A Post-Capitalocentric Critique of Digital Technology and Environmental Harm: New Directions at the Intersection of Digital and Green Criminology

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Abstract

Only recently have scholars of criminology begun to examine a wider spectrum of the effects of digital technologies beyond 'cybercrime' to include human rights, privacy, data extractivism and surveillance. Such accounts, however, remain anthropocentric and capitalocentric. They do not fully consider the environmental impacts caused by the manufacture, consumption, use and disposal of digital technologies under conditions of ecologically unequal exchange. The worst impacts of extractivism and pollution are borne by societies and ecosystems in the world's economic periphery and contribute to an acceleration of planetary ecocide. Three examples illustrate our argument: (1) deep-sea mining of metals and minerals; (2) the planned obsolescence of digital devices while limiting the right to repair; and (3) the disposal of e-waste. Acknowledging the urgent need to reorient the trajectory of technology innovation towards more-than-human futures, we advance some ideas from the field of design research—that is, the field of scholarly inquiry into design practices—on how to decouple technological progress from neoliberal economic growth. We venture outside criminology and offer a glimpse into how design researchers have recently begun a similar reflective engagement with post-anthropocentric critiques, which can inspire new directions for research across digital and green criminology.

Keywords

Green criminology; e-waste; extractivism; digital technology; digital criminology; political ecology.

Introduction

As we leap from the Third Industrial Revolution into Industry 4.0 and its emerging successors, the role of technology as an accelerator of innovation and disruption has come to the fore as a possible 'solution' or 'technofix' in discussions of 'green' economic growth (Foth et al. 2021; Monteiro 2019; Wakkary 2021). This is occurring against a backdrop of increased expansion, use and reliance on technology in all fields of life and with limited but growing recognition of the associated environmental costs (see, e.g., Brevini 2020). In the global economic core, proposals for green solutions to environmental crises tend to centre technology, which is heralded as indispensable for driving sustainable development and growth (for a discussion of the core and periphery concepts, see Wallerstein 2004). In pursuit of capitalist efficiencies and profit, however, technology leads to increased extractivism to supply the raw materials that are central to the 'green energy revolution'. Rather than driving down energy consumption and waste, technology increases it. By drawing on green and digital criminology, this article highlights new perspectives on harm and these 'green' technologies.

Criminology is repositioning and widening its disciplinary focus and reimagining the interrelationship between crime, harm and technology (e.g., Powell, Stratton and Cameron 2018; Wood 2020). Attempts to emphasise 'the embedded nature of technology in our lived experiences of criminality, victimisation and justice' can be considered the emerging field of 'digital criminology', which can be understood as a 'rapidly developing field of scholarship that applies criminological, social, cultural and technical theory and methods to the study of crime, deviance and justice in our digital society' (Powell, Stratton and Cameron 2018: 12). In essence, the emerging field of digital criminology is concerned with the broader effects of technological systems on society and culture and the ways social, political and cultural factors shape the development of technologies, and fits within the broader interdisciplinary academic field of STS studies. Digital criminology expands the discipline's historically constrained focus on 'cybercrime', such as, for example, online fraud, cyber attacks and identity theft, to more critically consider the relationships between the development and effects of technology and its broader sociopolitical contexts.

The discipline of criminology is also expanding to consider the environmental harms of technology from the subfield of green criminology. For example, White (2017: 241) reflected on 'the relative dearth of critical thinking about technology within the green criminology project more generally'. He offered a way to address this gap by proposing three perspectives of technology from an environmental approach: (1) technology as a tool for preventing and responding to ecological harms; (2) technology as the *problem/solution* to ecocide; and (3) *technology as paradoxical* in terms of contradictory effects. The latter two aspects—technology as problem/solution and its paradoxes—are of greatest interest here and ground the critique we set forth regarding the environmentally devastating impact of 'green technologies' as they are currently being developed within the global capitalist economy.

White (2017) also highlighted the unequal global distribution and demand of technology production and use, and calls into question technofixes to the environmental crisis and the positives and (false) promises of advanced industrial technologies as the 'solution' to environmental harm—a focus that we expand upon below. Brisman and South (2017) used a case study of hybrid/electric vehicles in their examination of the criminogenic significance of consumption. They showed how the 'championing of new environmentally beneficial devices and systems' (Brisman and South 2017: 316), under a shroud of 'greenwashed' marketing, fuels and perpetuates the consumption of rare earth materials contained within hybrid car batteries and magnets while stimulating more demand. Zehner (2012) offered a similar critique of global investments in 'green energy' such as wind and solar, which often ignore the hidden carbon footprint in their production, shipment and lifecycle. In this way, the green energy agenda reframes a planetary *consumption crisis* as a problem of inadequate innovation in our energy production systems. These critiques seed doubt in the idea that technological innovation—and making *more* consumption *more* efficient—will address the environmental crises we currently face. Brisman and South (2017: 317) emphasise that the benefits of the green energy revolution will be unequally distributed around the globe, while the harms associated with it will be most severe in 'nations that will be exhorted to supply the

mineral and other resources needed to support processes of technology-based consumption under the guise of technological efficiency'.

White's eco-global criminology emphasises a focus on context. He traced the role of technology during previous industrial revolutions, specifically the burning of fossil fuels, noting that this revolution was not driven by technology per se, but rather that 'global imperialism, colonialism and militarism … have served to entrench a dominant worldview and the material basis for certain types of production, consumption and reproduction' (White 2017: 248). This draws attention to the political ecology of technologies to understand their role in perpetuating uneven relationships of power and conflict and historicise their contribution to environmental harms.

The eco-global focus on technology and context also raises the issue of purported trade-offs between human wellbeing and environmental health, as if it is a zero-sum game. Clear thinking requires that, in light of climate change, we must accept the indivisibility of humans and their environment (and human embeddedness within Earth's ecosystems) and that more is required to break down the binary thinking that has come to dominate liberal discourse (e.g., dogmas of jobs, growth and development versus 'nature'). We need to tackle the paradoxes raised by White (2017) head-on and accept that while renewable technologies may reduce or slow down some environmental harms, as currently incorporated into the economy, they serve to perpetuate unsustainable economic and societal frameworks of extraction, consumption and waste. This is driven through increasing capital centralisation of technology design, imperialism, digital colonialism and modern forms of enclosure of the commons (Bellamy-Foster and Clark 2020; Mann and Daly 2019). As Bellamy-Foster and Clark (2020: 38) argued, in 'today's phase of globalized monopoly-finance capital … relations of expropriation have further asserted themselves, to the point that the system seems at times to have entered a period of the forcible dissolution … extended to the web of life itself'. In pursuit of economic growth, physically realised in an ever-expanding 'technomass' (Hornborg 2001), the pace of extraction, production, consumption and waste has disastrous consequences for all life on the planet.

This paper pursues two main research aims. First, we make the case that technological solutions to environmental problems carry with them harmful environmental impacts. Second, we provide examples along three stages of the lifecycle of technology to explicate how a critical reading of 'green tech' both affords and requires new research questions, directions and approaches at the intersection of digital and green criminology. We argue that while the structure of the current global economic system and its attendant ecocide appears inexorable—because it is so encompassing, systemic and entangled with historically derived processes, customs and norms as well as regulatory, policy and legal instruments—it is not preordained.

