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 impacts 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: (i) the mining of metals and minerals in the deep sea; (ii) the planned obsolescence of digital devices while limiting the right to repair, and; (iii) the disposal of e-waste. Acknowledging the urgent need to re-orient 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

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. 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 in driving sustainable development and growth (see Wallerstein 2004 for a discussion of the concepts of core and periphery). 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. 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 as 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 impacts 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 science technology and society (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 consider the relationships between the development and impacts of technology and its broader socio-political contexts more critically.

The discipline of criminology is also expanding to consider the environmental harms of technology from the sub-field of green criminology. For example, White (2017: 241) reflects upon 'the relative dearth of critical thinking about technology within the green criminology project more generally.' He offers a way to address this gap through proposing three perspectives of technology from an environmental approach: (1) technology as a tool in preventing and responding to ecological harms; (2) technology as the *problem/solution* to ecocide, and; (3) *technology as paradoxical* in terms of contradictory impacts. 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 draws attention to the unequal global distribution and demand of technology production and use, and calls into question 'techno-fixes' 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) use the case study of hybrid / electric vehicles (H/EVs) in their examination of the criminogenic significance of consumption. They show 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) offers 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 re-frames what is a planetary *consumption crisis* to 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 traces 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 perpetuation of 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 well-being, on the one hand, and environmental health on the other, 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 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 (Mann and Daly 2019; Bellamy-Foster and Clark 2020). As Bellamy-Foster and Clark argue, 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' (Bellamy-Foster and Clark 2020: 2). 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 in order 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, norms as well as regulatory, policy and legal instruments—it is not preordained. Our argument proceeds as follows: First, we discuss White's paradox in light of the extraction of minerals for the 'green technology' revolution and the case of deep sea mining (Section 1). This is followed by a discussion of how planned obsolescence and denying the right to repair fuels consumption, which is good for profit and economic growth but promotes extractivism and waste (Section 2). We then turn our attention to the transference, transport, and disposal of e-waste and associated social and environmental harms (Section 3). 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 harm 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.

1. Mining 'Blue Nullius'

The benefits and burdens of extractivism are unevenly distributed around the planet, driven by ecologically unequal exchange (EUE) whereby consumption and capital accumulation in the core is structurally contingent on environmental degradation and extraction in the periphery. EUE characterises the global capitalist system and which Hornborg and Martinez-Alier (2016: 328-9) argue is the 'underlying source of most of the environmental distribution conflicts in our time … obscured by the apparent reciprocity of market prices'. Serious allegations of environmental despoliation and social harm in the periphery of the global economic system are disregarded by mining companies, and attributed to localised corruption and a lack of regulatory oversight. In host countries and regions in the global economic periphery subject to extractivism, however, lack of regulatory oversight cannot be understood separately from the implications of enhancing the *efficiency* of global supply chains and the externalisation of the impacts 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, discussions of the impacts 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—the rationale for the approach to 'austerity' adopted by the World Bank and International Monetary Fund (IMF) 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 argue (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 2018: 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 reign 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 'seen 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. 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 et al. 2016), and also as a by-product 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). With more than half of the global supply of cobalt mined in the DRC, and half refined in China, however, 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 conflict in the extractive sector has led to significant instability (Davis and Franks 2014), and alternative sources of cobalt are now being sought. One as yet un-mined 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 region through a small number of mining companies and Pacific island nations, supported by the United Nations International Seabed Authority (ISA). Established in 1994, under the 1982 United Nations Convention for the Law of the Sea (1982), and headquartered in Jamaica, the ISA is an autonomous intergovernmental body that considers and approves applications for exploration of 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 of national waters and Exclusive Economic Zones (EEZ) (Miller et al. 2018). To date, the ISA has issued 31 exploration licenses to state-backed companies, multinational corporations and start-ups to explore more than 1.3 million square kilometres of the seabed in the Atlantic, Pacific, and Indian Oceans.

