(Non)Knowing the Environmental Impact of Video Streaming: Complexity, Transparency, and Corporate Sustainability Reporting

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Abstract

This article explores the environmental impact of video streaming by examining the incongruent emissions figures presented in various white papers and corporate sustainability reports. Investigating how emissions data are produced, it addresses the complexity of impact assessment and analyzes how these data are used in corporate sustainability reports. The article highlights the creation of opacity and nonknowing surrounding the environmental impact of video streaming, arguing that these practices ultimately serve corporate interests and reinforce power dynamics related to who has access to this knowledge and who remains uninformed.

Keywords: *Netflix*, *Carbon Footprint*, *Emission Data*, *Knowledge Production*, *Agnotology*.

In July 2019, The Shift Project, a Paris-based think tank promoting "the shift to a post-carbon economy,"[2] published a report on the environmental impact of video streaming.[3] Building on their earlier work in which they advocate for "digital sobriety" to prevent an explosion of greenhouse gas (GHG) emissions connected to the digital transition,[4] the report focuses on the unsustainable use of online video. It categorizes different uses of video streaming and addresses how unlimited accessibility and platform design drive video consumption. Emphasizing the need for regulations to reduce GHG emissions, the report calls for collaboration among all relevant actors to evaluate the pertinence of different uses of video streaming and prioritize certain ones. Its comprehensive approach addresses economic, societal, legal, and regulatory aspects of online video–and also includes a calculation of GHG emissions.

According to The Shift Project's estimation, in 2018, video streaming represented 60 percent of global data traffic and accounted for more than 300 $MtCO_2e$.[5]

The report was covered by newspapers and news channels such as France 24, Deutsche Welle, and the *New York Post*.[6] These and other media outlets focused mainly on the emission figures, ignoring the recommendations for evaluating different uses and implementing regulations. Interested in future prospects, they consulted additional sources to project GHG emissions in the future and suggest how consumers could help reduce the impact of video streaming by using less energy-intensive (smaller) viewing devices and lowering video resolution. On the other hand, tech journalists published critical responses, questioning the validity of the report's figures.[7] Even the International Energy Agency (IEA) took notice and challenged The Shift Project's calculation by presenting their own figures and criticizing the report's "flawed assumptions."[8] According to their estimation, 1 hour of video streaming emitted 36 gCO_2.[9]

Against the background of these discrepant emission figures, this article explores what we know about the environmental impact of video streaming, what these incongruous figures mean, and, more broadly, how this knowledge is produced. As a media studies scholar with an affinity to critical media industry studies, I seek to better understand not only the environmental impact of streaming but also the power structures that shape this knowledge. How knowledge production is "linked to specific interests and implicated in power relationships" has been extensively studied in science and technology studies, among others.[10] Regarding media technologies, Lisa Parks, Julia Velkova, and Sander De Ridder remind us in the introduction to their book *Media Backends* that "power is mobilized to hierarchize and sanction particular ways of knowing technological systems and phenomena, while devaluing, ignoring, or dismissing others."[11] Building on their observation that "many of the spheres of our mediated lives are in fact conditioned by nonknowing,"[12] this article focuses on video streaming as one of these spheres.

The contestation over calculations that followed the publication of The Shift Project's report attests to a struggle over expertise and the power to define the scope of the issue–a dynamic familiar from other health and environmental debates. Following Steve Rayner's analysis of how institutions handle wicked problems, the reactions by tech journalists and organizations can be understood as strategies to "manage uncomfortable knowledge"–in the case of video streaming, the knowledge that digitization has significant environmental consequences–by dismissal or displacement.[13] To uncover these strategies, it is essential to examine what remains unknown. This involves identifying gaps in existing knowledge and recognizing what is obscured or yet to be explored–a process that, paradoxically, requires knowledge itself. In the case of video streaming, formulating the right questions already requires foundational understanding–for example, of what constitutes the streaming infrastructure (infrastructural literacy), how data are collected and carbon calculations are made (data literacy), and what contributes to environmental degradation (carbon and ecological literacy).

While media studies scholars interested in media distribution possess infrastructural knowledge,[14] carbon and ecological literacy is not typically part of our training.[15] One might question whether this type of knowledge is necessary in our discipline, but I am convinced that–along with an awareness of nonknowing–some level of attentiveness to sustainability is essential

to fully understand media industries. Analyses of industrial practices that neglect social and environmental dimension remain fundamentally incomplete. Moreover, ecological perspectives draw attention to the industry's role in innovation processes that shape technological development. These innovations ultimately drive the industry's economic profit, which makes ecological literacy particularly relevant for media industry studies.

In what follows, I will address the availability and complexity of data used to assess the environmental footprint of video streaming, and how these data are presented and meaning is made of them by the media industry.[16] Among the key sources of information are environmental reports, including Netflix's annual "Environmental Social Governance" reports, which the company has been publishing since 2020. While these reports claim to promote transparency, I will show how they rather obscure the environmental impact of video streaming and primarily serve as public relations tools. I argue that the increasing abundance of emissions data that these reports provide must be considered within the broader context of knowledge production, raising critical questions about which data are available and which aspects of video streaming are not prioritized in knowledge production.

