Colonialism, Technology and the Environment

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Contents

Objectives

- A greater understanding of the relationship between colonialism, the environment and technology
- An understanding of how historical case studies can be used alongside current examples to inform the actions that should be taken
- An understanding of how we can make judgements of what is and isn't a proportional use of technology, both at the large corporation and the individual level

Introduction

Scholarship on the links between colonialism and the environment has increased in recent years, developing our understanding of how the history of climate change is interwoven with the history of colonialism, specifically European imperialism (Mahony and Endfield, 2018). Colonialism is always about Land (Liboiron, 2021): many colonial practices attempted to engineer the climate through actions such as deforestation and mining that stripped indigenous Land of resources and, consequently, contributed to climate change which has now become a global emergency that is disproportionately affecting indigenous communities as a result of the legacies of colonialism (Green and Raygorodetsky, 2010; IPCC, 2022).[1] This report aims to situate these histories within the context of technology to show how legacies of colonialism are linked to technology and its environmental impact specifically. Whilst the technology industry is a capitalist system and thus not inherently synonymous with colonialism, the supply chains and exploitation of people, resources, and Land in the sector can be traced back to colonial practices (Crawford, 2022) However, this is obscured from public knowledge, much like how many environmentalist actions also perpetuate colonial practices and legacies due to assumed access to Land (Liboiron, 2021). This report aims to raise greater awareness of how colonialism, technology and the environment are interlinked and to equip individuals with the knowledge to make conscious decisions around their usage of technology.

It is inaccurate, however, to put all responsibility on individuals in this scenario; an individual could never have the same impact on the environment as large corporations are having and this relationship between individual and collective responsibility will be further discussed in this report (Whitmarsh, Poortinga and Capstick, 2021). However, whilst changes in supply chains and the tech sector itself must come from the large corporations, we – as individuals – can make choices about our own technology usage. This report aims to aid individuals in making these decisions as, due to the development of society, it would be hypocritical and misinformed to instruct people to simply not use technology. Whilst it would be practically impossible to avoid technology altogether, being aware of the interwoven histories of colonialism and climate – and how this impacts the technology sector today – will allow us, as individuals, to make informed choices about what technology we buy, how we use it and how we discard it.

This report will therefore look at the legacies of colonialism, technology and the climate crisis. Firstly, we will explore the interwoven histories of colonialism and climate change before discussing the contemporary connections between technology and colonial practices. The third section will explore historical case studies in order to inform the final section which focuses on what actions can be taken by individuals and large corporations respectively in order to tackle the climate crisis as well as decolonising both environmentalism and the technology sector. The report will finish with a checklist of sample questions to visually represent this.

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[1] Land is capitalised because it is "the shorthand for all these relations as a proper name that is specific and unique, not universal and common" (Liboiron, 2021, p.46). Liboiron (2021) discusses this in more detail in their book, *Pollution is Colonialism.*

This report will focus on three lines of enquiry:
- How is colonialism linked to the environment and technology?
- What can we, as individuals, do to inspire meaningful change when it comes to sustainability and decolonisation in the technology sector?
- Why is it important to highlight, understand and make change based on the ways in which the legacies of colonialism impact the environment, including efforts to become more sustainable?

Definitions

In order to understand the connections between colonialism, technology and the environment, it is vital that the deeper historical context – which begins with the relationship between colonialism and the environment – is also understood. History plays a key role in shaping contemporary understandings of these issues and therefore provides potential solutions to these problems (Berridge, 2018; Neustadt and May, 1986)

We should begin by defining key concepts such as 'climate change', 'colonialism' and 'imperialism'.

- Climate Change
  - "Any change in climate over time whether due to natural variability or as a result of human activity" (IPCC, 1996)
  - "A change of climate that is attributed directly or indirectly to human activity, that alters the composition of the global atmosphere, and that is in addition to natural climate variability over comparable time periods." (United Nations, 1992)
- Colonialism
  - "A form of domination - the control of individuals or groups over the territory and/or behaviour of other individuals or groups" (Horvath, 1972)
  - "A way to describe relationships characterised by conquest and genocide that grant colonialists and settlers 'ongoing state access to land and resources that contradictorily provide the material and spiritual sustenance of Indigenous societies on the one hand, and the foundation of colonial state-formation, settlement and capitalist development on the other'" (Liboiron, 2021; Coulthard, 2014)
- Imperialism
  - "A form of inter-group domination wherein few, if any, permanent settlers from the imperial homeland migrate to the colony" (Horvath, 1972)
- Technology
  - "Methods, systems, and devices which are the result of scientific knowledge being used for practical purposes" (Collins English Dictionary, 2023)
  - In terms of this report, this includes smartphones, computers, AI systems and electric cars to name a few. Technology is a non-exhaustive list but this report mainly focuses on devices with rechargeable batteries.

Understanding the Relationship between Colonialism and the Environment

The most common view of the starting point of colonialism in its 'modern' form is 1492, when Columbus landed off the coast of the Bahamas (Murphy, 2009). However, this ignores considerably earlier colonial actions such as English conquests of Gaelic Scotland and Ireland in the 11th and 12th centuries: English colonial rule in these countries is representative of "many of the 'ethnocidal policies' which became synonymous with colonialism" and European imperialism, as well as the idea that the earth is simply here for humans to exploit and extract from (Murphy, 2009, p.7; Margolin, 2019). These ideas expanded alongside empires from the sixteenth century onwards, with 84% of the globe under European control – or had been previously – by 1914 (Hoffman, 2015).
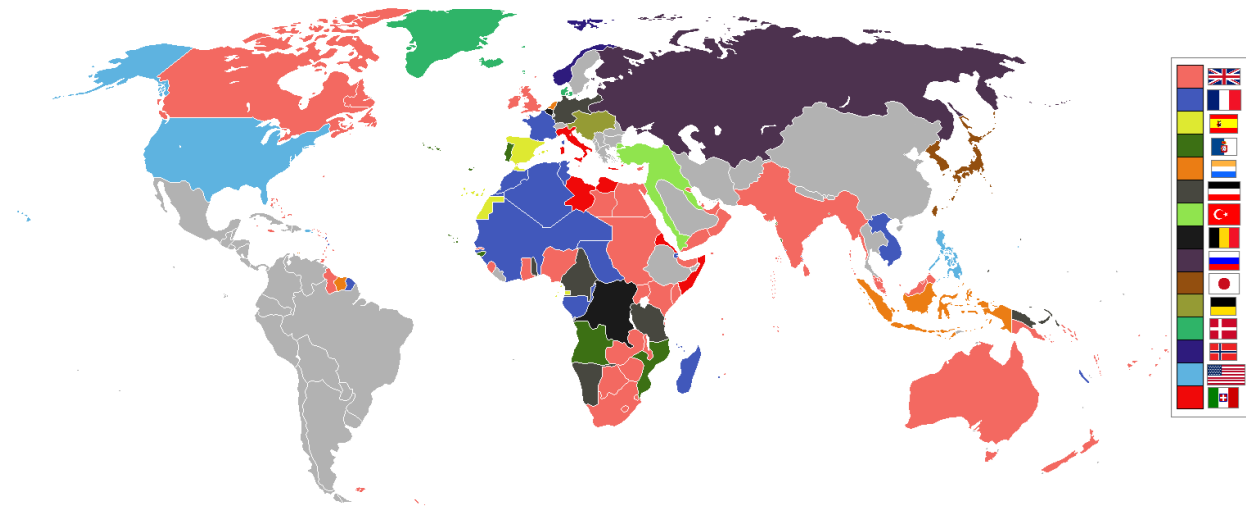

Figure 1: Map of Colonial and Land-based Empires in 1914 (Wikimedia Commons, 2010)

