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Data and oil: Metaphor, materiality and metabolic rifts

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Abstract

'Data is the new oil' is a phrase that is frequently employed to indicate that digital technologies and data extraction have supplanted fossil fuels and geological extractivism as the central driver of the global economy. While this metaphor has been subject to discursive and ideological critique within media, communication and cultural studies, this article conducts a materialist analysis of the connections between data and oil. While claims that data is the new oil typically assume digital technologies to be clean, renewable and sustainable, an infrastructural approach reveals the vast quantities of oil and other fossil fuels necessary for digital capitalism, therefore repudiating claims that data can grow exponentially with no material costs. Consequently, the article explores how metabolic rifts and degrowth offer productive frameworks for outlining the contours of a sustainable and equitable digital future.

Keywords

Advertising, bitcoin, data, data colonialism, data is the new oil, data mining, degrowth, extractivism, infrastructure, metabolic rift

Introduction

In 2011, The World Economic Forum declared that 'data will be the new oil' (Schwab et al., 2011: 5), arguing that exponential growth in data would soon see it become 'a new type of raw material that's on a par with capital and labour' (Schwab et al., 2011: 7). Since then, the metaphorical assertion that data is the new oil has become commonplace within business and technology publications such as Wired (Toonders, 2014), Forbes (Bhageshpur, 2019) and the Financial Times (Capital, 2016). In 2017, the Economist

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argued that data had supplanted oil as the world's most valuable resource (Economist, 2017). The argument advanced here is that digital data has supplanted fossil fuels as the key material that defines contemporary socio-economic organisation. The data revolution is argued to be of similar historical and social importance to the industrial revolutions in the 19th and 20th centuries. Furthermore, claims that data is the new oil indicate an imagined shift from the dirty extractive industries of the past and present, towards a smart, sustainable future where disembodied information floats weightlessly like the clouds that are used to describe today's planetary digital infrastructures. Whereas oil is a finite and rivalrous resource, data is understood to be not just nonrivalrous (able to be shared, copied and reused without affecting the original), but is erroneously considered able to grow ad infinitum without having any tangible material impact, leading to claims that data is the 'ultimate renewable resource' (Bhageshpur, 2019).

Data and oil are further connected through shifting notions of extractivism and mining. As Nick Couldry and Ulises Mejias (2019) have recently argued, whereas industrial capitalism was predicated on a colonial model of extractivism that exploited and profited from conquering new territories, resources and labour forces, today data colonialism proceeds by acquiring a new type of common resource from which value is extracted: data about and designed to predictively act upon life itself, especially human life. This is not merely the intensification of processes of epistemic extractivism that always comprised a key element of colonialism (Smith, 2013), but a novel mode of biopolitical control centred on probabilistic predictions that rely upon planetary-scale computational assemblages, machine learning algorithms and big data (Amoore, 2020; Bridle, 2018). Although this connection is not typically foregrounded within claims that data is the new oil, it productively highlights how differing forms of extractivism have been and remain pivotal to capitalist-colonialist political-economic models.

While the metaphorical connection between data and oil and its underlying ideological connotations have been critically examined within media, communication and cultural studies (Couldry and Yu, 2018; Gregg, 2015; Lupton, 2019; Puschmann and Burgess, 2014; Stark and Hoffmann, 2019), this article aims to construct a bridge between this body of work, eco-materialist media studies (Cubitt, 2016; Parikka, 2015; Taffel, 2019) and critical infrastructure studies (Hogan, 2018; Parks and Starosielski, 2015; Rossiter, 2016). Doing so reveals that practices such as data and bitcoin mining are dependent on energetically and materially intensive extractive industrial processes; alongside the metaphor, there exists numerous socially exploitative and ecologically unsustainable material relationships that are scarcely acknowledged by most discussions surrounding data and oil. The fact that digital infrastructure is typically designed to be unseen and unacknowledged (Leigh-Star, 1999) acts alongside the discursive framings of data as immaterial or as liquid to mystify these entanglements between computational capitalism and the extractive industries. Data is actively produced by diverse extractive processes whose social and ecological harms are profoundly differentiated, with these harms predominantly experienced far from urban centres in wealthy nations. The rhetoric of ongoing exponential increases in digital data is fundamentally incompatible with addressing Anthropocenic ecological crises; it forms a capitalist-colonialist fantasy that sustains the myth of perpetual economic growth without material limitations.

