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# The Climate Entanglements of Television Archives: The Materiality of Digital Preservation

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Over the last decade, many television archives have digitized their collections, making them increasingly accessible online. While this is a major advancement for historical research, the shift to online accessibility comes with significant environmental costs. Using the Netherlands Institute for Sound and Vision as a case study, this article scrutinizes the environmental impact of archiving television. It provides context for the establishment of television archives as well as their digitization, and addresses the financial underpinnings of preserving Dutch audiovisual heritage. The article emphasizes the materiality of digital culture, drawing attention to the generation of e-waste and the substantial consumption of energy and water, which is exacerbated by the use of AI in managing these archives. Ultimately, the article challenges researchers to reconsider their expectations for immediate online access, urging reflection on the environmental implications of such demands.

As a medium that addresses social issues, television has increasingly focused on the climate crisis in recent years. News items cover floods, hurricanes, and heat records, documentaries provide information about global warming, talk shows facilitate discussions of meaningful climate action, and fictional programmes incorporate climate issues in their stories. Beyond featuring environmental topics within their regular programming, public service broadcasters have also started to identify climate-related content that they preserve in their archives, and are showcasing this historical material online. On their websites, they feature curated collections of clips and programmes about «global warming» or the «environment», which are available for streaming.

These online archives facilitate the discovery of interesting examples, such as a BBC news item from 1989 about a report providing evidence of global warming, which British Prime Minister Margaret Thatcher endorsed in her call for immediate action on climate change,[1] or a 9-minute segment of the West German political magazine *Panorama* from the same year, revealing that a significant portion of waste separated for recycling ends up in landfills in Asia.[2] The Swiss SRG provides access to a 52-minute *MTW Spezial* feature and a 14-minute *Rundschau* feature from the same period, explaining how greenhouse gas emissions contribute to climate change and discussing political measures to reduce them.[3] Items like these provide not only insights into climate communica-

1 «Global Warming Report», *BBC News*, BBC, 20 February 1989. Online: https://archive-downloader.bbcrewind.co.uk/remarc/19890220_Events_GlobalWarming?q=warming (17.6.2024).

2 «Die Recycling-Lüge», *Panorama*, ARD, 7 February 1989. Online: https://daserste.ndr.de/panorama/archiv/1989/-,panorama12156.html (17.6.2024).

3 «Klima vor dem Kollaps?», *MTW-Spezial*, SRF, 18 November 1988. Online: https://memobase.ch/de/object/srf-007-DFD0A450-4106-4C26-BC51-3E48C8C91B3B_01 (12.11.2024); «Treibhauseffekt. Mit Vollgas in die Klimakatastrophe», *Rundschau*, SRF, 10 October 1990. Online: https://memo

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tion in popular media, but are also proof that global warming and environmental pollution were already addressed on television 35 years ago.

Research into media history and the environment – such as the articles of this dossier – would not have been possible without television broadcasters making their programming archives accessible to the public. With their curation of theme-based collections, archives invite research into how television coverage of ecological destruction has evolved over time. For example, the French *Institut national de l'audiovisuel* (INA) provides online access to hundreds of items compiled in collections addressing topics like pollution, natural and industrial disasters, or global warming, dating back to the early 1960s.[4] The Swiss *Memobase* platform displays audiovisual documents related to the keyword *#Umweltschutz* (protection of the environment).[5]

While the significance of such archival services for historical research into environmental communication is undeniable, this article addresses their problematic aspects, focusing particularly on their associated environmental costs. In the context of the climate emergency, our own use of online archives prompts us to critically examine both our research practices and our expectations of the infrastructures that support historical work. By scrutinizing the environmental impact of digital resources, we aim to start a discussion about balancing the preservation of historical television programmes with ecological responsibility. This is not meant to evoke moral guilt but rather to foster awareness and emphasize the challenges that younger and future generations will face in navigating these and similar trade-offs.

Focusing on the *Netherlands Institute for Sound and Vison* (NISV), we will first outline the establishment and tasks of television archives. Next, we will examine the materiality of digital media and then address the environmental impact of television archives. NISV is recognized as an exceptional archive due to its role as a key institution in media preservation and its innovative approaches. In comparison, many other television archives are in the process of advancing their technological capabilities. This makes NISV an ideal case study for exploring the intersection of preservation, digitization, and environmental considerations. It is also important to note that precise figures regarding the environmental impact of archives are not available, as calculating them is complex and as an environmental report for NISV has not yet been produced.

base.ch/de/object/srf-011-88BB800E-1ADD-4B8C-B779-9C47EF74CDD1_05 and https://youtu.be/dv7Cx_PsB4Y?list=PLe-6xkdjkBtYlgTRskt2aHi-MzXNVjJ4x (12.11.2024).

4 https://www.inamediapro.com/eng/Themes/Sciences-Environment/ENVIRONMENT/GLOBAL-WARMING (17.6.2024).

5 https://memobase.ch/de/vitrine/audiovisuelles-zum-stichwort-umweltschutz (12.11.2024).

