#1ed760: How green is Spotify?

The importance of reporting for democratic and sustainable digitalisation

Francesca Fitzgerald

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LUCSUS
Lund University Centre for
Sustainability Studies

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Submitted January 3, 2023
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Abstract

Internet services can aid steps towards sustainability, but can also be a means of exploitation and power-ownership. Data centres are an intrinsic part of this system, but reporting regulations do not require full disclosure on them. This paper takes the position that incomplete or misleading reporting is a form of delay discourse. Using the case study of Spotify, a structured literature review was conducted, and Lamb et al's delay discourse framework applied to analyse reporting. A discrepancy was found between actual and reported sustainability impacts, specifically for water use. Another delay discourse category was therefore suggested, 'Doing our part', the idea that an acknowledgment of climate change can hide other sustainability impacts. This paper suggests further investigation and regulation for sustainability reporting are necessary for a democratic future for digitalisation, especially relevant due to changes in reporting standards under development.

Key words: participatory democracy, information literacy, delay discourse, hegemony, climate change, data centres

Word count: 11364

Acknowledgements

To quote Snufkin, “The main thing in life is to know your own mind”. It has taken me longer than I first imagined to know my own mind when it comes to this thesis, but here I am! I’ve had the time to explore one corner of this subject, and it’s been brilliant – but I couldn’t have done it without so many of you.

First, I would like to thank my supervisor, Torsten Krause. Your guidance and reassurance, especially in the early very rocky stages of this thesis, was massively helpful. Thanks also to my wonderful thesis group, it’s been a wild ride at times, but I’m glad we did it together.

I would also like to thank my family, who have all been incredibly supportive. And last but certainly not least - to all my friends, who’ve listened to me talking about this for months, thank you!

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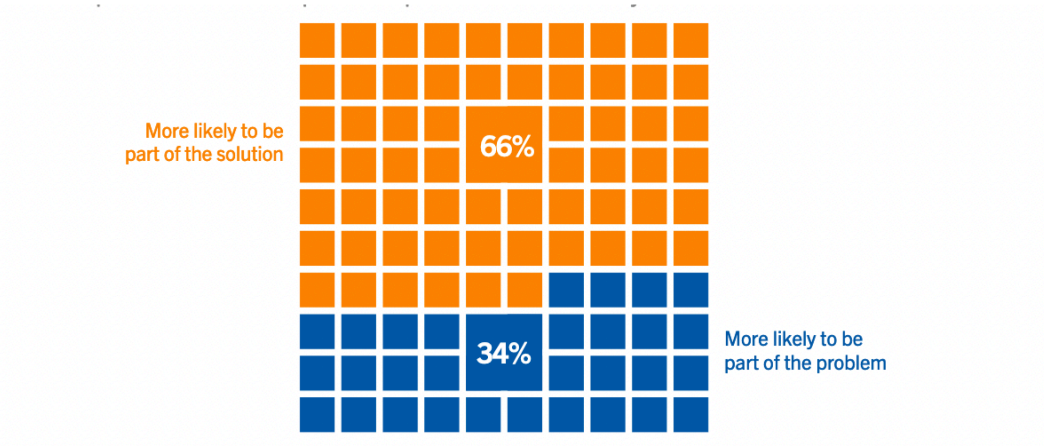
1 Introduction & Background

Data centres are the brains of the internet, made up of building filled with computers, a cooling system, and fuelled by very large amounts of energy (Mytton, 2021; D. Zhang, 2022). They are what make digitalisation possible, something which is part of the technological revolution often seen as a ‘problem solver’ for climate change (Lenz, 2021). Indeed, operators of data centres do in general see themselves as part of the solution, according to a recent Uptime Institute survey (Davis, 2022)

Figure 1: Operators' perception of themselves with regards to reducing carbon emissions



Note: The results of the survey indicate that when asked “In terms of carbon emissions, would you say the data centre industry is more likely to be part of the solution or part of the problem?”, a majority responded that they felt it would be more likely to be part of the solution (orange). Retrieved from: (Davis, 2022)

By the same token, however, digital technologies have a price; as the IPCC recently noted, “Digitalisation can enable emission reductions, but can have adverse side-effects unless appropriately governed.” (IPCC, 2022, B.4).

Whether or not digitalisation is being ‘appropriately governed’ will indeed be one of the questions I will seek to answer here. In order to refine the scope of this paper, I will focus on Spotify, the audio streaming service. As of 2022, Spotify has a registered 406 million users, or approximately 5% of the total global population (*Spotify — About Spotify*, n.d.). They use Google Cloud services to host their platform, and as a result this paper will also look at Google’s sustainability reporting. Given the scope of this paper, I will focus on a comparison of carbon emissions and water use for both Spotify and Google, with Mytton (2021) having called for further research on data centre water use.

Spotify are, in their own words, “a growing company in an energy intensive industry”, though “[their] impact on the climate isn’t always obvious” (Spotify, 2022). A further question may then be asked as to what might be done to make their ‘impact on the climate’ more ‘obvious’.

Governance, defined as “the purposeful effort to steer, control or manage sectors or facets of society”, (Kooiman, 1993, p.2 in Evans, 2012, p. 4), is one part of the answer. More specifically, transparent and mandated sustainability reporting. Pickering et al (2020, p. 1) argued for the need for “a stronger dialogue between environmental and political theory and empirical, policy-oriented research on democracy and sustainability, as well as a further exploration of the complementarities between ecological and environmental democracy”. I will here seek to contribute to filling this gap, by taking the stance that policy regarding reporting has a tangible effect on the capacity for democratic processes to move for a just future and towards sustainability within the digital space.

New reporting standards are currently in development globally, including by the European Union, United States Securities and Exchange Commission, Global Reporting Initiative, many of which are in collaboration with the Taskforce on Climate-related Financial Disclosures (Climate Disclosure Standards Board, 2021; GRI - Schedule of Standards Projects, 2022; Herren Lee, 2021). It is therefore relevant to ask the following questions:

RQ1: How can transparent reporting for e-business contribute to a democratic and sustainable future for the digital space?

RQ2: What are the current requirements for reporting water use and carbon emissions for e-businesses?

RQ3: How is “common good” information versus “commodity” information used in Spotify and Google’s sustainability reporting on water use and carbon emissions?

2 Theoretical Entry Point

For a just future, change must happen through democratic means. If, as Brooke (2016) states, “information is the essence of democracy and the lynchpin of power-ownership” (p.7), then it follows that in order to achieve that future relevant information must be available to actors in order to achieve a genuinely participatory democracy (Fuchs, 2019, p. 120). Furthermore, the information available must be reliable, not a form of misinformation or delay discourse (Lamb et al., 2020). The entry point for this paper therefore comes through a combination of theoretical approaches, namely a Marxist interpretation of digital capitalism and information literacy using delay discourses as a framework for analysis.

2.1 Marxism and digital capitalism

Marxism will primarily be looked at through the lens on digital capitalism as identified by Fuchs (2019), as well as through Gramscian thought on cultural hegemony. There are two aspects of these interpretation of Marx's works that are of consequence to this paper.

The first lies in the understanding of crises under a capitalist system. In general, capitalism has a tendency to postpone crisis situations where possible, in order to maintain the status quo of growth, expansion, and accumulation (Fuchs, 2019). Technology is often touted as one way of maintaining the status quo through innovation, with examples from electric cars to the fourth industrial revolution (4IR) itself (Benady, 2022; Nasman et al., 2017; Willis, 2020). As Fuchs (2019) writes, "[t]hey propagate industry 4.0 as the new capitalist panacea… that is said to solve all economic (and other) problems" (98). It is easy to see why 'industry 4.0' might draw scepticism here; capitalism has often been characterised by both the alienation and domination of nature (Garrard, 2004; Saito, 2017, p. 14). Understood through a capitalist, cornucopian lens, nature can be seen as "an enormous, soulless mechanism that worked according to knowable natural laws." (Garrard, 2004, p. 62).

On the other hand, some interpret the 4IR as a crisis of capitalism, arguing that rather than presenting a 'panacea', technological advancement instead "raises questions about the capability of capitalism to sustain social reproduction and individual consumption"(Hughes & Southern, 2019, p. 59). Arguably, this means that digitalization either presents an opportunity for change, or that it can further cement the current capitalist modus operandi (Fuchs, 2019).

This is where a Marxist look at communications becomes of particular interest. Narratives have everything to do with how a particular thing is perceived. Reporting to a greater or lesser extent allows an organisation to control the way in which its actions are seen by consumers and investors. Gramsci introduced the concept of ideological hegemony, the importance of the capitalist class's ability to convince others of their legitimacy, to establish their world-view as dominant (Berberoglu, 2017, p. 100). A distinction must be made between information "as a common good" which supports participatory democracy, and information as a "commodity" which is either incomplete or which reinforces the hegemony of the capitalist class (Fuchs, 2019, p. 28). This is also the distinction between advertising and good practice reporting.

2.2 Information literacy for democratic participation

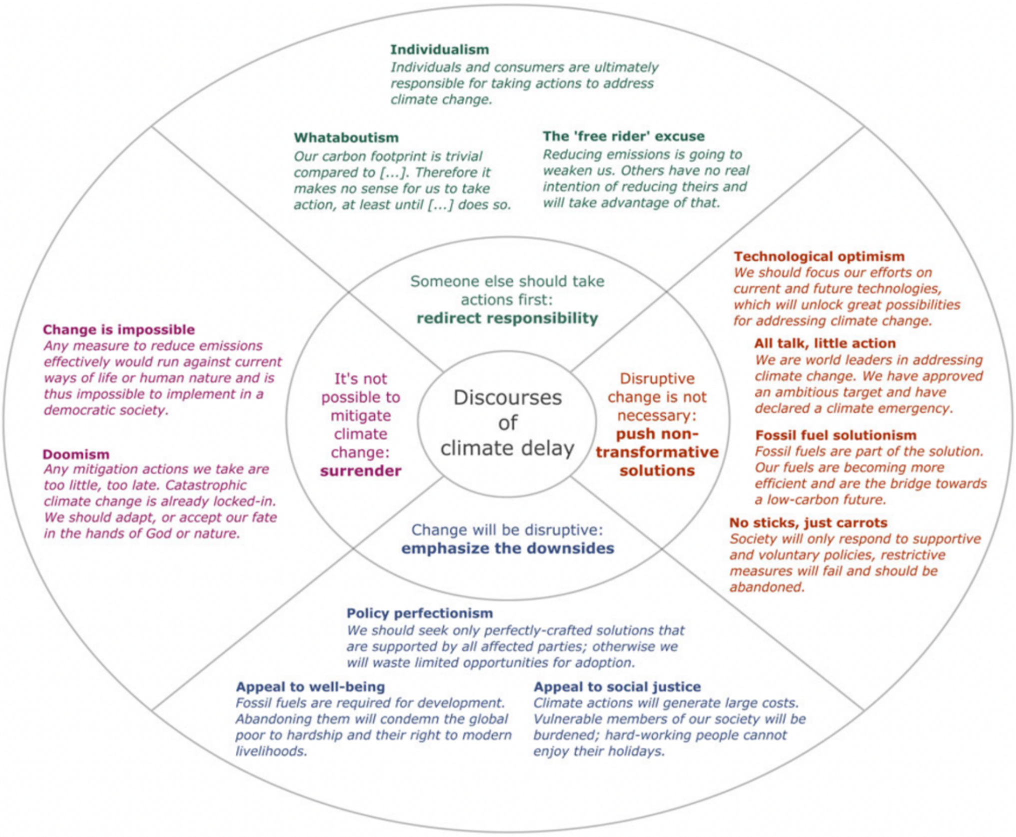
Information literacy, the capacity to make “effective and appropriate use of information” is therefore hugely important (Armstrong et al., 2005, p. 1). Information literacy can be understood as the ability to recognise the dominant hegemonic narrative and not accept it unquestioningly, “a means of helping people to address their information needs… to take advantage of the opportunities for participation that democracy entails” (Goldstein, 2019, p. XXIII–IV).

This is especially important in the digital age; as noted above, the internet allows users to tell their own narrative in ways that have not historically been possible. Information literacy is then imperative if only in the sense that users should have a good comprehension of the potential that the internet carries to “affect democracy and civic and political participation” (Polizzi, 2020, p. 2) Spotify is clearly aware of its position in respect to this: as they themselves write, “The Future of Pop Culture Isn’t Passive” (Lasnik, 2020).