Our argument proceeds as follows. First, we discuss White's (2017) paradox in light of the extraction of minerals for the 'green technology' revolution and the case of deep-sea mining. This is followed by a discussion of how planned obsolescence and denying the right to repair fuel consumption and, while good for profit and economic growth, promote extractivism and waste. We then turn our attention to the transference, transport and disposal of e-waste and associated social and environmental harms. These three examples have been purposefully chosen to accompany our main argument by illustrating how digital technology innovation—even under the pretence of aiming for sustainability outcomes—causes environmental harms across the entire lifecycle from cradle (mining) to usage (consumption) to grave (waste). In concluding, we discuss the prospect of decoupling technological progress and economic growth. We venture outside criminology and offer a glimpse into how scholars in the field of design research—that is, the field of scholarly inquiry into design practices—have recently begun a similar reflective engagement with post-anthropocentric critiques. This offers inspiration for identifying and debating criminology's potential new directions for research across digital and green criminology.

Mining 'Blue Nullius'

The benefits and burdens of extractivism are unevenly distributed around the planet, driven by ecologically unequal exchange whereby consumption and capital accumulation in the core are structurally contingent on environmental degradation and extraction in the periphery. Ecologically unequal exchange characterises the global capitalist system and is the 'underlying source of most of the environmental distribution conflicts in our time … obscured by the apparent reciprocity of market prices' (Hornborg and Martinez--Alier 2016: 328-329). Serious allegations of environmental despoliation and social harms in the periphery of the global economic system are disregarded by mining companies and attributed to localised corruption and a lack of regulatory oversight (Davis and Franks 2014). In host countries and regions in the global economic periphery subject to extractivism, however, a lack of regulatory oversight cannot be understood separately from the implications of enhancing the *efficiency* of global supply chains and the externalisation of the effects of economic growth in the economic core. Whereas significant mining of minerals for digital technology occurs 'in regions with little or no legislation and enforcement of social and environmental protection regulation' (Fox et al. 2020: 113), without reference to the global system of exchange and regulation, we argue that discussions of the effects of mining are founded on a colonial deficit narrative and adopt a 'developmentalist' ideology. They fail to recognise that it is through 'the force and violence of regulatory interventions that external, non-commodified spaces could, and can, be incorporated into the dynamic of capitalist accumulation' (Gonçalves and Costa 2020: 157).

The implication of the developmentalist agenda and deficit narrative is that the solution to social and environmental harms from mining lies in better regulation at a national 'host country' level—orchestrated from the core—which is the rationale for the approach to 'austerity' adopted by The World Bank and the International Monetary Fund with disastrous consequences for communities and environments in the global periphery (see, e.g., Rothe and Friedrichs 2015). Rather, corruption, *legalised* plunder in the form of tax avoidance through transfer pricing (Peyer, Feeney and Mercier 2014), old and new forms of economic imperialism, violations of international labour standards and environmental despoliation are, as Hornborg and Martinez-Alier argued (2016: 330), driven by 'more affluent and militarily powerful nations' who are able to externalise the environmental impacts of mining and disposal of waste to the economic periphery. Rather than prevent or mitigate these impacts, they are 'exacerbated by rising levels of foreign direct investments, the increase of which is ultimately prompted by austerity measures designed by global financial institutions' (Hornborg and Martinez-Alier 2016: 330).

The overt regulatory capture of state governance and regulation by international finance and regulatory institutions, and covert regulatory capture by multinational corporations, gives corporate actors free rein to dispossess communities and destroy local environments with impunity (e.g., Bedford, McGillivray and Walters 2020; Hornborg and Martinez-Alier 2016). As such, 'entangled capitalist accumulation', when understood 'from a global perspective and not simply within a particular nation-state, tends to erase the borders between the state and the market, and even legality and illegality' (Gonçalves and Costa 2020: 161). This is illustrated in the case of deep-sea mining.

Minerals and metals such as cobalt, copper and nickel are designed and manufactured into 'green' energy technologies such as 'energy efficient' smart thermostats and wind turbines and are a key component in wiring and cabling that undergirds basically every electronic device. Cobalt is used to boost battery power and is a key ingredient in lithium-ion batteries that power electric vehicles. Due to its use in electric vehicles and batteries that store 'green' energy, cobalt is often put forward as a critical mineral in the 'green' energy revolution (van den Brink et al. 2020). One Swiss-based multinational mining company, Glencore, accounts for more than a quarter of the world's land-based cobalt output as a by-product of copper mining in the Democratic Republic of the Congo (DRC) (Frankel, Chavez and Ribas 2016) and of nickel mining in Australia and Canada (Glencore 2020). A 460% increase in global cobalt demand is projected by 2050 (Hund et al. 2020: 103). However, with more than half the global supply of cobalt mined in the DRC and half refined in China, the global supply chain is highly vulnerable to disruption (van den Brink et al. 2020: 155). In the DRC, as elsewhere, the high costs of company–community conflicts in the extractive sector have led to significant instability (Davis and Franks 2014), and alternative sources of

cobalt are now being sought. One as yet unmined source of cobalt is the deep ocean seabed (the focus of our discussion below).

International waters 'cover more than half of the global seafloor and contain more valuable minerals than all the continents combined' (Hylton 2020). The push for seabed mining of metals and minerals to fuel the 'green' technology revolution is being accelerated in the Pacific Ocean through a small number of mining companies and Pacific Island nations, supported by the United Nations (UN) International Seabed Authority (ISA). Established in 1994 under the *United Nations Convention on the Law of the Sea* (Division for Ocean Affairs and the Law of the Sea, Office of Legal Affairs, UN 2001) and headquartered in Jamaica, the ISA is an autonomous intergovernmental body that considers and approves applications for exploring deep-sea resources in the hydrothermal vents, seamounts along the mid-ocean ridges and abyssal plains in 'The Area', the vast seabed and high seas water column outside national waters and the exclusive economic zones (Miller et al. 2018). To date, the ISA has issued 31 exploration licenses to state-backed companies, multinational corporations and startups to explore more than 1.3 million square kilometres of the seabed in the Atlantic, Pacific and Indian Oceans (ISA 2021).

The ISA's mandate is to ensure that the resources of the international seabed beyond the limits of national jurisdictions will be developed for the benefit of all *humankind* (*United Nations Convention on the Law of the Sea*: arts. 136, 137.2, 145) by 'attracting investment and technology, whilst demanding that necessary measures be taken to ensure effective protection of the marine environment' (Van Nijen, Van Passel and Squires 2018: 134). The role of ISA is not to *prevent* mining in The Area but to identify locations where mining will be permitted by state-sponsored companies. Within the exploration contracts of the ISA, it is up to the companies granted exploration licences to monitor and report on their own environmental impacts, and sponsoring states are expected to monitor and enforce the activities undertaken by mining companies. Scholars, scientists and activists have argued that the different roles of the ISA stand in direct conflict, highlighting its 'dual mandate of promoting the development of deep-sea minerals whilst ensuring that this development is not harmful to the environment' (International Union for the Conservation of Nature [IUCN] 2018). As Levin, Amon and Lily (2020: 789) argued, there 'is no other precedent of an international intergovernmental treaty body … attempting to act as a minerals licensing, environmental permitting, monitoring and enforcement, and revenue collection agency, as is required of the ISA'. Further, with an annual budget of less than US$10 million (ISA 2018), the ISA lacks the capacity to monitor or regulate the contracts in the deep oceans, kilometres beneath the ocean surface.