## Television Archives

The possibility of watching and studying old television programmes is not a given, as broadcast institutions historically paid little attention to archiving. This oversight has technological, institutional, and economic reasons. In television's early years, the medium's ephemeral nature prevented the preservation of shows, which were transmitted live. In the late 1950s, the introduction of videotape recorders enabled the preproduction of television programmes. However, this new technology was often used cost-efficiently: Videotapes were frequently erased and reused for the production of new shows, resulting in the loss of previous recordings. Only a few programmes have survived on tape, often without clear reasons for their preservation.

The increasing use of film in television production implied greater permanence of the audiovisual carrier. This shift can be linked to producers realizing that shows could be exploited multiple times through syndication and international programme exchange.[6] Against the backdrop of this economic rationale, the historical value of television as cultural heritage was largely overlooked, regardless of whether programmes were broadcast on public or commercial television. The primary focus of television institutions and companies was (and still is) providing contemporary programming for transmission, rather than archiving old shows.

In 1980, UNESCO adopted the *Recommendation for the Safeguarding and Preservation of Moving Images,* marking the first time television was officially recognized, alongside film, as an integral part of cultural heritage. To ensure the systematic preservation of this heritage, UNESCO recommended that «moving images of national production […] should be deposited in at least one complete copy» in «officially recognized film or television archives».[7] In Europe, the promotion of safeguarding cultural heritage has been a key aspect of creating a European identity since the 1970s, with various archives already engaged in the collection and preservation of film. However, it was not until 2001 that the *European Convention for the Protection of the Audiovisual Heritage* established an «obligation to deposit moving image material» for all member states of the Council of Europe. This *Convention* not only mandated the systematic storage of audiovisual material but also explicitly included television in its scope.

Except for France, where the *Institut national de l'audiovisuel* has served as a legal depository for television since 1992, other countries lacked dedicated television archives, with material typically stored by the broadcasters themselves.

6 See Derek Kompare, Rerun Nation. How Repeats Invented American Television, New York 2005, p. 59.

7 Recommendation for the Safeguarding and Preservation of Moving Images, UNESCO, 27.10. 1980, 9(a), 9(c), p. 5. https://www.unesco.org/en/legal-affairs/recommendation-safeguarding-and-preservation-moving-images (17.6.2024).

For instance in Germany, the *Deutsches Rundfunkarchiv* (German Broadcasting Archive), a foundation of the federal broadcaster ARD, documents the television shows in its database, with one of the nine regional ARD branches storing the respective copy. The television collection of the *Deutsche Kinemathek*, which exists since 2006, features only selected broadcasts copied from other programme archives. Even though these archives ensured the availability of historical television programmes, accessing the materials was challenging due to their dispersed locations and the limited personnel available to assist researchers.

Stimulated by EU funding schemes, television archives across Europe began collaborating in initiatives such as *Video Active* (2006–2009), *EUscreen* (2009–2012), and *EUscreenXL* (2013–2016). These consecutive projects played an important role in making European (including Swiss) television history accessible online. Interestingly, their focus changed significantly over the decade-long duration of this venture: While the initial aim was to facilitate the «interactive discovery of television's contribution to the construction of a European cultural space»,[8] *EUscreen* subsequently developed an online platform offering access to selected television items, including from Switzerland's SRF and RTS. To ensure the maintenance and further development of this platform, the *EUscreen* consortium even transformed into a foundation in 2013.[9] Over the course of time there has been a shift in focus from the deposition and availability of materials to their online accessibility.

This shift from ensuring the «availability for consultation of deposited moving image material», as mandated by the 2001 *Convention*, to providing online access to digital content occurred within the broader context of initiatives by the European Commission to promote the digitisation of cultural heritage. Since the late 1990s, funding schemes such as the *Framework programmes for research and technological development* encouraged activities aiming to «establish a lasting infrastructure» to «support and extend the role of Europe's libraries, museums and archives in the digital age», as well as to provide «quality access» for all European citizens and to preserve cultural heritage for the future.[10] One of the most ambitious projects in this respect is *Europeana*, a portal designed to encourage cultural heritage institutions to make selections from their (digital or digitized) collections accessible online. As an aggregator, *Europeana* consolidates content from various institutions (including *Memoriav*, Switzerland's network for the preservation of audiovisual heritage), with *EUscreen* being one of the contributors that provides television segments to the portal.[11]

8 https://videoactive.wordpress.com/workplan-2/ (17.6.2024).

9 https://euscreen.eu/ (17.6.2024).

10 https://wayback.archive-it.org/12090/20110521163845/https://cordis.europa.eu/ist/ka3/digicult/home.html (17.6.2024).

11 Swiss television items on the *EUscreen* online platform are provided via *Memoriav*, an associate member of the *EUscreen* network.