2.3 Delay Discourses as a framework

Lamb et al.’s (2020) Discourse of Climate Delay can then be used as a framework to support information literacy, through making a differentiation between a hegemonic narrative and this ‘common good’ information. On a simplistic level, delay discourses justify a lack of action on climate change. More specifically, they are “policy-focused discourses that exploit contemporary discussions on what action should be taken, how fast, who bears responsibility and where costs and benefits should be allocated” (Lamb et al., 2020, p. 1). *Figure 2* illustrates the discourses identified by Lamb et al. (2020). Delay discourses are often built on existent, legitimate, climate issues to “misrepresent rather than clarify” (Lamb et al., 2020, p. 5). Technological optimism, for example, redirects action on climate change towards technological innovation as a solution to the problems raised. It should be noted that in general Lamb et al (2020) focused on carbon emissions. This paper will apply Lamb et al.’s delay discourse framework in a wider sense to sustainability dialogues as a whole.

Figure 2: Discourses of climate delay as identified by Lamb et al. 2020



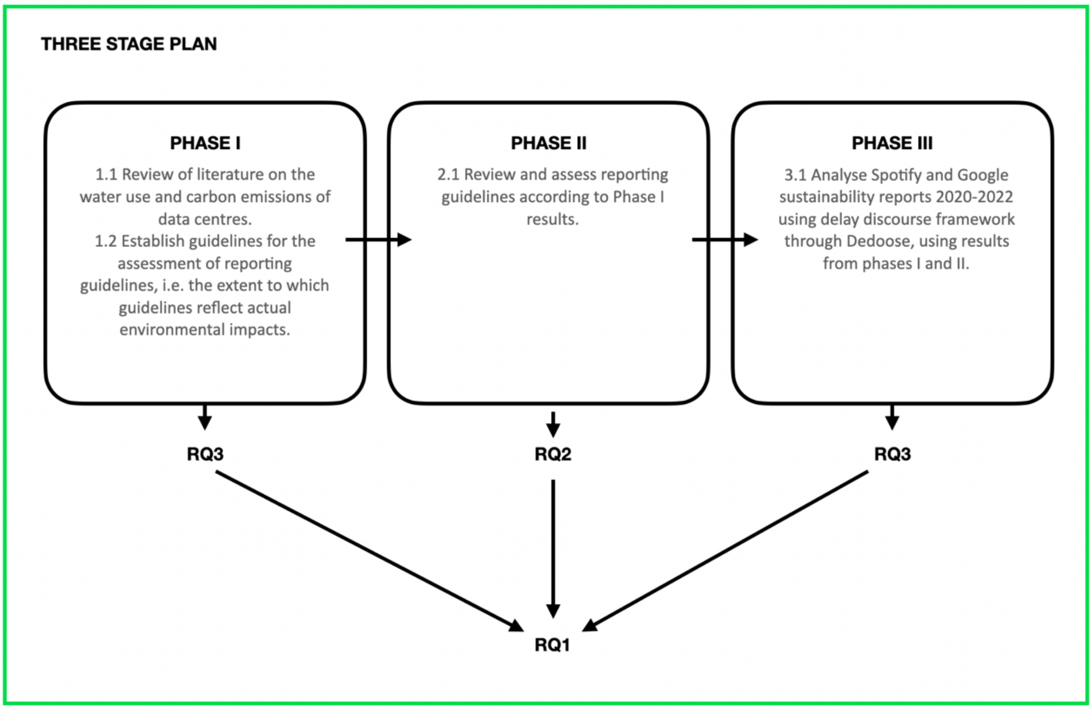
Note: Discourses of climate delay are split into two tiers, with tier one identifying four broad areas of delay discourse which are then split down further into specific manifestations of the tier one discourses. Figure retrieved from Lamb et al, 2020, p.2.

In this paper, delay discourse will then be utilised as a framework for the analysis of sustainability reporting. The results of this analysis will allow judgement on the extent to which reporting in this case functions as a tool for participatory democracy, or rather the opposite; whether climate talk is in this case correlated to climate walk (Coen et al., 2022). Further, whether climate talk is in this case instead reinforcing a hegemonic discourse with the aim of maintaining the status quo.

3 Methods

To answer the proposed research questions, a three-stage approach was adopted (*Figure 3)*. This consisted of a structured literature review for relevant scholarly and grey literature, and finally an analysis of sustainability reports using the delay discourse framework.

Figure 3: Three stage plan for research process



3.1 Phase One: Structured Literature Review

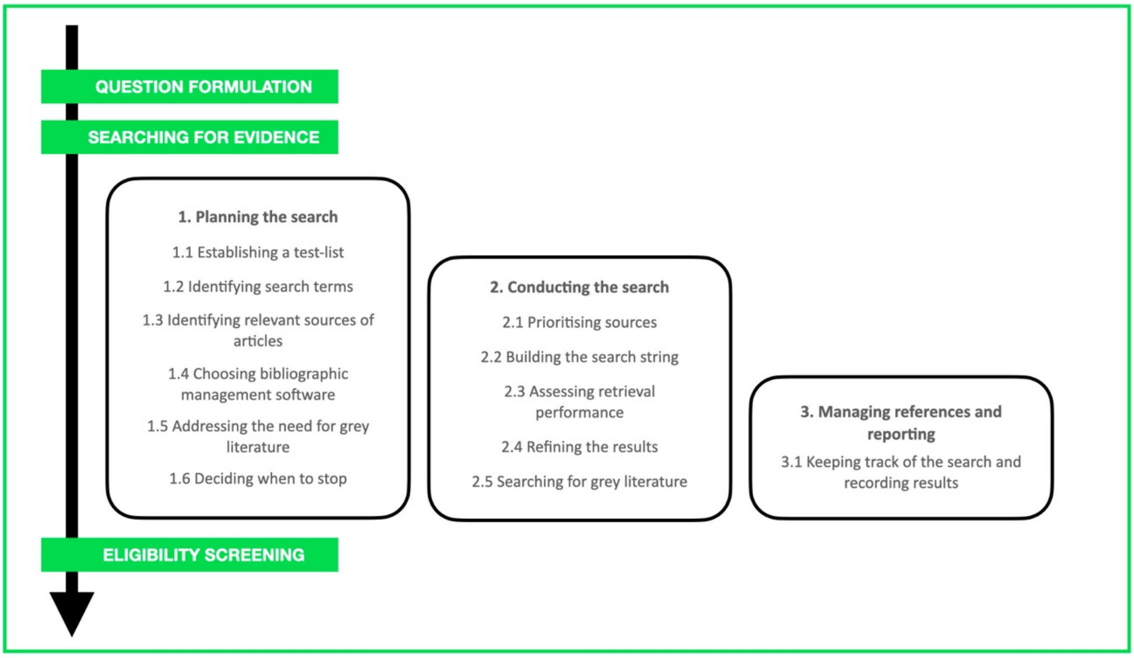
The initial literature review was conducted in line with the Standards for Evidence Synthesis in Environmental Management according to the Collaboration for Environmental Evidence (CEE) (Version 5.1). CEE's methodology was chosen for both their reputability and relevance to the topic area. The first step was therefore a scoping stage, which helped to develop inclusion criteria, acknowledge limitations, and gain an understanding of the literature available. *Table 1* illustrates the information gathered.

Table 1: Scoping stage of structured literature review

Estimated volume of relevant and available literature	>1,000
Data type	Qualitative, some quantitative
Likely limitations	Language, number of reviewers
Key words	Data centre/center, water, carbon emissions, CO2, carbon dioxide

This information was established through the testing and development of a search strategy. The search phase was conducted according to *Figure 4*, developed from Livoreil et al. in Frampton et al. (2017).

Figure 4: Planning, conduct, and management of the searching phase of the structured literature review



Note: Searching phase methodology inspired by Livoreil et al. in Frampton et al. (2017) and adapted for the scope of the paper.

The data type was established as largely qualitative on the basis of the research questions, although information such as power usage effectiveness (PUE) and water use effectiveness (WUE) of systems would also be of relevance.

Limitations were acknowledged through both the CEE guidelines and the initial test search. Language may present one limitation, but is unlikely to be significant. This is because the proportion of results in languages other than English or French was low, as will be discussed in further detail below. CEE recommends the use of more than one reviewer to avoid fatigue. This could not be undertaken, however acknowledgement of this limitation meant that it could be mitigated as far as possible, as discussed below.

The estimated volume of relevant and available literature was estimated through an initial search using the key words ‘data centers*, water’ through Web of Science. The total number of results was N=1,000. It was therefore reasonable to estimate that after relevancy checks the total would be N= >1,000, further, results from the initial review suggested research particularly pertaining to water use is low (Mytton, 2021). The initial search also revealed a result number variance dependent on the spelling of ‘data centre’ versus ‘data center’, so both were included in the final search, formulated as ("data centre*" or "data center*").

Given the relatively low estimated number of relevant results, a high sensitivity method was chosen to net the highest number of relevant results. This did generate low specificity, as seen in *Figure 5*, but aimed at a more comprehensive review.

Both the Web of Science and Scopus were chosen as databases to search, because the test search revealed a difference in result numbers indicating that there was some likelihood of results unique to each database for the same search string. Zotero and Excel were chosen as bibliographic management software. It was decided that grey literature would be used in stage one where relevant, guided by results from the structured review. The search for grey literature would be unstructured, and used in a limited sense.

Results were refined for language to English and French given the language competencies of the reviewer. They were also refined by the years 2022 to 2020. This is because the Uptime Institute’s 2022 data centre survey suggests that 33% of suppliers have a server refresh cycle of 1-3 years, with a further 15% at 4 years, 33% at 5 years and 19% at >5 (Davis, 2022, p. 9). There is some evidence to suggest cooling systems can be replaced far more often than this, though data on cooling system refresh rate is low (Google Workspace, 2014, 4.00-4.11). Nevertheless, this information suggests results from the last three years would be most likely to have the highest relevancy.

Based on this search criteria, the number of results netted for the Web of Science and Scopus search on water and data centres was therefore 2,078 results total for WoS and 475 for Scopus. For the WoS search, language bias is unlikely to be problematic due to a vast majority of the results being in English, with a further ten in Chinese, Russian, Indonesian, and Spanish respectively. The Scopus search had a higher number of non-English or French language results, with a further 41 in Chinese, and 22 in various other languages. As a proportion of the results, however, this number was relatively low.

These results were then refined further. In order to minimise mistakes as a result of fatigue, and to simulate as far as possible the work of two reviewers, the first exclusion stage was conducted twice, with the second after a break period of two days. A systematic screening process according to CEE guidelines was used, with Relevancy Check 1 (RC1) and Relevancy Check 2 (RC2) conducted based on the relevancy of the title and key words (Frampton et al., 2017). All search results were reviewed together, as overlapping relevancy between water and energy/carbon emissions in areas like cooling meant an equal overlap in the results.

Table 2: Initial inclusion criteria for relevancy checks 1 & 2

Initial Inclusion Criteria
a) Published after 2019 b) Use of words ‘data centre/center’ in title or key words c) Use of words ‘water’, ‘carbon emissions’, ‘energy’, ‘cooling’ in title or key words

A third exclusion stage (RC3) was then conducted, based on the abstract of each paper.