This report specifically focuses on how colonial practices involving the exploitation of Land and the altering of the climate are linked with ideas of empire (Mahony and Endfield, 2018, p.2). Many atrocities occurred under colonial rule, including genocide, slavery and labour exploitation (Liboiron, 2021; Mahony and Endfield, 2018; Schaller and Zimmerer, 2008) and colonialists viewed Land as a resource to be exploited instead of being "sacred and priceless" like Indigenous views of Land (Margolin, 2019; Liboiron, 2021). Specific examples will be explored in this report, but the general theme is that early European colonialists misunderstood the climate by assuming that they could alter it to fit with the same crop cycles as they were used to in Europe. Centuries of Indigenous knowledge and practices were ignored, with "pseudo-ecological arguments […] used to discredit local peoples and justify the clearance of communities"; this enabled colonialists to destroy the climate in order to produce cash crops as opposed to the staples that had sustained communities for centuries (Voskoboynik, 2018, pp.39-40). Landscapes and the climate were destroyed to suit the needs of coloniser nations through practices such as deforestation and mining, practices which are still ongoing today (Mahony and Endfield, 2018; Sarkar, 2020; Voskoboynik, 2018). The direct impact of such

practices can be seen through the climatic impact of the industrial revolution and the subsequent industrial age, including the acceleration of climate change (Reichl, 2019; More, 2014).
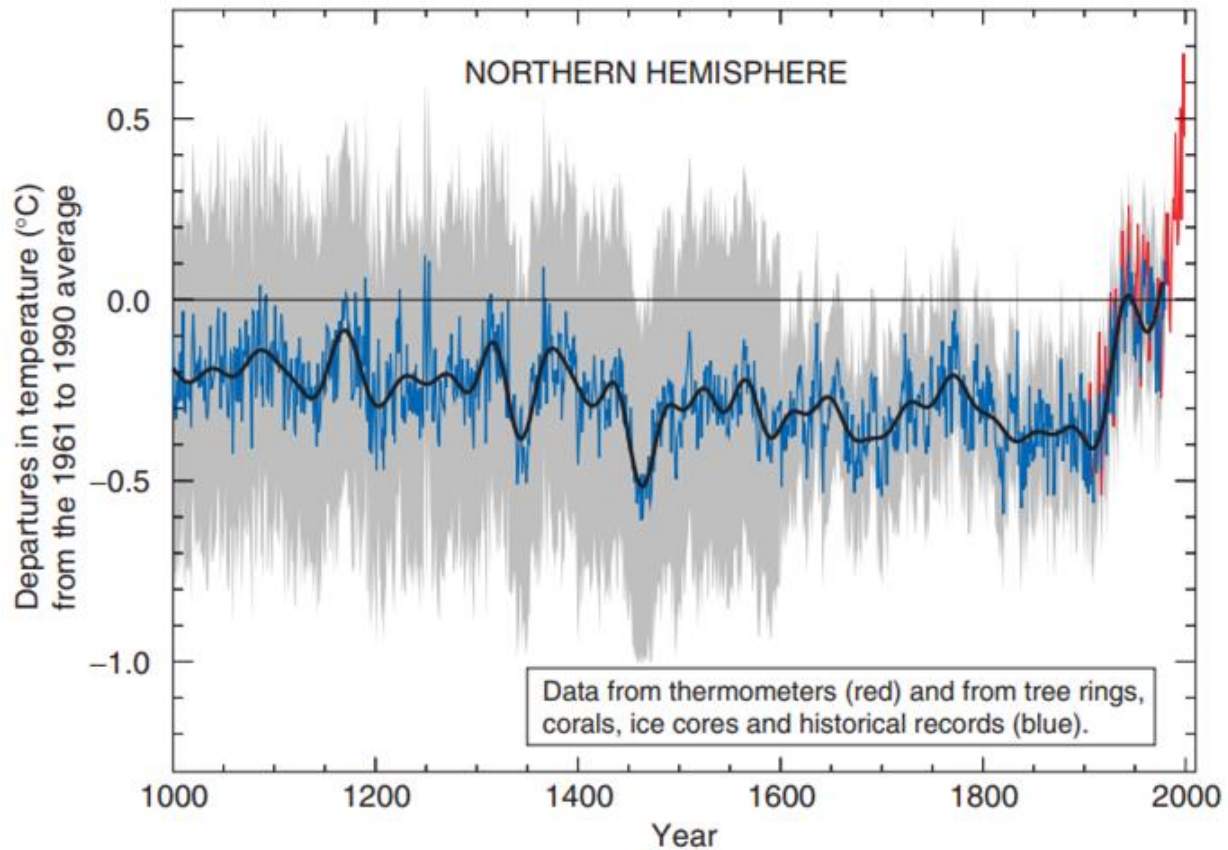
Figure 2: Variation in the Earth's Surface temperature in the past 1000 years, showing a significant increase in the 20th century (IPCC, 2001)

Evidence of the acceleration in climate change over the last century is depicted within Figure 2 which – as the 'age of colonisation' began over 400 years before this – implies that colonialism is not as influential in climate change. However, the altering of the climate and exploitation of Land and resources that were central to colonial practice contributed to this. These practices grew on a larger scale alongside the industrial revolution, with colonialism's effect on the environment beginning to take place, as shown in Figure 2.

Investigating links between colonialism and climate change is important for understanding both the rapid pace of climate change and the significance of intersectional environmental justice. The Global South is where the effects of climate change are being felt the most and these effects are worst in the poorest countries – often countries that were under colonial rule (Torres et al., 2020). These areas are also less likely to have their climate impacts researched, further

demonstrating how colonialism and its legacies are still very much alive when it comes to climate change as research focuses on Europe and wealthier nations (Callaghan et al., 2021).
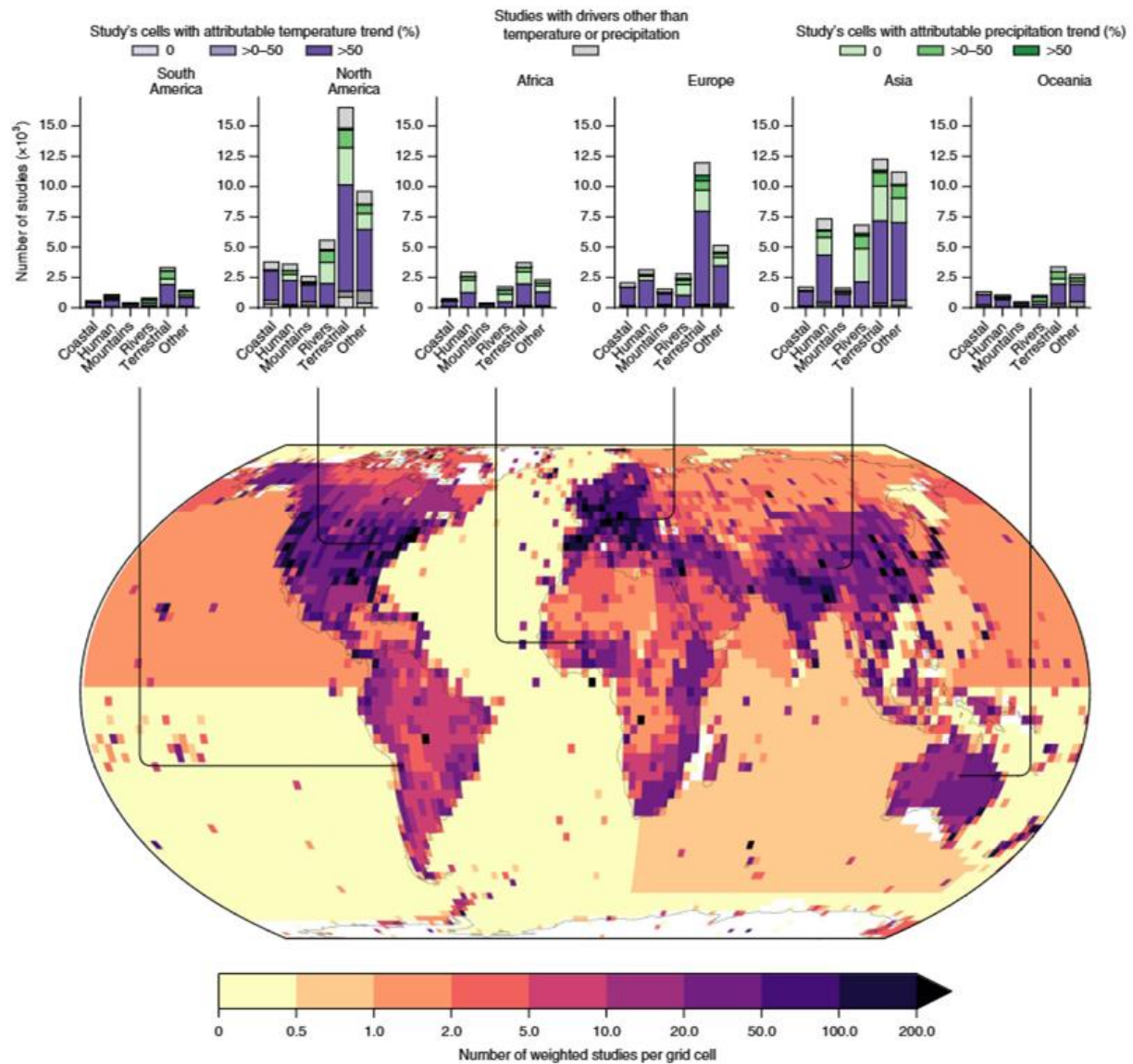

Figure 3: Map of climate impact studies. The darker the colour of the cell, the more research conducted in that area (Callaghan et al, 2021).