Data

For media studies scholars, drawing conclusions about the environmental impact of video streaming is demanding. One difficulty lies in the inconsistent figures published in white papers and reports.[17] These discrepancies stem partly from the limited availability of data that are necessary to accurately calculate emissions, complemented by the complexity of impact assessments that can produce varying results. The abstract nature of emission figures that lack meaningful context also hinders understanding, and the use of different metrics and methodologies in calculations makes comparisons difficult.

Impact assessment of video streaming relies on calculations that consider the energy consumption of the streaming infrastructure, which means data centers, delivery networks, and viewing devices. In 2017, when The Shift Project established a working group to address the environmental impact of the digital transition, they had to gather this information from a variety of sources. For instance, the report on the unsustainable use of video streaming drew on data from the Cisco Visual Networking Index, the Global Internet Phenomena Report by Sandvine–a company specializing in applications for analyzing and optimizing network traffic–and its own calculations, which were derived by crossing-referencing data published in various academic and newspaper articles, industry reports, and other documents, such as product information sheets that provide data about a device's energy consumption.[18]

Since then, relevant data have become much more accessible, mainly because the calculations are made publicly available. By analyzing the energy intensity of data transmission, the IEA contributed new sources to the discussion, concluding that "streaming a Netflix video in 2019 typically consumed around 0.077 kWh of electricity per hour."[19] In 2021, more data were provided by players of the European television and broadcast industry who initiated the "Low Carbon TV Delivery Project" (LoCaT) and commissioned Carnstone, a sustainability management consultancy, to compare GHG emissions of different television delivering

methods. Based on new primary sources, the study found that the energy consumption and associated emissions of Digital Terrestrial TV (DTT) "are an order of magnitude lower" than estimates for Over-The-Top (subscription and broadcast video-on-demand) and managed IPTV (Internet Protocol Television, i.e. linear television delivered via the Internet).[20] At the same time, Carbon Trust, a London-based company that supports businesses, governments, and institutions in reducing carbon emissions, published a white paper focusing solely on the carbon impact of video streaming. The paper was developed in consultation with DIMPACT, a project initiated by Carnstone where media companies collaborate with the University of Bristol to assess their GHG emissions.[21] It concluded that "the European average footprint is [. . .] approximately 55gCO_2e per hour of video streaming"[22]–a figure which is also included in Netflix's sustainability report.

New data are also generated by companies operating streaming platforms. While the BBC presented the results of its energy footprint for the financial year 2019/2020, with a particular focus on its iPlayer, in a blog post,[23] other content providers use corporate sustainability reports (CSRs) to showcase their environmental efforts and achievements. Amazon and Disney don't specifically mention video streaming in their CSRs–probably because the majority of their emissions stem from transportation (e.g., logistics fleet and cruise ships) and energy consumption in theme parks and resorts.[24] In contrast, Netflix has been reporting on the carbon footprint of video streaming since 2019.[25] As a participant in DIMPACT and a funder of Carbon Trust's white paper, it is not surprising that since 2021–when the white paper was published–Netflix has referred to the study's emission figure in its annual reports.

For nonexperts, the data presented in these reports are abstractions that need context to be understood. For instance, while The Shift Project's estimate of 300 MtCO_2e for video streaming is an undeniable large figure, it gains significance only when the report clarifies that this equals the annual emissions of Spain.[26] On the other hand, estimates such as 36 g or 55 g of CO_2e per hour of video streaming are relatable because they correspond to physical weights we can easily understand. To emphasize how relatively small these emissions are, Carbon Trust translates these figures into even more tangible comparisons by explaining that "the emissions from microwaving a bag of popcorn for four minutes is about 16g CO_2e [. . .] while driving 100 metres in an average petrol car emits around 22g CO_2e."[27]

Complexity

Even if data on the energy consumption of networks, data centers, and devices were readily available, discrepancies in emission figures would persist due to the variability of certain factors. For example, the relationship between energy consumption and GHG emissions depends heavily on the energy mix, as emissions differ significantly between fossil fuel-based and renewable energy sources. Consequently, estimating the GHG emissions for 1 hour of video streaming requires knowledge about the carbon intensity of energy generation in a specific region.[28] This is why the Carnstone study specifies energy and GHG impacts by country, while Carbon Trust's white paper accounts for this variability by estimating the "European average footprint."[29] As energy generation tends to be more carbon-intensive in

other regions of the world, their calculations would result in higher emission figures for North America, Australia, or globally.[30]

Emission also varies depending on the viewing device used for video streaming. Small devices such as smart phones consume significantly less energy than big screens, as Carbon Trust shows in their white paper.[31] While it is easy to understand that screen size determines energy consumption, it is also important to note that the calculation includes only the "operational electricity" of devices.[32] Emissions generated during the production of equipment are not considered, nor is the frequency with which small devices are replaced, creating a boundary in the scope of the analysis. However, it is not the in-use electricity but precisely the production process and the short lifespan of smart phones that are responsible for their "disproportionate impact."[33] In a research paper on the footprint of the Information and Communication Industry, Lotfi Belkhir and Ahmed Elmeligi demonstrate that "the production energy makes up 85–95% of [a smart phone's] lifecycle annual footprint, driven by the short average useful life of smart phones of 2 years."[34]