Table 3: Final inclusion criteria for relevancy check 3

Final Inclusion Criteria
Articles should include qualitative or quantitative information on any of the following topics: a) Water use in data centres for cooling systems a. In specific terms, e.g., a particular cooling method b. In general term, e.g., data centre water use in general in a geographic area b) Water use by data centres from electricity consumption c) Carbon emissions from data centres from electricity consumption d) Power use effectiveness/energy intensity of data centres dependent on a. Software use b. Hardware use (including cooling systems) e) Assessments of metrics used, e.g., PUE, WUE

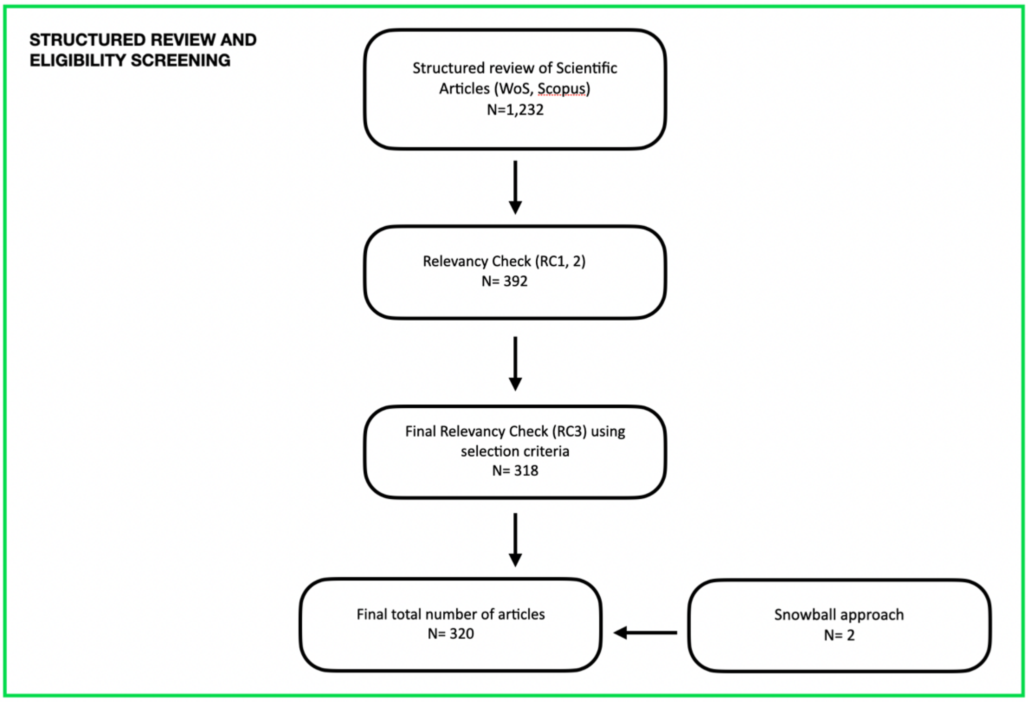
Some further results were then excluded after RC3, in which the abstract was checked for relevancy. Reasons for exclusion are exemplified in *Table 4.*

Table 4: Reasons for exclusion of papers at RC3 stage

Reason for Exclusion	Example
High specificity	• Focus on very narrow geographic location or singular data centre, where results are unlikely to be widely applicable. • Focus on specific aspect of one cooling method, e.g., the materials used in construction.
Economic focus	• Look at decreasing energy consumption from a profit-based standpoint. Excluded if abstract shows unlikely to include sustainability-related data or reflections.

Though it is possible that some relevant papers could have been excluded in this stage, that the number of papers on each topic was high. It is therefore unlikely that the information covered in the low number of papers excluded would make a significant difference to findings. At this stage, two papers from 2019-2018 were also added through a snowball approach.

Figure 5: Structured Review and Eligibility Screening



Note: Three stages of relevancy check were conducted. Two articles were added through a snowball approach, ending with a final total of 320 articles.

A limited, unstructured review of grey literature was then conducted, guided by findings from the original literature review. Searches included a review of the industry standard white papers.

3.2 Phase Two: Reporting requirements review

To conduct a structured literature review of the reporting standards affecting Spotify and Google, three steps were necessary. The first step was to identify which of the reporting standards both were either voluntarily or legally required to hold to.

Table 5: Identification and classification of reporting standards

Reporting Body	*Used by (Spotify/Google/None)*	*Source*
New York Stock Exchange (NYSE)	Spotify	(NYSE, 2022)
European Union Non-Financial Reporting Directive (EU NFRD)	Spotify, Google	(*Google NFRD*, 2022; *Spotify Report 2021*, 2022)
Greenhouse Gas Protocol	Spotify, Google	(Google, 2021; *Spotify Report 2021*, 2022)

In addition, the EU NFRD recommends and is influenced by the United Nations Global Compact (UN GC), Global Reporting Initiative (GRI), and Task Force on Climate-related Financial Disclosures (TCFD). As these support the only binding set of legally reporting requirements, they were also included in the literature review. The second step was then to establish a set of research objectives *(Table 6).*

Table 6: Research objectives. Objectives were selected to construct the best overview of the reporting requirements, and with the aim of answering RQ2.

Research objectives
For each white paper, the following information was identified: • Area of applicability globally • Whether the reporting standard operated on a voluntary or legally binding basis • Relevance and specificity with regards to e-business and data centres • Focus areas, e.g., greenhouse gas emissions

Finally, the papers were reviewed, and findings were summarised. Based on the results from Phase I, it was then possible to assess the degree of comprehensiveness present in the above reporting standards.

3.3 Phase Three: Review and Delay Discourse Analysis

In order to analyse both Google and Spotify's reporting using the delay discourse framework, sustainability reports from 2020 to 2022 were inputted into Dedoose. This time period was chosen to match that of the literature review. Salmona et al.'s (*NYSE*, n.d.) approach to Dedoose for mixed method analysis was used. This was appropriate given the dual objectives of the research at this stage, to look for any patterns of delay discourses used in reporting, and to quantify and compare the reporting of carbon emissions versus water.

Within Dedoose, each of the delay discourse categories were coded in, with tier one discourses (e.g., "Non-transformative solutions") as parent codes and tier two discourses (e.g., "Fossil fuel solutionism") as child codes, as can be seen in *Table 7* (Lamb et al., 2020).

Table 7: Coding for analysis using delay discourse framework

Parent Code	Child Code
Non-transformative solutions	No sticks, just carrots
	Fossil fuel solutionism
	All talk, no action
	Technological optimism
Emphasize the downsides	Appeal to social justice
	Appeal to wellbeing
	Policy Perfectionism
Redirect Responsibility	'Free rider' excuse
	Individualism
	Whataboutism
Surrender	Change is impossible
	Doomism

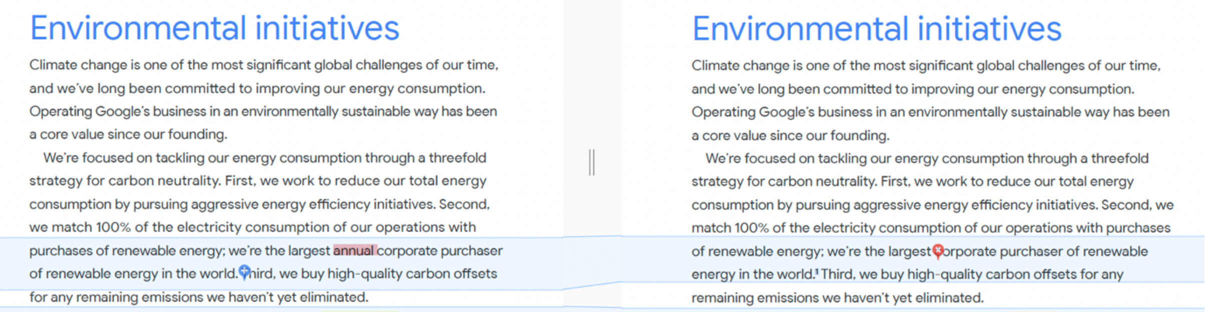
In addition, codes based on the findings of Phase I were added as parent codes to assess the commonality of these in the reports. As only certain sections of each report were relevant to this paper, a process of excerpting was conducted, meaning that for each report relevant sections identified *(Table 8)* (Salmona et al., 2020).

Table 8: Criteria for excerpting. The criteria are chosen from the research questions, meaning that some sustainability sections e.g., on a circular economy, are excluded.

Reason for Inclusion/Exclusion	Example
Topic area	• Section relevance: 'Climate Action' section of Spotify's 2021 Equity & Impact Report was identified as relevant versus the 'Mental Health' section was identified as not relevant. • Mention or lack thereof of carbon emissions, energy, or water use.

Duplicated text (*Figure 6)* was also excluded in order to avoid duplication of analysis.

Figure 6: Side by side comparison of section from Google NFRD reports (2019-2020)



Environmental initiatives

Climate change is one of the most significant global challenges of our time, and we've long been committed to improving our energy consumption. Operating Google's business in an environmentally sustainable way has been a core value since our founding.

We're focused on tackling our energy consumption through a threefold strategy for carbon neutrality. First, we work to reduce our total energy consumption by pursuing aggressive energy efficiency initiatives. Second, we match 100% of the electricity consumption of our operations with purchases of renewable energy; we're the largest annual corporate purchaser of renewable energy in the world. Third, we buy high-quality carbon offsets for any remaining emissions we haven't yet eliminated.

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Note: Excerpt on the left taken from Google's NFRD report from 2019, the right from the 2020 report. Red highlight indicates where a word has been deleted. Comparison generated through Adobe Acrobat Pro. Retrieved from (Google NFRD, 2020; *Google NFRD,* 2021*)*

Reports were then coded by sentence. Finally, Dedoose's analysis tools were used to examine the results with regards to code presence, application, and co-occurrence.

4 Results

4.1 Phase I: Structured Literature review

The review is split into two sections: CO_2 & Energy Efficiency, and Cooling & Water Use. It is important to note that although this differentiation has been made for the purposes of this paper, these topics are inter-related. This is because of two factors. The first is that within the data centre (DC), cooling and air conditioning units make up around 30 to 50% of the total energy cost (H. Liu et al., 2020; Manaserh et al., 2022). The second is the trade-off between water and energy, and therefore in most cases CO_2; in many cases, if one aims to decrease the energy cost of the cooling system then water use increases (Karimi et al., 2022).

4.1.1 CO_2 & Energy Efficiency

It is difficult to say with authority exactly how much of the global energy use and carbon emissions data centres are truly responsible for. Estimates range from 1% through to 4.2% for energy use

(Landré et al., 2022). Within Europe, the GreenDataNet Project puts this number at between 2% and 2.5% (*Project Description, Green Data Net*, n.d.). Their contribution to global carbon dioxide emissions is put at between 2% and 3.8%, with this number expected to as much as double every year (Gourisaria et al., 2021). Zhou et al (2020) put an average data centre's daily energy usage at around 25,000 KWh. This is approximately eight times the yearly electricity consumption of a home in the UK, or about two hundred office spaces (Department for Business, Energy & Industrial Strategy (BEIS), 2021; Gourisaria et al., 2021). Regardless of the specific numbers, it can be said with a good degree of certainty that the number is high and will continue to grow given the corresponding growth in demand for and access to computing services, particularly those based in the cloud (Kak et al., 2022; Landré et al., 2022). e

The metric used calculate the energy efficiency of a data centre through power usage effectiveness (PUE) through the following equation (*WP#49 - PUE: A Comprehensive Examination of the Metric*, 2012):

$$PUE = \frac{Total\ Facility\ Energy}{IT\ Equipment\ Energy}$$

This industry definition of PUE does leave room for interpretation, but other more specific definitions also exist as can be seen below (Zhang et al, 2022).

$$PUE = \frac{P_{IT} + P_{cooling} + P_{other}}{P_{IT}}$$

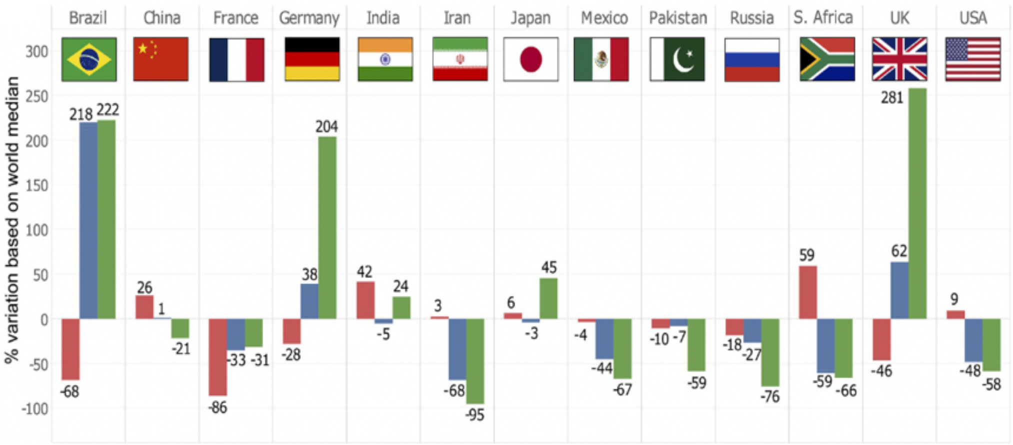
P_{IT} represents the power consumption from IT infrastructure, $P_{cooling}$ the power used for cooling, and P_{other} power used for the operation of other necessary infrastructure, including lighting (Zhang et al, 2022). An ideal PUE value would be 1.0, but on average PUE is around 1.55 (Davis, 2022, p. 6).