Whilst awareness does not solve problems or inherently lead people to make moral decisions (Baker, 2013), it does give us, as individuals, the opportunity to understand how histories of climate change are interwoven with histories of colonialism. This leads to the next section of the report, which discusses the connections between technology and the environment as well as how they link to the legacies of colonialism.

Technology and the Environment

The role of technology in everyday life is becoming ever more significant with computing power increasing exponentially every year since 1965 (Mack, 2011; Bailey et al., 2022). Technological advances can have positive impacts on human life and the environment, yet we can also see their potentially negative effects when we consider the entire lifespan of technology: its "birth, life and death" (Crawford and Joler, 2018). What happens before we, as consumers, interact with technology – as well as what happens after we discard it – is something that is concealed by corporations and governments for financial and practical considerations (Lebaron and Lister, 2015).Technology – specifically electronics used for computing – and its environmental impact go beyond the mere energy it consumes in the time that we, as users, have it for.
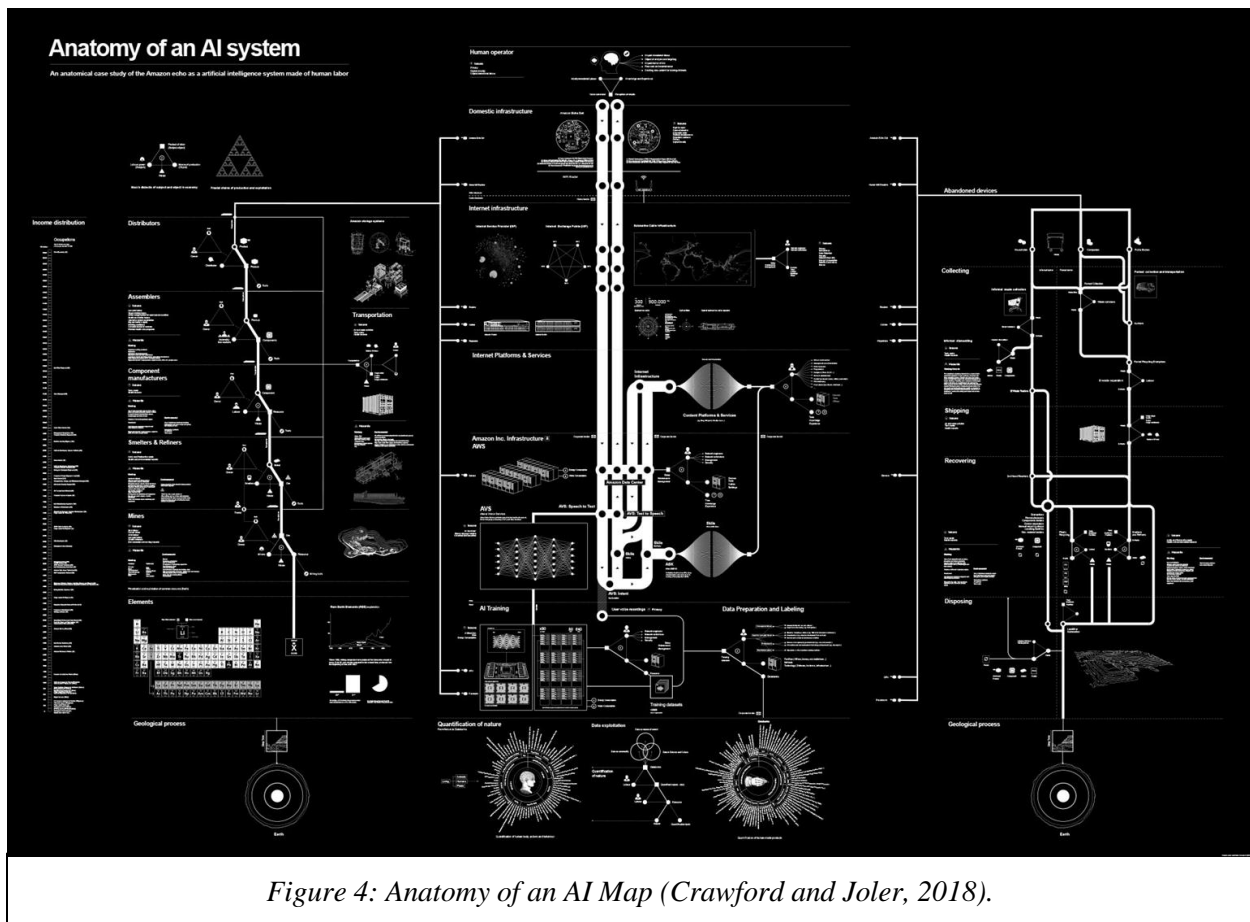

Figure 4: Anatomy of an AI Map (Crawford and Joler, 2018).

These hidden aspects of the life-cycle of technology is where a lot of the environmental damage occurs. On the surface, ICT user devices only make up somewhere between 1.8-3.9% of global greenhouse gas emissions (Freitag et al., 2020) which is significantly lower than sectors such as fashion, tourism and farming (Cambridge Centre for Alternative Finance, 2023). However, what is actually included in this estimate of greenhouse gas emissions from the tech sector is unclear. Crawford and Joler's (2018) anatomy map of the Amazon Echo has additional layers as it is an artificial intelligence (AI) system (Hussain and Al-Turjman, 2021). However, a significant amount of their anatomy map can be applied to other devices such as laptops,

smartphones and other tech devices that we use in everyday life. The creation and disposal of technological devices is often where it has the most impact on the environment, and also where it intersects with colonialism due to the practices used in this process.
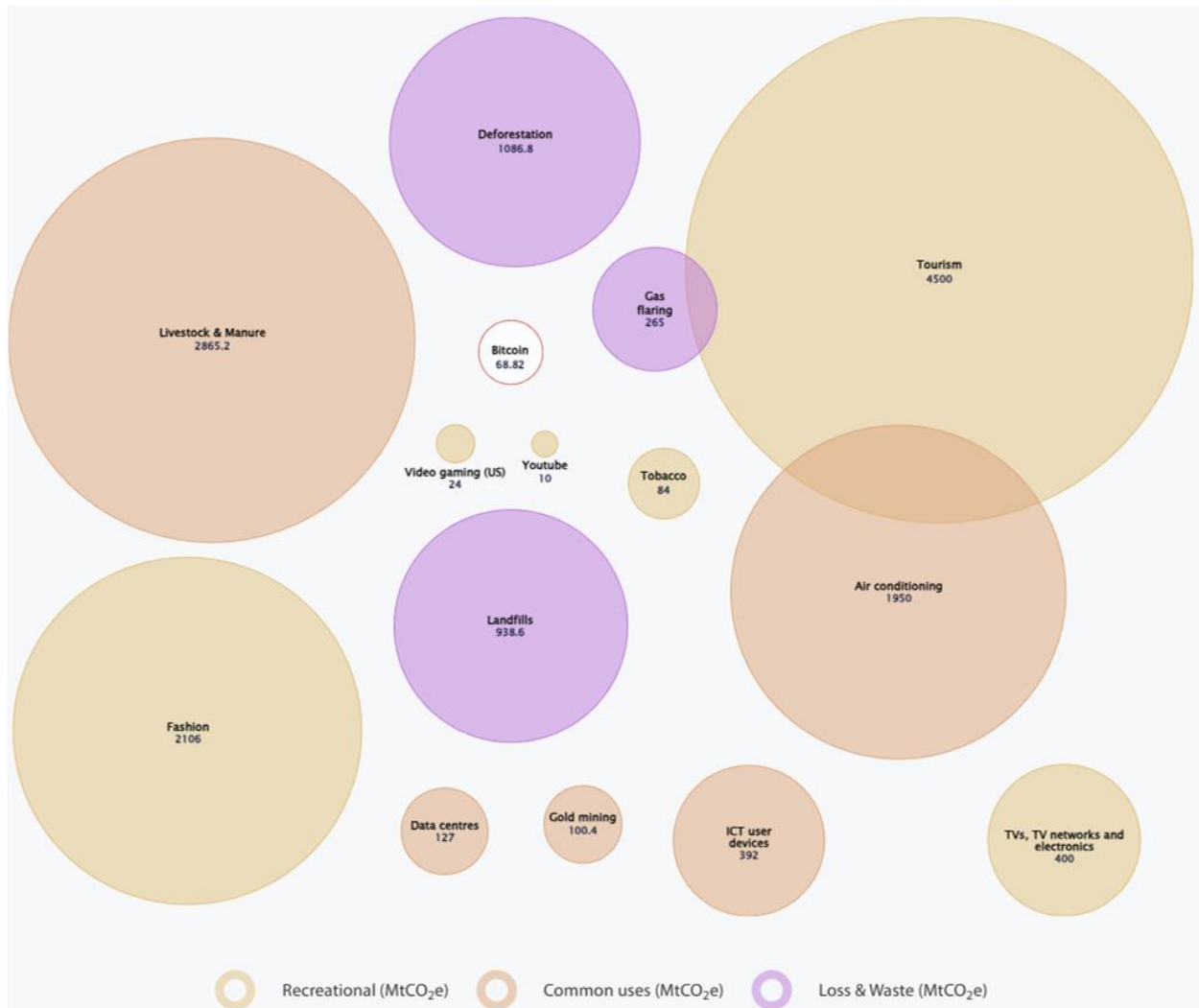

Figure 5: Visual representation of greenhouse gas emissions by sector (Cambridge Centre for Alternative Finance, 2023).

