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RASMUS KARLSSON*

Ecomodernism

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* Dr Rasmus Karlsson, Associate Professor

Department of Political Science

Umeå University, Sweden

rasmus.karlsson@umu.se

Introduction

In essence, ecomodernism is about ending human domination of nature in ways that build on, rather than relinquish, the hope of a global cosmopolitan society (Symons, 2019). At a time when liberal democratic norms have come under siege and pessimism about the human prospect prevails (Wallace-Wells, 2019), ecomodernism points to a world both remade and rewilded, one in which human flourishing no longer depends on the industrial-scale processing of biomass, and the perfectionist social ethic of contemporary environmentalism with its quest for epistemic certainty has been replaced by liberal tolerance and a renewed curiosity about the future that recognizes human fallibility (Frega, 2013; Karlsson, 2020).

If the environmental crisis was any less severe, and the global carbon algebra any more forgiving, a reasonable case could be made for "degrowth" (Kallis, 2018) or perhaps the outright banning of things like leisure air travel (Becken *et al.*, 2021), but as the pandemic experience has clearly shown, even far-reaching behavioural restrictions do not amount to a sufficiently sustainable global trajectory. To be effective, a degrowth agenda would have to entail a near-instant rematerialization of the global economy, paired with radical depopulation, and comprehensive restrictions on consumption (Trainer, 2012). Considering the populist backlash that even moderate carbon taxes tend to provoke, the notion of such a radical energy descent agenda simply cannot be taken seriously. The problem for ecomodernism is that much the same can be said about the kind of technological innovation that would be necessary to make an ecomodernist future even remotely possible (Karlsson, 2013). While public support for some key ecomodernist technologies, nuclear in particular, may be growing in some countries, not the least in the wake of the war in Ukraine, the idea of rapidly building thousands of new reactors to completely displace the fossil economy (Qvist & Brook, 2015), is, at best, met with an ironic smile.

Trapped between the strict political enforcement of planetary boundaries and the open vistas of a future multi-planetary civilization, real-world environmental policymaking is currently sleepwalking into a full-blown climate disaster (Buck, 2019), a tragic future of massive biodiversity loss, and melting ice caps. Against the sea of formulaic noise known as "Agenda 2030" and the mainstreaming of "sustainable development", reality itself becomes distorted. Still, developing countries, whose energy choices are now reduced to intermittent renewables by donor mandates while the rich world remains deeply fossil dependent, know all too well of its hypocrisies. Underlying mainstream political discourse is the fundamental belief that all of humanity cannot be allowed to live a modern life, lest the world will end. More than anything, it is that belief that ecomodernism sets out to challenge.

Outlining ecomodernism as a distinct ideological approach to the Anthropocene (Arias-Maldonado, 2020), the aim of this chapter is to engage with the broader landscape of environmental political theory, mindful of how quickly all theoretical distinctions tend to become blurred once confronted with the messiness of political reality. If anything, the last decades have eroded many timeworn certainties as civil discourse has broken down, in particular in the United States, with sectarianism replacing productive disagreement. Going forward, polarization is likely to remain rampant as the climate crisis worsens. With the global share of fossil fuels remaining constant at around 80%, and renewables so far failing to displace fossil fuels (Cherp et al., 2021; York & Bell, 2019), the need for solar radiation management (SRM) and other divisive climate interventions is becoming increasingly apparent, potentially giving further rise to alternative epistemologies and conspiracy theories. As such, questions about the future of democracy and democratic pluralism (Arias-Maldonado, 2023) are fundamental to any assessment of ecomodernist ideas. However, prior to engaging with the current political context, the chapter first seeks to explore ecomodernist thinking in relation to three key concepts of environmental political theory: nature, sustainability, and justice.