By excluding the energy used to manufacture devices or to produce video content, the Carbon Trust comes to the reassuring conclusion that, at an individual level, the environmental impact of video streaming is relatively small. They suggest that end-users who are nevertheless concerned with their carbon footprint from video streaming could focus on the size and energy efficiency of their screens.[35] However, defining the boundaries of video streaming differently and including, for example, the environmental footprint generated by the production of devices would alter Carbon Trust's calculations. Similarly, summing up the energy consumption of all individually used devices would present a different picture, as would comparing individual viewing to a scenario where a group of people watches together on a single larger screen.[36]

In contrast, the Carnstone study addresses these embodied emissions that "arise from the raw material production, manufacturing, transport, and installation of devices."[37] Its comparison of different content delivery methods, which focuses on TV sets for its calculations, found that only 20 percent of a viewing device's emissions are generated during its use-phase, as a result of its energy consumption, while 80 percent are embodied emissions.[38] In addition to concluding that linear DTT "offers the highest energy efficiency and lowest carbon impact for delivery of TV content,"[39] the report reminds the readers that "prolonging the life of infrastructure and devices currently in use could play a significant role in reducing the emissions associated with TV viewing."[40]

By comparing different studies, I do not intend to suggest that any of their calculations are incorrect but rather to emphasize the complexity of impact assessment. Emission figures vary depending on how boundaries are defined, and comparisons offer insights into the differing approaches and underlying assumptions. As a result, the *outcomes* of studies such as The Shift Project's system-wide approach, Carnstone's comparison of delivery methods, and Carbon Trust's calculation of the footprint of an individual viewer are not directly comparable.

At the same time, the choice of approach has significant implications that are political. A system-wide calculation underscores collective accountability for the GHG emissions from video streaming. Addressing the shared responsibility of all stakeholders provides a basis for

the feasibility of implementing regulations. Conversely, focusing on individual-level impacts shifts the responsibility to end-users, while simultaneously leading to low emissions, which downplays the urgent need for action. Furthermore, study outcomes often reflect the interests of the commissioning organization. Carnstone's conclusion that DTT has the lowest environmental impact aligns with the interests of its sponsors, primarily made up of DTT network operators and TV channels delivered via DTT.[41] Similarly, Carbon Trust's finding of a low environmental impact for video streaming benefits Netflix, which provided seed funding for the study.[42] Since the choice of a particular approach can produce desired outcomes, the generation of data on a complex issue can be seen as a strategy to shape a highly uncertain area of knowledge.

Assessing the environmental impact of video streaming becomes even more complex when factors beyond energy consumption, including less prioritized knowledge about streaming infrastructure, are taken into account. In addition to GHG emissions associated with energy use, video streaming affects freshwater resources and land uses.[43] Central to this issue are data centers, where video libraries are stored and from which content is streamed. Although these facilities increasingly adopt renewable, less carbon-intensive energy sources, they demand physical space, contributing to the loss of land, nature, and biodiversity. Moreover, their vast freshwater consumption, primarily for cooling purposes, and the release of wastewater containing pollutants threaten both the availability and quality of drinking water. Furthermore, video streaming impacts the environment through the extraction of raw materials needed for manufacturing equipment, devices, and network infrastructure, as well as through the e-waste generated by discarded hardware. This indicates that its environmental consequences are also connected to concerns of social sustainability, as they affect the living conditions and well-being of local communities.

These factors also need to be taken into account to fully understand the environmental impact of video streaming. However, as with data on energy use a few years ago, obtaining accurate information remains challenging. For instance, water consumption by data centers is difficult to estimate due to the lack of available data. A 2024 report highlighting the need for water resource management in response to the exponential growth of AI notes "a lack of publicly available information" about water consumption and refers to news articles from the early 2020s that published some figures.[44] These figures vary depending on a data center's size, location, and specific technology. The lack of knowledge is illustrated by an article published in 2021–before the widespread adoption of AI–which combines vagueness with concrete figures. The article reported that a "typical data center" consumes 3–5 million gallons of water daily, comparable to the water usage of a city with a population of 30,000–50,000.[45]

Environmental Reporting (Netflix)

While awareness of nonknowing regarding carbon emissions led think tanks, energy organizations, and media consortia to collect data and conduct calculations, companies began showcasing their environmental responsibility through corporate sustainability reporting. This "institutionalized disclosure" is rooted in the democratic ideal of transparency, which

maintains that access to information fosters accountability.[46] In the context of climate crisis, transparency is expected to ultimately lead to more sustainable operations. However, CSRs often use disclosure and obfuscation techniques to achieve desired outcomes, contributing to greenwashing rather than driving genuine environmental change.