To start assessing the total environmental impact of a technological device, we must look at the processes which lead to its creation. The life of all technological devices begin with geological processes as they are made up of a combination of elements ranging from gold to aluminium to cobalt (Wheeler, 2018). The motherboard – or mainboard – is the main circuit board of most tech devices, which typically contains (GCFGlobal, 2020):[2]

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[2] Disclaimer: this report does not consider the detailed mechanisms behind how these components work. Instead, the key focus is on how the practices used to create these devices and their environmental impact are linked to colonialism.

- CPU (central processing unit)
- GPU (graphics processing unit)
- RAM (random access memory)
- Hard drive
- Power supply unit
- Expansion cards:
  - Sound
  - Video
  - Bluetooth

129 Grams: The Materials That Make Up The iPhone
Materials used in iPhone 6, 16GB model

- 31.1 g Aluminium
- 19.9 g Carbon
- 18.7 g Oxygen
- 18.6 g Iron
- 8.1 g Silicon
- 7.8 g Copper
- 6.6 g Cobalt
- 5.5 g Hydrogen
- 4.9 g Chrome
- 4.9 g Others
- 2.7 g Nickel
- 129.0 g Total

Total value of elements $1.03
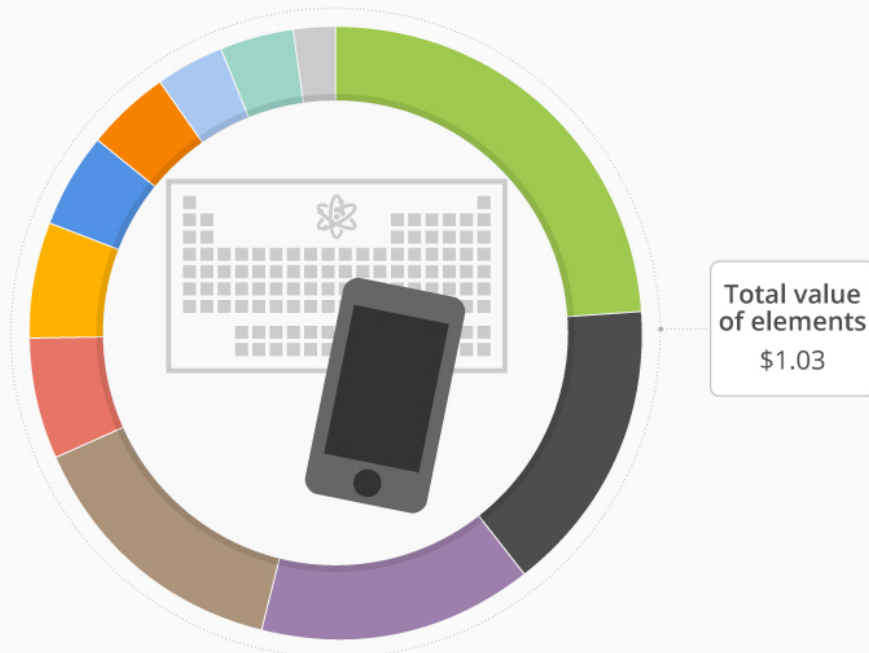
@StatistaCharts Source: 911 Metallurgist

statista

Figure 6: Total value (US$) of all the materials that make up the iPhone 6 (Statista, 2017).

Each of these components are made up of raw materials such as silicon, copper, and cobalt (Feeney, 2022). Mining is the most common method of extraction, a practice which became intensive and commonplace under colonial rule and developed into the large-scale industry it is today (Voskoboynik, 2018). Mining relies on the exploitation of both the earth and people, with businesses assuming access to Land that does not belong to them, as well as access to labour in these places. For example, cobalt mining – a material that is required to make renewable batteries used in smartphones and electric cars – is reliant on the exploitation of vulnerable workers, including children and migrants (Murray, 2022; Sovacool, 2020), further highlighting how colonial practices of labour exploitation persist within the technology industry. Further still,

cobalt is a vital component of many sustainable developments in tech. Sustainability should be about more than just reducing emissions: it should include ensuring that workers have a sustainable life, that the sources of these materials are sustainable, and that extraction of materials does not devastate landscapes. Taken together, these social and environmental impacts demonstrate how beliefs around the earth as an exploitable resource have emerged out of colonialism into the tech industry, with colonial legacies visible in the practices and exploitation that exist in the life-cycle of tech devices.
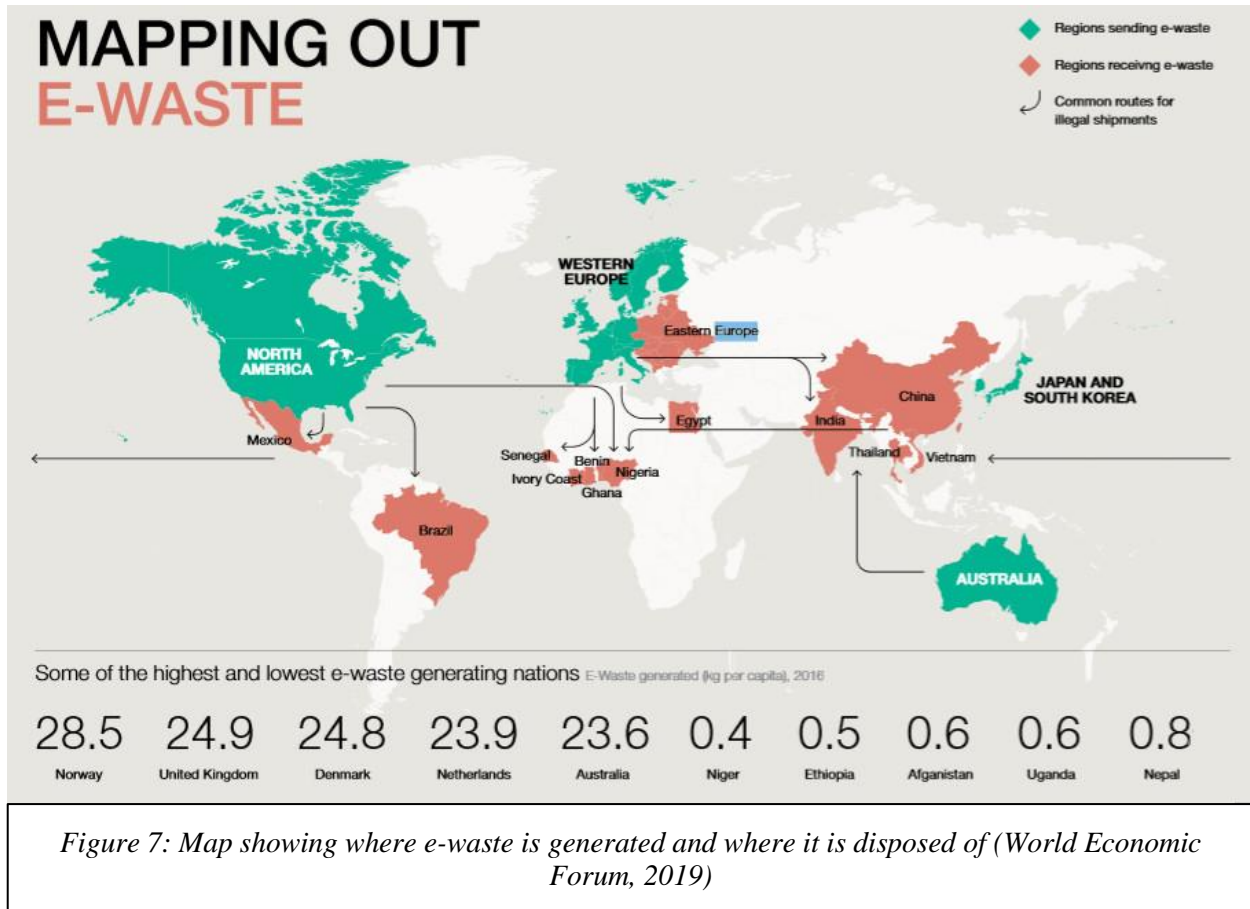
The next stages in the life-cycle of tech are smelting and refining, followed by assembly. This stage includes significant amounts of plastic. If you look at any tech device that you own, ranging from plugs to laptops, the casing is almost definitely made of plastic (Turner and Filella, 2017). After this is the shipping stage, an industry that is responsible for 2% of global CO_2 emissions (Josephs, 2021), and next is the consumer stage. This is where we, as consumers, play the most direct role and thus where we are most likely to understand how our tech usage has an impact on the climate as we can see visibly how we are using energy.