Nature

In the fictional universe of *Star Trek*, there are a few scenes that are set on Earth in the future. In these scenes, the planet has fully healed from the twenty-first century horrors of atomic warfare and the broader ecological trauma induced by industrial modernity. With heavy manufacturing having been moved off-planet and molecular engineering replacing the need for the everyday production and transportation of goods, the planet has once again become a realm of endless natural wonders, much as it must have seemed before the advent of humans. While the ecological credentials of *Star Trek* may be contested (Gonzalez, 2015), ecomodernism is founded on a similar vision of planetary-scale rewilding that sees nature as valuable in its own right (Karlsson, 2020). Unlike traditional environmental thinking, which seeks to re-embed the economy in nature, ecomodernism seeks the exact opposite as in further spatial decoupling, initially through technologies such as precision fermentation (Terefe, 2022), believing that ecological survival depends on that nature is left alone to recover and rebound. Likewise, whereas neoliberal conservation seeks to *manage* nature through the financialization of different ecological services (Büscher et al., 2014), ecomodernism seeks to *liberate* it by removing the economic need for natural resource extraction in the first place through state-driven technological innovation.

However, just as the notion of "wilderness" more generally (DeLancey, 2012), rewilding is susceptible to several lines of criticism (Jørgensen, 2015), in particular its perceived insensitivity to the local context and the interests of those current living off the land. Considering the long colonial shadow of conservation efforts more generally, this is not a criticism that can be brushed off lightly. After all, by definition, to "rewild", is to make room for nature by advocating for a return to a time when there were more animals and less people. To this, ecomodernists may respond, that rather than returning to some imagined pre-historic state, the more immediate concern for ecomodernists is to halt the ongoing human encroachment on natural habitats that is being done to extract fossil fuels or to construct wind farms with their extensive networks of access roads (Jager *et al.,* 2022; Kati *et al.*, 2021). By advocating for denser and cleaner energy sources such as nuclear, ecomodernists hope to prevent some of this energy sprawl while simultaneously making energy affordable enough to drive a broader modernization of society.

Yet, technology alone may not be sufficient to spare nature. Consider for example the widespread practice of domestic wood burning in Scandinavia, almost always taking place in houses that are already adequately heated by district heating or low-carbon electricity from nuclear and hydro power. Despite its many well-documented negative health effects, which may even include higher risk for dementia (Oudin *et al.*, 2018), wood burning continues apace for recreational and aesthetic reasons. In fact, as people get richer, demand for such pseudo-authentic experiences of "nature" is likely to increase. As such, the ecomodernist belief that cheaper and cleaner technologies will displace more expensive and polluting ones seems to depend on the existence of biophilic norms in society and a universalist ethic that considers the global implications of otherwise seemingly "sustainable" local practices.

One common criticism against rewilding, but also against ecomodernism, is that it is based on a dualistic understanding of nature and society (Hällmark, 2022). Often, little justification is given as to why such Cartesian dualism is undesirable (Haila, 2000), beyond the postmodern dislike for dichotomies in general or the suggestion that is simply "untenable" given how entangled the human economy has become in nature. Yet, at a practical level, a short forest hike is often sufficient to experience first-hand the difference between "culture" and "nature", even if one recognizes that it may be impossible to find a place or ecosystem on the planet completely unaffected by human activities. Moreover, as with the illustration from *Star Trek* above, there is also a strong intuitive

argument for believing that nature would fare significantly better in a world without large-scale agriculture, forestry, and mining. If anything, it is precisely the many "entanglements", be it zoonotic diseases or antibiotic resistance caused by factory farming, that is the problem here. As such, a future of molecular engineering and space colonization may be much more effective at sparing nature than one in which there is a rematerialization of the economy.

Still, some authors associated with ecomodernism have taken a more post-environmental outlook, often embracing hybrid ecosystems and rejecting the exclusive normative focus on "wilderness", as seen in this passage by Emma Marris (2011:151):

> "Street trees are not just attractive shade-providing devices. In the annual cycles of the ginko and the maple, an urbanite can see the seasons turn. Birds nest in street trees; circadas climb them, leaving their molted shells behind. Wasps rearrange the tissues of urban oaks, building galls in the shapes of balloons. Street trees are nature. And practicing seeing them that way can help everyone with the gestalt switch. If conservation is to take place everywhere, we must all learn to see nature as the background to our lives and not just as islands far away."

While such a view may appear diametrical opposed to ecomodernism's vision of planetary-scale rewilding at a theoretical level, in practice it is obvious that conservation will always be politically contentious and dependent on local circumstances. Over time, ecomodernists may hope that the tension will become less pronounced as advanced technologies may allow for more comprehensive forms of decoupling. Nevertheless, it is important to recognize that the ecomodernist movement remains divided on these issues and that its real-world implications are often contradictory as many ecosystems have already been thoroughly altered by human activities (Kelly & Landres, 2022). Take for example the proper role of forest management in the vast conifer monocultures that have come to dominate subarctic North America and Eurasia (Huuskonen, 2021). Left alone in a climate changed world, these monocultures would be extremely vulnerable to catastrophic forest fires and biotic damage, yet their active management would perpetuate and further legitimize the forest-industrial complex.