Recognising that data cannot grow infinitely requires re-evaluating digital activities which are currently appraised by their contribution to exchange value on financial markets. In formulating this re-evaluation, I propose that combining elements of eco-socialist discourse focussing on metabolic rifts with a degrowth perspective offers a promising avenue. Metabolic rift theory productively delineates how capitalist models of production that emphasise exchange value systematically exploit humans and ecosystems (Foster et al., 2011; Moore, 2015), whereas degrowth stresses the urgent need for a deliberate reduction in energy and resource use that increases equity (Hickel, 2019; Kallis, 2018). While some eco-socialist approaches problematically advocate for perpetual economic growth on a finite planet (Kallis, 2019), degrowth potentially remedies this. Conversely, elements of the degrowth movement exhibit a profound technological scepticism that can be addressed by eco-socialism. Digital degrowth then, is a purposeful approach to systematically reducing the sum material and energy footprints of digital technologies while increasing social equity. In the final section, I focus on bitcoin mining and advertising platforms (Srnicek, 2016) as two current data-based activities whose ecological damage vastly outweighs their social benefits.

Metaphor

The relationship between data and oil is principally conceptualised through metaphor, as exemplified by claims that data is the new oil. Existing analyses correspondingly focus upon how and why metaphors are employed to construct discourse. As Cornelius Puschmann and Jean Burgess (2014: 1695) outline, metaphor 'is an important conceptual tool that enables us to understand abstract concepts in terms of more familiar and concrete ones'. 'Data is the new oil' is not the only metaphor that surrounds data; there are also proclamations of a data deluge (Anderson, 2008), data revolution (Kitchin, 2014), and data tsunamis (Zander and Mähönen, 2013); however, claims that data has superseded fossil fuels as the paradigmatic commodity in contemporary society will be my focus here because of the importance accorded to this purported transition from industrial to informational societies.

There are, however, several additional important connotations suggested by this metaphor. These include data as a natural force to be controlled, data as a resource to be extracted and consumed (Puschmann and Burgess, 2014) and data as a liquid substance (Lupton, 2014: 106–107). Each connotation has ideological implications, stating data to be an independently existing entity which can be extracted, that data is hard to control or regulate due to its fluidity and that data should be subject to marketisation due to its status as a commodity. Together, these connotations work to naturalise data as something to be bought and sold within the framework of a competitive market (Couldry and Yu, 2018).

Claims that computational information and communication systems have supplanted fossil fuels in driving social, cultural and economic logics are, however, far from new. For example, Spanish sociologist Manuel Castells' trilogy of books on the information age which were released in the mid-1990s argued that since the introduction of the personal computer in the late 1970s, society was transitioning from an industrial to an informational society, where information was understood to be the raw material on which technologies acted (Castells, 1996). Following the metaphor, the industrial revolution is commonly understood to have been composed of several relatively distinct periods where different fossil fuels played transformational roles. While coal was key to the expansion of railways and steamships in the 19th century, oil later occupied a dominant role associated with automobiles, aircraft and products such as plastics in the mid-20th century.[1] Homologously, whereas the introduction of the personal computer and TCP/IPv4 networking protocols were associated with global supply chain logistics, just-in-time production and neoliberalism (Beer, 2016; Harvey, 2005), today's digital landscape, incorporating the internet of things, wirelessness and cloud computing is associated with platform capitalism and data colonialism, where according to Nick Srnicek (2016), data is the raw material enabling platforms to flourish.

The discursive move away from information, which implies already processed, analysed or structured data, towards the idea of data as raw material, or worse still, raw data, should not simply be accepted at face value. As Geoff Bowker (2005) and Lisa Gitelman (2013) have argued, raw data is an oxymoron. Data does not exist 'out there' in the world waiting to be collected; it must be actively produced or generated. The mystification that occurs when discussing raw data or data as a raw material is that the material processes and instruments required to produce data are obscured while data is effectively naturalised. Raw data employs a metaphorical sleight of hand, contending that whereas crude oil requires fractional distillation before the raw material becomes marketable commodities such as kerosene, naphthene and petroleum gas, an analogous process sees raw data aggregated, cleaned and analysed to become commercially productive information. This should, however, be understood as obfuscating processes of data collection, which are purposive actions whereby sensors measure and record phenomena, either directly or by proxy. This process is not the revelation of pre-existing truths about the world, but following key insights from science and technology studies, the act of measuring is a relational encounter defined by the social and technological actors enrolled in the process of generating measurements (Latour, 1999).