Whilst the basic energy usage of tech devices is somewhat visible via cables, the cloud is not and thus its harm to humans and the environment is often overlooked. The cloud – defined by five key characteristics: on-demand self-service, broad network access, resource pooling, rapid elasticity, and measured service (Mell and Grance, 2011) – has allowed for higher levels of computing power and allows us, as consumers, access to the vast majority of things online such as Instagram, Google Drive, and Hulu (Monserrate, 2022). Despite how ethereal it may seem, "the cloud is material": it functions using data centres that consume vast amounts of electricity, water, materials and metals (Monserrate, 2022). Every time someone makes a Google search, sends an email or makes a social media post, energy is used via the cloud, demonstrating how the 'life' stage of tech devices has an impact on the environment. This also extends to human labour: behind every one of these actions is the 'ghost work' of a human (Gray and Suri, 2019). Sites such as 'Amazon Mechanical Turk' employ people to do monotonous tasks, such as sorting and labelling images to ensure they do not contain offensive content, and pay their workers very little (Gray and Suri, 2019; Wakefield, 2021).[3] This demonstrates how the 'life' stage of tech has both environmental and social consequences.

When it comes to the end of the 'life' stage, the main issue is how often we are replacing our tech and the fact that over 45% of smartphone and tablet users would rather buy new than repair their existing device (YouGov, 2020). This then leads to the 'death' stage of devices: where do our tech devices go when we dispose of them?

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[3] 'Ghost Work' (Gray and Suri, 2019) contains a very insightful discussion of the prevalence of 'ghost work' in the tech industry which I would highly recommend for further information on this topic.

Figure 7: Map showing where e-waste is generated and where it is disposed of (World Economic Forum, 2019)

Just 20% of the 50 million tonnes of global e-waste produced each year is formally recycled, with the rest ending up in landfills and dumpsites which are often in developing or former colonised nations (UNEP, 2019). E-waste is incredibly toxic and the dump sites are often uncontrolled, exposing workers to substances that they are not adequately equipped to deal with and consequently posing potential health risks to them (Beula and Sureshkumar, 2021; Myburgh, 2021). This demonstrates how legacies of colonial relations are ongoing; wealthier nations such as the UK, alongside large corporations like the 'Big Five', make assumptions that they have access to Land that does not belong to them (Liboiron, 2021).[4]

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[4] The 'Big Five' tech companies are Alphabet (Google's parent company), Amazon, Apple, Meta and Microsoft.

Figure 8: Electronic waste at a dump site in the Samut Prakan province, Thailand
(The Guardian, 2018)

The life-cycle of tech devices is interwoven with climate change and the legacies of colonialism. These devices would not exist if colonial exploitation of Land had not occurred as current practices, such as mining and waste dumping, emerged from colonialism. The tech industry is reliant on exploitation of both humans and the environment and it is vital that we, as consumers, are aware of this. Ideas around responsibility will be explored later in the report but, whilst the vast majority of responsibility lies with the 'Big Five', informed individuals are able to act and make change, thus demonstrating the importance of being educated about the lifecycle of our tech devices is a responsibility that we, as individuals and consumers, must take.

Historical Case Studies

History plays a vital role in informing solutions to current problems, including the question of climate change and its links to colonialism (Berridge, 2018). This section of the report will explore two case studies to explore how colonialism, climate change and the tech industry are connected, further demonstrating how these studies can be used to inform actions for decolonising the industry as well as making it more environmentally sustainable.

Case Study I: The Mining Industry

The first case study relates to the mining industry, focusing specifically on gold and silver [or 'precious metals'] mining in sixteenth- to nineteenth-century Latin America (Voskoboynik, 2018). An industry which was reliant on the labour of enslaved Indigenous and African peoples, working conditions in mining were poor: the vaults were "low, cramped and poorly ventilated" and workers were required to crush "silver and mercury with their bare feet in large vats", sometimes causing potentially fatal mercury poisoning (Dore, 2000, p.8). In addition to this, 100 million kilograms of silver was mined in Latin America between the 16th and 19th centuries, demonstrating the sheer size of the mining industry and therefore the number of workers required to excavate that quantity of silver alone (Voskoboynik, 2018, p.38). In addition to the human exploitation caused by mining, there was a vast amount of environmental damage too (Rice et al., 2014). The mines themselves devastated terrain and the mercury – used to separate gold and silver from ore – contaminated rivers which led to the intoxication of the entire food chain (Dore, 2000).

Figure 9: Silver mines in the Cerro de Pasco region of Peru (Van Houtryve, 2018)

Both the human and environmental effects of colonial mining can still be seen today and persist within the modern mining industry, even when mining for minerals to make more environmentally friendly devices. Both lithium and cobalt are minerals required to make rechargeable batteries used for electric cars and for storing power generated from wind and solar (McKie, 2021); although viewed as more 'environmentally friendly', the mining industry remains built on exploitation and unsustainable practices. The lithium mining industry shares a similar story of exploitation of communities to cobalt. Lithium mines have polluted large parts of Tibet, Chile and Argentina, damaging the environment as well as bringing health concerns to communities (Denyer, 2016; Agusdinata et al., 2018; Voskoboynik, 2018; Riofrancos, 2021). This shows how colonial attitudes towards exploitation of human labour and the environment are very much still alive in the mining industry.

Figure 10: A Lithium Mine in Chile (Peoples Dispatch, 2022)

Case Study II: Palaquium gutta

The second historical case study which is useful for informing current decisions concerns a Southeast Asian tree named *Palaquium gutta* that produced a "natural latex called gutta-percha" (Crawford, 2022, p.38). Used by indigenous communities for centuries, it was 'discovered' by colonial powers in the 19th century and found to be particularly useful for insulating and protecting the underwater electrical cables required for the newly-developed telegraph system (Crawford, 2022; Tully, 2009). Colonial powers quickly expanded the system and exploited gutta-percha, causing the tree to become near-extinct, only just being saved by a ban on the extraction of gutta-percha in 1883 "in a last ditch effort" by the British "to save their supply chain" (Crawford, 2016, p.18). This is indicative of colonial attitudes towards Land and plants: they are

seen as exploitable resources and are only protected when there is risk of them running out and no longer being usable.

This should serve as a cautionary tale for everyone, the tech industry in particular. The world is at risk of running out of some of the required materials for tech devices if production continues at its current rate. Materials, such as lithium, are being similarly exploited to *Palaquium gutta* due to how useful they are for the tech industry yet this is not sustainable. For example, the world will run out of lithium by 2025 if mining continues at its current rate (Shine, 2022), and the same risk applies to many other required materials for tech devices as a result of unsustainable mining practices (Royal Society of Chemistry, 2023). Intervention needs to take place immediately to prevent the world running out of these resources, we do not have infinite amounts and acting as soon as possible will help to prevent the need for a ban on lithium mining, like the 1883 ban on the extraction of gutta-percha.

Figure 11: Palaquium gutta saplings at the Cipetir factory in Java (Wilkie, 2016)

These case studies highlight how many of the practices and attitudes that currently exist in the tech sector are very similar to colonial attitudes in regard to Land and its materials. In order to slow down the damage caused by climate change and create a sustainable tech industry, the legacies of colonialism in the sector must be addressed.

Individuals vs. Companies: Where Does Responsibility Lie?

One important issue that consistently arises when discussing climate change is how much responsibility lies with individuals as opposed to large corporations. What can, and should, we as consumers accept responsibility for? In order to understand the role of 'ordinary' individuals in climate change and the legacies of colonialism, it is important to understand the role of large corporations and their responsibility.

