of respects, they also suggest the need for and opportunity to become more resilient, by having more adaptable supply chains, workforces, and approaches to governance from the local to the global levels. Globalization has been one of the defining features of the international political economy over the past fifty years and it appears the next fifty will be significantly shaped by the disruptions caused by ecological breakdown and its impacts on virtually every facet of society.

With this in mind, it would be prudent for policymakers in Canada to improve monitoring and research to better interpret future risks tied to ecological breakdown and efforts to mitigate it, all while enhancing planning scenarios and domestic capacity to address supply chain problems or other disruptions brought about to the patterns of globalization we have come to know over the last few decades.

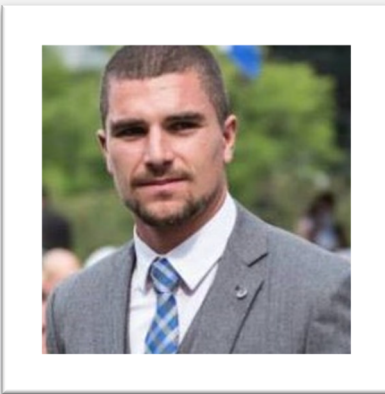
³⁵ Michael J. Mouat, Russell Prince, and Michael M. Roche, "Making Value Out of Ethics: The Emerging Economic Geography of Lab-Grown Meat and Other Animal-Free Food Products," *Economic Geography* 95, no. 2 (March 15, 2019): 136–58, <https://doi.org/10.1080/00130095.2018.1508994>.

³⁶ Andrew Heffernan and Ryan Katz-Rosene, "Between promise and peril: Can fake meat save the planet? - Articles - Cavalier Bleu - Collège militaire royal de Saint-Jean," May 28, 2021, <https://www.cmrsj-rmcsj.forces.gc.ca/cb-bk/art-art/2021/art-art-2021-8-fra.asp>.

³⁷ Joe Fassler, "Lab-Grown Meat Is Supposed to Be Inevitable. The Science Tells a Different Story.," *The Counter*, September 22, 2021, <https://thecounter.org/lab-grown-cultivated-meat-cost-at-scale/>.



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