Seabed mining has been identified as one of five sectors with a high potential for development within the European Commission's Blue Growth Strategy, alongside coastal tourism, aquaculture, blue energy and blue biotechnology (Scholaert 2020). From 2010 to 2016, the European Union (EU) funded the Pacific Community (formerly the South Pacific Commission [SPC]) to develop model deep-sea mining legislation for Pacific Island states through the SPC-EU Deep Sea Minerals (DSM) Project and the Abyssal Initiative (Deep Sea Mining Campaign [DSMC], London Mining Network [LMN] and Mining Watch Canada [MWC] 2019). This is despite deep concerns raised by civil society organisations that rather than seeking to regulate the industry, the SPC-EU DSM Project was enabling it and creating an unfounded perception of a social license to operate (DSMC, LMN and MWC 2019). Indeed, the SPC was established as a colonial structure in 1947, and today it acts as a conduit of funding from donor nations by providing technical and scientific advice to Pacific Island Countries (PICs). It is largely funded externally by the Australian Government, EU, France, New Zealand and the United States (US) and currently has an Australian director-general (SPC 2021). Only one year after its inception, the SPC-EU DSM Project had developed the *Pacific-ACP Regional Legislative and Regulatory Framework for Deep Sea Minerals Exploration and Exploitation* (DSMC, LMN and MWC 2019) 'without the meaningful discussion of PIC governments and their citizens' to ensure that 'targeted countries are in a position to comply with their national and international obligations as seabed activities progress' (DSMC, LMN and MWC 2019: 6).

One company at the forefront of opening up the seabed to extractivism is the Canadian-based multinational DeepGreen which merged with a special purpose acquisition company Sustainable Opportunities Acquisition Corporation to go public in late 2021 as The Metals Company [TMC]. DeepGreen/TMC holds

exploration contracts sponsored by three small South Pacific islands—Nauru, Kiribati and Tonga. DeepGreen spawned from the ostensible 'failure' of an early controversial player in seabed mining exploration, Nautilus Minerals (IUCN 2018). Adopting a 'greenscam' designation (Ehrlich and Ehrlich 1996: 23), DeepGreen moved away from the approach adopted by Nautilus Minerals of striking deals with individual Pacific Island countries to mine in their exclusive economic zones and instead invested its energies in The Area through its state-sponsored subsidiaries. The chairman of Deepgreen/TMC is the founder of Adstream— 'the world's most powerful TV and online advertising delivery platform' (Adstream 2019). DeepGreen/TMC does not refer to their proposals as 'mining' but instead portrays itself as 'collecting' the polymetallic nodules it is seeking to acquire from the abyssal plains of the deep ocean floor. DeepGreen/TMC has been accused of 'greenwashing' (de Freitas Netto et al. 2020) in its positioning of deep-sea mining as essential to the 'green' energy revolution and in its argument that the environmental and social impacts of deep-sea 'extraction' are significantly lower than land-based mining (IUCN 2018):

> The main component of the global public good that could be created by developing the polymetallic nodule resource in The Area is supplying critical minerals for the global transition off fossil fuels at a fraction of environmental and social costs associated with metal production from conventional land ores. (The Metals Company 2020)

DeepGreen's history of having emerged from the controversial Nautilus Minerals venture (IUCN 2018), its offtake agreement with the transnational mining company, Glencore, and its recent partnering with the Swiss firm Allseas, which specialises in offshore oil and gas pipeline installations (Barich 2019b), calls their efforts to market a 'green' social license to operate into serious question. In response, DeepGreen has argued that not only will it be reducing reliance on fossil fuels by providing the raw materials for 'green' technologies, but it will also be giving their oil and gas partners an incentive to pivot away from fossil fuels (Barich 2019a), a move they expect will appease the increasingly negative reactions from scientists and activists.

Although DeepGreen claims that the ocean floor has very low biodiversity (Barich 2019a), the deep ocean has particularly rich biodiversity, with the vast majority of species as yet undiscovered (Miller 2018). Even before mining has commenced, the environmental impacts of exploration on the seabed ecosystems and benthic and suprabenthic megafauna are already significant and effectively irreversible (Heffernan 2019; Miller et al. 2018: 12). Impacts will include the physical destruction of habitat and organisms in the mining path, changes to the functioning and composition of ecosystems, species extinctions, changes in light or noise levels that may interfere with organisms' abilities to communicate (and procreate) and the formation of sediment plumes that could impact the organisms living both within and above the seabed, including the upper water column (Heffernan 2019; Miller et al. 2018). This is concerning because 'many of the regions identified for future seabed mining are already recognised as vulnerable marine ecosystems' (Miller et al. 2018: 1), and recovery from 'human-mediated disturbance could take decades, centuries or even millennia, if these ecosystems recover at all' (Miller et al. 2018: 18). Already, ocean ecosystems are being decimated by heating, acidification, pollution (including plastics) and overfishing, and mining will compound these problems.

DeepGreen's apparent regulatory capture of the ISA and the Government of the Republic of Nauru has been suggested by a number of not-for-profit organisations, including Greenpeace, IUCN, DSMC, LMN and MWC. While private mining companies do not have participant status at the ISA's annual sessions and do not qualify for the ISA's observer status (reserved for non-government or intergovernmental agencies), Greenpeace reports that DeepGreen contractors routinely 'attend ISA meetings in Kingston, Jamaica, including as members of their sponsoring State delegations' (Greenpeace 2020: 25). In a February 2019 session of the ISA Council, spokespersons from DeepGreen allegedly 'addressed the meeting under their sponsoring State flag and were seated in the seat marked Nauru' (Greenpeace 2020: 25; see also DSMC, LMN and MWC 2019). This highlights the way the 'ISA Secretary General and the Nauru Government have allowed DeepGreen to use their positions in an attempt to influence international and Pacific regional law and policymaking to serve the company's interests' (DSMC, LMN and MWC 2019: 2).

Van Dover (2017, cited in Miller et al. 2018) has stressed that we do not know enough to mitigate impacts from mining or restore habitats in the deep seas. Concerns about the impact of mining have led to calls from 'civil society, NGOs, fisheries, tourism operators, scientists and governmental bodies' around the globe for the application of the precautionary principle and a moratorium on deep-sea mining until the impacts can be better assessed (DSMC, LMN and MWC 2019: 2). Despite these concerns, in April 2018, DeepGreen's Nauru subsidiary launched the first of five seafloor exploration expeditions in its 75,000 square kilometre exploration area to collect the data required for its environmental impact statement and to attract investors to allow it to move from exploration to exploitation (DSMC, LMN and MWC 2019). DeepGreen has partnered with 'independent' scientific institutions for the purposes of gathering data for its environmental impact statement to allow for evidence-based decisions and find ways to 'minimise harm' (The Metals Company 2020). They are also seeking support from conservation organisations (Barich 2019a). Apart from the performative public relations, engagement theatre and greenwashing, concerns might be raised in this case regarding the influence of corporate funding on 'independent' scientific research and academic institutions. Such concerns have been highlighted in many sectors, including digital technology (see, e.g., Abdalla Abdalla 2020), the gas industry (The Australia Institute 2016) and coal mining (Cox 2019).