Companies in the 'Big Five' all produce annual sustainability reports that are publicly accessible.[5] Each report is full of statements such as "we're committed to minimising our environmental impact and improving the lives of all people who make our products" (Google, 2022b), "our approach is designed to drive engagement with suppliers that meet our expectations for respecting human rights, providing safe and inclusive workplaces, and promoting a sustainable future" (Amazon, 2021), and "we envision a just and equitable transition to a zero-carbon economy, and we are working with others to scale inclusive solutions that help create a healthier planet for all, ensuring that no one is left behind" (Meta, 2018). At first glance, these statements suggest that the 'Big Five' are truly committed to sustainability and they also include statistics of their positive impacts, with Google for example claiming to be carbon neutral since 2007 (Google, 2022b) and Microsoft aiming to be "a carbon negative, water positive, zero waste company" by 2030 (Microsoft, 2021). However, the reality of these claims and aims lies in carbon offsetting schemes, which does not appear to solve the problem. Offsetting schemes – or "carbon credits" (Google, 2022a) – most commonly involve planting trees to capture a company's CO2 production (Polonsky, Grau and Garma, 2010). This does not, however, solve the root of the problem – the unsustainable lifecycle of technology – but merely conceals it (Hyams and Fawcett, 2013; Al Ghussain, 2020). These sustainability reports do not show the true picture – or responsibility – of the tech industry when it comes to climate change and colonialism. It is therefore vital that we, as consumers, interrogate not only our own usage of tech but also its origins, energy usage, and disposal or recycling procedures.

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[5] For convenience, I have linked each company's sustainability reports here:
Home - Amazon Sustainability (aboutamazon.com)
Environment - Apple
Our Sustainability Efforts & Progress - Google Sustainability
Homepage - Meta Sustainability (fb.com)
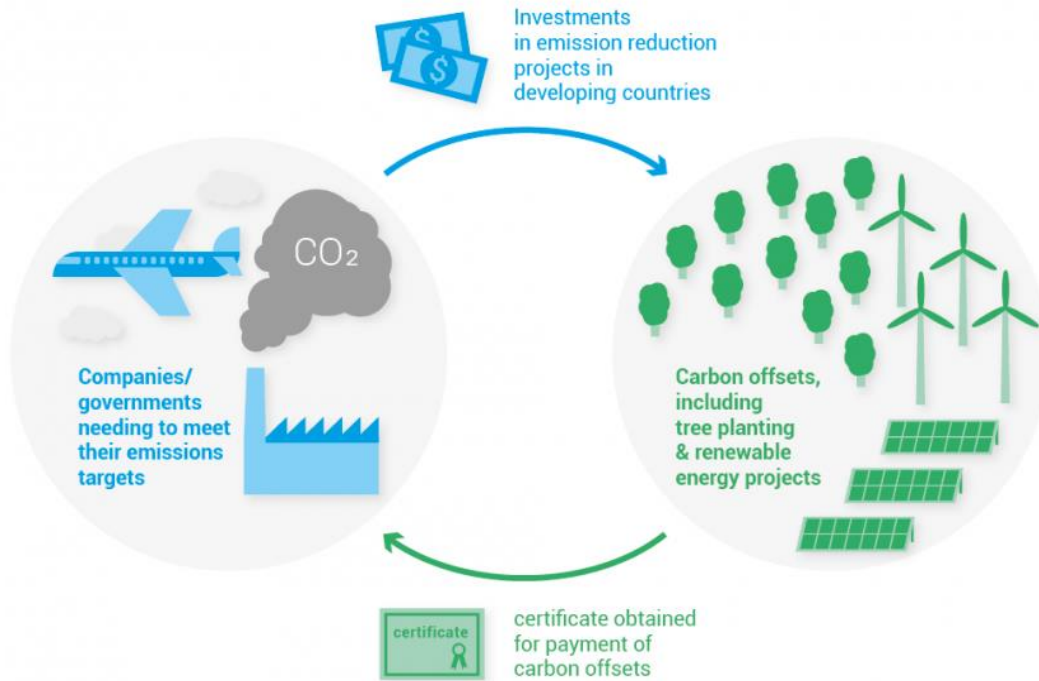2022 Environmental Sustainability Report | Microsoft CSR

Figure 12: Diagram of How Carbon Offsetting Works (Hagelberg, 2019)

There are some examples of positive steps in the tech industry as a result of legislation, particularly in the EU, UK and US. Legislation on the right to repair devices instead of replacing them, as well as making USB-C charging ports common to all new tech devices, is coming into force as a result of EU legislation (Šajn, 2022; Šajn, 2023). These are measures that the 'Big Five' have opposed, citing concerns over safety and security of devices (Godwin, 2021) which, whilst these concerns may be valid, implies that there is still a long way to go for the tech industry to become sustainable, both in terms of exploitation of humans and the environment. Legislation aims to hold companies accountable and makes it easier for consumers to act more sustainably, which is a positive step. This does not, however, mean that we – as individuals and consumers – should stop trying to educate ourselves and become as informed as possible on the lifecycle of our devices. Although it is practically impossible for an individual to avoid tech and therefore have no role in the tech industry's impact on the environment and perpetuation of colonialism, it does not mean that we are free of responsibility. We, as individuals who have the privilege to access tech devices without directly experiencing the impacts of their lifecycle, should take the time to educate ourselves on these issues and work on minimising our impact whilst also acknowledging that the vast chunk of responsibility lies with large tech corporations, particularly the 'Big Five'. Lack of regulation of the tech industry has allowed colonial practices and exploitation of both humans and the environment to continue which is something that is difficult for individuals acting alone to stop. This indicates the importance of raising awareness of this topic as it will allow conscious choices to be made as well as enabling collective action to take place which can lead to sustainable changes in the practices of the tech sector.

What Can Individuals Do?

One thing that we, as individuals and consumers, can do is ask questions. As previously mentioned, this report does not aim to stop people from using technology, that would be very hypocritical considering that a laptop was required to research and write this paper as well as the fact that this report will be shared digitally. This report does, however, aim to give us a base of knowledge to build upon. This report barely scratches the surface in terms of the interwoven nature of colonialism, climate change and technology, but it aims to provide a starting point for further research into this intersection as well as giving insight into the impact of technology both on the environment and on human life. As mentioned elsewhere, change can be orchestrated if awareness of an issue is raised, reminding us of the importance of interrogating not only our own usage but also the lifecycle of technology (which companies are often unwilling to share).

In order to be aware of our own individual impact, this report provides a list of sample questions that we can ask ourselves about our usage of technology and whether it is proportional. However, as individuals, we can hold ourselves to account and ask questions about our own role in the life cycle of tech devices.

Conclusion

This report has provided an overview of the interwoven histories of colonialism and climate change, as well as situating these histories in the contemporary challenges of the tech industry and how we – as individuals and as a collective – can challenge and interrogate the large corporations that are at the centre of this. The following points are key when considering how to approach these challenges:
- Technology users must be better educated for the exploitation of humans and Land in the tech industry to end.
- Historical and contemporary examples should be drawn upon to increase awareness of the relationship between colonialism, the environment and technology.
- Increased awareness will allow technology users to make informed choices regarding minimising their individual impact and putting pressure on the 'Big Five' to accept responsibility and make change.
- Energy proportionality must be considered; there are ways to use tech in sustainable ways but we must be conscious of our choices and their impact.

This report serves as a starting point for individuals to interrogate their own tech usage as well as the industry as a whole. By aiming to buy less and repair more, as well as ensuring our uses of tech are proportional to their purpose, we can minimise our individual impact and show that the legacies of colonialism that are ongoing in the tech industry – and its exploitation of both humans and the environment – are not acceptable and changes need to be made.

References

Agusdinata, D.B., Liu, W., Eaken, H. and Romero, H. (2018). Socio-environmental impacts of lithium mineral extraction: towards a research agenda. *Environmental Research Letters*, [online] 13(12), p.123001. doi:https://doi.org/10.1088/1748-9326/aae9b1.

Al Ghussain, A. (2020). *The Biggest Problem with Carbon Offsetting Is That It Doesn't Really Work*. [online] Greenpeace UK. Available at: https://www.greenpeace.org.uk/news/the-biggest-problem-with-carbon-offsetting-is-that-it-doesnt-really-work/.

Amazon (2021). *Amazon's 2021 Sustainability Report*. [online] Available at: https://sustainability.aboutamazon.com/2021-sustainability-report.pdf [Accessed 18 Jul. 2023].

Bailey, D.E., Faraj, S., Hinds, P.J., Leonardi, P.M. and von Krogh, G. (2022). We Are All Theorists of Technology Now: A Relational Perspective on Emerging Technology and Organizing. *Organization Science*, 33(1), pp.1–18. doi:https://doi.org/10.1287/orsc.2021.1562.