Sustainability

Turning to the concept of sustainability, ecomodernism is not so much a continuation of ecological modernization theory as it is a radical break with the idea that there exists some golden ratio that appropriately balances social, economic, and ecological concerns. Rather than looking at local static indicators of sustainability in the present, ecomodernism seeks to refocus the discussion towards the long-term global trajectory that the world is on (Karlsson, 2016; Friederich & Symons, 2022). Fantastic as an ecomodernist future of spaceflight and molecular assemblers may seem, the relative distance to such a future may be significantly shorter than to one of massive depopulation and globally enforced restrictions on consumption, once social and political factors are considered. While little academic spite tends to be spared when it comes to attacking the belief in "techno-fixes" (Barry, 2016), it is often not recognized that traditional environmentalism is based on an even stronger form of human exceptionalism, one in which humans, unlike any other species, can collectively and permanently lessen their appetite and desire for reproduction.

Yet, it is not difficult to see the intuitive appeal of traditional environmentalism. Not only does it resonate with the sense of guilt and loss that many (rightfully!) have come to experience when thinking about what humans have done to the natural world, its unidirectional understanding of sustainability also offers a return to "simpler times" without the many existential demands of a globalized, fluid, and individualized world. However, for those less fortunate, the desire to escape

agrarian poverty is no less pronounced than it was a hundred years ago. At the same time, through "fair trade", REDD+, and other similar schemes, rich-world environmental elites remain transfixed on making poverty in the developing world slightly less unbearable, conveniently ignoring the question of where the rich world would have been today had its own small-holders of the 19th century been prevented from urbanizing and, thus, bringing about more transformative forms of socio-economic change. Of course, for its more radical anarcho-primitivist voices (Zerzan, 2015), a pre-modern world may ultimately be ethically preferable but, for most traditional environmentalists, it is more that they see no sustainable way that everyone in the world can share the comforts of modernity. What is interesting, however, is the disinterest that traditional environmentalists tend to take in developing solutions that would make such shared prosperity possible. To some extent, anti-nuclear activism and the dismissal of space colonization as "irrational" (Williams, 2010) can be understood as a way of forcing cultural and behavioural change, using the threat of a climate catastrophe to ram through policies that would otherwise not be democratically acceptable.

As energy prices have spiked in the wake of the war in Ukraine, the limits of a 100% renewable energy future have become more widely recognized. Deregulated electricity markets with larger shares of variable energy have proven both fragile and volatile (Angwin, 2020). While ecomodernists generally recognize that renewable energy sources can make some positive contribution towards decarbonization, their large surface footprint, low Energy Return On Investment (EROI) and intermittent nature simply make them unsuitable to do the heavy lifting necessary to move the global economy as a whole away from fossil energy. This is particularly the case when looking beyond electricity towards high-energy industrial processes (such as steelmaking), manufacturing, and district heating. As such, it is not surprising that nuclear energy has come to play such a central role in ecomodernist thinking about global sustainability. Not only could nuclear energy be used to provide firm and dispatchable generation of low-carbon electricity and hydrogen for industrial uses (Ausubel, 2007), but the waste heat could also be utilized for direct air capture of carbon dioxide (as is now being tested at the Sizewell C reactor in the UK), all providing a realistic pathway toward negative emissions and, ultimately, restoration of atmospheric carbon to pre-industrial levels (Dmitry & Pavel, 2020; Dorr, 2016) without relying on environmentally destructive forms of bioenergy (Searchinger *et al.*, 2022; Söderberg & Eckerberg, 2013). More generally, ecomodernists see nuclear energy as instrumental in sustaining an advanced global society into the future, one capable of responding to a wide range of existential threats such as pandemics and asteroid collisions, but also to provide the energy needed for large-scale desalination of sea water, air conditioning, and vertical farming, all increasingly important in a climate-changed world. In contrast, an energy-starved degrowth future is thought to lead to violence as countries will find themselves competing over dwindling natural resources and incapable of drawing down the already accumulated stock of atmospheric carbon, unleashing increasingly extreme weather events and sea level rise.