Fuelling Consumption: Planned Obsolescence and Denying the Right to Repair

There are numerous factors that contribute to, and drive, extractivism, production, consumption and waste, including wider capitalist and regulatory incentives, or indeed regulatory capture and failure (Ludlam 2016; Monbiot 2016). Another significant aspect is product or planned obsolescence, which creates demand—by design—to produce new products and contributes to the extraction of new raw materials and a steady stream of waste (Brisman and South 2013; Satyro et al. 2018). There are four types of product obsolescence: (1) technological or functional, where a product becomes obsolete due to enhanced technology; style obsolescence where products are designed so the consumer purchases a more fashionable product; (3) systemic obsolescence, where a wider system is altered so that it is difficult to use or maintain services for a product; and (4) product failure and breakdown (Guiltinan 2009; Rivera and Lallmahomed 2016). Forms of product failure or breakdown are an explicit design strategy to shorten the lifespan of a product so that it becomes non-functional. As a result, consumers purchase new replacement products and, thus, contribute to extraction, production and consumption—all required to fuel the growth of the capitalist economy.

Planned obsolescence can also involve intentionally designing for limited repair opportunities so that products must be replaced entirely rather than fixed (by the consumer, manufacturer or a third party). The first, and perhaps most (in)famous, case of planned obsolescence is the intentional design of a lightbulb so that the filament has a limited lifetime and eventually becomes useless, requiring complete replacement of the globe, when there are longer-lasting alternatives (Guiltinan 2009; Rivera and Lallmahomed 2016). Intentionally shortening the lifespan of products by design or intellectual property stipulations, especially those of electronic and digital devices, has significant environmental impacts because more waste is created and needs to be disposed of (Guiltinan 2009; Rivera and Lallmahomed 2016). New products are produced, which require the extraction of materials from the land and the sea.
This explicit strategy to drive extraction, consumption and waste creation is supported by intellectual property laws that provide limited rights for consumers to repair broken or non-functional products themselves (or by third parties). There have been some attempts to introduce or enforce 'right to repair' laws, for example, in the US, which would allow consumers to be able to repair products; however, their introduction has been delayed as a result of lobbying by manufacturers that argue they contravene their intellectual property rights (Grinvald and Tur-Sinai 2019; Montello 2020). To illustrate how corporations deny consumers their right to repair (Hernandez, Miranda and Goñi 2020), we point to the example of agricultural technology company John Deere, which received negative press internationally for preventing farmers from repairing their own tractors (Carolan 2017). Another example is Apple—a company that explicitly brands itself as 'officially in the green' (Apple 2022). Apple has been successful in lobbying against proposed right to repair laws across the US and Canada (see, e.g., Hollister 2019; Owen 2019). So, while Apple runs 'greenwashed' campaigns about its environmental efforts and credentials, it scuttles laws

that aim to reduce needless and wasteful consumption. This is in addition to its efforts to design components for its products that are difficult to repair or replace (e.g., batteries that are glued in and the use of proprietary screws that only Apple or authorised third parties can unscrew) (see, e.g., Statt 2017). All this contributes to more mining of rare minerals for new batteries or electronic components, more e-waste that is dumped rather than recycled, repaired or reused, and, ultimately, more social and environmental harms.

E-Waste: Transference, Transport and the Disposal of Global Harm

In 2019 human beings set an inauspicious record, discarding 53.6 million metric tons of e-waste, a global toxic dump that threatens to worsen (Cho 2020). Further, only 20% of global e-waste is recycled (UN Environment Programme 2019); the remainder forms part of what the UN Environment Assembly has termed a 'global crisis' (Parker 2019). The production of global solid waste has reached an all-time high, with over two billion tons discarded each year—much of it burned, illegally dumped at sea or buried in unregulated landfills (The World Bank 2019). Of the estimated 50 million tons of e-waste created each year, much of it is trafficked and transported to nations in the economic periphery—such as the Agbogbloshie e-waste dump site in Accra, Ghana—and left in 'appalling conditions' where impoverished local communities are exposed to carcinogenic substances (Forti et al. 2020; Park 2019: 1).

Emerging from the dumping of e-waste is an identifiable pattern of exploitation, namely, the transference of waste from the global economic core to the periphery (Frey, Gellert and Dahms 2019; British Broadcasting Company 2018), which often involves illicit disposal methods and 'terrorist and organised criminal groups' (Lambrechts and Hector 2016: 251). The e-waste industry is one of the largest and fastest-growing illegal industries in the world (Interpol n.d.). The illegal trade in e-waste is fostered by both an ever-increasing demand for electronic products worldwide and the industry's systemic adoption of designing for fast consumption cycles, also known as 'planned obsolescence', as discussed above (Satyro et al. 2018). The illegal trade in e-waste involves smuggling operations where e-waste is sometimes classified as 'second-hand' goods (discarded computers, televisions and other electronic products) and dumped in countries such as Benin, Ghana, India, Nigeria, Pakistan and Vietnam. Much of it ends up in 'unreported largely unknown destinations' (Kamal 2017: 1). The international community has responded with laws and regulations that, ostensibly, seek to ensure that waste is disposed of in safe, sustainable and renewable ways. By increasing the costs of disposal, however, they have inadvertently strengthened illegal markets in dumping and transference (European Environmental Agency n.d.).

The identification of illegal flows of waste has resulted in various legal and regulatory instruments seeking to control and prevent illicit disposals. The *Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal* (1989) (*Basel Convention*) is the primary international treaty designed to regulate and reduce the movement of hazardous waste between nations—specifically, from countries of the global economic core to those of the periphery (Basel Convention 1989; Paraschiv 2015). The *Basel Convention* does not ban shipments of toxic waste outright, and state parties may enter into bilateral or multilateral agreements for the transfer of e-waste (Harrison 2017).

Despite the *Basel Convention*'s stated commitment to the 'principle of adequacy', many recipient countries are ill-equipped to handle toxic substances in a way that protects the environment and their citizens (Bisschop 2016). Consequently, the receiving nations report widespread ecological damage and serious health effects amounting to a humanitarian crisis (Ajibo 2016; World Health Organization 2019). In recipient countries, the techniques used to recycle e-waste can create risky situations, such as leachates from dumping activities, particulate matter from dismantling activities, toxic fly and bottom ashes from burning activities, fumes from mercury amalgamate 'cooking', wastewater from dismantling and shredding facilities and effluents from cyanide leaching (Bisschop 2016). As Walters and Fuentes Loureiro (2020: 16) argued, the internationalisation of e-waste 'has engendered "new industries" in recycling that have placed entire communities in an unjust toxic web of dependence not of their own doing, where contaminated landfill is now a normalised place to live, to work and to die'.