It should be acknowledged that there have been critics of PUE as a measurement, with some arguing it can encourage behaviours that lead to an increase in water use, because of the trade-off between energy and water use (Lawrence, 2020; Siddik et al., 2021).

An additional problem that should be noted when comparing PUE values is that they are very geographically dependent (Lei & Masanet, 2022). In general, PUE values are lower in DCs in cooler climates. Nevertheless, PUE remains the industry standard. This is perhaps because of its simplicity, but also because frequently a low PUE seems to be correlated with other issues including carbon emissions (Guo et al., 2021; H. Liu et al., 2020).

In reality, PUE values are not necessarily correlated with carbon emissions in a straightforward sense, but there are certainly significant global variations in terms of average carbon emissions and water use for internet services globally (Lei & Masanet, 2022). This is illustrated in *Figure 7*.

Figure 7: Carbon, water, and land-use footprint by gigabyte of internet use

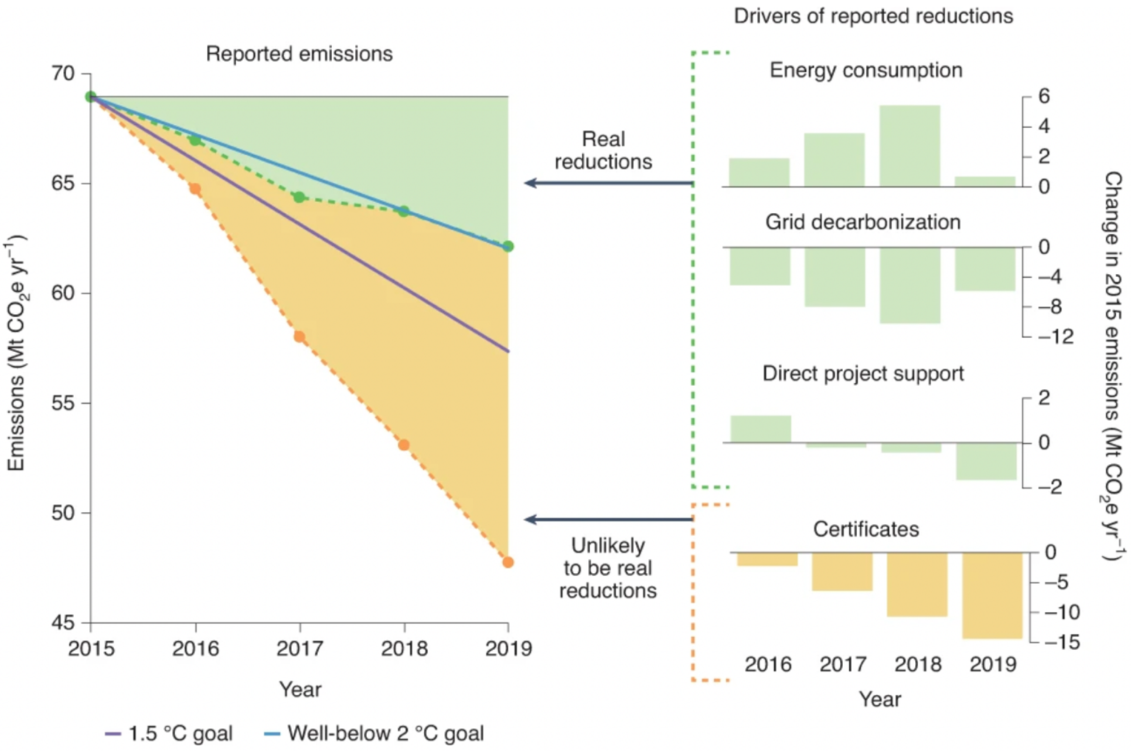


Note: Graph indicating the world carbon, water and land footprints by gigabyte of fixed-line internet use, giving examples of countries in terms of percentage variation from the world median. Carbon footprint is shown in red, water in blue, and land in green. Retrieved from: (Obringer et al., 2021, p. 2).

The correlation between PUE and carbon emissions occurs because a majority of global energy production occurs through the use of fossil fuels, although many service providers offset through what are called renewable energy certificates (RECs) in the U.S.A., Guarantees of Origin (GoO) in the EU, and more generally Power Purchase Agreements (PPAs) elsewhere (Kühne, 2021; *Stepping Up*, 2022; US EPA, 2022). RECs essentially allow operators to buy the ‘greenness’ of electricity produced by renewable energy providers, with each REC representing 1 MWh of renewable electricity (US EPA, 2022). Conceptually, RECs support the renewables industry through investment and thereby drive an increase in renewable energy production, but there is not sufficient evidence to support this claim (Bjørn et al., 2022; Herbes et al., 2020). Part of the reason for this is the two subsections of renewable energy credits: RECs that provide additionality, and unbundled RECs.

RECs can be sold either bundled, that is with the energy produced, or unbundled from the energy (Miller, 2020). An unbundled REC is effectively the right to call 1 MWh of electricity 'renewable'. Unbundled RECs are very unlikely to lead to a real mitigation of climate change *(Figure 8).*

Figure 8: Company-reported emissions trends compared with Bjørn et al's estimates of real emissions reductions



Note: Graph shows that although organisations reported emissions reductions in line with the Paris agreement's goal of 1.5ºC (purple line), two thirds of this were attributable to RECs. These certificates are unlikely to have resulted in real reductions in carbon emissions. Bjørn et al. estimate a real reduction of 10%, which falls well below the 2ºC goal (blue line). Retrieved from: (Bjørn et al., 2022a, p. 509).

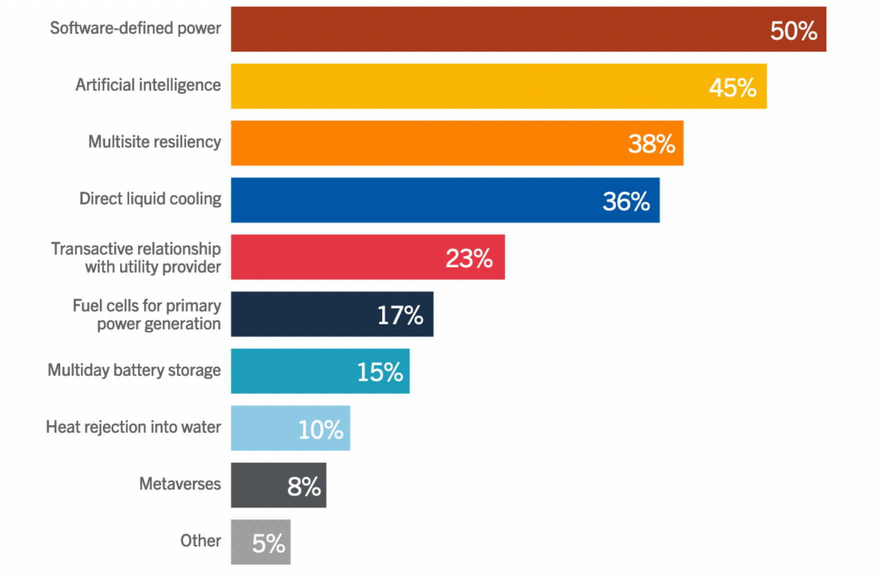
Additionality can be defined as "the relationship between cause and effect. For any cause and effect, the effect can be described as being additional if it would not have occurred in the absence of the cause" (*ISO 14064-2*, n.d. in Bjørn et al., 2022, p. 547).

In this case, the effect is defined as "the generation of renewable energy and the development of new capacity (for example, windmill or solar panels) for renewable energy generation" (Bjørn et al., 2022, p. 547). Power purchase agreements which support the building of a new renewables project are more likely to lead to actual mitigation of climate change, and the increase of renewable energy production *(Figure 8).*

Setting aside RECs, the best way to reduce carbon emissions for data centres is through energy efficiency (Guo et al., 2021; Pambudi et al., 2022). One way of doing so is cloud computing. Studies conducted by the Global e-Sustainability Initiative and by Microsoft have indicated that services run over the cloud can be around 95% more energy efficient than those that are not (Kak et al., 2022). Cloud computing, as opposed to traditional IT, will part of the focus for this section of the paper, as it is the form of computing most relevant to the case of Spotify with their use of Google Cloud. Furthermore, it is in general the most appealing form of computing for commercial customers, and is currently seeing a surge in popularity (Guo et al., 2021). This is in no small part because cloud computing, as Google defines it, is “the on-demand availability of computing resources as services over the internet. It eliminates the need for enterprises to procure, configure, or manage resources themselves, and they only pay for what they use.”(*What Is Cloud Computing?*, n.d.).

Within cloud computing, energy use reduction can come about through both hardware and software improvements. The Uptime Institute’s 2022 survey results (*Figure 9*) identified software as the field most likely to deliver on improvements in the efficiency of data centres ((Davis, 2022) p28).

Figure 9: Graph to show expectations by operators for drivers of energy efficiency



Note: Reponses to the question, “Thinking about the next five years, which of these innovations is likely to deliver improvements in the efficiency of the data centres? Choose no more than three.”. N=744. Results indicate operators believe that power and cooling show the most promise, particularly software innovations. Retrieved from Davis, 2022, p28.

Strategies for software include the use of virtual machine (VM) migration, and (Sabyasachi & Muppala, 2022). VMs can aid energy efficiency through load balancing, that is, distributing work evenly across the available computing resources. This in turn improves the overall performance of the data centre; an inefficient distribution of tasks can by the same token reduce the performance of the cloud data centre. VMs have the capacity to improve data centre performance because management in this way allows for the fewest possible servers to be used in periods of low demand, and prevents servers from being overloading during periods of peak work load (H. Liu et al., 2020; Sabyasachi & Muppala, 2022). In general, many different proposals have been made with regards to algorithms in recent years, including Sabyasachi & Muppala's (2022) Cost-Effective Whale Optimization Algorithm, EcoCloud, and Landré et al's (2022) polynomial time algorithm proposal, among others (Fernández-Cerero et al., 2020; Zhou et al., 2020). Research suggests that algorithms like these indeed have various useful capabilities from energy consumption reduction to increasing the feasibility of a renewables-fuelled data centre through the use of mechanisms like energy aware request geo-distribution approaches (Guo et al., 2021; Landré et al., 2022; Sabyasachi & Muppala, 2022). Software, then, can indeed be said to have an undeniable and measurable impact on the environmental impacts and demands of a given data centre (Fernández-Cerero et al., 2020).

Hardware modifications have a similarly significant impact on the demands of a given data centre. These can range from the server processing speed to the temperature that processors, including the central processing units (CPUs) and graphics processing units (GPUs), are able to operate at (Nonaka & Shoji, 2020). In this case, the higher the better for energy efficiency (Nonaka & Shoji, 2020). This is because, as already noted, the cooling system is one of most impactful aspects of data centre operations (Manaserh et al., 2022).

4.1.2 Cooling & Water Use

Cooling is necessary for data centres, because of the increase in the rate of failure above an optimal 18-27°C (64-81°F) (*Thermal Guidelines*, 2016). Energy and water use vary dependent on the geographical location of the centre; those located in places with a lower temperature on average will have a correspondingly lower demand on energy for cooling (Kak et al., 2022). Geographical location is not the only determinant of energy or water use. Each of the methods of cooling chosen has an different impact on the PUE and water use efficiency (WUE) values of the data centre (Lei & Masanet, 2022). It is important to note, however, that as far as WUE is concerned it is fairly challenging to quantify water use for data centres, because most data centre operators excepting Facebook and Scaleway do not report on it (Lei & Masanet, 2022; Mytton, 2021). As a result, any models that have been constructed have a lower accuracy, and overall there have been very few studies of data centre direct water use in peer-reviewed literature to date (Lei & Masanet, 2022).