While the importance of energy sources with sufficiently high EROI-levels may easily be overlooked in the present-day global economy where energy-intensive goods, batteries, and solar panels can be imported from overseas, a localized economy relying exclusive on renewable energy would soon find itself in a state of "greenflation" as it would expend more and more of it is remaining energy to extract less and less new energy at ever higher costs. In fact, and despite the spreadsheet sorcery of a few vocal online activists like Mark Jacobson, the EROI of an all-renewable energy system would fall "well below the range of the thresholds identified in the literature as necessary to sustain high levels of development in current industrial and complex societies" (Capellán-Pérez et al. 2019, p. 18). Again, for some, such self-imposed energy austerity may be welcomed, but as the recent example of Germany restarting its coal power plants shows, green idealism may quickly fade as countries revert to fossil fuels in response to economic realities.

Justice

After the Second World War, as colonialism was crumbling, and the incredible productive capacity of modern industrial society had become apparent, there was broad consensus that the entire world would eventually climb the same ladder toward social and economic development. While capitalist and socialist worldviews clashed about the means, they shared the same super-ideology of industrialism (Heywood, 2021:213) and desire to permanently end agrarian poverty.

It would be far beyond the scope of this chapter to seek to understand the psychology of how the generation that followed, who enjoyed a richer and longer life than any generation before them, came to abandon the promise of progress. Still, overwhelmed by the immense responsibilities of the nuclear age, and witnessing all the abuses and ambiguities of civilization, continued adherence to the Enlightenment project would probably have been a far more surprising outcome. After all, the perfectionism of traditional environmentalism, with its insistence on greening subjectivities rather than merely changing environmental outcomes, and its fetishization of the "local", cannot be understood apart from the traumatic and destabilizing character of late modernity. Without a longer view of human evolution and the material possibilities of a multi-planetary future, it is only logical that the notion of "limits" has come to achieve such a hegemonic position in contemporary environmental discourse (Vidal, 2023). This especially so when considering how neatly criticism of "mass-consumption" fits into the broader cultural concerns of an aspirational class that has come to express status through inconspicuous consumption (Currid-Halkett, 2018) and perceived "self-limitation" (Blühdorn, 2022). Rather than imagining a world where everyone can live a life free from want, and the technological means necessary to make such a future ecologically possible, the main concern of traditional environmentalism has been the visible excesses of capitalism, often in conjunction with long-running Malthusian fears that the world "faces a serious overpopulation problem […] especially in Africa and Asia" (Pimental, 2012:151). All of this would be of limited significance if traditional environmentalism were only to be judged based on its marginal electoral appeal. However, the belief in absolute planetary boundaries has come to paralyze political imagination everywhere and effectively forestalling any serious discussion about the energy needs of a fully developed and equal world (Arto *et al.*, 2016).

As such, the ecomodernist metaphor of a "high-energy planet" runs directly counter to prevailing views and discourses (Karlsson, 2018). Recognizing the existence of significant production-side rebound effects (Nordhaus, 2017) as well as the vast unmet demand in the developing countries, ecomodernists believe that the primary political focus should be on bringing about a clean energy revolution at the global level rather than seeking marginal domestic "energy savings". Whereas most donor initiatives are limited to achieving some nominal measure of energy access and household electrification using micro-grids and intermittent renewable energy, ecomodernists believe that to effectively eradicate poverty and facilitate a transition to more productive forms of off-farm employment, the energy needs of the developing world are no different from those of the developed world (Nordhaus, Devi & Trembath, 2016). Writing in *Issues in Science and Technology*, Morgan Bazilian and Roger Pielke Jr. succinctly sum up the ecomodernist position (2013:79):

> "The course of development followed by virtually all nations demonstrates that people around the world desire a high-energy future. Our plea is that we begin to recognize that fact, and focus more attention and resources on positively planning for, and indeed bringing about, that future."

In this, ecomodernists reaffirm their basic belief that any attempt to "harmonize" the economy with nature at present technological levels would be disastrous for habitats and biodiversity. Without the benefits of scale that can be derived from global commodity chains, production would exert a devastating toll on the local environment as lower-grade deposits would be used for mining, less productive land used for farming etc., all leading to a downward spiral of environmental destruction, inflation, and loss of human capital.