Meanwhile, the number of platforms for accessing television history has significantly expanded, as television broadcasters are making selections from their historical collections also available through their own websites and video-on-demand services. This development complements the collaborative efforts of projects like *EUscreen* and *Europeana*. For example, the German *Norddeutsche Rundfunk* (NDR) offers online access to all episodes of its political magazine *Panorama* that have been broadcast since its inception in 1961, including the one mentioned in the introduction above.[12] Viewers located in the UK can explore «thousands of BBC archive films» on the BBC Rewind website,[13] allowing them to see «unique snapshots of our shared past».[14] The Swiss SRF is similarly opening up its archives, making its radio and television items accessible via its media player.[15] With this approach, television broadcasters not only enhance the visibility of their archival materials, they also underscore their commitment to preserving the audiovisual heritage which they had been neglecting throughout their existence so far.

## The Netherlands Institute for Sound and Vision

In the Netherlands, the *Netherlands Institute for Sound and Vision* (NISV) is responsible for both preserving the country's public media heritage as well as making it accessible to the public.[16] In 1995, the Dutch government recognized the need for a national audiovisual archive that combined the collections of smaller archives for public access. As a result, the *Netherlands Audiovisueel Archief* was established in 1997, merging the archives of the Dutch public service broadcasters, the film department of the Government Information Service, the Dutch Film and Science Foundation, and the Broadcasting Museum. Its self-determined tasks included archival functions, as well as public and educational missions. Interestingly, the Dutch Media Law, passed in 2008, only mentions the maintenance and exploitation of a media archive.[17]

12 https://daserste.ndr.de/panorama/archiv/index.html (17.6.2024).

13 https://www.bbc.co.uk/archive (17.6.2024).

14 Introducing Rewind, BBC, https://www.bbc.co.uk/archive/introducing_rewind/zbwdqfr (17.6.2024).

15 Opening up our archives, SRG SSR, https://www.srgssr.ch/en/what-we-do/broadcasting/opening-up-our-archives (21.11.2024).

16 Beeld en Geluid, Iedereen mee in media. Meerjarenbeleidsplan 2022–2026, no place and date, p. 16. https://files.beeldengeluid.nl/pdf/Meerjarenbeleidsplan_2022-2026-Iedereen_mee_in_media.pdf (17.6.2024).

17 J.M. Breemen, V.E. Breemen, P.B. Hugenholtz, Digitalisering van audiovisueel erfgoed. Naar een wettelijke publieke taak. Onderzoek in opdracht van het Nederlands Instituut voor Beeld en Geluid, Amsterdam 2012, p. 20. https://www.ivir.nl/publicaties/download/1043.pdf (17.6.2024). See also Mediawet, 2008. https://wetten.overheid.nl/BWBR0025028/2020-04-01 (17.6.2024).

In 2006, this national archive, which had changed its name to *Netherlands Institute for Sound and Vision* (NISV) in 2002, moved into a brand-new building at the Media Park in Hilversum, the heart of the Dutch television industry. The spectacular structure houses not only the institute's archival holdings and rooms for viewing and video editing, but also a permanent exhibition that showcases the highlights of the collection. Moreover, the building is part of an infrastructure that enables the automatic influx of all content broadcast by Dutch public service television. This results in an annual increase of about 8'000 hours of television material entering the archive by default. Understanding television programming as cultural heritage, NISV aspires to preserve its daily growing collection «for eternity».[18]

The collection of NISV includes not only digital-born content that automatically enters the archive, but also historical television programming stored on analogue carriers such as film and videotape. Due to the successive obsolescence of video formats like AMPEX, U-Matic, Betamax, and VHS, some of these programmes have been transferred to newer formats multiple times.[19] To make this material accessible online, it needed to be digitized. Starting in 2007, NISV was part of a wide-scale digitisation project called «Images for the Future». Over seven years, NISV, alongside the National Archives, EYE Film Museum, and other partners, received funding from the *Fonds Economische Structuurversterking* (Fund to strengthen the economic structure) intended to enhance infrastructure and the knowledge economy. The project corresponded with the EU-wide efforts to stimulate the digitisation of cultural heritage mentioned above and enabled NISV to digitise 137'000 hours of its analogue video material.[20]

The funding for «Images for the Future» originated from revenues generated by exploiting natural gas resources in the northeast of the Netherlands. Since its discovery in 1959, the Groningen gas field yielded the state billions of revenues,[21] which were used for public welfare spending. In 1995, the governments decided to invest 40% of this money in the economic future of the Netherlands and established the *Fonds Economische Structuurversterking*. In addition to investments in transportation infrastructure, the fund, which existed until 2010, also aimed to strengthen technology, telecommunication, and the knowledge economy. With its focus on developing a digital infrastructure not only to preserve audiovisual heritage, but also to support the creative industry and facilitate

18 About Sound and Vision, https://www.beeldengeluid.nl/en/about (17.6.2024); see also Beeld en Geluid, Meerjarenbeleidsplan 2022–2026, p. 3, 11.

19 The machines used to play these formats are among the best-preserved objects in the archive.

20 See Thijs van Exel et al.., Beelden van het verleden. 7 jaar beelden voor de toekomst, n.p. 2015, p. 20. https://publications.beeldengeluid.nl/pub/17/BVDT_eindpublicatie_web.pdf (17.6.2024).