Nevertheless, it is possible to examine the ways in which water is used, and note their water and energy intensity in relative terms. In the same way as PUE, it is possible to calculate WUE for cooling through the following equation (Mytton, 2021).

$$WUE = \frac{Annual\ Site\ Water\ Usage}{ICT\ Equipment\ Energy}$$

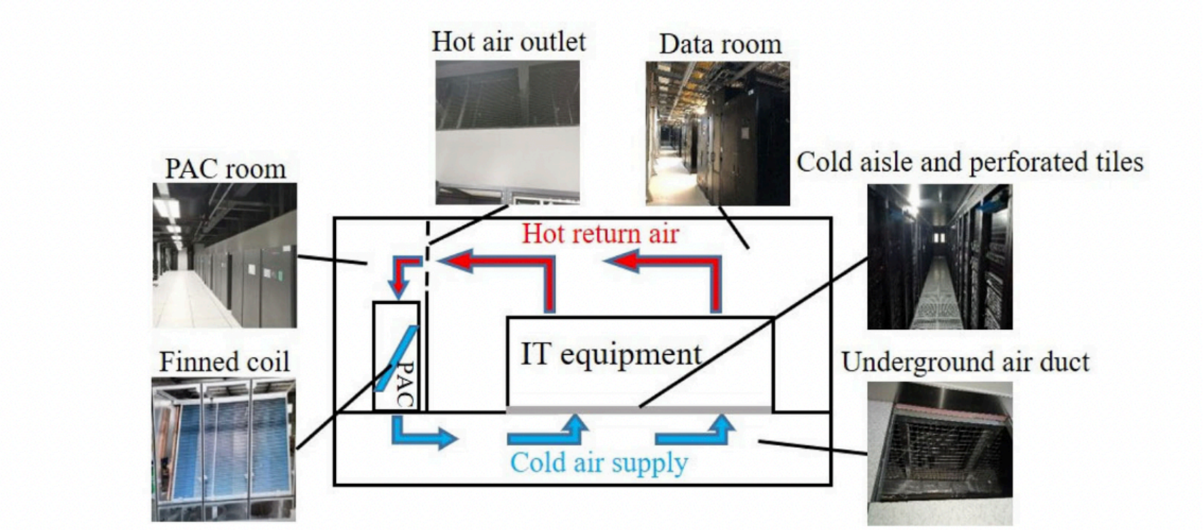
The unit for WUE is L/kWh. The above calculation, however, does not include the water used in energy production. The equation for this would be:

$$WUE_{source} = \frac{Annual\ Source\ Energy\ Water\ Usage + Annual\ Site\ Water\ Usage}{ICT\ Equipment\ Energy}$$

It is possible to estimate that around 44% of total water withdrawals globally are for energy production, though data on water use for energy production is low (Larsen & Drews, 2019). Water withdrawals are made through-out the process, in extraction of resources though mining, through to the generation of electricity (Rio Carrillo & Frei, 2009). In thermo-electric power stations, which as of 2013 made up 90% of the total electricity generation in the U.S.A., this comes through water withdrawals for the cooling towers, and through the use of high-pressure steam to spin turbines to generate electricity (*Energy Demands*, 2006; Pan et al., 2018). Differing systems have different levels of economy when it comes to water use; closed loop systems have cooling towers allow for water to be recirculated through the system (*Energy Demands*, 2006). This means WUE will somewhat vary dependent on the proportion of energy generation in each area that is dependent on water withdrawal. For example, in areas with a high proportion of energy from power stations using thermos-electric power stations, WUE can be improved through energy efficiency.

Methods of cooling can be split into five main groups. One of the most common cooling methods is through computer air conditioning units (Shahi et al., 2020; *Liquid Cooled Solutions*, 2019). These generally involve a vapour compression refrigeration system and hot/cold aisle layout (Cheng et al., 2022; Y. Zhang et al., 2022). In this way, cold air enters through perforated tiles on floor, the heated air exits from the rear of each rack. Precision air conditioners are also sometimes used, which have the advantage of having a small enthalpy difference and a comparatively large air volume (Cheng et al., 2022). In both forms of air conditioning, water is used to cool the hot return air *(Figure 10).*

Figure 10: Diagram of the layout and airflow of a data centre with use of the Precision Air Conditioning cooling method.



Notes: In a data centre using the precision air conditioning method, cool air enters through underground air ducts and move up into the data room through perforated tiles. Hot air exits into the PAC room through an outlet higher up. The hot air is then cooled as it is passed over coils containing cold water. Once cooled, the air is recirculated into the data room. Retrieved from Cheng et al, 2022. 430.

Air conditioning as a method has the advantage of allowing for a longer lifespan through preventing the degradation of components (Zhang et al, 2022). It is, however, fairly energy intensive, especially for high performance computing data centres (Shahi et al., 2020). Other methods have therefore been developed with the increasing awareness of the importance of carbon emission and energy consumption reduction. These methods predominantly include free cooling, and liquid cooling. Others are currently still largely in the lab phase, and therefore are not discussed here, including two-phase cooling, and TES based cooling (Cataldo et al., 2020; Y. Zhang et al., 2022).

4.1.2.1 Free cooling

Free cooling means bringing in ambient cool air to decrease the inside temperature of a DC. It therefore reduced the energy consumption of computer room air conditioning units and improves their energy efficiency (Y. Zhang et al., 2022). Depending on the source, free cooling can be broken down into either air-side or water-side cooling. Its efficacy in terms of energy saving can vary slightly depending on environmental conditions, but it is still possible to successfully operate data centres using free cooling in higher temperatures (J. Liu et al., 2021; Van Le et al., 2022).

Air-side free cooling takes in air from the external environment to cool the DC (Hnayno et al., 2022; Y. Zhang et al., 2022). It can either be achieved through direct free cooling, in which outdoor air is brought directly into the DC, or through indirect free cooling, which utilises heat exchangers between the outdoor and indoor environments (Hnayno et al., 2022). The latter has an advantage in the sense that indoor air quality requirements necessitate the use of dehumidification and filtration units in the case of direct free cooling (Y. Zhang et al., 2022). This is because, without indoor air quality assurance measures, airborne contaminants can cause a faster rate of corrosion (Van Le et al., 2022).

Water-side free cooling, by contrast, takes cold water from a nearby source such as an ocean or river, and can also be divided into direct or indirect cooling (Chu & Huang, 2023). As with air-side free cooling this method is also geographically affected; the colder the climate, the lower the energy used (Diaz et al., 2020; J. Liu et al., 2021). Direct cooling in this case uses natural cold water to cool the air inside the DC, similarly to the original computer air conditioning units discussed above (J. Liu et al., 2021; Y. Zhang et al., 2022). In an indirect cooling system, a heat exchanger is used rather than direct use of the cold water from the external environment (J. Liu et al., 2021; Y. Zhang et al., 2022).

4.1.2.2 Liquid cooling

Liquid cooling uses “liquid as a heat transfer medium to cool servers” (Zhang et al., 2022, 6). Water and aqueous glycol are some of the coolants used in liquid cooling (Karwa, 2020; Shia et al., 2021). These can be augmented with other substances better at thermal conduction. Graphene is one example of this, and (*Flexegraph*, 2021). Neither in their pure form are dielectric liquids, however, so in cases where these are needed other substances including deionised water, fluorinated liquids, mineral oils, and others based on hydrocarbons are used (Karwa, 2020). This is one of the major differences between cold plate and immersion liquid cooling.

Cold plate liquid cooling uses the eponymous cold plates, which fit closely to the CPU of the server. The plates are made out of a material with a high thermal conductivity, for example copper (Nada et al., 2021; Shahi et al., 2020). The positioning of the cold plates close to the CPU improves the temperature differential between the components and the coolant, which in turn gives a better PUE (Y. Zhang et al., 2022). In cold plate cooling, non-dielectric fluids like water and glycol can be used, but in practice leakage is a problem so dielectric fluids like those in immersion liquid cooling are sometimes utilised as a precaution (Nada et al., 2021; Y. Zhang et al., 2022).

In immersion liquid cooling, the server is immersed in a coolant (Pambudi et al., 2022). Heat is then transferred from the coolant via an external circuit. Coolants used are generally chemically stable, dielectric substances like FC-72, a fluorocarbon derivative of hexane, also called perfluorohexane (Karwa & Motta, 2021; *Perflexane*, 2022). It has a very high global warming potential of 5000 on a 20 year time horizon (UNFCC, n.d.). Other coolants such as Novec-649 have been designed with the intention of providing a replacement for ozone-depleting substances and compounds like FC-72 with high GWPs, but are not yet universally used (*3M Novec*^{TM}, n.d.; *R1234ze*, n.d.; Karwa, 2020).

There is currently a move towards lower global warming potential dielectric fluids, although those based on hydrocarbons currently have a higher dielectric strength than deionised water, for example (*Dielectric Fluid*, 2020; Karwa, 2020). Furthermore, water must be carefully managed compared. This is because it is corrosive to elements, and is not biostatic (Karwa, 2020; Shia et al., 2021). Biological growth here refers to pathogens including legionella; Legionnaire's disease outbreaks from cooling towers have been known to happen (*Legionella*, 2022). Biocides are therefore used (Karwa, 2020; Shia et al., 2021).

Due gaps in data, and to the aforementioned variations in hardware and software in each company, in fact in each data centre, it is difficult to make generalisations about the specific environmental demands of data centres, to paint a full picture. It is, however, possible to say what might be required in terms of data to gain that full picture *(Table 9).*

Table 9: Information recommended for water and carbon emissions sustainability reporting

Information recommended for 'full picture' water and carbon emissions sustainability reporting
From the information above, it would be useful to know: • Total electricity use • Total water withdrawal • Use of RECs/PPAs • PUE • WUE • Global location • Cooling system used • Software used • Hardware used

This is, of course, still excluding the environmental costs of materials used to build the centre.

4.2 Phase II: Reporting Standards

Currently, reporting requirements are not comprehensive, as can be seen in *Table 10.* Both Spotify and Google are influenced by several different reporting standards to varying levels.

As it is listed on the New York Stock Exchange (NYSE), Spotify required to submit reports according to NYSE rules; however, ESG reporting on the NYSE is voluntary, "not listing standards, regulations or requirements… intended to help you make further progress, or even get started, on your ESG journey" (Cunningham, 2022). Similarly, Google is listed on the National Association of Securities Dealers Automated Quotations Stock Market (NASDAQ), also based in New York, and which also provides "a supporting resource for companies" (*ESG Reporting Guide*, 2019; *GOOG*, n.d.; *Welcome to Times Square*, n.d.).

By contrast, the European Union requirements are legally binding for both Spotify and Google. For Spotify, this is because it is registered for tax purposes in Luxembourg, and is therefore bound by European Union legislation (*SPOTIFY LIMITED*, 2018). Google has to report on its operations in Sweden, Denmark, and Spain under Directive 2014/95/EU, so is to this extent bound by the European Union Non-Financial Reporting Directive (*Google NFRD*, 2022)**.** For the preparation of NFRD reporting, the EU currently recommend the use of "EU-based or international frameworks" (CEPS et al., 2021, 107). Within their 2021 study on the non-financial reporting directive, the EU identifies the top five of these frameworks to be the Global Reporting Standards (GRI), United Nations Global Compact (UN GC), European Commission Guidelines (2017 and 2019), and Carbon Disclosure Project. Below (*Table 10*) for comparison are their scopes and key areas of accountability. In addition to these five, the NYSE, NASDAQ, and Greenhouse Gas Protocol have also been included, as these are pertinent to Spotify and Google in particular. The latter is recorded in Spotify's Sustainability Report 2021 as the tool used to help them calculate their emissions from their whole value chain, and further referenced in Google's 2022 Environmental Report (*Google Report*, 2022; Spotify, 2021). Finally, the Taskforce on Climate-Related Disclosure has been added, given their influence on many of the other reporting bodies included here (*CDP Guidance*, n.d.; *GRI - Towards New EU Sustainability Reporting Standards*, n.d.; CEPS et al., 2021).

Table 10: Summary of Relevant Global Reporting

Reporting Body	*Where/to whom applicable*	*Applies to (Spotify/Google/None)*	*Legal Status*	*Scope and Areas of Accountability*	*Source(s)*
New York Stock Exchange (NYSE)	To those registered on the NYSE	Spotify	Voluntary	No specifics, general encouragement to be 'accurate', 'balanced', 'comparable', 'contextualised'. Refers to GRI, SASB, TCFD, WEF-IBC as useful tools. Focus on narrative storytelling.	(Cunningham, 2022)
NASDAQ	To those registered on the NASDAQ stock exchange	Google	Voluntary	Environmental, social, and governance (ESG) metrics given on GHG emissions, water usage, and climate oversight, among others. ESG promoted as performance indicators for investors, and a way to increase operational efficiency.	(*ESG Reporting Guide*, 2019)
European Union Non-Financial Reporting Directive[1]	Companies registered in the European Union	Spotify, Google	Binding	Must report on environmental matters, use of renewable and/or non-renewable energy, GHG emissions, water use. Endorses UN GC, OECD, GRI and others. Not specific on metrics to be used.	(*NFRD Guidelines*, 2017; EU NFRD, 2014)
Global Reporting Initiative (GRI)	Global	None	Voluntary	Split into Universal, Sector and Topic Standards. No Sector-specific standards apply to Spotify yet. Detailed topic standards available e.g., Energy, Water and Effluents.	(*Consolidated Set of the GRI Standards*, 2022)

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[1] The EU Corporate Sustainability Reporting Directive (CSRD) has been developed, and will come into effect at earliest for reports on the financial year 2023, i.e. those released in 2024 (*CSRD*, 2021; *Final Green Light*, 2022). The CSRD will reportedly be informed by the TCFD.