For example, consider the data gathering associated with a Fitbit wearable fitness tracker. Among the activities the device supposedly measures are the number of steps taken by the wearer, which are quantified by a 3-axis accelerometer that converts movement into an electrical signal, acting in conjunction with a step counting algorithm which interprets data produced by the accelerometer, deciding which data indicates steps and which does not. While the device allegedly measures steps, it is worn on the wrist, so what is actually measured are movements of the arm that are claimed to be a reliable proxy for movements of the leg, as typically a swinging motion of the arm accompanies walking. However, the recorded motion data is not a dependable proxy in numerous circumstances; when the user is carrying a child, pushing a pram, or has their hands in their pockets, steps are not counted. Conversely, a range of activities which do not involve walking, but involve similar arm movements, such as patting a child to sleep, are often recorded as steps. The point here is not that the recorded data is imperfect or inaccurate, but that producing data is not a straightforward case of recording reality; it involves a material encounter between human and technological agents whose specific affordances generate and analyse data. These signals rely upon what David Beer (2015) discusses as 'productive measures', whereby what can straightforwardly be quantified becomes increasingly valuable within broader contexts of datafication. In turn, this enhanced value drives further datafication, leading to a significant feedback loop that drives the valorisation of what can readily be measured and recorded. This sense of data production as a material encounter involving social and technological actors is one that leads me away from the imagined metaphorical relationships between data and oil, towards thinking through their material ties.

Before doing so, however, I wish to highlight a dimension of the metaphor that is not typically foregrounded when the Economist and other right-wing outlets promote the idea that data is the new oil. Entangled with oil's pivotal economic role within mid- to late-20th century, industrial capitalism was its function as a driver of colonial conquest and geopolitical conflict. Even after formal colonisation ended, governments were overthrown for daring to suggest that oil might be nationalised, such as the 1953 Iranian coup that saw the United States and United Kingdom remove the democratically elected prime minister of Iran, Mohammed Mossadegh. Subsequently, in 1956, British Foreign Secretary Selwyn Lloyd noted that Middle Eastern oil was 'a vital prize for any power interested in world influence or domination. We must at all costs maintain control of this oil' (quoted in Curtis, 2003: 16). Indeed, the rise to prominence of neoliberalism during the 1970s is often ascribed to high inflation and unemployment in Western democracies that resulted from the 1973 oil shock, where the Organization of Arab Petroleum Exporting Countries launched an oil embargo at nations that were supportive of Israel during the Yom Kippur War (Harvey, 2005: 27–28; Mitchell, 2011; Srnicek and Williams, 2015: 60–62).

While 'data is the new oil' is intended to signify economic power, it is important to remind ourselves that contrary to claims of technocratic political neutrality, economic power always entails political dimensions. Geopolitical inequalities and colonial conquest are key factors in the history of carbon democracy and fossil capital. Rethinking the metaphor 'data is the new oil' should draw parallels between the injustices associated with colonial and postcolonial extractions of geological wealth and data colonialism's extraction of contemporary wealth.[2] In both cases, powerful corporate actors argue that they alone possess the means to extract valuable raw materials and refine them into commodities that will allegedly benefit humanity, but which actually enrich economic elites, increase economic inequality and cause significant ecological harm. This is not to merely argue that oil had undesirable social, ecological and political effects and that data likely has homologous issues surrounding privacy and security. Instead, it signals that extractive relations predicated upon inequality, domination and the formation of sacrificial zones have been and remain central to the expansion of capitalist economic development (Bridle, 2018; Farrier, 2019).

Materiality

Returning to the point that the production of data is always a material encounter, this section aims to illuminate numerous connections that exist between data and oil through employing the kind of materialist analysis associated with ecological (Caraway, 2018; Taffel, 2013) and geological (Parikka, 2015) approaches to media technologies. An ecological focus on following the circulation of matter and energy within media assemblages, allied with media geology's emphasis on the dependency of media technologies on planetary commons provides a useful corrective to approaches that posit data as the ultimate renewable resource. All too often, focussing on the problematic adoption of metaphors surrounding data and oil obscures the material entanglements between fossil fuels and platform capitalism.

Mapping assemblages of data and oil provides an important perspective for understanding how the knowledge/power nexus operates in computational capitalism. This involves shifting the focus of digital exploitation away from a critique of surveillance capitalism's encroachment upon the liberal fantasy of individual human autonomy (Zuboff, 2019), instead foregrounding unequally distributed social and environmental harms associated with the material dimensions of digital extractivism. The multiple material connections between data and oil require elaboration partially because of the commonplace misconception that a technological teleology runs from primitive tools, through dirty and polluting industrial machines, to smart, green information technologies that depend on immaterial labour, and produce virtual realities and where knowledge resides in a cloud. Behind this obfuscatory discourse, however, lies a material reality whereby digital technologies and the data they produce are deeply entangled with dirty, toxic and energy-intensive extractive industrial processes. Focussing upon materiality does not, however, imply that discourse is unimportant; the aim is to demonstrate how popular ideas about digital technology conceal substantive social and ecological harms. Without shifting the discourse, those harms are likely to remain unaddressed.