21 In 2019, the *Centraal Bureau voor de Statistiek* (Central Bureau of Statistics) calculated that the gas field had yielded 417 billion Euro. See https://www.cbs.nl/nl-nl/nieuws/2019/22/aardgasbaten-uit-gaswinning-bijna-417-miljard-euro (17.6.2024).

knowledge sharing, «Images for the Future» received more than 100 million Euro in funding.[22]

This subsidy enabled NISV to digitise large portions of its collection, with the stated goal of saving its media collection «for eternity».[23] While the goal of eternal preservation is admirable from a historical standpoint, it seems quite unrealistic, especially in a low-lying country that faces the threat of rising sea levels. Considering that the funds for the mass digitisation of film and television material came from the extraction of fossil fuels, the goal of saving television programmes for eternity appears contradictory. After all, fossil fuels are major drivers of climate change, leading to long-term consequences such as sea-level rise and increased flooding. In addition to the consumption of natural gas that emits carbon dioxide and other greenhouse gases, its extraction significantly contributes to global warming by releasing methane into the atmosphere.[24] Ironically, the very source of its funding may ultimately doom the eternal preservation of Dutch audiovisual heritage.

But the destruction associated with gas production goes even beyond its contribution to climate change. Seismic activities often accompany gas extraction.[25] Since the mid-1980s, the Groningen area has experienced an increasing number of earthquakes, resulting in serious damage to buildings and psychological stress for the inhabitants of the region.[26] In the affected area, it has been determined that around 30'000 houses may be unsafe and need fortification. According to its dashboard, the *Instituut Mijnbouwschade Groningen* (Institute for Mining Damage Groningen), which handles the damage claims, has received

22 Originally, a 90 million Euro subsidy was financed by the *Fonds Economische Structuurversterking*, but in 2011, the budget was adjusted to 117,9 million Euro, coming from the *Fonds* and the Ministry of Education, Culture and Science. See van Exel, Beelden van het verleden, p. 3.

23 About Sound and Vision, https://www.beeldengeluid.nl/en/about (17.6.2024); see also Meerjarenbeleidsplan 2022–2026, p. 3, 11.

24 Methane traps more heat in the atmosphere than carbon dioxide but has a shorter lifespan. Over a 20-year period it is 80 times more harmful than carbon dioxide. It is responsible for 25–30% of today's global warming.

25 The connection between gas extraction and earthquakes was recognized by a commission in 1993, but it took more than 20 years for a volume limit to be implemented (with the Council of State objecting several times and requesting that the maximum volume be lowered even further), and it was only in 2018 that the government decided to stop extraction entirely (though loopholes remain). For more information about these earthquakes, see the website of the Royal Netherlands Meteorological Institute: https://www.knmi.nl/kennis-en-datacentrum/uitleg/aardbevingen-door-gaswinning (12.11.2024).

26 A recent study reveals that the earthquakes affect the mental health of children, as well as their trust in government institutions. This results from the government's delaying tactic before it decided to stop the gas extraction (but left loopholes) and compensate damages, and from the bureaucracy complicating compensation claims and slowing down payments. See Susan Ketner, Ria Reis, Herstel en versterk de Groninger jeugd, nu! Groningen 2024, https://www.schadedoormijnbouw.nl/media/fuhggz5d/hanze-rapportage-over-kinderen-en-jongeren-in-het-aardbevingsgebied_digitaal.pdf (17.6.2024).

220'000 damage notifications. Of these, 6'343 affect cultural heritage.[27] This reveals the challenges of finding a balance between digitising thousands of hours of Dutch television programming and ensuring the safety and well-being of citizens as well as preserving physical cultural heritage.

## The Materiality of Media

In recent years, there has been a growing interest in the materiality of media, leading to insightful explorations of the components and materials that constitute media and enable communication. Scholars in media studies investigate elements such as air, light, and minerals,[28] and – drawing inspiration from science and technology studies – examine technological systems like satellites, undersea cables, and the internet.[29] These discussions also encompass ecological concerns by addressing the consumption of finite resources and the production of waste. Jennifer Gabrys, Richard Maxwell and Toby Miller, for example, highlight the unsustainable life cycle of electronic devices, which are often made from toxic and rare-earth materials.[30] It is not only the mining and processing of these materials that causes environmental pollution; once the devices become obsolescent, they are frequently disposed of in landfills, further contaminating the environment. Extraction often occurs in disadvantaged regions of the world, and after their obsolescence, these devices are commonly discarded in the Global South.[31] Both extraction and disposal practices adversely affect the livelihood and health of local communities, linking environmental pollution to social injustice.

The immateriality of digital media, epitomized by «the cloud», has particularly drawn the attention of media studies scholars. By investigating the infrastructures that enable internet connectivity and data transmission, their examinations of undersea networks and data centres highlight the materiality of digital technologies. Consequently, in his book on the environmental implications of these technologies, Sean Cubitt criticizes the «myth of immaterial media», noting that digital media are imagined as having no history: «no mines, no manu-

27 https://www.schadedoormijnbouw.nl/dashboard?topic=specials (17.6.2024).