A notable example of a company that has embraced corporate sustainability reporting to demonstrate its environmental responsibility is Netflix. Starting in 2020, Netflix has released annual Environmental, Social, and Governance (ESG) reports to share insights into its performance. In its first report, which covers the calendar year 2019, the company frames its transparency as result of its success, stating, "we [. . .] understand as we grow, we have a responsibility to be more transparent."[47] Comparing reports from different years, Netflix's efforts to collect data and increase its understanding of its environmental impact become evident. In its 2019 report, the company was only able to estimate the electricity used in its offices, own studios, and content delivery network (94,000 megawatt hours) and mentioned that it offset emissions from 357,000 megawatt hours of indirect energy consumed by data centers it partners with.[48]

Since then, Netflix has collected extensive data to identify its "largest sources of emissions [. . .] and the biggest opportunities [. . .] to reduce them."[49] Based on this information, the company developed its "Reduce, Retain, and Remove" strategy to achieve net-zero GHG emissions–a goal announced in its 2020 report with the aim to be effective by 2022.[50] The data collection led to more detailed accounting, resulting in the incorporation of additional measurements, increasing complexity, and new visuals. For instance, the 2020 report compares energy consumption for the reporting year with that of the previous year, and it includes an additional table showing emission figures.[51] The reported carbon footprint consists of Scope 1, 2, and 3 emissions minus offsets, which totaled 1,208,205 $MTCO_2e$ in 2019 and 997,457 $MTCO_2e$ in 2020.[52] In each of the subsequent reports, a new column is added with emissions for the respective reporting year.

Understanding these tables requires a certain level of climate literacy. First, it is essential to know what Scope 1, 2, and 3 emissions are, which is not explained in the report. Second, the reports use various accounting methods, and while the explanation of calculation methods clarifies the difference between location-based and market-based emissions, the technical definition leaves nonexperts confused.[53] Interpretating the calculations is particularly challenging because figures from different accounting methods are combined into a single table. The 2022 report introduces target-based emissions as yet another accounting method, leading to adjustments in emission figures published in previous years. The table presents data for each scope using different calculation methods, sums of emissions from different scopes by method and a total where figures from various methods are aggregated.[54] In the latest (2023) report, these figures are arranged more clearly, with data for the years 2019–2023 organized by accounting method. For each year, the report now provides three emission totals: one for all three scopes using location-based accounting, another using market-based accounting, and a third using target-based accounting.[55]

Netflix's efforts to enhance the reporting are evident, including on a visual level. What began as an eight-page document of text and tables on Netflix letterhead has evolved into a colorful, eighty-page presentation. The report now features distinct colors for each of the three

Figures 1–3 Global Warming and the Promise of Entertainment.

reporting areas (environmental, social, and governance) and incorporates an increasing number of photos and graphics to illustrate Netflix's successful performance. While the 2022 report still used dark text on monochromatic background, the 2023 report introduces an even more elaborate design with white text on dark-colored backgrounds enhanced with a gradient. Its title page features the current Netflix ident with its colorful stripes (Figure 1), which–according to company communications–are intended to reflect the diversity and variety of Netflix's content.[56] On the title page of the report (Figure 2), the ident is flipped vertically, making it resemble the climate stripes that represent global temperature rise (Figure 3).

Since the 2020 report, Netflix has been detailing the components of its carbon footprint by business activity, categorizing them into corporate operations, content production, and streaming. The data visualization has been modified each year, evolving from pie chart to square chart to doughnut chart, with the latest report introducing slider-style graphics that resemble website toggle switches for opting in or out of data collection. The relative contributions of the different business areas to Netflix's GHG emissions have also changed over time. In 2020, corporate operations, including offices and transportation, accounted for 45 percent of the total emissions. However, over the following 2 years, this figure decreased by 7 percent due to the company's decarbonization efforts. As a result, the share of emissions

attributed to content production increased from 50 percent in 2020 to 59 percent in 2022. In 2023, these proportions shifted significantly, with corporate operations generating 61 percent of Netflix's emissions and content production contributing only 35 percent. The report attributes this change to the industry strikes that lowered production activities. However, Netflix expects that in 2024, production will once again be the largest source of emissions.[57]

These numbers, figures and percentages give the impression that Netflix's environmental reports are comprehensive. However, not everything can be fully calculated. Direct emissions from sources controlled and owned by the company, such as those from offices and content production at Netflix's facilities (Scope 1), and indirect emissions from the use of purchased electricity (Scope 2) are easier to calculate than Scope 3 emissions. Scope 3 emissions include all activities outside the company's direct control, related to its entire value chain. This category encompasses the production, distribution, and consumption of products or services, including waste generation, employee commutes, and end-of-life treatments. Netflix estimates Scope 3 emissions only from branded content and parts of its distribution, while emissions from non-branded content, consumption, and waste generation remain unclear and are not included in their calculations.