Implications for democracy

Still, considering the worsening climate crisis, it is not difficult to feel sympathy for environmental activists and their demands for an end to "bla bla bla". Yet, ecomodernists worry that, as much as radical change is needed, the direction of that change must be one that does not make great harm to both humans and nature. Reversing the vast transformational processes of the last centuries would mean undermining the material conditions that brought forth post-materialism and environmental consciousness in the first place. In a world of energy austerity and hard agricultural labour, non-capitalist forms of domination could quickly end up being just as oppressive.

At the same time, contemporary political realities give little reason to worry about such things. Degrowth, at least on a scale sufficient to combat climate change, is simply not going to happen any time soon. If anything, the world is currently experiencing the opposite, as in fossil backsliding and resignation about the prospects of global governance. While traditional environmentalism may have largely failed to achieve its objectives, it has been extraordinarily effective in undermining belief in technological progress, spreading fear about nuclear energy in particular, and making it appear as an extreme fringe position to suggest that all of the world could one day enjoy living standards comparable to, say, the ones in the Scandinavian countries. It is against that backdrop that ecomodernism seeks to restore a sense of curiosity about the future, the kind of marvel perhaps best captured by *StarTrek*'s vision of a cosmopolitan and tolerant multi-planetary future.

However, just as the political prospects of degrowth remain limited, so do those of ecomodernism. To the extent that ecomodernist thinking has made inroads into real-world policymaking, it risks becoming nothing but an excuse for inaction, postponing difficult decisions, and downplaying the deep unsustainability of everything from private automobiles (Moriarty, 2022) to meat eating (De Boer *et al.*, 2013). To actually save the environment, ecomodernism would have to be truly utopian in its ambitions, which, in turn, would most likely trigger just as much of a populist counter-reaction as traditional environmentalism has ever done. All this creates a difficult political landscape where the frontlines are spelled Diablo Canyon, Tihange, and Emsland as ecomodernists fight to keep ageing nuclear plants open and prevent them from being replaced by fossil gas. Even if ultimately successful, halting closures would only be the first step towards a new atomic humanism (Lindberg, 2022), one that takes seriously the energy needs of the wider world and charts a path towards clean energy abundance.

Again, for the moment, all such prospects remain remote as populism and inter-state conflict have resurged, most visibly of course in the war in Ukraine. Meanwhile, climate activists, who are seeking to reduce the difficult trade-offs of the Anthropocene to a Manichean struggle between malevolent fossil corporations and their own idealized understanding of "science", are unlikely allies of the ecomodernist cause given its insistence on liberal pluralism. Likewise, critical social theorists who celebrate disagreement and see the world as a post-Marxist conflict of absolutes (Hällmark, 2022; Machin, 2013), are not likely to share the ecomodernist belief in the Enlightenment. Amidst conspiracy theories and a growing distrust of expert knowledge, the ecomodernist faith in the state as the key actor capable of bringing about transformative environmental change also seems

misplaced. Taken together, this makes it reasonable to expect that the environmental crisis will get much worse before it gets any better. While early decisive action on climate change could perhaps have eliminated or at least reduced the need for SRM, the lack of such action means that it may soon be the only way that catastrophic losses of biodiversity and polar ice can be prevented. However, if ever implemented, a SRM programme would likely make many of these debates even more intractable. Thinking about all these things, it is not surprising that the demand for quick and easy answers, be it to not have children or to stop flying (Wynes & Nicholas, 2017), is growing with little regard for the science of climate response times (Van Vuuren & Stehfest, 2013) and other factors pointing to its practical futility.

Conclusion

In conclusion, ecomodernism offers a distinct ideological approach to the Anthropocene, one that challenges many deeply held assumptions of traditional environmentalism and insists on that ecological flourishing can be made possible, not by restricting liberal freedom or harmonizing with nature, but through the progressive decoupling of the economy from the natural environment. Thanks to the transition to cleaner and denser fuels, it is thought that human needs can be met with ever lower demands for material inputs. Just as the transition from biomass to fossil fuels at the dawn of Industrial Age brought about immense environmental, social, and economic benefits, ecomodernists envision that nuclear energy can now make possible an ecologically vibrant "high-energy planet" with universal human prosperity.