28 See for example Nadia Bozak, The Cinematic Footprint. Lights, Camera, Natural Resources, New Brunswick 2012; Jussi Parikka, Geology of Media, Minneapolis 2015; John Durham Peters, The Marvelous Clouds. Toward a Philosophy of Elemental Media, Chicago 2015. For an overview see Nicole Starosielski, The Elements of Media Studies, in: Media + Environment 1/1 (2019), https://doi.org/10.1525/001c.10780.

29 See for example Lisa Parks, Cultures in Orbit. Satellites and the Televisual, Durham 2005; Nicole Starosielski, The Undersea Network, Durham 2015.

30 Jennifer Gabrys, Digital Rubbish. A Natural History of Electronics, Ann Arbor 2013; Richard Maxwell, Toby Miller, Greening the Media, Oxford 2012.

31 Gabrys, Digital Rubbish, p. 129.

facture, no freighting, no waste».[32] This absent history leads not only to a general disregard of the environmental costs of digital technologies but also to the assumption that they are inherently «green». In relation to film production, Nadia Bozak observes that «‹going digital› is more than ever considered a default means of ‹going green› and is generally taken for granted as having sustainability built in».[33] However, despite this conflation, the digital production, distribution, and preservation of media content consume finite resources: beyond the material hardware, they also require energy, storage space, and water for cooling.

Critical studies on data centres, where digitized and digital cultural heritage is processed and stored, highlight their environmental impact by scrutinizing their consumption of energy and water.[34] Although data centres are increasingly committed to carbon neutrality, industry reports and research papers show that their energy demand is constantly growing due to their continuous accumulation of data.[35] The recent proliferation of artificial intelligence (AI), which relies on massive datasets, is further driving up this demand. Studies in computer sciences demonstrate not only how computationally (and therefore energy) intensive the training of machine learning models is,[36] but also point to the environmental costs associated with their deployment. Using 88 different models, Alexandra Sasha Luccioni, Yacine Jernite and Emma Strubell have measured the energy use per inference, meaning each time text is generated based on a prompt. In their discussion of different types of models they conclude, amongst others, that «tasks involving images are more energy- and carbon-intensive compared to those involving text alone».[37]

Additionally, data centres use clean freshwater for their cooling systems to prevent the vast number of computers stored in racks and aisles from overheat-

32 Sean Cubitt, Finite Media. Environmental Implications of Digital Technologies, Durham 2017, p. 13.

33 Bozak, Cinematic Footprint, p. 12.

34 See for example Mél Hogan, Data Flows and Water Woes. The Utah Data Center, in: Big Data & Society 2/2 (2015), pp. 1–12; Julia Velkova, Data that Warms. Waste Heat, Infrastructural Convergence and the Computation Traffic Commodity, in: Big Data & Society 3/2 (2016), pp. 1–10; Patrick Brodie, Climate Extraction and Supply Chains of Data, in: Media, Culture & Society 42/7–8 (2020), pp. 1095–1114.

35 Martijn Koot, Fons Wijnhoven, Usage Impact on Data Center Electricity Needs. A System Dynamic Forecasting Model, in: Applied Energy 291 (2021), Article 116798, https://doi.org/10.1016/j.apenergy.2021.116798; International Energy Agency, Analysis and Forecast to 2026, n. p. 2024, pp. 31–36, https://www.iea.blob.core.windows.net/assets/18f3ed24-4b26-4c83-a3d2-8a1be51c8cc8/Electricity2024-Analysisandforecastto2026.pdf (17.6.2024).

36 Emma Strubell, Ananya Ganesh, Andrew McCallum, Energy and Policy Considerations for Deep Learning in NLP, in: arXiv cs.CL preprint 5.6.2019, http://arxiv.org/abs/1906.02243 (17.6.2024).

37 Alexandra Sasha Luccioni, Yacine Jernite, Emma Strubell, Power Hungry Processing. Watts Driving the Cost of AI Deployment?, in: arXiv cs.CL preprint 23.5.2024, p. 13. http://arxiv.org/abs/2311.16863 (17.6.2024).

ing.[38] The training of AI models increases their already problematic water consumption significantly, resulting in an estimated rise of 20–34 % in 2023.[39] Innovative systems and efficiency improvements may reduce data centres' water and energy demands in the future, with AI contributing to finding the most sustainable solutions. However, the technological advancements of data centres can easily result in higher energy consumption by end users.[40] Such technological solutionism furthermore does not address the issue of human «hyper agency», which Mark Coeckelbergh identifies as one of the reasons of climate change.[41] The increasing collection, processing, and storage of even more data might in fact exacerbate the environmental impact of digital technologies. Beyond their energy and water consumption, data centres also contribute to land loss and impact local biodiversity, due to their size. Furthermore, their generators and fans produce low-frequency sounds that cause stress for both human and non-human beings living nearby.[42]