According to the reports, streaming accounted only for 5 percent, or even less, of Netflix's carbon footprint. However, this estimation includes only emissions from data centers, while the text in each report acknowledges that internet transmission and user devices also consume energy. The 2022 and 2023 reports feature diagrams illustrating the infrastructure of streaming, assigning a percentage of energy use to each component. Based on Carbon Trust's calculations, the diagram attributes 1 percent of energy use to data centers, 10 percent to internet service providers, and 89 percent to devices in subscribers' homes (such as routers, TV peripherals, and screens).[58] Meanwhile, the 2022 report also highlights that Netflix's GHG emissions from its data storage and cloud computing decreased by 98 percent, as Amazon Web Services, where its data are stored, relies on renewable energy.[59] The 2023 report further states that "the electricity powering Netflix computing needs was 99% renewable."[60]

Transparency and Nonknowing

After studying various white papers and reports, the question of the environmental impact of video streaming remains difficult to answer. Should the answer refer to total emissions generated by data traffic, the carbon footprint of an individual viewer, or that of the companies behind the streaming platforms? One can easily get lost in the details and wonder if content production should be included in the calculations, how the percentages would change if the manufacturing of the different viewing devices were taken into account, and why the share of emissions generated by data centers remains at 5 percent, despite 99 percent of their energy sources being renewable. The deeper one delves into it, the stronger the sense of nonknowing is.

The confusion arises from several factors, including the use of different units of emissions–such as 300 $MtCO_2e$ (million tons of CO_2 equivalent) versus 1,208,205 $MTCO_2e$ (metric tons)–which can lead to misinterpretations of scale, as well as differing system boundaries that

hinder comparison. As Netflix's ESG reports illustrate, the aggregation of more and diverse data can further contribute to opacity. Using varying calculation methods within a single table, as previously mentioned, makes such reports even more difficult to interpret. The lack of alignment between the "business activities" and the categories of Scope 1, 2, and 3 emissions further complicates understanding. Moreover, shifting system boundaries create inconsistencies in what is included or excluded from calculations. While adjustments of previously published data based on new insights are valuable for improving accuracy, they also introduce another layer of confusion, hindering efforts to draw conclusions about the environmental impact of video streaming.

From the perspective of agnotology, the study of how ignorance is socially constructed, the opacity of data can be linked to an epistemic dimension of nonknowing, as well as to intentionality. The production of scientific knowledge always involves nonknowing since it "rests necessarily on selective observations of limited scope" (epistemic dimension).[61] Naomi Oreskes, in collaboration with others, has analyzed how uncertainty–an intrinsic aspect of science–has been, and continues to be, exploited by various industries to undermine "the status of stabilized scientific knowledge" (intentionality).[62] One strategy for creating such uncertainty is the generation of new data. Contrary to the common assumption that "more data enhances our ability to produce more knowledge," ignorance can be produced by "aggregating or disaggregating data in ways that mask evidence of existing patterns," as Scott Frickel and Abby Kinchy argue in a similar vein.[63]

The sharing of data is often seen as a means of increasing transparency. In the case of Netflix, the disclosure and proliferation of emission figures–in the main part and since the 2022 report also through the addition of an appendix–demonstrate the company's effort to act in an environmentally responsible manner. However, as the ideal of transparency assumes that "information is easily discernible and legible; that audiences are competent, involved, and able to comprehend,"[64] the opacity of the figures and the confusion they create suggest that Netflix's reports are primarily a *performance* of transparency. They appear to not only present objective data but also showcase expertise and, in doing so, promise a sense of control.[65]

Instead of providing a clear understanding of the environmental impact of video streaming, Netflix's reports serve more as a public relations tool, contributing to greenwashing. This becomes evident not only through their increasingly elaborate presentation but also in their content. Beyond the sheer proliferation of emissions data, these reports highlight climate targets and emission reductions, emphasizing the company's commitment to sustainability. In its 2020 report, Netflix announced its goal of achieving net-zero emissions by the end of 2022, introducing a plan to reduce, retain, and remove emissions–a strategy that was rephrased in 2021 as "Optimize, Electrify, Decarbonize." Since the 2021 report, the company has sought to demonstrate progress by recording emission reductions or avoidance achieved through electrification and the use of renewable energy sources, adding a new colon to the table each year. These figures are based on the comparison between actual emissions and projected GHG emissions that would have occurred without these sustainability measures. Alongside tables filled with figures, Netflix has also begun integrating narratives that highlight its efforts and successes. Short stories about the energy efficiency of Netflix's studio in Albuquerque or the use of batteries, hybrid generators, or hydrogen units

to power production sites showcase the successful implementation of its strategy. These narratives help obscure the opacity of the figures, which create an appearance of transparency but ultimately raise many questions.

Furthermore, like the ESG reports of many other companies, Netflix highlights projects it invests in to offset its remaining emissions, which explains how it achieves net-zero emissions.[66] These investments are intended to support the conservation of natural areas–primarily in South America, Africa, and the United States–that absorb CO_2. While such projects provide compelling stories and visuals for ESG reports, offsetting has faced growing criticism, as its effectiveness is often overestimated, and the rights of local communities are frequently violated, with some being forcibly displaced from their land.[67] This social impact falls within the sphere of nonknowing, despite Netflix's transparency about the projects it uses to offset its carbon emissions.