Baker, D.F. (2013). When Moral Awareness Isn't Enough. *Journal of Management Education*, 38(4), pp.511–532. doi:https://doi.org/10.1177/1052562913504922.

Berridge, V. (2018). Why Policy Needs History (and Historians). *Health Economics, Policy and Law*, 13(3-4), pp.369–381. doi:https://doi.org/10.1017/s1744133117000433.

Beula, D. and Sureshkumar, M. (2021). A review on the toxic E-waste killing health and environment – Today's global scenario. *Materials Today: Proceedings*, 47(9), pp.2168–2174. doi:https://doi.org/10.1016/j.matpr.2021.05.516.

Callaghan, M., Schleussner, C.-F., Nath, S., Lejeune, Q., Knutson, T.R., Reichstein, M., Hansen, G., Theokritoff, E., Andrijevic, M., Brecha, R.J., Hegarty, M., Jones, C., Lee, K., Lucas, A., van Maanen, N., Menke, I., Pfleiderer, P., Yesil, B. and Minx, J.C. (2021). Machine-learning-based evidence and attribution mapping of 100,000 climate impact studies. *Nature Climate Change*, 11. doi:https://doi.org/10.1038/s41558-021-01168-6.

Cambridge Centre for Alternative Finance (2023). *Cambridge Bitcoin Electricity Consumption Index (CBECI)*. [online] ccaf.io. Available at: https://ccaf.io/cbnsi/cbeci/ghg/comparisons [Accessed 19 Jun. 2023].

Collins English Dictionary (2023). *Technology device definition and meaning | Collins English Dictionary*. [online] www.collinsdictionary.com. Available at: https://www.collinsdictionary.com/dictionary/english/technology-device.

Coulthard, G. (2014). *Red skin, white masks : rejecting the colonial politics of recognition*. Minneapolis : University Of Minnesota Press 2014.

Crawford, K. (2022). *Atlas Of AI: Power, Politics and the Planetary Costs of Artificial Intelligence*. Yale University Press.

Crawford, K. and Joler, V. (2018). *Anatomy of an AI System The Amazon Echo as an anatomical map of human labor, data and planetary resources*. [online] Share Lab and AI Now Institute. Available at: https://anatomyof.ai/img/ai-anatomy-publication.pdf [Accessed 15 Jun. 2023].

Denyer, S. (2016). Tibetans in anguish as Chinese mines pollute their sacred grasslands. *Washington Post*. [online] 26 Dec. Available at: https://www.washingtonpost.com/world/asia_pacific/tibetans-in-anguish-as-chinese-mines-pollute-their-sacred-grasslands/2016/12/25/bb6aad06-63bc-11e6-b4d8-33e931b5a26d_story.html.

Dore, E. (2000). Environment and Society: Long-Term Trends in Latin American Mining. *Environment and History*, 6(1), pp.1–29.

Feeney, C. (2022). *What Are Motherboards Made Of? (Explained)*. [online] The Tech Wire. Available at: https://www.thetechwire.com/what-are-motherboards-made-of/ [Accessed 28 Jun. 2023].

Freitag, C., Small World, M.B.-L., Widdicks, K., Knowles, B., Blair, G. and Friday, A. (2020). *The climate impact of ICT: A review of estimates, trends and regulations*. [online] Available at: https://arxiv.org/ftp/arxiv/papers/2102/2102.02622.pdf [Accessed 19 Jun. 2023].

GCFGlobal (2020). *Computer Basics: Inside a Computer*. [online] GCFGlobal.org. Available at: https://edu.gcfglobal.org/en/computerbasics/inside-a-computer/1/#.

Godwin, C. (2021). Right to repair movement gains power in US and Europe. *BBC News*. [online] 7 Jul. Available at: https://www.bbc.co.uk/news/technology-57744091.

Google (2022a). *Environmental Report*. [online] Available at:
https://www.gstatic.com/gumdrop/sustainability/google-2022-environmental-report.pdf
[Accessed 18 Jul. 2023].

Google (2022b). *Our Sustainability Efforts & Progress*. [online] Google Sustainability.
Available at: https://sustainability.google/progress/#supplier-responsibility# [Accessed 18 Jul.
2023].

Green, D. and Raygorodetsky, G. (2010). Indigenous knowledge of a changing climate.
Climatic Change, 100(2), pp.239–242. doi:https://doi.org/10.1007/s10584-010-9804-y.

Hagelberg, N. (2019). *Carbon offsets are not our get-out-of-jail free card*. [online] UN
Environment. Available at: https://www.unep.org/news-and-stories/story/carbon-offsets-are-
not-our-get-out-jail-free-card.

Hoffman, P.T. (2015). *Why did Europe conquer the world?* Princeton: Princeton University
Press.

Horvath, R.J. (1972). A Definition of Colonialism. *Current Anthropology*, [online] 13(1), pp.45–
57. Available at:
https://www.jstor.org/stable/pdf/2741072.pdf?casa_token=SX_9PVAxf2IAAAAA:ca3Gh5jWz3c
OKIcGhRa08oraPKZoyIoYDZRkpZzqRe_hQJLO8vcqYmY-YH3GESoNrb-55oFCtHUUj-
0GQrTRuVykAJ1xnH-41RvUh-FscZehAEbiCA [Accessed 6 Jun. 2023].

Hussain, A.A. and Al-Turjman, F. (2021). Artificial intelligence and blockchain: A review.
Transactions on Emerging Telecommunications Technologies, 32(9).
doi:https://doi.org/10.1002/ett.4268.

Hyams, K. and Fawcett, T. (2013). The ethics of carbon offsetting. *Wiley Interdisciplinary
Reviews: Climate Change*, [online] 4(2), pp.91–98. doi:https://doi.org/10.1002/wcc.207.

IPCC (1996). *Climate Change 1995: The Science of Climate Change. Contribution of Working
Group I to the Second Assessment Report of the Intergovernmental Panel on Climate
Change*.

IPCC (2001). *TAR Climate Change 2001: The Scientific Basis*. [online] Available at:
https://www.ipcc.ch/site/assets/uploads/2018/03/WGI_TAR_full_report.pdf.

IPCC (2022). *Climate Change 2022: Mitigation of Climate Change*. [online] www.ipcc.ch. Available at: https://www.ipcc.ch/report/ar6/wg3/.

Josephs, J. (2021). Climate change: Shipping industry calls for new global carbon tax. *BBC News*. [online] 21 Apr. Available at: https://www.bbc.co.uk/news/business-56835352.

Lebaron, G. and Lister, J. (2015). Benchmarking global supply chains: the power of the 'ethical audit' regime. *Review of International Studies*, 41(5), pp.905–924. doi:https://doi.org/10.1017/s0260210515000388.

Liboiron, M. (2021). *Pollution Is Colonialism*. Durham: Duke University Press.

Mack, C.A. (2011). Fifty Years of Moore's Law. *IEEE Transactions on Semiconductor Manufacturing*, 24(2), pp.202–207. doi:https://doi.org/10.1109/tsm.2010.2096437.

Mahony, M. and Endfield, G. (2018). Climate and colonialism. *Wiley Interdisciplinary Reviews: Climate Change*, 9(2), pp.1–16. doi:https://doi.org/10.1002/wcc.510.

Margolin, J. (2019). *Patriarchy, racism, and colonialism caused the climate crisis | Jamie Margolin | TEDxYouth@Columbia. Tedx Talks*. Available at: https://www.youtube.com/watch?v=amGyIqIBzEk.

McKie, R. (2021). *Child labour, toxic leaks: the price we could pay for a greener future*. [online] The Guardian. Available at: https://www.theguardian.com/environment/2021/jan/03/child-labour-toxic-leaks-the-price-we-could-pay-for-a-greener-future.

Mell, P. and Grance, T. (2011). *The NIST Definition of Cloud Computing Recommendations of the National Institute of Standards and Technology*. [online] Available at: https://nvlpubs.nist.gov/nistpubs/Legacy/SP/nistspecialpublication800-145.pdf.

Meta (2018). *Facebook Sustainability*. [online] Facebook Sustainability. Available at: https://sustainability.fb.com/ [Accessed 18 Jul. 2023].

Microsoft (2021). *Microsoft 2020 Environmental Sustainability Report*. [online] Microsoft Sustainability. Available at: https://www.microsoft.com/en-us/corporate-responsibility/sustainability/report [Accessed 18 Jul. 2023].

More, C. (2014). *The Industrial Age: Economy and Society in Britain since 1750*. Routledge.