## The Environmental Impact of Television Archives

Returning to NISV, the source of funding of «Images for the Future» is not the only factor that prompts an eco-critical inquiry. Digitizing historical television programmes and making audiovisual heritage available online also has a substantial impact on the environment. However, these environmental costs are usually obscured by the common presumption that «the digital» is immaterial – and therefore sustainable. The profile and practices of NISV reflect this neglect of the material resources demanded by digital technologies and infrastructures. On its website, NISV highlights the size of its collection by proudly stating that it is «one of the largest» in Europe and «grows larger every day».[43] By mentioning that «a large part of this collection is digitally stored» and pointing to the online

38 Pengfei Li et al., Making AI Less «Thirsty». Uncovering and Addressing the Secret Water Footprint of AI Models, in: arXiv cs.CL preprint 29.10.2023, p. 4, http://arxiv.org/abs/2304.03271 (17.6.2024).

39 Li, Making AI Less «Thirsty», p. 2.

40 This occurs in the case of video compression, where efficiency improvement shifts the energy consumption to the devices (television sets, laptops, tablets, mobile phones) of end users. See Marek Jancovic, Judith Keilbach, Streaming Against the Environment. Digital Infrastructures, Video Compression, and the Environmental Footprint of Video Streaming, in: Karin van Es, Nanna Verhoeff (eds.), Situating Data. Inquiries in Algorithmic Culture, Amsterdam 2023, pp. 85–102, here p. 94–95.

41 Mark Coeckelbergh, AI for Climate. Freedom, Justice, and Other Ethical and Political Challenges, in: AI and Ethics 1 (2021), pp. 67–72, here p. 71.

42 Steven Gonzalez Monserrate, The Cloud Is Material. On the Environmental Impacts of Computation and Data Storage, in: MIT Case Studies in Social and Ethical Responsibilities of Computing, Winter 2022, n.p. https://doi.org/10.21428/2c646de5.031d4553 (17.6.2024).

43 Collection, https://www.beeldengeluid.nl/en/collection (17.6.2024).

accessibility or downloadability of «more than a million hours of audiovisual material»,[44] NISV contributes to the perception of digital storage and distribution as infinite and immaterial, a notion seemingly restricted only by copyright issues.

But digitizing thousands of hours of videotapes creates greenhouse gas emissions due to the energy that is necessary to power the equipment and storage systems. Moreover, after their digitization the videotapes become obsolete and turn into physical waste. Composed of diverse materials such as polypropylene and polyester coated with metals and chemical binders, they cannot be recycled, even after separating the magnetic ribbon from the case. As Jennifer Gabrys reminds us in her book on digital rubbish, such electronic waste frequently ends up in landfills. Due to its high levels of toxic substances, this waste is often deemed «not fit for Western dumps» and is therefore shipped to the Global South, where it pollutes the environment by leaching into the water and soil.[45] In reports on the digitization of cultural heritage, this impact on humans and nonhumans is not accounted for. Although the final report of NISV's «Images for the Future» mentions the material components of videotapes to address the vulnerability of the magnetic ribbon, it does not specify what happened to the tapes after the 137'000 hours of video material they contained were digitized.

Once digitized, the television programmes take up storage space.[46] NISV maintains multiple copies of its audiovisual heritage in various locations, which increases the required storage. This is done partly to ensure that the programmes are not lost. In addition to their policy of storing two copies, NISV keeps another backup copy of its complete collection at the Royal Library of the Netherlands, in case of calamity.[47] Furthermore, the number of copies increases due to the migration of files that is necessary every few years because of changing file format standards or newer generations of hardware. Additionally, there are copies used for viewing: one in lower quality for immediate preview in the online catalogue and two in higher quality for viewing on request. These high-quality copies can be accessed «nearline», meaning with a slight delay, and the existence of two copies allows the online delivery of the one that is closest.[48] The energy consumption of data storage varies depending on the resolution, medium (such as spinning disk storage or magnetic data tape), and whether an offline, nearline, or online storage system is used.

44 Collection, https://www.beeldengeluid.nl/en/collection; Order for private use, https://www.beeldengeluid.nl/en/collection/order-private-use (17.6.2024).

45 Gabrys, Digital Rubbish, p. 129.

46 According to unconfirmed information, the net storage volume without copies is 18 petabytes.

47 Mary-Joy van der Deure, Preservation for the Future. Understanding the Materiality of Digital, Audio-Visual Heritage, RMA Thesis, Utrecht 2022, p. 68. https://studenttheses.uu.nl/handle/20.500.12932/46404.