At one level, between 15% and 25% of the mass of most digital microelectronics devices are literally made of oil in the form of plastics (Fisher and Kingsbury, 2003; Hobi International, 2013): synthetic polymers derived from petrochemicals. Plastics are used in microelectronics for numerous reasons: as electrical and thermal insulators, they are well-suited for components such as circuit boards, their light-weight and capacity to be moulded while retaining strength and durability makes them appropriate for cast parts such as casings and fans and their elasticity is ideal for flexible components such as cable housings. Cumulatively, electronics industries use approximately 18 million tonnes of plastics every year (Geyer et al., 2017). The presence of such significant quantities of plastics within microelectronics allied with issues surrounding plastics' non-biodegradability and bioaccumulation denotes that digital technologies are among the substances associated with contemporary concerns over oceanic plastic pollution and terrestrial electronic waste (Taffel, 2016).

While the complex geographical flows of electronic waste significantly depart from straightforward narratives of the developed world dumping toxic waste on impoverished areas, 'there are undeniable toxic impacts on people and environments associated some forms of e-waste processing especially, but not exclusively in developing countries' (Lepawsky, 2015). E-waste is far from equally produced: of 53.6 million metric tonnes of e-waste produced in 2019, countries such as Rwanda and Sierra Leone generate around 0.5 kg per capita, whereas the United States, United Kingdom and Australia produce over 20 kg per capita (Forti et al., 2020). As with many Anthropocenic crises, the problem is not an undifferentiated humanity but economically privileged humans. Harms resulting from e-waste include children with elevated levels of lead in their blood (Guo et al., 2014) and DNA damage (Liu et al., 2009). While these harms arise from the presence of heavy metals, plastics in e-waste also impair human health in e-waste processing areas, such as elevating levels of endocrine-disrupting chemicals such as bisphenol a, which has been found in both adults and unborn babies in e-waste processing sites (Zhang et al., 2020), and the production of persistent organic pollutants such as dioxins and furans that are released when plastics are burnt, a process that occurs when wires have plastic casings incinerated so the valuable copper can be accessed (Basel Action Network, 2002).

Another material connection between data and oil surrounds the production of the devices and infrastructures that are required for digital capitalism to operate. Digital technologies are materially complex artefacts, typically requiring between 60 and 70 of the 84 nonradioactive elements found on earth. From tantalum capacitors to gold-plated pins, copper wires, silicon chips, indium-tin oxide capacitive touchscreens and lithium-nickel-cobalt batteries, these materials are employed to leverage their unique affordances (Crawford and Joler, 2018). Procuring these materials requires globalised extraction industries which have a wide range of deleterious impacts for ecosystems and human populations, not least of which are the energy – and therefore fossil fuel – requirements for extracting materials from the planet.

It should, however, be noted that what is removed from the earth is not tantalum, indium, lithium or lanthanum; extracted ores scarcely resemble the highly purified materials required for reliable, high-performance microelectronics (Starosielski, 2016). For example, consider the manufacture of silicon, which is used as the semiconductor base for integrated circuits. Despite being the second most-abundant element on earth (Opfergelt and Delmelle, 2012), naturally occurring forms of silicon such as the silicon dioxide that comprises the major constituent part of sand and quartz crystals are far removed from the highly purified silicon required for semiconductors.

The silicon chips that are often described as the brains of our digital devices require 'nine nines' purity, 99.99999999%; for every billion atoms, only one non-silicon atom is permissible. Producing this extremely pure material requires numerous complex chemical processes involving precise control over the temperatures at which reactions occur. This requires substantial amounts of energy, which with contemporary energy mixes means considerable usage of fossil fuels including oil. First, high-purity silica sand or lump quartz is placed in powerful electric furnaces, producing a reaction that removes oxygen, leaving 99% pure silicon metal. This is then subjected to the Siemens process, which combines silicon metal with hydrogen chloride to produce trichlorosilane, which is subsequently distilled and purified at 1050° C (Dazhou, 2017) to produce polysilicon. That polysilicon is then melted and spun within highly purified iota quartz crucibles – the only substance chemically similar enough to elemental silicon to avoid contamination – to produce silicon ingots which are sliced into wafers and sold to microchip manufacturers such as Intel and AMD (Vince, 2018).

In addition to the extraction of materials from the earth, contemporary microelectronics industries are dependent upon the extraction of specific elements from the ores that exist entangled with one another prior to anthropogenic processes of purification. These materials that rarely or never occur without human intervention are described as 'technofossils' and are said to provide a geological indicator that the earth has left the Holocene (Zalasiewicz et al., 2014). Elemental aluminium, plastics and nine nines silicon are examples of technofossils, without which digital colonialism simply could not exist in anything approaching its current form. The production of these technofossils depends upon planetary extraction industries and complex chemical processes, which both require immense amounts of energy. Again, we see that without oil and other fossil fuels, there would be no data revolution.