Returning to the hierarchization of knowledge mentioned above, it becomes evident that sources addressing the environmental impact of video streaming primarily focus on GHG emissions and energy consumption related to the use of hardware. This approach ignores, for example, the results of lifecycle assessment, which would account for the energy used in device production, emissions from raw material extraction, and waste generation. Water consumption is also not taken into account, with relevant data still lacking. Additionally, social impacts–such as flooding from hydro projects in energy generation or those resulting from offsetting–are entirely overlooked. In terms of agnotology, this ignorance of existing data (lifecycle assessment) and knowledge (social consequences) constitutes the intentional manufacturing of nonknowing.

Another area where knowledge is lacking is the environmental impact of edge caching. Netflix reports that, rather than distributing its content from a single centralized location, it operates 18,000 servers "across 6,000 locations in over 175 countries."[68] These servers store and deliver content locally, suggesting that streaming from a nearby server is more efficient–"instead of the film or series being streamed from halfway around the world, it's streamed from around the corner."[69] However, while Netflix's "Open Connect" program improves data transmission speed, it also increases the number of servers and data centers involved in the process. As Nicole Starosielski, Hunter Vaughan, Anne Pasek, and Nicholas R. Silcox point out, knowledge about "the relative environmental impact of different models of connection, whether edge caching, centralized delivery, or fog computing," is still lacking.[70] Here, it is the absence of research that produces nonknowing.

Netflix also emphasizes its involvement in developing a new encoding technology that reduces file sizes and optimizes bandwidth.[71] At first glance, this appears like an environmentally beneficial efficiency measure. However, as with edge caching, no calculation exists to determine how this advanced compression format impacts the carbon footprint of video streaming. While the file sizes get smaller, encoding and decoding require more computational power, ultimately leading to increased energy consumption by end devices, as they must decode increasingly complex video files.[72] Apart from the unknown energy-related impact, another important aspect is largely ignored. The new compression technology requires advanced hardware, meaning that in some cases, older devices become obsolete as they can no longer support the Netflix app. As of 2024, Netflix's Help Center warns that "Netflix may no longer

be available on some TVs and TV streaming devices made before 2015."[73] Given the resources used in manufacturing electronics and the growing issue of e-waste, rendering a TV obsolete due to technological updates is a wasteful practice–one that is unsustainable and environmentally harmful.[74]

For Whose Benefit?

While corporate sustainability reporting can be dismissed as a mere public relations tool, the transparency and the nonknowing that these reports–along with white papers and other studies–manufacture aim to structure an uncertain field of knowledge that ultimately serves specific interests and reinforces power dynamics. This helps explain the existence and advocacy behind various initiatives, such as The Shift Project, DIMPACT, LoCaT, or Greening of Streaming.[75]

As discussed earlier, the political implications of different calculation methods shape how environmental responsibility is assigned–either collectively to all stakeholders or individually to users. Acknowledging the increasing energy consumption of end devices due to new encoding technologies would challenge the narrative that individual users are responsible for the majority of GHG emissions from video streaming through their viewing device. Given this, it is not surprising that the environmental consequences of this new technology remain unknown, allowing corporations to maintain a narrative that shifts responsibility away from their own technological choices. Not knowing the environmental impact of encoding technology benefits not only device manufacturers who can sell newer hardware without facing questions about its environmental costs but also streaming providers. They have a vested interest in offering the highest possible video quality and fastest load times, as they can market superior streaming performance as a selling point to keep customers subscribed.

The focus on carbon emissions in sustainability discussions suggests that electrification and decarbonization are the primary solutions, framing the issue primarily as a technological challenge rather than one that also demands behavioral change from all actors (content providers, device manufacturers, viewers, etc.). This perspective portrays the problem as manageable through investments in cleaner energy sources and improved efficiency. At the same time, it avoids questioning overall consumption and production patterns–as highlighted by The Shift Project. However, the idea that streaming can become "green" through better energy grids and advanced technology can only be maintained if the enormous consumption of freshwater, raw materials, and the production of electronic waste are ignored.

The complexity and opacity of sustainability reports can be used as strategic tools, creating a barrier to understanding and reinforcing the authority of experts with the knowledge and technical skills to interpret the data. This expertise grants them power over those who lack the same level of understanding–such as media studies scholars or the general public. By making calculations and methodologies difficult to grasp, corporations and industry experts maintain control over the narrative, shaping discussions around sustainability in ways that serve their interests. This dynamic limits critical engagement and leaves nonexperts dependent on the interpretations provided by those with privileged knowledge.

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[12] Parks, Velkova, and De Ridder, *Media Backends*, 7.

[13] Steve Rayner, "Uncomfortable Knowledge: The Social Construction of Ignorance in Science and Environmental Policy Discourses," *Economy and Society* 41, no. 1 (2012): 113.

[14] See for example Lisa Parks, Julia Velkova, and Sander De Ridder, eds., *Media Backends. Digital Infrastructures & Sociotechnical Relations* (University of Illinois Press,

2024); Lisa Parks and Nicole Starosielski, eds., *Signal Traffic: Critical Studies of Media Infrastructures* (University of Illinois Press, 2015); Nicole Starosielski, *The Undersea Network* (Duke University Press, 2015).