48 Van der Deure, Preservation, p. 74.

By making their collections available online, audiovisual archives like NISV essentially operate as a streaming platform: they transmit video files over the internet to enable continuous viewing without the need for downloading. While quantifying the environmental impact of video streaming is a complex task and depends on various factors, such as the energy mix and the boundaries of the calculation,[49] it is clear that the data centres and network infrastructure required for video streaming consume significant amounts of energy, as do the vast number of end-user devices. Although industry reports about the carbon impact of video streaming conclude that emissions from content distribution are small compared to those from end-user devices,[50] the resource consumption (energy, water, raw materials, land) and waste production (e-waste, heat) of the data centres supporting this operation should not be underestimated. Claims by Dutch data centres that they are becoming increasingly «green» due to efficiency improvements, their transition to renewable energy sources, and investments in carbon offsetting programmes therefore need to be viewed critically.

In the Netherlands, data centres rely on the common energy grid. Powering their operations with energy produced by renewable sources means that they are consuming green energy that would otherwise be available for households. For instance, the Google Data Center in the north of Holland has faced criticism for using all the green energy generated by a publicly funded wind park, leaving citizens with no direct benefits from this renewable energy source, which their taxes were used to build.[51] Recently, data centres have started considering building their own solar farms to reduce their dependence on the common grid. However, solar farms require substantial amounts of land, which is already scarce in the Netherlands. Allocating land to solar farms for data centres disadvantages both local humans and non-humans by limiting the available space for natural habitats, agriculture, and housing. It also repeats the issue of excluding citizens from access to renewable energy sources.

Claims of being «green» are often based on the purchase of carbon offsetting or renewable energy certificates. These practices aim to neutralize greenhouse gas emissions in one location by investing in projects that are thought to sequester carbon dioxide, such as planting trees, or by buying certificates from renewable energy production elsewhere in the world. However, such «place-

49 Depending on the scope and boundaries (for example, only operational use or life cycle assessment out of all components), the result of the assessment will differ significantly.

50 Carbon Trust, Carbon Impact of Video Streaming, London 2021, p. 51. https://www.carbontrust.com/our-work-and-impact/guides-reports-and-tools/carbon-impact-of-video-streaming (17.6.2024). The high ratio of emissions produced by end-user devices is an effect of more efficient video compression. See Jancovic and Keilbach, Streaming, p. 94–95.

51 Merijn Rengers, Carola Houtekamer, Gebroken beloftes. Hoe de Wieringermeerpolder dichtslibde met windturbines en datacentra, in: NRC, 05.6.2020. https://www.nrc.nl/nieuws/2020/06/05/gebroken-beloftes-hoe-de-wieringermeerpolder-dichtslibde-met-windturbines-en-datacentra-a4001882 (17.6.2024).

agnostic» practices – as Anne Pasek calls them in their case study of Microsoft's cloud service Azure[52] – do not satisfy the increasing energy demand of data centres, which must be met by place-based, local power suppliers. Several studies have furthermore shown that such projects overestimate their ability to reduce emissions and have even led to the displacement of Indigenous people from their land.[53] A closer look at the energy consumption of Dutch data centres reveals that 61,4 % of the «green energy» they used in 2024 actually came from purchasing such certificates,[54] meaning that they offset their greenhouse gas emissions rather than using locally produced renewable energy.

Finally, in the Netherlands, data centres often highlight the reuse of their rest heat as a contribution to green innovations. The servers storing and streaming NISV's audiovisual collection generate heat and must be cooled to ensure their optimal operation.[55] Instead of releasing the rest heat into the environment, data centres have been experimenting with using it to provide heating for nearby buildings.[56] The success of such a repurposing has so far been limited because buildings need to be in close proximity to benefit from this process – which contrasts with the typical location of data centres in industrial parks outside cities. As a result, it is mostly offices that are being heated.[57] Emphasizing this repurposing, however, obscures the fact that cooling requires large quantities of water, impacting local water supplies – even in the Netherlands, a country that, despite frequent rainfall, experiences increasing water shortages.[58]

The recent implementation of AI technologies in the archival workflow adds to NISV's energy and water consumption associated with the preservation and online accessibility of its audiovisual collection. First, AI is used for recordkeeping in order to manage the large volumes of incoming data, such as the automatic influx of television programmes mentioned above, by automatically de-

52 Anne Pasek, Managing Carbon and Data Flows. Fungible Forms of Mediation in the Cloud, in: Culture Machine 18 (2019). https://culturemachine.net/vol-18-the-nature-of-data-centers/managing-carbon/ (17. 6. 2024).

53 For an overview, see CarbonBrief's special on carbon offsets, particularly its in-depth Q&A: Can «carbon offsets» help to tackle climate change?, published 23. 9. 2023. https://interactive.carbonbrief.org/carbon-offsets-2023/index.html (17. 6. 2024).

54 Dutch Data Center Association, State of the Dutch Data Centers, n.p. 2024, p. 7. https://www.dutchdatacenters.nl/publicaties/state-of-the-dutch-data-centers-2024/ (2. 8. 2024).

55 For a discussion of the thermal conditions of media see Nicole Starosielski, Media Hot and Cold, Durham 2021, particular chapter six on computers.

56 See also Velkova, Data that Warms.

57 Daniël van Kessel, ‹Groene› restwarmte datacenters is vooral kille PR, in: Follow the Money, 10. 4. 2021. https://www.ftm.nl/artikelen/restwarmte-datacenters-big-tech (17. 6. 2024).