Consequently, it is perhaps unsurprising that despite only weighting around 120 g, a top-of-the-line iPhone has lifetime carbon footprint of 110-kg CO2e (Apple, 2019a), whereas a top-end Mac Pro 2019 desktop has a carbon footprint of just under 7 tonnes (Apple, 2019b). Of course, the globalised network that moves ores from mines to numerous refineries for purification, then onto various factories for manufacturing into discrete components and eventually brings these components together to manufacture the phone requires a huge amount of transportation, the vast majority of which is currently powered by oil and other fossil fuels. According to Edward Humes (2016) 'the iPhone has a transportation footprint at least as great as a 240,000-mile trip to the moon, and most or all of the way back'. This logistical supply chain system is far from evenly distributed across the globe, existing within the geopolitical territoriality that Martin Arboleda (2020) describes as the 'planetary mine' and circuits of extraction of 21st century capitalism. Transportation, however, is a minor element in life cycle carbon emissions for microelectronic devices. Portable devices such as the iPhone typically see approximately 80% of lifecycle emissions associated with production, while over 90% of emissions from desktop computers such as the Mac Pro arise from production and use (Apple, 2019a, 2019b).

When considering the energy and fossil fuel demands of contemporary computing, it is crucial not to myopically focus on end-user devices which only comprise the tip of the technological iceberg required for platform capitalism to function. Data centres, 3/4/5G cellular towers, Wi-Fi routers, the sensors required for smart city projects, GPS satellites and hundreds of millions of kilometres of fibre optic cable are just a handful of the material- and energy-intensive technologies required for data colonialism to operate. Indeed, estimates are that by 2030, 21% of all global electricity demand will be for information and communications technologies (Andrae and Edler, 2015). While existing literature primarily focusses on the electricity requirements of data centres (Brevini, 2020; Brodie, 2020; Cubitt et al., 2011; Hogan, 2015), Andrae and Edler's (2015), modelling suggests that data centres will use less electricity than fixed access wired and Wi-Fi networks, with extraction/manufacturing and wireless network access use also being substantial contributors to the total energy requirement. In contrast to these infrastructural energy requirements, consumer devices are anticipated to be responsible for just 8% of the electricity use associated with communications technologies.

It turns out then, that the material assemblage involved in generating digital data requires vast amounts of oil in a very literal sense when considering the volume of microelectronics that are produced from plastics. Equally, the extraction of ores from the planet and the purification of those entangled materials for use in microelectronics hardware requires immense amounts of energy, which is primarily produced from fossil fuels including oil. Transporting materials across complex global supply chains requires further oil, as does the production of the electricity required to power digital assemblages. Far from being smart, green and weightless, the cloud turns out to be more akin to a miasma of toxic smog. While popular immaterialist accounts laud data as the ultimate renewable resource mapping the flows of energy and materials required for large-scale data extraction and analysis illustrates the significant and unevenly distributed ecological and social harms associated with digital capitalism. My argument is not that digital technologies have material costs, so they are bad, but that the harms associated with digital technologies principally affect marginalised groups and strategies to reduce these harms are urgently needed.

The material relationship between data and oil is not one-way traffic though. Just as vast amounts of oil are required for data colonialism, today digital data and sensing techniques are necessary for locating oil and other fossil fuels, as large and easily accessible reserves have mainly been depleted. Techniques including seismic reflection imaging and thermal sensing visualise oil reservoirs at depths of up to 3000 m, with processes of making the subterranean visible comprising the initial stage of unearthing new sources of oil. Throughout the procurement process, fossil fuel companies today promote their use of data-driven technologies, including artificial intelligence, advanced analytics and robotics, to improve yields, boost the rate of production and maintain safety (Shell, 2020). Viewed this way, we see the merit of claims surrounding the informationalisation of industry (Castells, 1996; Hardt and Negri, 2005): just as the industrial revolution industrialised agricultural processes, today digital technologies have informationalised industrial activities.

Metabolic rifts and degrowth

Adopting a materialist approach to data's entanglements with fossil fuels reveals the oft-neglected ecological impacts of computational capitalism. To meaningfully address these harms, my suggestion is that metabolic rifts and degrowth potentially provide productive frameworks. Karl Marx (1967: 506) initially discussed metabolic rifts in the context of capitalism robbing both the worker and the soil, therefore simultaneously undermining the original sources of all wealth. Consequently, metabolic rifts have become a key conceptual framework within contemporary eco-Marxist political-economic analyses (Foster et al., 2011; Moore, 2017). In the contemporary context of globalisation and supply chain capitalism (Tsing, 2015), metabolic rifts have expanded beyond specific agricultural places and practices, or the relation between urban and rural areas. As Patel and Moore (2017) demonstrate, the ecology of capitalism has long relied upon expansionist and extractivist logics that have required the exploitation of new sources of land, nature, food and labour for centuries.