Digital Technology's Environmental Harm as a New Direction for Criminology

The past and continuing colonial and imperial crimes of the economic core have left the economies, communities and environments in the global periphery vulnerable to the worst impacts of climate change. Those who are least responsible for climate change will suffer its gravest consequences, and 'countries that have succeeded in externalising environmental pressures have accrued an ecological debt to other nations' (Hornborg and Martinez-Alier 2016: 330). Ruggiero and South (2013: 13) argued that neoliberal discourses rationalise 'harm against humans and the environment' as the inevitable outcome of economic growth, such that, effectively, 'the entire planet is given to those who are most capable of exploiting it'. Without consideration of the colonial and imperialist history, trajectory and current status of the global economy, including the 'new scramble for Africa' (Ayers 2013), proposed technological 'solutions' to the climate crisis and biodiversity loss are fundamentally flawed.

To keep the global average temperature rise to less than 1.5°C, humanity's focus needs to shift to a rapid de-escalation of extraction, production and consumption. More resource-efficient design, reducing the need for mining on land and sea and rapidly increasing recycling of already mined materials will go some way in this process. As the IUCN (2018: 2) has argued, 'the repair, recycling and reuse of products should be encouraged to help reduce the demand for raw materials from the deep sea. Enhancing product design to make use of less or alternative materials can also reduce demand'. So, too, can designing green technologies and solar panels in such a way that metals and minerals are easily recoverable at the end of the product life cycle (UN Environment Programme 2013). However, the reduction of extraction, production and consumption is contradicted in capitalism, which requires endless growth.

In light of this, it is easy to be pessimistic and difficult to imagine a post-capitalist future. In the face of these challenges, however, design research may offer some optimistic inspiration for green and digital criminology scholars. Design research is the scholarly inquiry into design practices, or what Cross (2006) referred to—in epistemological terms—as 'designerly ways of knowing'. Design researchers also have a long history of engaging with questions of sustainability (Paulos et al. 2008) and are actively imagining alternative post-capitalist and post-anthropocentric futures (Light, Powell and Shklovski 2017; Yigitcanlar, Foth and Kamruzzaman 2019).

Some of this design research is grounded in critical—and often uncomfortable—reflections and self-assessments as to the way design disciplines enable extractivism, consumption and waste and are complicit in ongoing social and environmental harms (Monteiro 2019). These reflections have generated opportunities to consider more-than-human futures (Clarke et al. 2019; Loh et al. 2020; Wakkary 2021). Dourish (2010) questioned design's focus on the individual user and called for moving beyond efficiency gains and usability to extend design's remit beyond behavioural patterns and consumption choices to include notions of citizenship and polity. He argued for designing 'technologies of scale making' that can boost community activism and mount political engagement at a scale necessary to combat the ecological crises we are facing. Similarly, Foth et al. (2015; see also Foth 2018) have sought to bestow design with a wider remit to account for civil society and civic responsibilities beyond the designed artifact itself.

Forlano (2017) was one of the first design scholars to question the negative and unintended consequences of human-centred design, which nowadays often entails a short-sighted and commercial focus on human comfort and convenience at the expense of the planet's health and wellbeing. In response, the field of design research has started to embrace a more-than-human approach that rejects human exceptionalism and begins to decentre the human in design (Forlano 2017; Loh et al. 2020). This short excursion and glimpse into design scholarship is intended to generate interest and further debate in the way it provides another lens through which to view the post-capitalocentric, more-than-human intersection of digital and green criminology and find ways to challenge the oxymoronic narrative of 'green' economic growth driven by capitalism.

We invite readers and colleagues to join this debate and imagine what new directions lie ahead at the intersection of digital and green criminology. In our own research practice (including the co-authorship of

this paper), we have been able to derive a great deal of merit and utility from a close transdisciplinary collaboration between regulatory studies and criminology, on the one hand, and design researchers and technology developers, on the other hand. Conventionally, both regulations and the law tend to be reactive to technological advancements, whereas the mixed teams we operate within are better at anticipating regulatory repercussions already at the ideation stage before a new technology is launched. Further, because the field of design is currently engaged in self-reflection prompted by a growing awareness of its complicity in causing environmental harm, criminology's approach to zemiological research and axiology could, in turn, lend a helping hand in coming to terms with reforming the ethical frameworks within which design operates (Canning and Tombs 2021), including the design of technologies to 'fuel' the 'green tech' revolution. This, too, is a new prospect as a result of new directions at the intersection of digital and green criminology. We invite criminologists interested in and working on digital technologies to think about the ways in which digital technology and criminology intersect beyond the digital realm itself to explore the criminological significance that digital technology presents to the physical world and environment. In doing so, we propose that the scope and remit of the emerging field of criminological scholarship forming under the banner of 'digital criminology' be expanded and widened to include new inquiries and new directions at the intersection of digital and green criminology.

'Green growth' is increasingly embraced by liberal states and corporate actors, yet 'greenwashed' technology solutions offer a false choice between alternatives that are paradoxically related. We argue that proposals for 'green' growth create a deafening silence around the globalised nature of the current environmental crisis and suppress arguments regarding ecological and climate debt made by scholars and policymakers in the semi-periphery and periphery of the global economy (Martinez-Alier et al. 2014; Warlenius, Pierce and Ramasar 2015). The blithe response by mining companies to legitimate concerns of serious social and environmental harms is indicative of their confidence that their role in the supply chain is guaranteed by the regulatory structures that have served them well to date. 'Greenwashing' does nothing to prevent the externalisation of social and environmental harms to the economic periphery and reinforces rather than supplants imperialist expansionism and ongoing extractivism. As we discussed in the case of DeepGreen, the centralisation of oil and gas capital in deep-sea mining provides a direct conduit for the private enclosure—for the purposes of industrial plunder—of one of the most critical wild spaces on the planet, a vast, fragile and irreplaceable ecosystem legally set aside for the benefit of all.

The claim that continued economic growth under the current capitalist order can be 'green' needs to be squarely called into dispute and on the agenda of both green and digital criminologies. We need to move beyond a capitalist realism (Fisher 2009) with its vested arguments that we can consume our way out of the current unsustainable trajectory, led by the innovations of venture capitalists. The panacea of 'green growth' is now assumed in national and international policies, including in the UN Sustainable Development Goals, even though 'empirical evidence on resource use and carbon emissions does not support green growth theory' (Hickel and Kallis 2020: 469). If we are serious about justice and human rights, we need to work towards decoupling our economies from extractivism. To centre the more-than-human approach, we need to, as Wallerstein (2005) argued, 'push decommodification wherever [we] can … and open our mind to radical alternatives for the future' (Wallerstein 2005: 1227). Working beyond our narrow fields of interest, we are better able to work with environmental defenders and activists in both the core and periphery of the global economy to support the possibilities that are opened up by the prospects of a post-extractivist, post-capitalist and post-anthropocentric economy (Foth et al. 2021; Moore 2017; Yigitcanlar, Foth and Kamruzzaman 2019). Our paper suggests that digital technology may be conceived of as both a central driver and facilitator of extractivism and imperialism. We need more research, including in criminology, to better understand the role of digital technology in taking us towards more desirable, more-than-human futures.