58 Daniël van Kessel, De cloud laat ons water verdampen. Wie zorgt dat er straks nog genoeg is? in: Follow the Money, 1. 4. 2021. https://www.ftm.nl/artikelen/big-tech-datacenters-watervoorziening (17. 6. 2024). Jolijn van Engelenburg et al., Sustainability Characteristics of Drinking Water Supply in the Netherlands, in: Drinking Water Engineering and Science 14/1 (2021), p. 1–43. https://doi.org/10.5194/dwes-14-1-2021 (17. 6. 2024).

scribing and extracting their metadata. Second, AI is utilized for organising and accessing NISV's collections. It is tasked with indexing content, as well as searching for and retrieving it, such as high-quality copies for nearline access. Finally, AI is implemented for searching within audiovisual content. This includes tools for automatic transcription of speech to text, face detection and recognition, automatic synchronisation of subtitles, and automatic content segmentation.[59] All these tools and processes contribute to an increase in NISV's environmental impact. In their overview of AI practices in archives, Gregory Roland et al. conclude that «we tend to overestimate the effect of a technology in the short run and underestimate the effect in the long run».[60] Although this remark from 2019 is directed at the efficiencies that AI promises for archival work, it is even more applicable to AI's consequences for the environment.

## Best Practices

In recent years, environmentally conscious archivists have begun publishing suggestions on how to reduce the environmental impact of digital preservation. These best practices include managing archive buildings more efficiently, for example by optimizing light and temperature regulation, as well as implementing responsible recycling programmes. Taking a more critical approach, some even advocate for a paradigm shift and challenge traditional preservation methods and policies. Pendergrass et al. argue that cultural heritage organizations «need to reduce the amount of digital content that they preserve while reducing the resource-intensity of its storage delivery».[61] While they acknowledge technical solutions such as improving the efficiency of IT systems and scheduling energy-intensive tasks for off-peak hours, they emphasize that these can only be interim measures. Ultimately, they argue that a revaluation of the «basic assumptions of appraisal, permanence, and availability of digital content» is necessary.[62] This involves being more selective by critically examining which content is «worthy

59 See Eugenio López De Quintana and Antonio León Carpio, Artificial Intelligence for a Role Change in Television Archives. The Atresmedia-Etiqmedia Experience, in: *Journal of Digital Media Management* 10/2 (2021), pp. 177–187; Jasmijn van Gorp and Mary-Joy van der Deure, Speech-to-Local Data. Exploring ASR Files of Archived Television News (2004–2018) on the 1986 Chernobyl Nuclear Disaster, unpublished; for a general overview of the implementation of AI in archival work flows see Giovanni Colavizza et al., Archives and AI. An Overview of Current Debates and Future Perspectives, in: ACM Journal on Computing and Cultural Heritage 15/1 (2021), Article 4. https://doi.org/10.1145/3479010 (17.6.2024).

60 Gregory Roland et al., More Human than Human? Artificial Intelligence in the Archive, in: Archives and Manuscripts 47/2 (2019), pp.179–203, here p. 195.

61 Keith L. Pendergrass et al., Toward Environmentally Sustainable Digital Preservation, in: The American Archivist 82/1 (2019), pp. 165–206, here p. 177.

62 *Ibid.*

of long-term preservation».[63] Their suggestions include prioritizing specific content for migration to the highest-quality formats and evaluating acceptable levels of loss that might occur as a result of minimizing redundant copies. Rather than engaging in mass digitization or ensuring immediate online accessibility, they propose making content available on demand.[64]

These suggestions raise challenging questions that are also highly relevant to the practices at institutions like NISV. For instance, they prompt discussion about the criteria used to determine how many and which television programmes should be preserved as part of our cultural heritage. Should such decisions be based on historical significance, audience size, artistic values, or other factors? Additionally, they call into question who holds the authority or responsibility to make such decisions – archivists, historians, cultural policymakers, or perhaps even the public?

Attending to the environmental impact of audiovisual archives and their practices involves not only rethinking their preservation and curation strategies but also critically reflecting on our own research practices. Do our research endeavours truly require access to every piece of content? Is immediate access essential for our research, or can we allow for more deliberate, on-demand access? Moreover, what level of quality is truly necessary when viewing historical materials? Would lower resolutions compromise our research? These considerations highlight the need to balance the desire for comprehensive access with the environmental costs associated with audiovisual archives.

What is clear is that sustainability must be integrated into archival decision-making processes. However, accountability for environmental impact should not be limited to audiovisual archives; it must also extend to our own research practices. This includes questioning the necessity of extensive data collections and the use of energy-intensive digital tools and workflows. The next step in this ongoing discussion is for researchers from various disciplines to collaboratively explore how we can collectively implement more eco-friendly practices. Only by working together can we create more sustainable research practices that safeguard the planet.

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63 *Ibid.*, p. 182.
64 *Ibid.*, p. 182–195.