Monserrate, S.G. (2022). The Cloud Is Material: On the Environmental Impacts of Computation and Data Storage. *mit-serc.pubpub.org*, [online] Winter 2022(January). doi:https://doi.org/10.21428/2c646de5.031d4553.

Murphy, J. (2009). *Environment and Imperialism: Why Colonialism Still Matters Sustainability Research Institute*. [online] pp.3–25. Available at: https://www.see.leeds.ac.uk/fileadmin/Documents/research/sri/workingpapers/SRIPs-20_02.pdf.

Murray, A. (2022). *Cobalt Mining: The Dark Side of the Renewable Energy Transition*. [online] Earth.org. Available at: https://earth.org/cobalt-mining/#.

Myburgh, C. (2021). *Apple iWaste How is e-waste effecting us and what is Apple doing to minimise risks?* [online] Available at: https://student.hca.westernsydney.edu.au/units/wp_102264/wp-content/uploads/2021/10/Chante_Myburgh_Inside_Out.pdf [Accessed 5 Jul. 2023].

Neustadt, R.E. and May, E.R. (1986). *Thinking in time : the uses of history for decision-makers*. New York: Free Press ; London.

Peoples Dispatch (2022). *A Lithium Mine in Chile*. [Photo] *Green Left*. Available at: https://www.greenleft.org.au/content/why-lithium-power-politics-are-playing-out-very-differently-chile-and-bolivia [Accessed 8 Jul. 2023].

Polonsky, M.J., Grau, S.L. and Garma, R. (2010). The New Greenwash?: Potential Marketing Problems with Carbon Offsets. *International Journal of Business Studies*, 18(1), pp.49–54.

Reichl, J. (2019). *Deforestation in the pursuit of rootless economic growth: A matter of scale : Discovering Sustainability*. [online] discuss.leeds.ac.uk. Available at: https://discuss.leeds.ac.uk/2019/05/07/deforestation-in-the-pursuit-of-rootless-economic-growth-a-matter-of-scale/.

Rice, K.M., Walker, E.M., Wu, M., Gillette, C. and Blough, E.R. (2014). Environmental Mercury and Its Toxic Effects. *Journal of Preventive Medicine & Public Health*, [online] 47(2), pp.74–83. doi:https://doi.org/10.3961/jpmph.2014.47.2.74.

Riofrancos, T. (2021). *The rush to 'go electric' comes with a hidden cost: destructive lithium mining* . [online] The Guardian. Available at: https://www.theguardian.com/commentisfree/2021/jun/14/electric-cost-lithium-mining-decarbonasation-salt-flats-chile.

Royal Society of Chemistry (2023). *Precious Elements*. [online] Precious Elements. Available at: https://sustainability.rsc.org/ [Accessed 11 Jul. 2023].

Šajn, N. (2022). *Briefing: Right to Repair. https://www.europarl.europa.eu/RegData/etudes/BRIE/2022/698869/EPRS_BRI(2022)698869 _EN.pdf*.

Šajn, N. (2023). *BRIEFING EU Legislation in Progress A common charger for electronic devices Revision of the Radio Equipment Directive OVERVIEW*. [online] Available at: https://www.europarl.europa.eu/RegData/etudes/BRIE/2021/698819/EPRS_BRI(2021)698819 _EN.pdf.

Sarkar, A. (2020). *Settler Colonialism Is Behind Climate Denial. Novara Media*. Available at: https://novaramedia.com/2020/01/15/settler-colonialism-is-behind-climate-denial/ [Accessed 29 May 2023].

Schaller, D.J. and Zimmerer, J. (2008). Settlers, imperialism, genocide: seeing the global without ignoring the local—introduction. *Journal of Genocide Research*, 10(2), pp.191–199. doi:https://doi.org/10.1080/14623520802176698.

Shine, I. (2022). *The world needs 2 billion electric vehicles to get to net zero. But is there enough lithium to make all the batteries?* [online] World Economic Forum. Available at: https://www.weforum.org/agenda/2022/07/electric-vehicles-world-enough-lithium-resources/.

Sovacool, B. (2020). When subterranean slavery supports sustainability transitions? power, patriarchy, and child labor in artisanal Congolese cobalt mining. *The Extractive Industries and Society*, [online] 8(1), pp.271–293. doi:https://doi.org/10.1016/j.exis.2020.11.018.

Statista (2017). *Infographic: The Materials That Make Up The iPhone*. [online] Statista Infographics. Available at: https://www.statista.com/chart/10719/materials-used-in-iphone-6/.

The Guardian (2018). *Deluge of electronic waste turning Thailand into 'world's rubbish dump'*. [online] the Guardian. Available at: https://www.theguardian.com/world/2018/jun/28/deluge-of-electronic-waste-turning-thailand-into-worlds-rubbish-dump.

Torres, P.H.C., Leonel, A.L., Pires de Araújo, G. and Jacobi, P.R. (2020). Is the Brazilian National Climate Change Adaptation Plan Addressing Inequality? Climate and Environmental Justice in a Global South Perspective. *Environmental Justice*, 13(2). doi:https://doi.org/10.1089/env.2019.0043.

Tully, J. (2009). A Victorian Ecological Disaster: Imperialism, the Telegraph, and Gutta-Percha. *Journal of World History*, 20(4), pp.559–579.

Turner, A. and Filella, M. (2017). Bromine in plastic consumer products – Evidence for the widespread recycling of electronic waste. *Science of The Total Environment*, 601-602, pp.374–379. doi:https://doi.org/10.1016/j.scitotenv.2017.05.173.

UNEP (2019). *UN report: Time to seize opportunity, tackle challenge of e-waste*. [online] UN Environment. Available at: https://www.unep.org/news-and-stories/press-release/un-report-time-seize-opportunity-tackle-challenge-e-waste.

United Nations (1992). *United Nations Framework Convention on Climate Change*.

Van Houtryve, T. (2018). *Silver mines in Cerro de Pasco*. [Photo] *ScienceInfo.net*. Available at: https://scienceinfo.net/silver-mine-swallowed-up-the-400yearold-city-in-the-andes.html.

Voskoboynik, D.M. (2018). *The memory we could be : overcoming fear to create our ecological future*. Oxford: New Internationalist.

Wheeler, A. (2018). *What Raw Materials Are Used to Make Hardware in Computing Devices?* [online] Engineering.com. Available at: https://www.engineering.com/story/what-raw-materials-are-used-to-make-hardware-in-computing-devices.

Whitmarsh, L., Poortinga, W. and Capstick, S. (2021). Behaviour change to address climate change. *Current Opinion in Psychology*, 42, pp.76–81. doi:https://doi.org/10.1016/j.copsyc.2021.04.002.

Wikimedia Commons (2010). *World empires and colonies in 1914, just before the First World War*. Available at:

https://upload.wikimedia.org/wikipedia/commons/4/45/World_1914_empires_colonies_territory
.PNG.

Wilkie, P. (2016). *Palaquium gutta saplings at the Cipetir factory in Java*. [Photo] *Quartz*.
Available at: https://qz.com/785119/the-forgotten-tropical-tree-sap-that-set-off-a-victorian-tech-
boom-and-gave-us-global-telecommunications [Accessed 11 Jul. 2023].

World Economic Forum (2019). *A New Circular Vision for Electronics: Time for a Global
Reboot* . [online] Available at:
https://www3.weforum.org/docs/WEF_A_New_Circular_Vision_for_Electronics.pdf.

YouGov (2020). *45% of smartphone owners would rather upgrade than repair | YouGov*.
[online] yougov.co.uk. Available at: https://yougov.co.uk/topics/technology/articles-
reports/2020/05/07/45-smartphone-owners-would-rather-upgrade-repair.

Appendix 1: Questions to Ask Ourselves About Tech

Questions to ask ourselves about our tech

Why should we ask these questions

Questions around our usage and purchase of technology has an impact far beyond what we can see.

We should consider our own impact and how to minimise it as well as the impacts of the wider tech industry and its links to the climate and colonialism.

Being educated empowers us to make change

Purchasing tech

☐ Do I need to buy a new device or can I repair/recycle an existing device?

☐ Do I know the origins of this device?

☐ Do I have a device that can perform the same function already?

Using tech

☐ How much energy does my device use?

☐ Where does this energy come from?

☐ Can I achieve the same outcome using less energy?

☐ Am I using the device for a necessary purpose?

☐ What can I do to educate myself on the impact of my tech usage?

Created by Joely Fake. This poster stems from a larger research project on the connections between colonialism, climate change and the tech industry. The full report, entitled 'Colonialism, the Environment and Technology', is available from the University of Southampton Digital Humanities Department via Zenodo.