United Nations Global Compact (UN GC)	Global	None	Voluntary	Must include a description of the steps the organisation has undertaken to implement the Global Compact principles, including the environment (Principles 7-9[2]).	(*UN Global Compact*, n.d.)
Carbon Disclosure Project (CDP)	Global	None	Voluntary	Aligned with TCFD recommendations. Identifies climate change, forests, and water security as three key areas. Questionnaire for sector-specific information, Spotify falls under 'All other sectors'.	(*Guidance for Companies*, 2022)
Greenhouse Gas Protocol	Global	Spotify, Google	Voluntary	Focus on greenhouse gases and reporting relating to this. Includes accounting emissions from electricity. Has developed the Scope 3[3] Standard, "the only internationally accepted method for companies to account for these types of value chain emissions" (*Scope 3 Calculation Guidance | Greenhouse Gas Protocol*, n.d.).	(*GGP Standard*, 2015)

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[2] "Principle 7: Businesses should support a precautionary approach to environmental challenges; Principle 8: undertake initiatives to promote greater environmental responsibility; and Principle 9: encourage the development and diffusion of environmentally friendly technologies." (*UN Global Compact*, n.d.)

[3] Scopes can be understood in this context through the Carbon Trust's definition: "Scope 1 covers direct emissions from owned or controlled sources. Scope 2 covers indirect emissions from the generation of purchased electricity, steam, heating and cooling consumed by the reporting company. Scope 3 includes all other indirect emissions that occur in a company's value chain." (*Briefing*, 2019).

				Allows reporting of market-based emissions[4].	
Task Force on Climate-related Financial Disclosures (TCFD)	Global	None	Voluntary, used as basis for development of legally binding reporting standards.	Guidance split into four sections, including specific recommended disclosures. Encourages disclosure of water usage, and Scopes 1-3 for emissions. Supplemental guidance provided for energy, transportation, materials, and agriculture industries. Acknowledges climate risks, including recognising financial impacts if no action taken.	(*TCFD Recommendations*, 2021; *TCFD Recommendations*, 2017)

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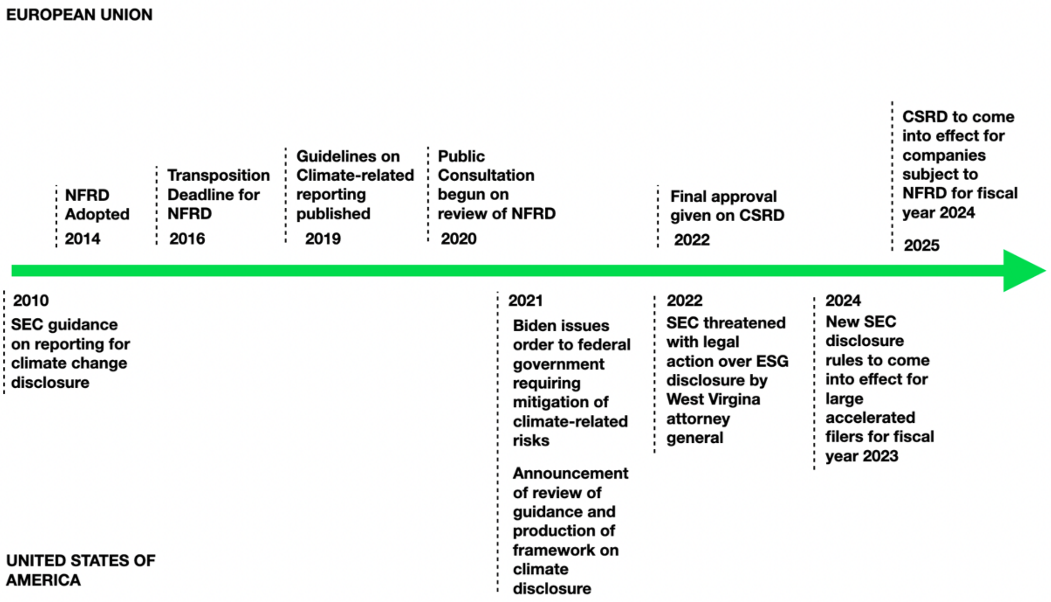
[4] Market based emissions can be defined "emissions from electricity that companies have purposefully chosen (or their lack of choice)". Calculations of market-based emissions take RECs and PPAs into account. This is as opposed to location-based emissions, which "[reflect] the average emissions intensity of grids on which energy consumption occurs" (*Scope 2 Guidance*, 2015, p. 4).

Movements are being made in the governance space, led in no small part by the Taskforce on Nature-related Financial Disclosures (*TCFD Recommendations*, 2017). Nevertheless, progress remains relatively slow on mandated reporting, as can be seen in *Figure 11*. Further, by comparison to sectors like oil, agriculture, or textiles, internet services sit low on the priority list, as can be seen in the development of the Global Reporting Initiative's new sector-specific standards. Both Software and Media and Communication sit in group three out of four, below Textiles, Asset Management, and Insurance – all of which are judged to be "basic materials and needs" and therefore occupy space in Group 1 (*GRI Sector Program*, 2021). At the current rate of work, it is unlikely that Group 3 sectors will be addressed before 2024 or 2025 (*GRI - Schedule of Standards Projects*, 2022).

Figure 11: A timeline of governance over sustainability reporting in the U.S. versus E.U. (2010-2025)



Note: For the EU, the last decade shows a clear progression on climate reporting. For the U.S.A, there has been more opposition to action on climate change reporting, with the court case the SEC faces coming on the basis that the proposed framework requiring reporting on climate change would go beyond the SEC's jurisdiction. Information retrieved from: (Herren Lee, 2021; NFRD Briefing, 2021; Ramonas & Iacone, 2022; Tyson, 2021).

Though many of the above reporting bodies do have principles circulating around the importance of comparability "among companies within a sector, industry or portfolio" (*TCFD Recommendations*, 2017), without sector specific standards or consistency it is difficult to ensure true comparability. Further, competitors to Spotify do not report on their activities in this space. Amazon, Google, and Apple Music do not release a separate sustainability report for this part of their service (*Apple Report*, 2022; *Amazon Report*, 2022; *Google Report*, 2022). Neither Deezer nor TenCent Music appear to report either (Deezer, 2022; TenCent, 2022). In Deezer's case likely because it is not a publicly listed company and has less that 500 employees, so is therefore not required to do so under EU law (*Corporate Sustainability Reporting*, n.d.). Spotify is to date the only real blueprint for reporting on music streaming. This may change. As of 2021, Spotify has joined DIMPACT, a project which aims to "tak[e] the complexity out of calculating the carbon emissions of the downstream value chain of digital media content" (*About DIMPACT - DIMPACT*, n.d.). It functions as a collaborative project, between researchers from the University of Bristol, and eighteen media and technology companies, including the BBC, Netflix, Viaplay group, and others (*Participants - DIMPACT*, n.d.). Nevertheless, for the time being comparison remains difficult.

4.3 Phase III: Sustainability Reporting & Delay Discourse Analysis

As noted above, both Spotify and Google are legally required to report on their sustainability impacts. The extent to which the results of this are representative of their actual environmental demands is under question. In order to assess the comprehensiveness of their sustainability reporting, it is useful to first compile a general overview of what they do report on.

4.3.1 Spotify

The information that is made available with regards to Spotify's sustainability impacts is largely confined to carbon emissions, though in its latest report water was acknowledged. There are some significant differences between their 2020 and 2021 reports.

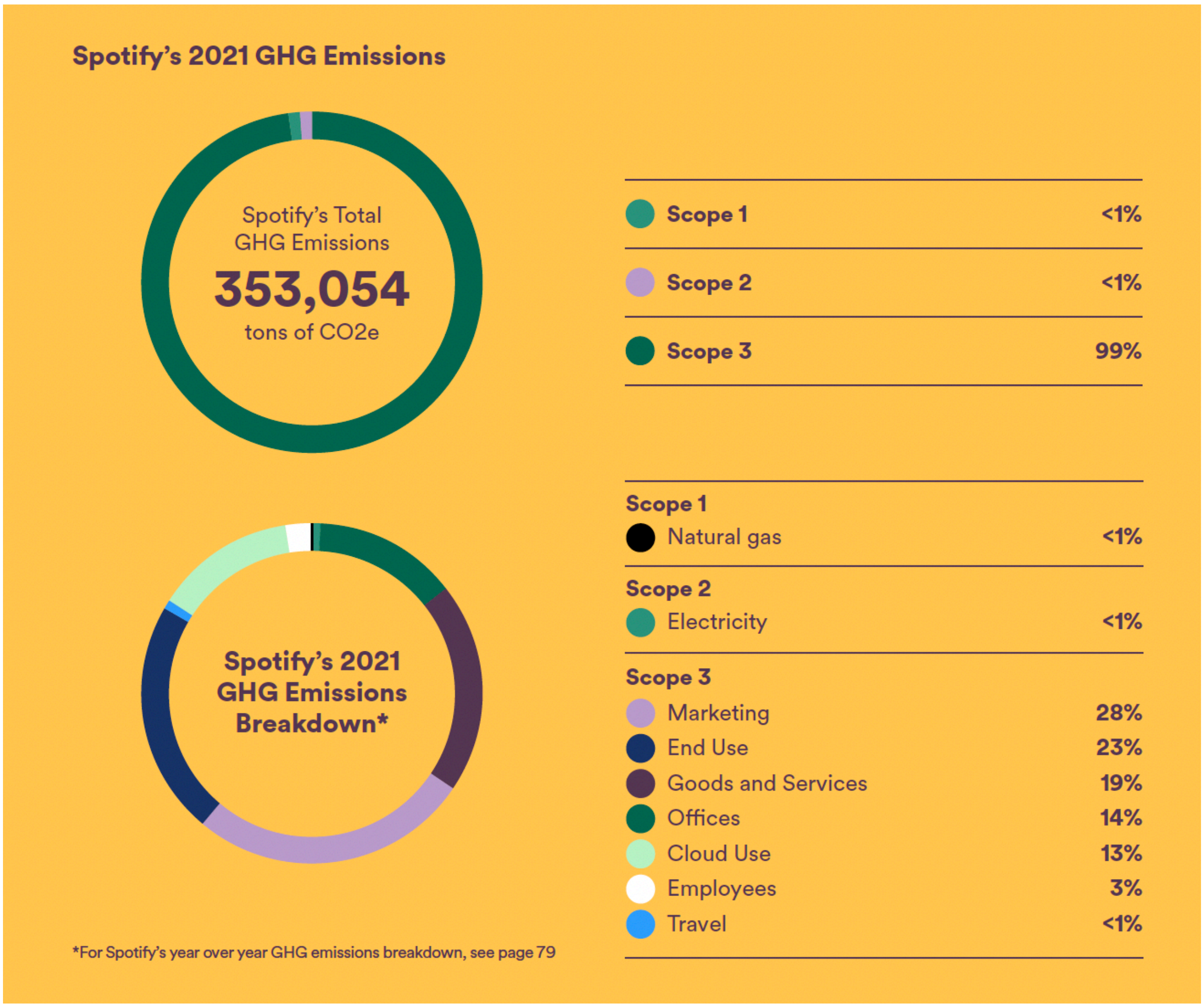
In 2020, Spotify identified the following as its environmental impact (Spotify, 2021).

- Scope 1 - 0 tons CO_2e
- Scope 2 - 2,600 tons (market based), 3,700 (location based)
- Scope 3 - 166,300 tons

Scope 3 is in no small part from its data centres, which Spotify acknowledges as "cloud services and content delivery network providers", making up 43% of emissions in 2020 (Spotify, 2021, p. 25). Interestingly, a further 42% is identified as originating from 'listener use'.

For the fiscal year 2021, however, Spotify's reporting methodology changed, which reflected in their reporting of GHG emissions (*Figures 12 and 13)* (*Spotify Report 2021*, 2022). Scope 3 does clearly still account for the largest part of Spotify's reported GHG emissions, but it is now further broken down. More significantly, Cloud Use now apparently accounts for only 13% of the total, while Marketing makes up 28%. None of the categories are defined, so it is not possible to concretely say why this is, or what makes up any of the categories. It is likely, for example, that End Use might represent listener use from the previous year, but this cannot be said with complete certainty.