As a political movement, ecomodernism's future remains most uncertain. While ecomodernist associations (such as "RePlanet") now exist in many countries, their political influence remains marginal. Likewise, given the hegemony of traditional environmental thinking in academia, there is little funding for ecomodernist research or perspectives that question Malthusianism.

References

Angwin, M. (2020) *Shorting the grid. The hidden fragility our electric grid*. Wilder, VT: Carnot Communications.

Arias-Maldonado, M. (2020). Blooming landscapes? The paradox of utopian thinking in the Anthropocene. *Environmental Politics*, 29(6), 1024-1041.

Arias-Maldonado, M. J. (2023). *Democratic Pluralism and Political Unity in the Anthropocene*. Conference paper presented at the annual meeting of the Western Political Science Association, San Francisco, 6-8 April, 2023

Arto, I., Capellán-Pérez, I., Lago, R., Bueno, G., & Bermejo, R. (2016). The energy requirements of a developed world. *Energy for Sustainable Development*, 33, 1-13.

Ausubel, J. H. (2007). Renewable and nuclear heresies. *International Journal of Nuclear Governance, Economy and Ecology*, 1(3), 229-243.

Bazilian, M., & Pielke, R. (2013). Making energy access meaningful. *Issues in science and technology*, 29(4), 74-78.

Barry, J. (2016). Bio-fuelling the Hummer?: transdisciplinary thoughts on techno-optimism and innovation in the transition from unsustainability. In *Transdisciplinary perspectives on transitions to sustainability* (pp. 106-123). London: Routledge.

Becken, S., Friedl, H., Stantic, B., Connolly, R. M., & Chen, J. (2021). Climate crisis and flying: social media analysis traces the rise of "flightshame". *Journal of Sustainable Tourism*, 29(9), 1450-1469.

Blühdorn, I. (2022). Planetary boundaries, societal boundaries, and collective self-limitation: moving beyond the post-Marxist comfort zone. *Sustainability: Science, Practice and Policy*, 18(1), 576-589.

Büscher, B., Dressler, W., & Fletcher, R. (2014). *Nature Inc.: environmental conservation in the neoliberal age*. Tucson: University of Arizona Press.

Cherp, A., Vinichenko, V., Tosun, J., Gordon, J. A., & Jewell, J. (2021). National growth dynamics of wind and solar power compared to the growth required for global climate targets. Nature Energy, 6(7), 742-754.

Currid-Halkett, E. (2017). *The sum of small things: A theory of the aspirational class*. Princeton: Princeton University Press.

De Boer, J., Schösler, H., & Boersema, J. J. (2013). Climate change and meat eating: An inconvenient couple?. *Journal of Environmental Psychology*, 33, 1-8.

DeLancey, C. (2012). An ecological concept of wilderness. *Ethics & the Environment*, 17(1), 25-44.

Dimitry, G. & Pavel, K. (2020) Feasibility study for coupling of Nuclear Power Generation with Green House Gas capture. *Proceedings of ICAPP 2020*, Paper 20537.

Dorr, A. (2016). The impact pulse and restoration curves: Going beyond mitigation and stabilization. Anthropocene, 16, 61-66.

Friederich, S., & Symons, J. (2022). Operationalising sustainability? Why sustainability fails as an investment criterion for safeguarding the future. Global Policy.

Frega, R. (2017). The wide view of democracy. *Thesis Eleven*, 140(1), 3-21.

Heywood, A. (2021). *Political ideologies: An introduction*. London: Red Globe Press.

Huuskonen, S., Domisch, T., Finér, L., Hantula, J., Hynynen, J., Matala, J., ... & Viiri, H. (2021). What is the potential for replacing monocultures with mixed-species stands to enhance ecosystem services in boreal forests in Fennoscandia?. *Forest ecology and management*, 479, 118558.

Hällmark, K. (2022). Politicization after the 'end of nature': The prospect of ecomodernism. *European Journal of Social Theory*, 13684310221103759.

Jager, H. I., Efroymson, R. A., & McManamay, R. A. (2021). Renewable energy and biological conservation in a changing world. *Biological Conservation*, 263, 109354.