[15] For exceptions, see the work by Laura Marks and Anne Pasek.

[16] For a critique of the term "carbon footprint," see Geoffrey Supran and Naomi Oreskes, "Rhetoric and Frame Analysis of ExxonMobil's Climate Change Communications," *One Earth* 4, no. 5 (2021): 712, https://doi.org/10.1016/j.oneear.2021.04.014.

[17] See also Anne Pasek, Hunter Vaughan, and Nicole Starosielski, "The World Wide Web of Carbon: Toward a Relational Footprinting of Information and Communications Technology's Climate Impacts," *Big Data & Society* 10, no. 1 (January 1, 2023). https://doi.org/10.1177/20539517231158994.

[18] Shift Project, "Lean IT," 68.

[19] Kamiya, "Factcheck" and "Carbon Footprint." This figure was updated after the initial publication. In his detailed reaction to George Kamiya's commentary, Maxime Efoui-Hess, lead author of The Shift Project's report, commended the IEA's transparency, noting that it facilitates critical analysis and advances the "scientific discussion on the energy consumption of network infrastructures." See Maxime Efoui-Hess and Jean-Noël Geist, "Did the Shift Project Really Overestimate the Carbon Footprint of Online Video?" *The Shift Project*, June 2020, https://theshiftproject.org/wp-content/uploads/2020/06/2020-06_Did-TSP-overestimate-the-carbon-footprint-of-online-video_EN.pdf.

[20] "Quantitative Study of the GHG Emissions of Delivering TV Content," *Carnstone*, September 2021, 45, https://thelocatproject.org/wp-content/uploads/2021/11/LoCaT-Final_Report-v1.2-Annex-B.pdf. The study estimates that on average across Europe in 2020, "the energy consumption associated with one device viewing hour of DTT was 14 Wh, 109 Wh for OTT and 153 Wh for managed IPTV. This equated to 3 g of carbon dioxide equivalent emissions (CO_2e) for DTT, 26 gCO_2e for OTT and 37 gCO_2e for IPTV."
Carnstone, "Quantitative Study of the GHG Emissions," 2.

[21] "Our Community," DIMPACT, accessed February 24, 2025, https://dimpact.org/community.

[22] "Carbon Impact of Video Streaming," *Carbon Trust*, June 2021, 8, https://ctprodstorageaccountp.blob.core.windows.net/prod-drupal-files/documents/resource/public/Carbon-impact-of-video-streaming.pdf, 8.

[23] Chloe Fletcher, "The Carbon Impact of Streaming. An Update on BBC TV's Energy Footprint," *BBC Research & Development*, June 11, 2021, https://www.bbc.co.uk/rd/blog/2021-06-bbc-carbon-footprint-energy-envrionment-sustainability.

[24] "2023 Amazon Sustainability Report," Amazon, July 2024, https://sustainability.aboutamazon.com/2023-amazon-sustainability-report.pdf; "2023 Sustainability & Social Impact Report," *The Walt Disney Company*, https://thewaltdisneycompany.eu/app/uploads/2024/04/TWDC-EMEA-CSR-Report_2023.pdf.

[25] "Environmental Social Governmental," Netflix, https://ir.netflix.net/governance/ESG/default.aspx.

[26] Shift Project, "Climate Crisis," 14.

[27] Carbon Trust, "Carbon Impact," 8.

[28] This is why Nicole Starosielski, Hunter Vaughan, Anne Pasek, and Nicholas R. Silcox suggest disaggregating the internet's energy use and focusing on "localized geographically specific parts." Nicole Starosielski, Hunter Vaughan, Anne Pasek, and Nicholas R. Silcox, "Disaggregated Footprints," in *The Routledge Handbook of Ecomedia Studies*, ed. Antonio López, Adrian Ivakhiv, Stephen Rust, Miriam Tola, Alenda Y. Chang, and Kiu-wai Chu (Routledge, 2023), 111.

[29] Carnstone, "Quantitative Study of the GHG Emissions," 46–47; Carbon Trust, "Carbon Impact," 8.

[30] For detailed data per country and region, see "Carbon Intensity of Energy Generation," *Our World in Data*, accessed December 20, 2024, https://ourworldindata.org/grapher/carbon-intensity-electricity.

[31] Carbon Trust, "Carbon Impact," 52.

[32] Carbon Trust, "Carbon Impact," 7.

[33] Lotfi Belkhir and Ahmed Elmeligi, "Assessing ICT Global Emissions Footprint: Trends to 2040 & Recommendations," *Journal of Cleaner Production* 177 (March 10, 2018): 448–63, 458. https://doi.org/10.1016/j.jclepro.2017.12.239.

[34] Belkhir and Elmeligi, "Assessing ICT," 458. The authors attribute this unsustainable use of technology to the business model of the telecom industry.

[35] The white paper shows that lowering the image resolution has only a minor effect on emissions. See Carbon Trust, "Carbon Impact," 9, 63–66.

[36] Carnstone addresses such shared viewership, see "Quantitative Study of the GHG Emissions," 14.