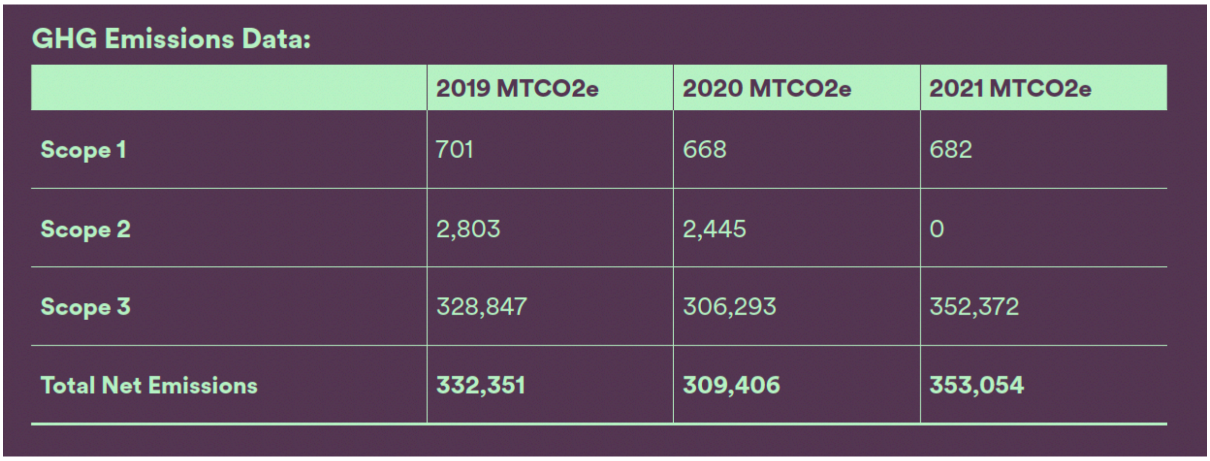
Figure 12: Spotify's 2021 GHG Emissions represented as percentages of the whole



*Note: The top chart breaks down Spotify's emissions for 2021 into its scope 1, 2 and 3 emissions. Scope 3, in dark green, makes up 99% of the total. The bottom chart breaks down each scope further. It is possible to say, for example, that travel makes up little of Spotify's scope 3 emissions, while Marketing and End Use collectively make up over 50%. Retrieved from: (*Spotify Report 2021*, 2022, p. 18).*

Spotify's GHG Emissions Data *(Figure 12*), however, suggests that Spotify may no longer be reporting on location-based emissions, and instead only using data including the use of carbon credits or RECs. This could account for the lower figure for cloud use, and the difference between reported emissions for Scope 2 in *Figure 13.*

Figure 13: Spotify GHG emissions data for scopes 1-3 (2019-2021)



GHG Emissions Data:

	2019 MTCO2e	2020 MTCO2e	2021 MTCO2e
Scope 1	701	668	682
Scope 2	2,803	2,445	0
Scope 3	328,847	306,293	352,372
Total Net Emissions	**332,351**	**309,406**	**353,054**

Note: Through this table, it is possible to see that Spotify's emissions have fluctuated somewhat. Spotify's carbon emissions calculations retroactively changed when reporting for the 2021 fiscal year. *Retrieved from: (*Spotify Report 2021*, 2022, p. 79).*

Spotify do themselves offset their carbon emissions to some extent through "third-party carbon removal and avoidance projects", though there is no information on what these might involve (*Spotify Report 2021*, 2022, p. 17).

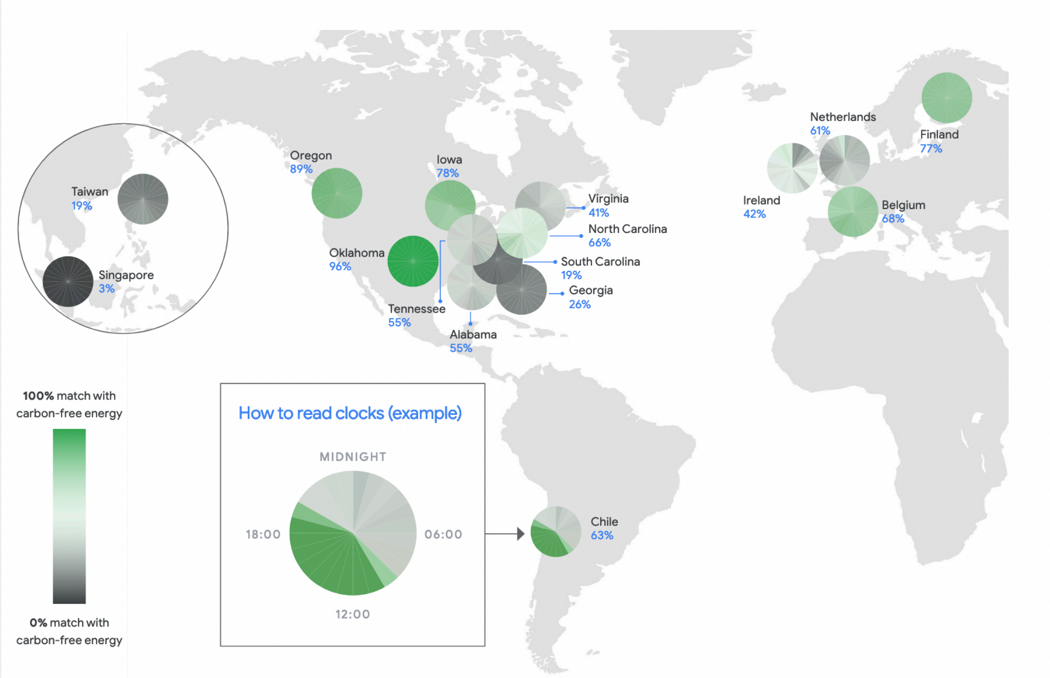
For reporting on water, the picture is even less complete. Spotify writes that "[w]hile our water impact is limited to what we use in our offices, we know that every drop counts." (*Spotify Report 2021*, 2022, p. 20). There is no acknowledgement of water use in Scope 3, or in the generation of electricity for Scope 2.

4.3.2 Google

By contrast, Google does report on its carbon emissions, both location and market-based, and water use, albeit on a whole-company level (*Google Report*, 2022). It is nevertheless possible to gain a general idea of data centre electricity usage from these numbers, because "[their] data centres represent the vast majority of our electricity use" (*Google Report*, 2020, p. 21).

Data is available for the PUE values for individual data centre location, though the total carbon emissions for each of those data centres is not available (*Efficiency*, n.d.; *Google Report*, 2022). Google's average PUE is 1.10, below the industry average of 1.55 (Davis, 2022, p. 5; *Google Report*, 2022, p. 5). Despite this energy efficiency they report an energy increase from 12,237,198 to 18,287,143 MWh between 2019 and 2021 (*Google Report*, 2022). Indeed, Google has the ability to track energy consumption well, and does allow users the ability to track their energy use and carbon emission through its Cloud Platform service (*Carbon Footprint*, n.d.). This is likely where Spotify's data on its emissions for cloud use originate. Google’s capacity to track its emissions is demonstrated in *Figure 14,* which accounts for estimated real percentage of renewable energy used for data centres dependent on grid electricity.

Figure 14: Annual average and hourly ‘carbon-free’ energy performance at each Google data centre on September 14, 2019

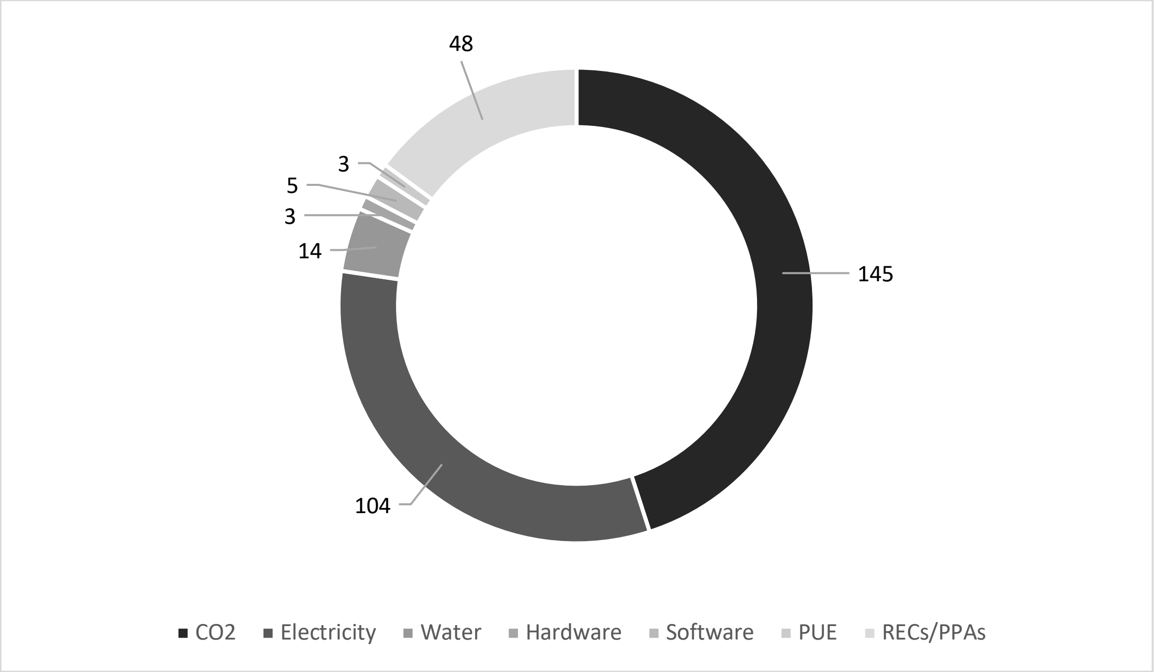


Note: Annual average can be seen in blue. Hourly ‘carbon free’ energy performance is indicated by the carbon clocks. According to these metrics, the data centre based in Oklahoma performs the best, Singapore the worst. Google notes that “Although [they] matched 100% of [their] global, annual electricity consumption with renewable energy…without Google’s purchases of renewable energy this figure would have only been 39%, equivalent to the existing “grid mix” in regions where [they] operate.” There are also significant differences in sites, where in Singapore most electricity is generated through natural gas, while in Oklahoma, Google’s purchase of wind power helped drive carbon-free energy performance at our data centre to 96%” (*24/7 by 2030*, 2020, p. 6)*.. Image retrieved from* (*24/7 by 2030*, 2020, p. 5)

Notably, Google does purchase PPAs, as well as ‘high quality’ carbon credits (*Google Report*, 2022). They claims that their “renewable energy purchasing resulted in a cumulative 65% reduction in our Scope 1 and Scope 2 emissions, as compared with a business-as-usual scenario in which we didn’t procure renewable energy via PPAs” (*Google Report*, 2022, p. 6).

Total water withdrawal has also increased, doubling from 3,071 through to 6,297 million gallons between 2017 and 2021 (*Google Report*, 2022). Google does not either report use-specific or location-based water use (*Google Report*, 2022). Indeed, within their sustainability reporting alone, information is limited.

Figure 15: Chart to show occurrence of codes associated with water use and carbon emissions in data centres in Spotify and Google reporting (2020-2022)



Note: Cooling system, Location, and WUE were all excluded as none received any mention. Codes signify an acknowledgement of or data on the relevant code. The most frequently used codes were for CO_2*, Electricity, and the use of RECs, PPAs, or offsets. The least frequently found were those of hardware, software, and PUE, with a large discrepancy in numbers between frequency of reporting on* CO_2 *versus water.*

As *Figure 15* shows, there are some areas of low or no information, particularly relating to water use, withdrawals, and WUE. A short case study can be used to illustrate the impacts of this lack of information.

Case Study: The Dalles, Oregon

The Dalles is located along the banks of the Columbia River, on the border between Oregon and Washington state. Its water supply, however, does not come from the river, but instead from an aquifer. In 1959 water level decline resulted in the area of The Dalles being declared a Critical Groundwater Area. At the time, this was because of agricultural use for irrigation, and the aluminium smelter that once existed on the same site that Google now owns (Rogoway, 2021). The Dalles remains as such today, however. A Critical Groundwater Area is declared to restrict withdrawal where “the resources is overdrawn… designed to prevent excessive declines in groundwater levels” (Oregon Water Resources Department, 2018, 12).