The ISA’s mandate is to ensure that the resources of the international seabed beyond the limits of national jurisdiction will be developed for the benefit of all *humankind* (UNCLOS 1982 Articles 136, 137.2 and Article 145) by ‘attracting investment and technology, whilst demanding that necessary measures be taken to ensure effective protection of the marine environment’ (Van Nijen 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 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’ (IUCN 2020). As Levin et al. (2020) argue, 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’ (Levin et al. 2020: 789). Furthermore, 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 2010-16, the European Union funded the Pacific Community (SPC) to develop model deepsea mining legislation for Pacific Island states through the SPC-EU DSM project and the Abyssal Initiative (DSMC 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 2019). Indeed, the SPC was established as a colonial structure in 1947, and today it acts as a conduit of funding from donor nations though providing technical and scientific advice to Pacific island countries. It is largely funded externally by the Australian Government, EU, France, New

Zealand and the United States (SPC 2020) and currently has an Australian Director-General (SPC 2020). Only one year after its inception, the SPC-EU DSM project had developed a Regional Legislative and Regulatory Framework for Deep Sea Minerals Exploration and Exploitation (RLRF) '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 2019: 6).

One company at the forefront of opening up the seabed to extractivism is the Canadian based multinational, DeepGreen, which 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 Inc. (IUCN 2020). Adopting a 'greenscam' designation (Ehrlich and Ehrlich 1991: 23), DeepGreen moved away from the approach adopted by Nautilus of striking deals with individual Pacific island countries to mine in their EEZs, instead investing its energies in The Area through its state-sponsored subsidiaries. Its Chairman is the founder of AdStream—'the world's most powerful advertising delivery platform' (Adstream 2020). DeepGreen does not refer to their proposals as *mining*, but instead DeepGreen portrays itself as '*collecting*' the polymetallic nodules it is seeking to acquire from the abyssal plains of the deep ocean floor. DeepGreen has been accused of 'greenwashing' (de Freitas Netto et al. 2020) in its positioning of deepsea 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 2020).

> 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. (DeepGreen 2020).

DeepGreen's history of having emerged from the controversial Nautilus venture (IUCN 2020), its off-take agreement with the transnational mining company, Glencore, and its recent partnering with the Swiss firm Allseas that specialises in offshore oil and gas pipeline installation (Barich 2019a) 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 2019b), a move they expect will appease the increasingly negative reaction from scientists and activists.

Although DeepGreen claims that the ocean floor has very low biodiversity (Barich 2019b), 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 (Miller et al. 2018: 12; Heffernan 2019). Impacts will include the physical destruction of habitat and organisms in the mining path, changes to the functioning and composition of ecosystems, species extinction, changes in light or noise

levels which may interfere with organisms' ability 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 (Miller et al. 2018; Heffernan 2019). 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 ISA and the Nauru government has been suggested by a number of not-for-profit organisations, including Greenpeace, IUCN, Deep Sea Mining Campaign (DSMC), London Mining Network and Mining Watch Canada. While private mining companies do not have participant status at ISA annual sessions and they do not qualify for ISA observer status (reserved for non-governmental 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 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 2019: 2).

Van Dover (2017, cited by 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 application of the precautionary principle and a moratorium on deep sea mining until impacts can be better assessed (DSMC 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 (EIS), and to attract investors in order to allow it to move from exploration to exploitation (DSMC 2019). DeepGreen has partnered with 'independent' scientific institutions for the purposes of gathering data for its EIS to allow for evidence-based decisions and find ways to 'minimise harm' (DeepGreen 2020). They are also seeking support from conservation organisations (Barich 2019b). Apart from the performative PR, 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 are highlighted in many sectors, including digital technology (see, e.g., Abdulla Abdulla 2020), the gas industry (The Australia Institute 2016), and coal mining (Cox 2019).

2. Fueling 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. 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 (Satyro et al. 2018; Brisman and South 2014). There are four types of product obsolescence: 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; systemic obsolescence where a wider system is altered so it is difficult to use or maintain services for a product; and, 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 it becomes non-functional. As a result, consumers purchase new replacement products and thus contribute to extraction, production, consumption—all required to fuel the growth of the capitalist economy.