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References

Abdalla M and Abdalla M (2021, July) The Grey Hoodie Project: Big tobacco, big tech, and the threat on academic integrity. In *Proceedings of the 2021 AAAI/ACM Conference on AI, Ethics, and Society*: 287-297. https://arxiv.org/abs/2009.13676.\

Adstream (2019) *What makes the most powerful ad delivery platform?* 1 April. https://www.adstream.com/what-makes-the-worlds-most-powerful-advertising-delivery-platform

Ajibo KI (2016) Transboundary hazardous wastes and environmental justice: Implications for economically developing countries. *Environmental Law Review* 18(4): 267-283. https://doi.org/10.1177%2F1461452916675538

Apple (2022) *Environment*. https://www.apple.com/au/environment/

Ayers AJ (2013) Beyond myths, lies and stereotypes: The political economy of a 'new scramble for Africa'. *New Political Economy* 18(2): 227-257. https://doi.org/10.1080/13563467.2012.678821

Barich A (2019a) DeepGreen Metals eyeing alliances with conservationists in deep sea mining drive. *S&P Global Market Intelligence*, 12 June. https://www.spglobal.com/marketintelligence/en/news-insights/latest-news-headlines/deepgreen-metals-eyeing-alliances-with-conservationists-in-deep-sea-mining-drive-52324710

Barich A (2019b) Oil and gas suppliers to join DeepGreen Metals' deep sea mining initiative. *S&P Global Market Intelligence*, 14 March. https://www.spglobal.com/marketintelligence/en/news-insights/latest-news-headlines/oil-and-gas-suppliers-to-join-deepgreen-metals-deep-sea-mining-initiative-50551446

Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal (Mar 22, 1989) 28 I.L.M. 657 (1989); 1673 U.N.T.S. 125. https://treaties.un.org/doc/Publication/MTDSG/Volume%20II/Chapter%20XXVII/XXVII-3.en.pdf

Bedford L, McGillivray L and Walters R (2020) Ecologically unequal exchange, transnational mining, and resistance: A political ecology contribution to green criminology. *Critical Criminology* 28(3): 481-499. https://doi.org/10.1007/s10612-019-09464-6

Bisschop L (2016) How e-waste challenges environmental governance. In Wyatt T (ed.) *Hazardous waste and pollution: Detecting and preventing green crimes*: 27-43. Cham: Springer International Publishing.

Brevini B (2020) Black boxes, not green: Mythologizing artificial intelligence and omitting the environment. *Big Data & Society* 7(2): 1-5. https://doi.org/10.1177%2F2053951720935141

Brisman A and South N (2013) Conclusion: The planned obsolescence of Planet Earth? How green criminology can help us learn from experience and contribute to our future. In South N and Brisman A (eds) *Routledge international handbook of green criminology*: 425-423. Abingdon: Routledge.

Brisman A and South N (2017) Consumer technologies, crime and environmental implications. In McGuire MR and Holt TJ (eds) *The Routledge handbook of technology, crime and justice*: 310-324. Abingdon: Routledge.

British Broadcasting Company (2018) *Transcript of "file on 4"—"criminal waste"*. 23 October. http://downloads.bbc.co.uk/rmhttp/fileon4/26_criminal_waste_new.pdf

Canning V and Tombs S (2021) *From social harm to zemiology*. Abingdon: Routledge.

Carolan M (2017) 'Smart' farming techniques as political ontology: Access, sovereignty and the performance of neoliberal and not-so-neoliberal worlds. *Sociologia Ruralis* 58(4): 745-764. https://doi.org/10.1111/soru.12202

Cho R (2020) E-waste is taking over the world. 5G will make it even worse. *World Politics Review*, 27 October. https://www.worldpoliticsreview.com/articles/29169/how-to-manage-the-world-s-growing-e-waste-problem

Clarke R, Heitlinger S, Light A, Forlano L, Foth M and DiSalvo C (2019) More-than-human participation: Design for sustainable smart city futures. *Interactions* 26(3): 60-63. https://doi.org/10.1145/3319075

Cox L (2019) Adani mine: Emails revealing pressure on CSIRO spark calls to review approval. *The Guardian*, 14 May. https://www.theguardian.com/business/2019/may/14/adani-mine-emails-revealing-pressure-on-csiro-spark-calls-to-review-approval

Cross N (2006) *Designerly ways of knowing*. London: Springer. https://doi.org/10.1007/1-84628-301-9

Davis R and Franks D (2014) *Costs of company-community conflict in the extractive sector*. Corporate Social Responsibility Initiative Report No. 66. Cambridge, MA: Harvard Kennedy School. https://www.csrm.uq.edu.au/media/docs/603/Costs_of_Conflict_Davis-Franks.pdf

Deep Sea Mining Campaign, London Mining Network and Mining Watch Canada (2019) *Why the rush? Seabed mining in the Pacific Ocean*. https://miningwatch.ca/sites/default/files/why_the_rush.pdf

de Freitas Netto SV, Sobral MFF, Ribeiro ARB and da Luz Soares GR (2020) Concepts and forms of greenwashing: A systematic review. *Environmental Sciences Europe* 32(1): Article 12. https://doi.org/10.1186/s12302-020-0300-3

Dourish P (2010) HCI and environmental sustainability: the politics of design and the design of politics. In *Proceedings of the 8th ACM Conference on Designing Interactive Systems (DIS '10)*: 1-10. New York: Association for Computing Machinery. https://doi.org/10.1145/1858171.1858173