The planetary scale of contemporary extractivism is therefore an intensification of long-standing colonial-capitalist relations; however, the long-term ramifications for the climate, biodiversity and human society form a substantial departure from earlier metabolic rifts. While previous societies had significant impacts upon local ecosystems, they did not cause a planetary mass extinction event or substantively alter global atmospheric chemistry, ocean acidity or global temperatures. The numerous ecological crises that are problematically referred to as the Anthropocene (Bonneuil and Fressoz, 2016; Malm and Hornborg, 2014) indicate that the contemporary metabolic rift involves a planetary extractivist system which undermines the future by robbing the planetary commons and burning its geological heritage. Past life becomes today's fuel which poisons the future.

While speculative new frontiers for resource extraction exist, such as deep sea (Sharma, 2017) and comet mining (Bastani, 2019), capitalism's requirement for new resource frontiers to fuel economic growth has increasingly led to the commodification of communication (Dean, 2009) and data (Couldry and Mejias, 2019; Mezzadra and Neilson, 2019). Processes of datafication (Van Dijck, 2014) depend upon the extraction of materials and energy which are not global; they are unevenly distributed in specific places across the planet: Congolese tantalum and cobalt, South American lithium and copper, Chinese rare-earth elements and Middle Eastern oil are just a few pertinent examples. Whereas immaterialist accounts situate data outside of extractivist relationships, a political ecology of digital media positions data within the contemporary metabolic rift that threatens the capacity of current and future generations of life on earth to flourish.

With regard to oil, it is absolutely clear that to avoid ecological and social disaster it's paramount that we 'keep it in the ground' (Princen et al., 2013). There are clear limits to the amount of oil that can be burnt before we breach multiple planetary boundaries (Rockström et al., 2009), especially when unconventional sources of oil, such tar sands and fracking, are taken into account. Consequently, the emerging degrowth movement has sought to outline how societies can flourish without the fantasy of unlimited economic growth on a finite planet (Kallis, 2018; Raworth, 2017). There is a strong historical correlation between material use and economic growth, with no evidence for the aggregate decoupling of growth from increased material usage (Pothen and Scymura, 2015). While some developed nations have reduced domestic material use, analyses that include the importation of goods manufactured overseas (which is particularly pertinent for digital technologies) indicate that rises in gross domestic product (GDP) continue to correlate with material usage (Wiedmann et al., 2015).

Similarly, examining mainstream arguments for green growth designed to stay within the carbon budgets for 1.5° C or 2° C warming consistent with the Paris Agreement, Hickel and Kallis (2019) conclude that while a handful of cases exist where relative decoupling between material use and GDP has occurred nationally, there is no evidence supporting the permanent, absolute decoupling of resource use and GDP which is required for sustainable green growth. Consequently, they conclude that 'Staying within planetary boundaries may require a de-growth of production and consumption in high-consuming nations' (Hickel and Kallis, 2019: 483). It is important to emphasise that degrowth does not, however, posit a homogeneous reduction in economic activity. One key critique advanced by the degrowth movement is that in much of the global North, GDP is no longer a useful indicator of human flourishing. For example, despite GDP per capita in Costa Rica being just 12% of that in the United States, Costa Ricans have a longer life expectancy and report higher levels of well-being (Hickel, 2019: 58). While up to a certain point GDP per capita correlates with increased life expectancy, health and education, beyond a certain level, this correlation breaks down. Inequality within nation states, which frequently contains significant racial dimensions, entails that despite overall levels of resource and energy consumption leading to ecological crises, significant social issues around poverty, access to healthcare, education and so on obdurately endure. A postcapitalist redistribution of wealth potentially enables many of these social issues to be meaningfully addressed while substantially reducing ecological and resource footprints (Kallis, 2018).

While this is a prominent debate within ecological economics and environmental social movements, relatively little has been said about what metabolic rifts and degrowth might mean for digital technologies. Indeed, where degrowth and technology has been the subject of discussion, the focus has primarily been on labour-powered tools that increase human autonomy, drawing upon Ivan Illich's (1973) concept of conviviality (Kerschner et al., 2018; Vetter, 2018). Consequently, where digital technologies and degrowth have been discussed, attention has concentrated upon open source and open design as strategies that enhance autonomy and commonwealth, rather than the environmental impacts of data and other digital technologies (Kostakis et al., 2018; March, 2018).[3]

Given the historical emphasis on widening participation and access to reduce the digital divide, any discussion of digital degrowth may be subject to kneejerk criticism that this is merely the preserve of privileged groups who have long accrued benefits surrounding digital connectivity seeking to entrench this privilege. The retort must be that degrowth does not advocate adopting punitive measures for the global poor and digital have-nots; it requires the redistribution and reimagining of information and communication technologies, just as it requires redistributing and reimagining wealth, care and social services. Once we accept that data does not simply exist out there, waiting to be immaterially captured, but has to be actively produced through energy- and resource-intensive extractive processes, the rhetoric of ongoing exponential increases in data collection to fuel surveillance-driven models of platform capitalism is revealed to be little more than the latest colonial-capitalist fantasy.