[37] Carnstone, "Quantitative Study of the GHG Emissions," 12.

[38] Carnstone, "Quantitative Study of the GHG Emissions," 43.

[39] "International Broadcast Consortium Releases a Major Holistic Study on the Energy and Carbon Impacts of the Delivery of TV Content across Different Platforms in Europe," *Carnstone*, Press Release, November 15, 2021, https://thelocatproject.org/wp-content/uploads/2022/03/LoCaT-Press-Release-Final-.pdf.

[40] Carnstone, "Quantitative Study of the GHG Emissions," 44.

[41] Carnstone, "Quantitative Study of the GHG Emissions," 1.

[42] Carbon Trust, "Carbon Impact," 2.

[43] These aspects have been addressed, among others, in Mél Hogan, "Data Flows and Water Woes: The Utah Data Center," *Big Data & Society* 2, no. 2 (December 27, 2015). https://doi.org/10.1177/2053951715592429; Patrick Brodie, "Climate Extraction and Supply Chains of Data," *Media, Culture & Society* 42, nos. 7–8 (October 1, 2020). https://doi.org/10.1177/0163443720904601; Patrick Brodie, "Data Infrastructure Studies on an Unequal Planet," *Big Data & Society* 10, no. 1 (January 2023). https://doi.org/10.1177/20539517231182402.

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[45] Olivia Solon, "Drought-Stricken Communities Push Back against Data Centers," *NBC News*, June 19, 2021, https://www.nbcnews.com/tech/internet/drought-stricken-communities-push-back-against-data-centers-n1271344.

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[48] "Environmental Social Governance," 2019 report, 2.

[49] "Environmental Social Governance 2020. Sustainability Accounting Standards Board (SASB) Report," Netflix, 2021, https://s22.q4cdn.com/959853165/files/doc_downloads/2021/03/2020-SASB-Report_FINAL.pdf, 3.

[50] "Environmental Social Governance 2020," 2.

[51] "Environmental Social Governance 2020," 2 and 4. The 2020 report presents different energy figures for 2019 compared to the 2019 report, as new insights prompted adjustments.

[52] "Environmental Social Governance 2020," 4.

[53] See "Environmental Social Governance 2020," 4.

[54] "Environmental Social Governance Report 2022," Netflix, 2023, https://s22.q4cdn.com/959853165/files/doc_downloads/2023/06/29/Netflix_2022-ESG-Report-FINAL.pdf, 16. For an explanation of different accounting methods see Appendix, 11 and 12.

[55] "Environmental Social Governance Report 2023," Netflix, 2024, https://s22.q4cdn.com/959853165/files/doc_downloads/2024/6/2023-Netflix-Environmental-Social-Governance-Report.pdf, 13.

[56] "Your New Netflix Ident Animation (Cue *Netflix Sound*)," Netflix, February 1, 2019, https://about.netflix.com/en/news/your-new-netflix-ident-animation-cue-netflix-sound.

[57] "Environmental Social Governance Report 2023," 14. Given the increasing contribution of corporate operations to the overall emissions, the new visualization in the form of a slide might not be accidental, as percentages are no longer visible at first glance.

[58] "Environmental Social Governance Report 2022," 27; "Environmental Social Governance Report 2023," 26.

[59] "Environmental Social Governance Report 2022," 26.

[60] "Environmental Social Governance Report 2023," 27.

[61] Ulrich Beck and Peter Wehling, "The Politics of Non-Knowing: An Emerging Area of Social and Political Conflict in Reflexive Modernity," in *The Politics of Knowledge*, ed. Patrick Baert and Fernando Domínguez Rubio (Routledge, 2011), 37.

[62] Naomi Oreskes, "The Fact of Uncertainty, the Uncertainty of Facts and the Cultural Resonance of Doubt," *Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences* 373, no. 2055 (2015): 20140455, 3. https://doi.org/10.1098/rsta.2014.0455.

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[70] Starosielski, Vaughan, Pasek and Silcox, "Disaggregated Footprints," 116.
[71] "Environmental Social Governance Report 2022," 26, "Environmental Social Governance Report 2023," 27.
[72] See Marek Jancovic and Judith Keilbach, "Streaming against the Environment: Digital Infrastructures, Video Compression, and the Environmental Footprint of Video Streaming," in *Situating Data: Inquiries in Algorithmic Culture*, ed. Karin van Es and Nanna Verhoeff (Amsterdam University Press, 2023). https://doi.org/10.1515/9789048555444-007.
[73] "Netflix Supported Devices | Watch Netflix on Your TV, Phone, or Computer," Netflix | Help Center, accessed December 10, 2024, https://help.netflix.com/en/node/14361.
[74] As if targeting this development, the Carnstone study warns that "radical change in infrastructure and devices, which could cause a premature obsolescence of those currently in use," might result in a significant increase in emissions due to the mass replacement of older devices. Instead, they advise "prolonging the life of infrastructure and devices currently in use" to reduce the emissions associated with TV viewing." Carnstone, "Quantitative Study of the GHG Emissions," 44.
[75] https://www.greeningofstreaming.org.

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