Planned obsolescence can also involve intentionally designing for limited repair opportunities so 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, where there are longer-lasting alternatives (Guiltinan 2009; Rivera and Lallmahomed 2016). Intentionally shortening the lifespan of products by design or intellectual property stipulations, especially electronic and digital devices, has significant environmental impacts as more waste is created and needs to be disposed of. New products are produced and these require the extraction of materials from the earth 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). As an example to illustrate how corporations deny consumers their right to repair (Hernandez et al. 2020), we point to agricultural technology (AgTech) company John Deere, which received negative press internationally for preventing farmers from repairing their own tractors (Carolan 2018). There has been some attempts to introduce or enforce 'right to repair' laws, for example in the United States (US), that 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). Another example is Apple—a company that explicitly brands itself as *'officially in the green.'* 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 on one hand Apple runs 'greenwashed' campaigns about its environmental efforts and credentials, on the other, 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 (for example, batteries that are glued in, the use of proprietary screws that only Apple (or

authorised third parties) can unscrew (see e.g. Statt 2017). All of 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 environmental harm.

3. E-waste: Transference, transport, and 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). To make matters worse, only 20% of e-waste is recycled (UN Environment 2019), the remainder forms part of what the United Nations 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). The e-waste industry is one of the largest and fastest growing illegal industries in the world (Interpol 2019). It is estimated that about 50 million tons of e-waste is created each year, much of which 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).

The illegal trade in e-waste is fostered by both an ever-increasing demand for electronic products worldwide and industry's systemic adoption of design for fast consumption cycles also known as 'planned obsolescence', as discussed above (Satyro et al. 2018). Hundreds of tons of used computers, televisions and other electronic products are discarded every month. The illegal trade in e-waste involves smuggling operations where e-waste is sometimes classified as 'second-hand' goods and dumped in countries such as Benin, Ghana, India, Nigeria, Pakistan, and Vietnam. Much of it ends up in 'unreported largely unknown destinations' (Kamal 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; Kenyon 2018), which often involves illicit disposal methods and 'terrorist and organised criminal groups' (Lambrechts and Hector 2016: 251). 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 2019).

The identification of illegal flows of waste has resulted in various legal and regulatory instruments seeking to control and prevent illicit disposal. The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal 1992 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 (Paraschiv 2015; Basel Convention 2019). 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 impacts amounting to a humanitarian crisis (Ajibo 2016; World Health Organisation 2019). 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/or effluents from cyanide leaching (Bisschop 2016). As Walters and Fuentes-Loureiro (2020: 16) argue, 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.'

4. 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) argue 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, for example 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 in 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 (2020) argues: '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 technology and solar panels in such a way that metals and minerals are easily recoverable at the end of the product life cycle (United Nations Environment Program 2013). Reducing extraction, production and consumption is, however, 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. Yet, in face of these challenges, design research may offer some optimistic and positive inspiration for green and digital criminology scholars. Design research is the scholarly inquiry into design practices, or what Cross (2006) – in epistemological terms – refers to 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 et al. 2017; Yigitcanlar et al. 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 harm (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) questions design's focus on the individual user and calls for moving beyond efficiency gains and usability in order to extend design's remit beyond behavioural patterns and consumption choices to include notions of citizenship and polity. He argues 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 and colleagues (2015; see also Foth 2018) seek 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 well-being. 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 lot 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 regulation and the law tend to be reactive to technological advancement, whereas the mixed teams we operate within are better at anticipating regulatory repercussions already at the ideation stage before a new technology is launched. Furthermore, as 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, which 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 around ecological and climate debt made by scholars and policy makers in the semi-periphery and periphery of the global economy (Martinez-Alier et al. 2014; Warlenius et al. 2015). The blithe response by mining companies to legitimate concerns of serious social and environmental harm is indicative of their confidence that their role in the supply chain is guaranteed by the regulatory structures which 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 deepsea mining provides a direct conduit for 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 be 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 new innovations of venture capitalists. The panacea of 'green growth' is now assumed in national and international policy, 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 Kallios 2019: 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 we need, as Wallerstein (2005) argues, to '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 (Yigitcanlar et al. 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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