A second objection to digital degrowth centres upon the pace of digital innovation. While decoupling material use from GDP has not been demonstrated, significant material- and energy-related efficiency increases are demonstrable in numerous specific measures of digital performance, from transistor density within integrated circuits, to data centre compute and storage, to GPU performance-per-watt. The problems with lauding these technological advancements as a technologically deterministic pathway to resolving the material and energy costs of digital assemblages are not just fast approaching material barriers to continued efficiency gains,[4] but that these substantive improvements in efficiency occur within the broader context of continued increases in energy and material requirements. This exemplifies Jevons (1865) paradox, whereby gains from increasingly efficient use of a resource fail to result in reduced consumption of that resource. Put simply, while GPUs, smartphones and servers are many times more efficient than they were a decade ago, corresponding increases in processing power mean they require more energy and materials than their less efficient predecessors. Furthermore, this occurs within the context of expanding numbers of digital devices and accompanying infrastructure required for these assemblages to function. Consequently, despite considerable efficiency savings, Andrae and Edler (2015) anticipate a four-fold increase in energy consumption from ICT between 2010 and 2030.

Addressing this situation requires going beyond efficiency savings (Zoellick and Bisht, 2018) and necessitates reconsidering what kinds of value are generated by specific digital assemblages. While the overall goal may be systemic degrowth, this involves significant digital growth for those with no or minimal current connectivity and within areas where computational activities produce significant social and ecological benefits. This growth should be achieved alongside substantial reductions in current digital activities that serve little or no social or ecological purpose. What constitutes social benefit will be highly contentious and requires significant debate including input from marginalised groups; however, one productive approach involves re-evaluating practices based upon use values, rather than the currently hegemonic practice of leaving this to market-based exchange value.[5]

An extreme example of perverse digital behaviour can be observed in bitcoin mining, a process that currently uses a similar amount of electricity as Argentina, a country which houses over 40 million people (Cambridge Centre for Alternative Finance, 2021). This immense amount of energy produces very little in the way of use value; it predominantly creates value based on the exchange value of bitcoin. While there are some advantages surrounding ease-of-use and liquidity compared to traditional currencies, the specific issues around bitcoin and energy use are not inherent to all cryptocurrencies but pertain to bitcoin's proof-of-work calculations which are designed to be computationally intensive and whose energy requirements rise alongside the exchange value rate of bitcoin (Greenfield, 2017: 140–142). In any ecologically sane society, bitcoin does not exist, so a degrowth strategy would promote national and international legislation prohibiting creating, issuing or circulating bitcoin, thereby reducing bitcoin's financial value and energy footprint (Hendrickson and Luther, 2017).

Equally though, digital degrowth must question the economic model that underpins advertising platforms such as Google and Facebook, one based on utilising vast amounts of data allied with computationally – and therefore energy – intensive machine learning algorithms to target users with adverts. On a planet where resources are being consumed far faster than they are replenished, while billions still live in poverty, a highly sophisticated technological system designed to manufacture desire for increased levels of consumption can only be understood as a fundamentally suicidal and self-defeating logic, one designed to extract as much profit as possible with no regard for the ecological calamity this causes.

At first glance, this position appears to parallel the critique of advertising-driven surveillance capitalism posited by Shoshana Zuboff (2019). However, the central thesis of Zuboff's argument juxtaposes a model of surveillance capitalism largely derived from Google with an advocacy-oriented capitalism based on the corporate practices of Apple. According to Zuboff (2019: 35), Apple's commercial success has been predicated upon their ability to individualise consumption, enabling 'the possibility of a new rational capitalism able to reunite supply and demand by connecting us to what we really want in exactly the ways that we choose'. From an ecological perspective, it must be emphasised that there is nothing rational about marketing campaigns designed to increase the pace and breadth of consumption of gadgets with inbuilt planned obsolescence (Haskins, 2019). The purpose of advertising is not to simply connect us with existing desires but to manufacture new desires for consumption, which consequently situates it as a key component driving ecologically and materially unsustainable economic growth. Consequently, considering what is to be done about advertising across digital contexts should be a key area for future research surrounding digital media, degrowth and metabolic rifts.