Jørgensen, D. (2015). Rethinking rewilding. *Geoforum*, 65, 482-488.

Kallis, G. (2018). *Degrowth*. Newcastle upon Tyne: Agenda Publishing.

Karlsson, R. (2013). Ambivalence, irony, and democracy in the Anthropocene. *Futures*, 46, 1-9.

Karlsson, R. (2016). Three metaphors for sustainability in the Anthropocene. *The Anthropocene Review*, 3(1), 23-32.

Karlsson, R. (2018). The high-energy planet. *Global Change, Peace & Security*, 30(1), 77-84.

Karlsson, R. (2020). Conflicting temporalities and the ecomodernist vision of rewilding. In *Non-human nature in world politics* (pp. 91-109). Cham: Springer.

Kati, V., Kassara, C., Vrontisi, Z., & Moustakas, A. (2021). The biodiversity-wind energy-land use nexus in a global biodiversity hotspot. *Science of The Total Environment*, 768, 144471.

Kelly, P., & Landres, P. (2022). Does Wilderness Matter in the Anthropocene? Resolving a Fundamental Dilemma About the Role of Wilderness in 21st Century Conservation. *Ethics, Policy & Environment*, 1-16.

Lindberg, J. C. (2022). The Humanitarian Atom: The Role of Nuclear Power in Addressing the United Nations Sustainable Development Goals. In *Nuclear Law* (pp. 271-298). TMC Asser Press, The Hague.

Machin, A. (2013). *Negotiating climate change: Radical democracy and the illusion of consensus*. London: Zed Books.

Marris, E. (2011). *Rambunctious garden: saving nature in a post-wild world*. New York: Bloomsbury

Moriarty, P. (2022). Electric vehicles can have only a minor role in reducing transport's energy and environmental challenges. *AIMS Energy*, 10(1), 131-148.

Nordhaus, T., Devi, S., & Trembath, A. (2016). Debunking Microenergy: The Future Lies With Urbanization. *Foreign Affairs*, 08-30.

Nordhaus, T. (2017). The energy rebound battle. *Issues in Science and Technology*, 33(4), 51-58.

Oudin, A., Segersson, D., Adolfsson, R., & Forsberg, B. (2018). Association between air pollution from residential wood burning and dementia incidence in a longitudinal study in Northern Sweden. *PLoS One*, 13(6), e0198283.

Pimentel, D. (2012). World overpopulation. *Environment, Development and Sustainability*, 14(2), 151-152.

Qvist, S. A., & Brook, B. W. (2015). Potential for worldwide displacement of fossil-fuel electricity by nuclear energy in three decades based on extrapolation of regional deployment data. *PLoS One*, 10(5), e0124074.

Searchinger, T. *et al.*, (2022) EU climate plan sacrifices carbon storage and biodiversity for bioenergy*, Nature*, 612:27-30, https://doi.org/10.1038/d41586-022-04133-1

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

Söderberg, C., & Eckerberg, K. (2013). Rising policy conflicts in Europe over bioenergy and forestry. *Forest Policy and Economics*, 33, 112-119.

Terefe, N. S. (2022). Recent developments in fermentation technology: toward the next revolution in food production. *Food Engineering Innovations Across the Food Supply Chain*, 89-106.

Trainer, T. (2012). De-growth: Do you realise what it means?. *Futures*, 44(6), 590-599.

Van Vuuren, D. P., & Stehfest, E. (2013). If climate action becomes urgent: the importance of response times for various climate strategies. *Climatic change*, 121(3), 473-486.

Vidal, F. (2023). The Anthropocene New Stage: The Era of Boundaries. In *The Palgrave Handbook of Environmental Politics and Theory* (pp. 599-626). Cham: Springer International Publishing.

Wallace-Wells, D. (2019). *The uninhabitable earth: A story of the future*. London: Penguin UK.

Williams, L. (2010). Irrational dreams of space colonization. *Peace Review*, 22(1), 4-8.

Wynes, S., & Nicholas, K. A. (2017). The climate mitigation gap: education and government recommendations miss the most effective individual actions. *Environmental Research Letters*, 12(7), 074024.

York, R., & Bell, S. E. (2019). Energy transitions or additions?: Why a transition from fossil fuels requires more than the growth of renewable energy. *Energy Research & Social Science*, 51, 40-43.