Ehrlich AH and Ehrlich PR (1996) Brownlash: The new environmental anti-science. *Humanist* 56(6): 21.
European Environmental Agency (n.d.) *Resource efficiency and waste*. https://www.eea.europa.eu/themes/waste
Fisher M (2009) *Capitalist realism: Is there no alternative?* Winchester: Zero Books.
Forlano L (2017) Posthumanism and design. *She Ji: The Journal of Design, Economics, and Innovation* 3(1): 16-29. https://doi.org/10.1016/j.sheji.2017.08.001
Forti V, Baldé CP, Kuehr R and Bel G (2020) *The global e-waste monitor 2020: Quantities, flows, and the circular economy potential*. Bonn: United Nations University/United Nations Institute for Training and Research; International Telecommunication Union; International Solid Waste Association. https://www.itu.int/en/ITU-D/Environment/Documents/Toolbox/GEM_2020_def.pdf
Foster JB and Clark B (2020) *The robbery of nature: Capitalism and the ecological rift.* New York: Monthly Review Press.
Foth M (2018) Participatory urban informatics: Towards citizen-*ability*. *Smart and Sustainable Built Environment* 7(1): 4-19. https://doi.org/10.1108/SASBE-10-2017-0051
Foth M, Mann M, Bedford L, Fieuw W and Walters R (2021) A capitalocentric review of technology for sustainable development: The case for more-than-human design. In Association for Progressive Communications and Swedish International Development Cooperation Agency, *Global information society watch 2020. Technology, the environment and a sustainable world: Responses from the global South*: 78-82. Melville, South Africa: Association for Progressive Communications. https://giswatch.org/sites/default/files/gisw2020-australia.pdf
Foth M, Tomitsch M, Satchell C and Haeusler MH (2015) From users to citizens: Some thoughts on designing for polity and civics. In *Proceedings of the Annual Meeting of the Australian Special Interest Group for Computer Human Interaction (OzCHI'15)*: 623-633. New York: Association for Computing Machinery. https://doi.org/10.1145/2838739.2838769
Fox B, Goggin G, Lupton D, Regenbrecht H, Scuffham P and Vucetic B (2020) *The internet of things*. Australian Council of Learned Academies. https://acola.org/wp-content/uploads/2020/10/hs5_internet-of-things_report.pdf
Frankel TC, Chavez MR and Ribas J (2016) The cobalt pipeline: Tracing the path from deadly hand-dug mines in Congo to consumers' phones and laptops. *The Washington Post.* 30 September. https://www.washingtonpost.com/graphics/business/batteries/congo-cobalt-mining-for-lithium-ion-battery/
Frey RS, Gellert PK and Dahms HF (2019) Introduction: Ecologically unequal exchange in comparative and historical perspective. In *Ecologically unequal exchange*: 1-10. Cham: Palgrave Macmillan. https://link.springer.com/book/10.1007/978-3-319-89740-0#toc
Glencore (2022) *Metals and Minerals: Cobalt.* https://www.glencore.com/what-we-do/metals-and-minerals/cobalt
Gonçalves GL and Costa S (2020) From primitive accumulation to entangled accumulation: Decentring Marxist theory of capitalist expansion. *European Journal of Social Theory* 23(2): 146-164. https://doi.org/10.1177/1368431018825064
Greenpeace (2020) *Deep trouble: The murky world of the deep sea mining industry.* Greenpeace International https://www.greenpeace.org/static/planet4-international-stateless/c86ff110-pto-deep-trouble-report-final-1.pdf
Grinvald LC and Tur-Sinai O (2019) Intellectual property law and the right to repair. *Fordham Law Review* 88(1): 63-128. https://ir.lawnet.fordham.edu/flr/vol88/iss1/3
Guiltinan J (2009) Creative destruction and destructive creations: Environmental ethics and planned obsolescence. *Journal of Business Ethics* 89: 19-28. https://doi.org/10.1007/s10551-008-9907-9
Harrison J (2017) *Saving the oceans through law: The international legal framework for the protection of the marine environment*. Oxford: Oxford University Press.
Heffernan O (2019) Seabed mining is coming—bringing mineral riches and fears of epic extinctions. *Nature*, 24 July. https://www.nature.com/articles/d41586-019-02242-y
Hernandez RJ, Miranda C and Goñi J (2020) Empowering sustainable consumption by giving back to consumers the 'right to repair'. *Sustainability* 12(3): 850-865. https://doi.org/10.3390/su12030850
Hickel J and Kallis G (2020) Is green growth possible? *New Political Economy* 25(4): 469-486. https://doi.org/10.1080/13563467.2019.1598964
Hollister S (2019) An Apple lobbyist just sneakily pushed California to postpone its right-to-repair bill. *The Verge*, 1 May. https://www.theverge.com/2019/5/1/18525542/apple-right-to-repair-bill-california-lobbyist-cIndigenousomptia
Hornborg A (2001) *The power of the machine: Global inequalities of economy, technology, and environment*. Vol. 1. Maryland: Rowman Altamira.
Hornborg A ad Martinez-Alier J (2016) Ecologically unequal exchange and ecological debt. *Journal of Political Ecology* 23(1): 328-333. https://doi.org/10.2458/v23i1.20220

Hund K, La Porta D, Fabregas TP, Laing T and Drexhage J (2020) *Minerals for climate action: The mineral intensity of the clean energy transition*. World Bank. https://pubdocs.worldbank.org/en/961711588875536384/Minerals-for-Climate-Action-The-Mineral-Intensity-of-the-Clean-Energy-Transition.pdf
Hylton WS (2020) History's largest mining operation is about to begin: It's underwater—and the consequences are unimaginable. *The Atlantic*, January/February. https://www.theatlantic.com/magazine/archive/2020/01/20000-feet-under-the-sea/603040/
International Seabed Authority (2021) *Exploration Contracts.* https://www.isa.org.jm/exploration-contracts
International Seabed Authority (2018) *Draft decision of the Council of the International Seabed Authority relating to the budget of the Authority for the financial period 2019–2020*. https://isa.org.jm/files/files/documents/isba24c-l2rev1-en.pdf
International Union for the Conservation of Nature (2018) *Deep-sea mining* [Issues brief]. https://www.iucn.org/sites/dev/files/deep-sea_mining_issues_brief.pdf
Interpol (n.d.) *Pollution crime*. https://www.interpol.int/en/Crimes/Environmental-crime/Pollution-crime
Kamal B (2017) Where do 50 million tonnes a year of toxic e-waste go? *Inter Press Service*, 27 September. http://www.ipsnews.net/2017/09/50-million-tonnes-year-toxic-e-waste-go/
Lambrechts D and Hector M (2016) Environmental organised crime: The dirty business of hazardous waste disposal and limited stated capacity in Africa. *Politikon* 43(2): 251-268. https://doi.org/10.1080/02589346.2016.1201727
Levin LA, Amon DJ and Lily H (2020) Challenges to the sustainability of deep-seabed mining. *Nature Sustainability* 3(10): 784-794. https://doi.org/10.1038/s41893-020-0558-x
Light A, Powell A and Shklovski I (2017) Design for existential crisis in the Anthropocene age. In *Proceedings of the 8th International Conference on Communities and Technologies (C&T'17*): 270-279. New York: Association for Computing Machinery. https://doi.org/10.1145/3083671.3083688
Loh S, Foth M, Caldwell GA, Garcia-Hansen V and Thomson M (2020) A more-than-human perspective on understanding the performance of the built environment. *Architectural Science Review* 63(3-4): 372-383. https://doi.org/10.1080/00038628.2019.1708258
Ludlam S (2021) *Full Circle: Power, Hope and the Return of Nature*. Black Inc.
Mann M and Daly A (2019) (Big) data and the north-in-south: Australia's informational imperialism and digital colonialism. *Television & New Media* 20(4): 379-395. https://doi.org/10.1177%2F1527476418806091
Martinez-Alier J, Anguelovski I, Bond P, Del Bene D, Demaria F, Gerber J, Greyl L et al. (2014) Between activism and science: Grassroots concepts for sustainability coined by environmental justice organizations. *Journal of Political Ecology* 21(1): 19-60. https://doi.org/10.2458/v21i1.21124
Miller KA, Thompson KF, Johnston P and Santillo D (2018) An overview of seabed mining including the current state of development, environmental impacts, and knowledge gaps. *Frontiers in Marine Science* 4: Article 418. https://doi.org/10.3389/fmars.2017.00418
Monbiot G (2016) *How did we get into this mess? Politics, equality, nature.* Verso Books.
Monteiro M (2019) *Ruined by design: How designers destroyed the world, and what we can do to fix it*. San Francisco: Mike Monteiro. https://www.ruinedby.design/
Montello S (2020) The right to repair and the corporate stranglehold over the consumer: Profits over people. *Tulane Journal of Technology and Intellectual Property* 22: 165-184. https://journals.tulane.edu/TIP/article/view/2993
Moore JW (2017) The Capitalocene, part I: On the nature and origins of our ecological crisis. *Journal of Peasant Studies* 44(3): 594-630. https://doi.org/10.1080/03066150.2016.1235036
Owen M (2019) Apple & other tech companies lobby efforts kill Ontario 'right to repair' bill. *Apple Insider*, 3 May. https://appleinsider.com/articles/19/05/03/apple-tech-companies-successfully-lobby-to-kill-ontario-right-to-repair-bill
Pacific Community (2021) *Director General.* Pacific Community (SPC). https://www.spc.int/about-us/director-general
Paraschiv D-S (2015) International regulations on the trans-boundary movement of hazardous waste. *Acta Universitatis George Bacovia. Juridica* 4(1): 35-41. https://www.ugb.ro/Juridica/Issue7EN/4._Reglementari_internationale_privind_circulatia_transfrontaliera_a_deseurilor_toxice.Daniel_Paraschiv.EN.pdf
Park M (2019) Electronic waste is recycled in appalling conditions in India. *The Conversation*, 15 February. https://theconversation.com/electronic-waste-is-recycled-in-appalling-conditions-in-india-110363
Parker L (2019) The world agrees there's a plastic waste crisis—can it agree on a solution? *National Geographic*, 26 March. https://www.nationalgeographic.com/environment/article/un-environment-plastic-pollution-negotiations