Conclusion

Connecting critiques of the metaphor 'data is the new oil' with materialist approaches to digital technologies foregrounds the ecologically unsustainable, extractive dimensions of digital capitalism and situates these contemporary processes within violent and inequitable colonialist-capitalist histories. Forging this connection additionally points towards the utility of scholarship in media, communication and cultural studies adopting the kind of eco-Marxist position associated with political ecology, metabolic rifts and degrowth. The conclusions drawn from such a synthesis regarding the socially inequitable and ecologically unsustainable direction of contemporary digital capitalism complement recent critiques of digital colonialism (Couldry and Mejias, 2019) and data as capital (Sadowski, 2019). However, while these accounts predominantly focus on the extraction of knowledge, materialist approaches to datafication additionally emphasise how planetary-scale extractive industries are a prerequisite for the acquisition of digital data.

The fantasy that digital technology is somehow immaterial – that data is the ultimate renewable resource – allows the imagined continuation of the infinite economic growth that is required for current capitalist economic models to avoid collapse. While mainstream liberal understandings of climate change and associated Anthropocenic ecological crises entail a widespread comprehension that usage of oil and other fossil fuels requires urgent curtailment, the discourse that data is the new oil maintains the fantasy that economic growth can be decoupled from material use. This is precisely why it is vital that these oft-repeated claims are revealed to be nothing more than a pipe dream based upon a fundamental misunderstanding of the energy- and resource-intensive planetary assemblages that comprise digital infrastructures.

Addressing this requires a critical re-evaluation of the ideologically laden notion that data can continue to grow exponentially irrespective of whether that data serves a socially useful purpose that exceeds enhancing exchange values or accelerating the pace of consumption. In short, this requires a reassessment of whether numerous digital systems that are typically designated as innovative and disruptive are in fact socially desirable. While this article has briefly touched upon bitcoin mining and digital advertising as two examples where little or no social benefit or use value accrues from materially intensive activity, legions of similar cases should be considered, including spam, high-frequency financial trading and streaming 8K video.[6] More broadly, the ecological impact of the privatised, oligopolistic models of platform capitalism, data colonialism, infrastructural provision and artificial scarcity-producing copyright laws are areas ripe for future studies focussed on pathways for digital degrowth. Within digital capitalism, adjudication of value is primarily left to the market, and in each of these cases, the potential for activities to enrich individuals or corporations entails that they are deemed valuable. A postcapitalist approach predicated on degrowth evaluates these activities very differently because value is centred on collective rather than individual benefits, use value rather than exchange value and ecological sustainability rather than economic growth.

This does not mean advocating for an end to all data transmission and collection – huge numbers of socially and ecologically beneficial projects rely upon data, including climate change modelling (Mattern, 2017), analysing urban air pollution (Gabrys, 2016), vaccine research and more mundane activities such as enabling friends and family to share memories and communicate across space and time. In each of those cases though, data extraction and analysis produce obvious use value, they contribute to a common good rather than simply enhancing exchange value, consuming resources to further enrich already wealthy humans at a time where the planetary metabolic rift presently results in severe and inequitably experienced harms and is predicted to have calamitous consequences for future generations.

Just as we need to keep fossil fuels in the ground, we need to abandon the fantasy that data extraction is a weightless endeavour that can grow infinitely. This means having public debate alongside the introduction of national and international regulation designed to prevent the proliferation of modes of data extraction that produce no tangible use value while requiring the unsustainable consumption of planetary resources.

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Notes

1. An important socio-political component of the transition from coal to oil relates to labour relations; this afforded significant reductions in the number of workers, allowing corporations to partially negate the power of unionised workforces whose capacity for industrial action had previously resulted in substantial gains for the working class, including the 8-hour day, social insurance programmes and pensions (Mitchell, 2011: 25–28).
2. At the same time, we should be cognisant of the long history of epistemic extractivism whereby colonising forces appropriated knowledge and cultural practices alongside land, labour and resources (Shotwell, 2020; Smith, 2013).
3. Although we should note that many beneficiaries of open-source software today are multinational corporations such as Google, Microsoft and IBM.
4. This is the case with Moore's law, where the pace of increased transistor density has slowed in recent years as integrated circuits approach the limitations of field-effect-transistor IC designs. At 2 nm, 'electron behaviour will be governed by quantum uncertainties that will make transistors hopelessly unreliable'. (Waldrop, 2016)
5. This is somewhat oversimplified, as a significant fraction of digital activities are speculative venture capital-funded ventures that fail even to enhance exchange value.
6. YouTube streams 8K MP4 video with a bitrate of 78 Mbps, over 33 times the bandwidth of a 1080p stream.

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