In 2021, a local newspaper, The Oregonian, appealed to the county district attorney to get the data on Google’s water use in The Dalles (Rogoway, 2021). They had asked the city council, but had been rebuffed with the reply that the water use was a trade secret (and therefore exempt from disclosure), and that the city had signed nondisclosure agreements that would keep them from giving the information in any case. The case has yet to be settled.

5.3.3 Delay Discourse Analysis

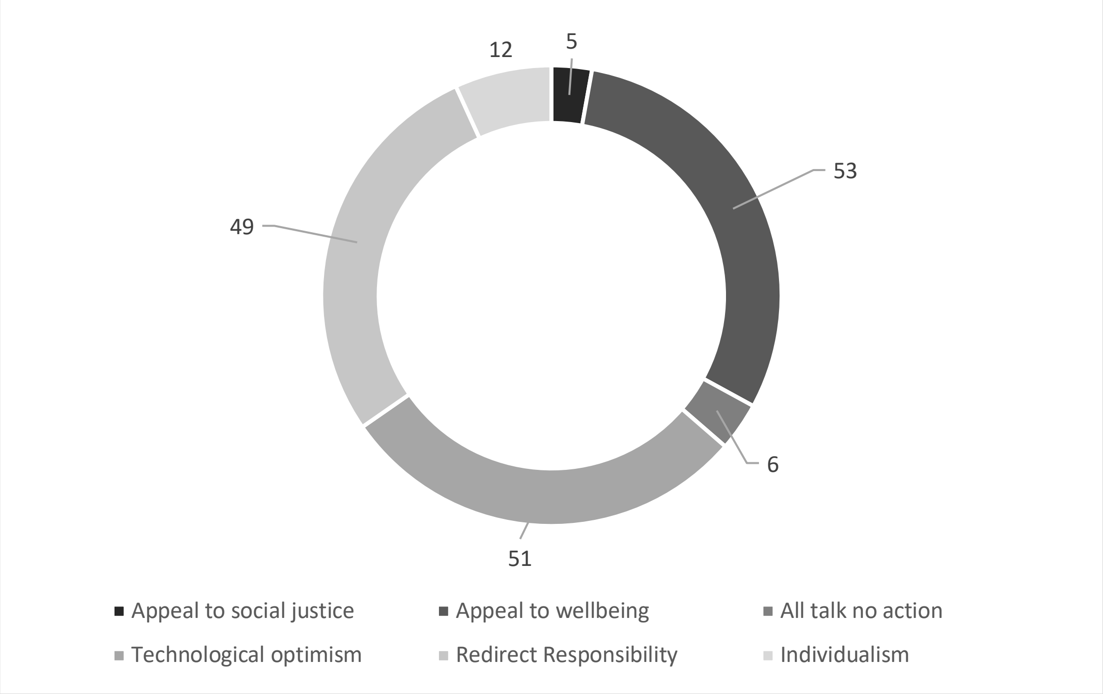
For delay discourse analysis, a total of five documents were chosen after an initial review of Google and Spotify's sustainability reporting from 2020 to 2022 (Lamb et al., 2020) *(Table 11).* The Google NFRD reports from 2020 and 2021 were excluded after analysis showed the 2022 report was materially the same as the previous two, with some additional material (*Google NFRD*, 2020; *Google NFRD*, 2021). Similarly, the 2021 Google Environmental Report was also excluded because of its significant similarity to the 2022 report, while the 2020 report was included as it is substantially different from the 2021 and 2022 reports (*Google Report*, 2020; *Google Report*, 2021; *Google Report*, 2022).

Table 11: Sources and Excerpts for Delay Discourse Analysis

Source	Excerpts
Google NFRD Report 2022 (*Google NFRD*, 2022)	9
Google Environmental Report 2020 (*Google Report*, 2020)	184
Google Environmental Report 2022 (*Google Report*, 2022)	49
Spotify Sustainability, Equity and Impact Report 2020 (Spotify, 2021)	14
Spotify Equity and Impact Report 2021 (*Spotify Report 2021*, 2022)	22

It is possible to say that, to varying levels, delay discourses are present in both Google and Spotify's sustainability reporting. The most common are technological optimism, redirect responsibility, and appeal to wellbeing (Lamb et al., 2020) *(Figure 16)*.

Figure 16: Chart to show occurrence of delay discourses from document analysis



Note: Of the delay discourses present, the most common codes were techological optimism, appeal to wellbeing, and redirect responsibility (Lamb et al., 2020).

Of these, technological optimism and appeal to wellbeing were most often coded together, with 23 examples of this. Other codes were not frequently coded together, with the next most often being individualism and technological optimism coded 3 times together *(Table 12)*.

Table 12: Examples of dual coding from analysis of sustainability reporting

Example Excerpt	*Source*	*Delay Discourse(s) Identified*
"We're focused on three key areas: enhancing our stewardship of water resources across Google offices and data centers; replenishing our water use and improving watershed health and ecosystems in water-stressed communities; and sharing technology and tools that help	(*Google Report*, 2022, p. 4)	Technological optimism, Appeal to wellbeing.

everyone predict, prevent, and recover from water stress.”		
“Spotify strives to be part of the solution and… act urgently and decisively on climate change, both in terms of getting our own operations to net zero emissions as well as inspiring and supporting climate engagement and action among our creators and listeners.”	(*Spotify Report 2021*, 2022, p. 15)	Technological optimism, individualism.

5 Discussion

Mazzucato (2021, p. 109) writes that “[h]aving a vision is not enough: it is essential to engage with citizens about it”. It is a double-edged sword; this statement applies equally well to both “common good” and “commodity”, to the narratives of the capitalist cultural hegemony and to the counter-hegemonic narrative (Fuchs, 2019, p. 28). It would be too simplistic to conclude that either organisation puts forward information that is either all “common good” or “commodity” (Fuchs, 2019, p. 28). What can be said, however, is that in what might otherwise be considered common good information is frequently serving as commodity. Spotify and Google’s very recognition of their role as part of the problem is an example of this. For better or for worse, this is exactly the role that Google and Spotify’s reporting currently plays: to tell a story, and to engage with citizens about it. The results of this paper indicate that the story they are writing is not necessarily one that leads to a just future. The delay discourses used, technological optimism and appeal to wellbeing, in this case frame these organisations as part of the solution. They offer a way forward, whilst simultaneously placing the impetus on the individual or on others to use the services that Google and Spotify provide to do better. In effect, what is constructed here is a technological saviour narrative, hinting at “modern myths… of utopian worlds and possibilities”, something not uncommon to discourses around digital technologies (Brevini, 2021, p. 145). Myths, here being defined as the “dominant ideologies of our time” (Brevini, 2021, p. 145). Operating within these myths, it is comparatively easy for e-business to paint themselves as saviours, all the while acknowledging their contribution to climate change. Further, while climate change mitigation is of course hugely important, it is here being used to obscure other forms of environmental degradation, to reinforce the cultural hegemony of the status quo, and the business-as-usual approach (Fuchs, 2019). One aspect of this has been the RECs, PPAs, and carbon offsets whose purchased greenness are what allow Google to claim carbon neutrality from 2007 (*Google Report*, 2022). As Kühne (2021) writes, "[i]t is becoming clear that sustainability is good business".

What is perhaps less good business, however, is what can be found in what is not said. The contrast found between their reporting on carbon emissions versus water use is stark, for example. As Sultana (2018, p. 485) writes, "[w]ater is essentially about power – the power to decide, control, allocate, manage – thereby affecting people's lives.". This is arguably the root of the issue; as much can be applied to almost any other environmental impact issue, including both energy and carbon emissions. Here, those who have the information have the power to decide, a power which does indeed affect people's lives. Case studies of this very phenomena can be seen in multiple of Google's data centre locations. In addition to The Dalles' experience with water shortages, Dublin, Ireland, faces an energy crisis while 14% of Ireland's electricity supply is consumed by data centres (Pollack, 2022; Rogoway, 2021).

Without the capacity to make an informed decision, to construct a counter-hegemonic discourse, the way forward to a participatory democracy is difficult to envisage (Fuchs, 2019; Goldstein, 2019)

From the above findings, it can be said that the current reporting standards do err on the side of supporting the capitalist cultural hegemony rather than challenging it. Google's NFRD report, for example, contains little of material significance in terms of data, pointing to underlying issues in the extent to which current EU reporting standards support transparency versus obfuscation. The same can very much be said for the other reporting standards discussed in this paper; whether by their voluntary status, or by what they leave up to interpretation, each leaves room for a very lack of reporting.

Indeed, one of the greatest problems that surfaces here is that of a lack of speech, a silence, which is itself a form of discourse in the sense that it too speaks. In a similar way, to 'all talk no action' delay discourses, it sends the message that the speakers are 'doing their part', are sufficiently taking action, while ignoring sustainability issues that might prove more problematic. Coen et al (2022) find that while some reporting standards do correlate positively between 'climate talk' and 'climate walk', others do little more than support greenwashing. Given the findings of this paper, it seems valid to suggest 'Doing our part' as a form of delay discourse, as an addition to Lamb et al's (2020) framework. 'Doing our part' narratives are essentially invisible, in the sense that they are visible in the negative space. They can be defined as the idea that an acknowledgment of one sustainability issue, e.g., carbon emissions, can hide other sustainability impacts.

5.1 Limitations and Further Research

There are undeniably significant limitations to this research. It is focused to two examples only, rather than looking at a representative sample of the e-business sector. In some senses, Spotify and Google are a current best-case scenario for their fields in sustainability if only for the fact that they do report on sustainability; findings for them might not be applicable elsewhere (Davis, 2022). Further, given the wide range of different global and data centre specific variations, it is difficult to make any generalisations.

Equally, the findings could to a limited extent be applied more broadly given the sheer scope of Google's business and the use of Google Cloud by other businesses in turn. In addition, much of the findings are generally applicable to data centre operators and might form a starting point for further research.

As this paper was limited to water and carbon emissions, it would be useful to look at reporting on materials and mining, particularly given recent lawsuits between technology companies based in the global north and miners in the global south (Kelly, 2019).

It is also important to note that transparent reporting is not a be-all-end-all solution. Citizens also need the resources, not least of which is time, to search out the necessary information (Dahl, 2006, p. 52). Furthermore, the introduction of greater amounts of information into a system that is in all other ways unchanged is unlikely to make transformative change happen to any significant extent (Brulle et al., 2012, p. 187). Nevertheless, reporting does have a part to play.

(Rogoway, 2022; *Tracking Our Carbon-Free Energy Progress*, 2021)

5.2 Recommendations

This paper would seek to highlight the importance of the development of co-ordinated global reporting standards, and to recommend more comprehensive reporting legislation. For fully informed and participatory democracy, there is no room for silences in the place of pertinent information. As Ghotge (2018, p. 9) writes, "Marx's theoretical treatment of the three fictional commodities: land, labor and money leads inevitably to the conclusion that the capitalist system is a house of cards built on a foundation of fiction"; a lack of good reporting standards then allows for this fiction to be perpetuated, and for it to become normalised (Brevini, 2021, p. 145).

Further, the 'global' aspect of these reporting standards must be emphasised. Spotify may be an EU company, but it gets its data from Google, who are not. We live in "a world that over the past century has seen a true trans-nationalisation of economic activity" (Poulsen et al., 2018, p. 83); many large and small-scale companies have international value chains which therefore in the chain of information-sharing impact power-relations on both local and global scales that they do not directly necessarily interact with.

5.3 Conclusion

This thesis contributes to the dialogue around the water use of data centres, and the need for accountability from internet services providers and data centre operators. With this in mind, I looked at delay discourses, particularly as used by tech companies and internet services. Analysis of sustainability reporting from Spotify and Google shows the continued use of narratives of technological optimism and possibility (Brevini, 2021; Lamb et al., 2020). It highlighted the need for differentiation between 'common good' versus 'commodity' information, and the current lack of it in sustainability reporting (Fuchs, 2019).

My research therefore supports the case for mandated reporting as necessary for a just future for digitalisation. One of the findings of this paper was that in data centres a trade-off must often be made between energy, water, and carbon emissions (Siddik et al., 2021). This sort of trade-off is common across sustainability science, and in many cases there may be no silver bullet solution. Ensuring that the information to make an informed decision is available, however, is the most democratic way forward.

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