Paulos E, Foth M, Satchell C, Kim Y, Dourish P and Choi H-J (eds) (2008) Ubiquitous sustainability: Citizen science and activism. In *10th International Conference on Ubiquitous Computing (UbiComp 2008)*. New York: Association for Computing Machinery. https://eprints.qut.edu.au/14130/

Peyer C, Feeney P and Mercier F (2014) *PR or progress? Glencore's corporate responsibility in the Democratic Republic of the Congo*. Rights and Accountability Development; Bread for All; Fastenopfer. https://www.raid-uk.org/documents/pr-or-progress-glencore-corporate-responsibility-democratic-republic-congo

Powell A, Stratton G and Cameron R (2018) *Digital criminology: Crime and justice in digital society*. New York: Routledge.

Rivera JL and Lallmahomed A (2016) Environmental implications of planned obsolescence and product lifetime: A literature review. *International Journal of Sustainable Engineering* 9(2): 119-129. https://doi.org/10.1080/19397038.2015.1099757

Rothe DL and Friedrichs DO (2015) *Crimes of globalization*. Abingdon: Routledge.

Ruggiero V and South N (2013) Green criminology and crimes of the economy: Theory, research and praxis. *Critical Criminology* 21(3): 359-373. https://doi.org/10.1007/s10612-013-9191-6

Satyro WC, Sacomano JB, Contador JC and Telles R (2018) Planned obsolescence or planned resource depletion? A sustainable approach. *Journal of Cleaner Production* 195: 744-752. https://doi.org/10.1016/j.jclepro.2018.05.222

Scholaert F (2020) *The blue economy: Overview and EU policy framework*. European Parliamentary Research Service. https://www.msp-platform.eu/sites/default/files/eprs_ida2020646152_en.pdf

Statt N (2017) Why Apple and other tech companies are fighting to keep devices hard to repair. *The Verge*, 3 August. https://www.theverge.com/2017/8/3/16087628/apple-e-waste-environmental-standards-ieee-right-to-repair

The Australia Institute (2016) GISERA and the threat to independent science. 20 October. https://australiainstitute.org.au/post/gisera-and-the-threat-to-independent-science/

The Metals Company (2020) *Response to Greenpeace report*. https://metals.co/response-to-greenpeace-report/

The World Bank (2019) *Solid waste management*. 23 September. https://www.worldbank.org/en/topic/urbandevelopment/brief/solid-waste-management

Division for Ocean Affairs and the Law of the Sea, Office of Legal Affairs, United Nations (2001) *Agreement relating to the implementation of Part XI of the United Nations Convention on the Law of the Sea of 10 December 1982* https://www.un.org/depts/los/convention_agreements/texts/agreement_part_xi/agreement_part_xi.htm

United Nations Environment Programme (2013) Soaring demand for metals calls for rethink of recycling practices, says International Resource Panel [Press release]. 24 May. https://www.unep.org/news-and-stories/press-release/soaring-demand-metals-calls-rethink-recycling-practices-says

United Nations Environment Programme (2019) UN report: Time to seize opportunity, tackle challenge of e-waste [Press release]. 24 January. https://www.unep.org/news-and-stories/press-release/un-report-time-seize-opportunity-tackle-challenge-e-waste

van den Brink S, Kleijn R, Sprecher B and Tukker A (2020) Identifying supply risks by mapping the cobalt supply chain. *Resources, Conservation and Recycling* 156: Article 104743. https://doi.org/10.1016/j.resconrec.2020.104743

Van Nijen K, Van Passel S and Squires D (2018) A stochastic techno-economic assessment of seabed mining of polymetallic nodules in the Clarion Clipperton Fracture Zone. *Marine Policy* 95: 133-141. https://doi.org/10.1016/j.marpol.2018.02.027

Wakkary R (2021) *Things we could design for more than human-centred worlds*. Cambridge, MA: MIT Press.

Wallerstein IM (2004) *World-systems analysis: An introduction*. Durham: Duke University Press.

Wallerstein IM (2005) After developmentalism and globalization, what? *Social Forces* 83(3): 1263-1278. https://doi.org/10.1353/sof.2005.0049

Walters R and Fuentes Loureiro MA (2020) Waste crime and the global transference of hazardous substances: A southern green perspective. *Critical Criminology* 28(3): 463-480. https://doi.org/10.1007/s10612-020-09522-4

Warlenius R, Pierce G and Ramasar V (2015) Reversing the arrow of arrears: The concept of "ecological debt" and its value for environmental justice. *Global Environmental Change* 30: 21-30. https://doi.org/10.1016/j.gloenvcha.2014.10.014

White R (2017) Technology, environmental harm and green criminology. In McGuire MR and Holt TR (eds) *The Routledge handbook of technology, crime and justice*: 241-259. London: Routledge.

Wood MA (2020) Rethinking how technologies harm. *British Journal of Criminology* 61(3): 886. https://doi.org/10.1093/bjc/azaa098

World Health Organization (2019) Electronic waste. *Children's environmental health*. https://www.who.int/ceh/risks/ewaste/en/

Yigitcanlar T, Foth M and Kamruzzaman Md (2019) Towards post-anthropocentric cities: Reconceptualizing smart cities to evade urban ecocide. *Journal of Urban Technology* 26(2): 147-152. https://doi.org/10.1080/10630732.2018.1524249

Zehner O (2012) *Green illusions: The dirty secrets of clean energy and the future of environmentalism*. Lincoln: University of Nebraska Press.

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