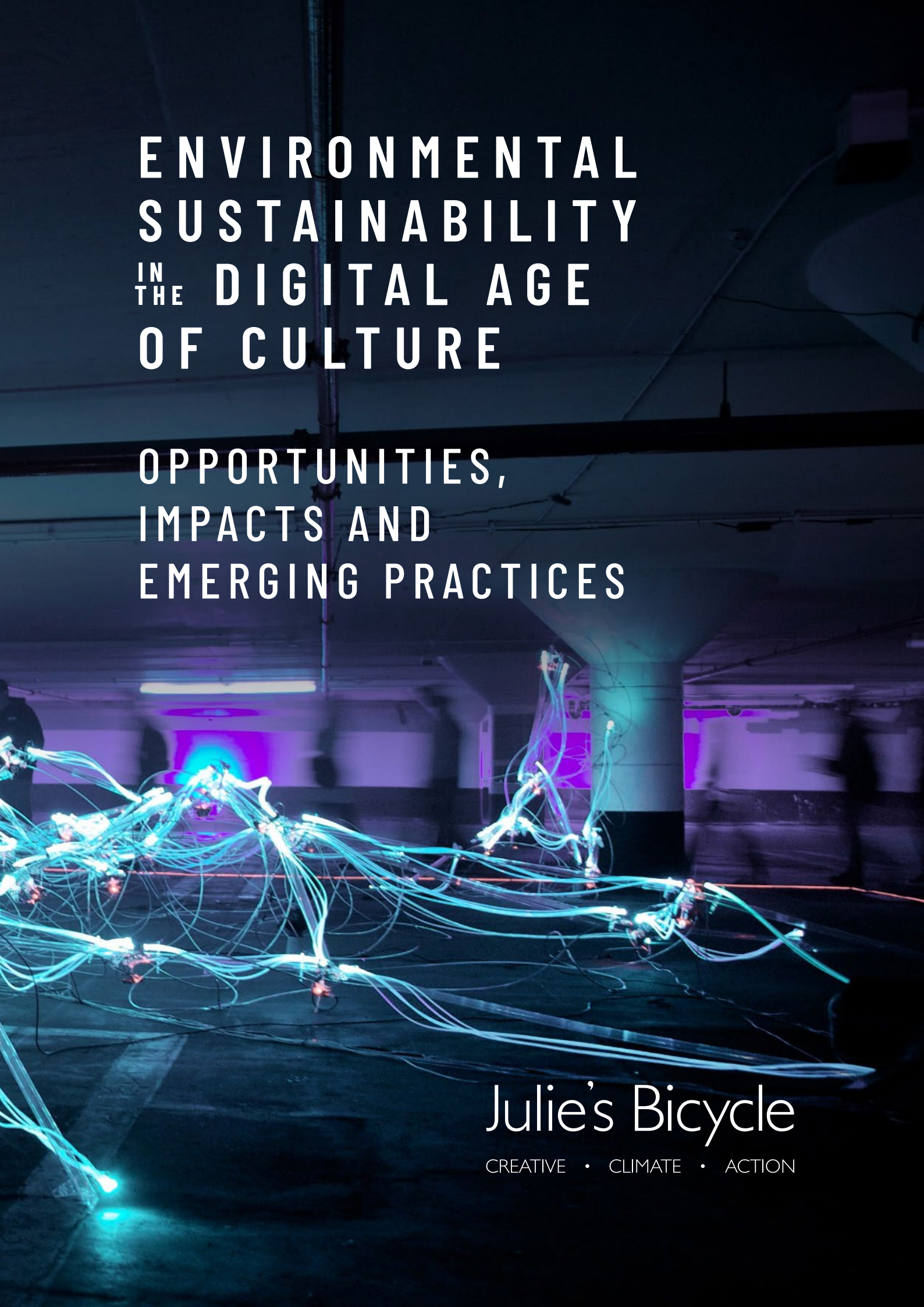
ENVIRONMENTAL SUSTAINABILITY IN THE DIGITAL AGE OF CULTURE

OPPORTUNITIES, IMPACTS AND EMERGING PRACTICES



Julie's Bicycle

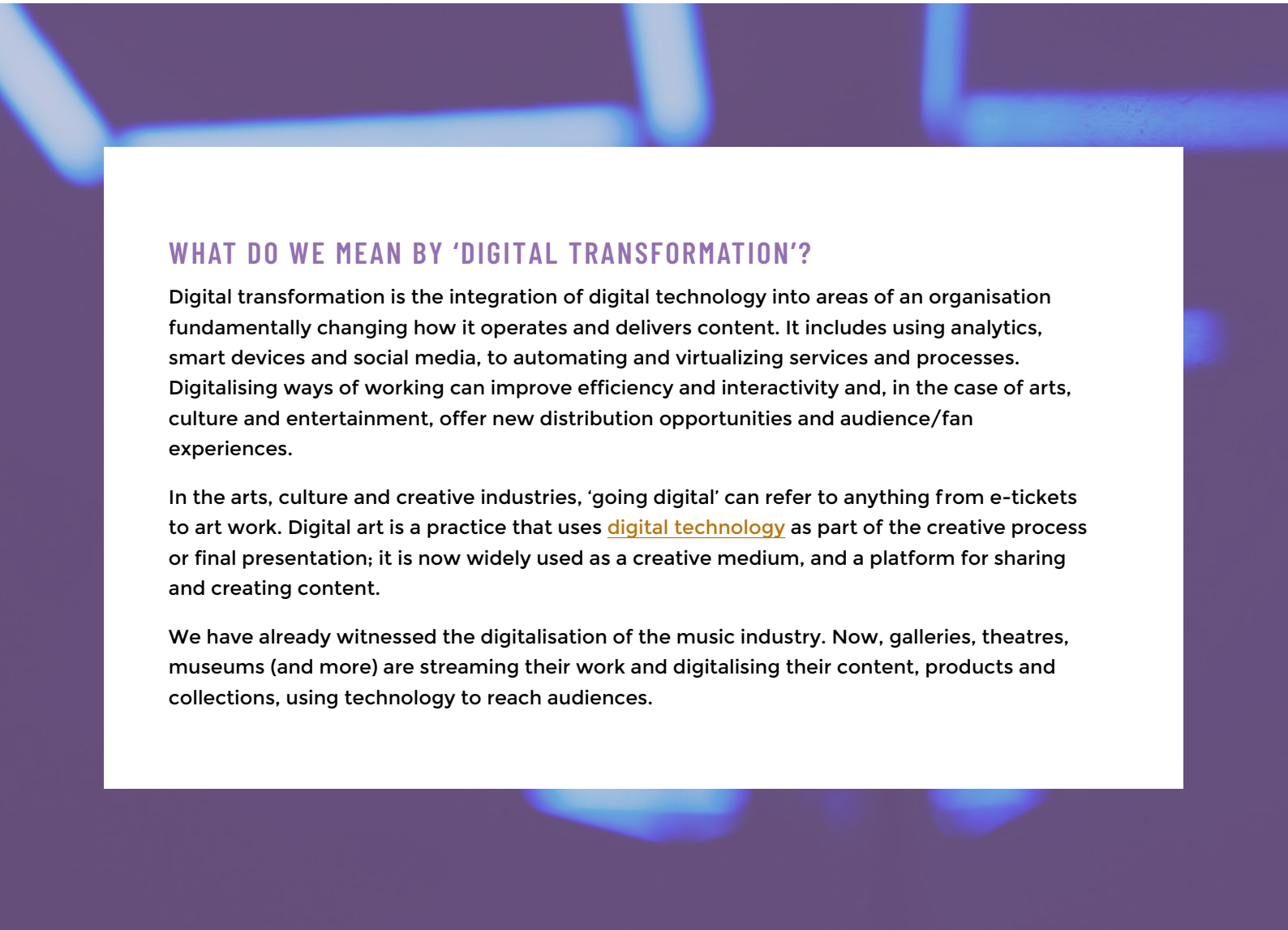
CREATIVE • CLIMATE • ACTION

EXECUTIVE SUMMARY

‘Digital’ is fast transforming arts and culture, bringing with it a multitude of creative possibilities and opportunities for audience engagement. The COVID-19 pandemic has accelerated this inevitable shift as many organisations have transitioned their entire operations online.

What are the environmental and social costs of this new world? How do we make the most of the opportunities the digital transformation brings, whilst understanding the consequences of our decisions?

This briefing aims to summarise what we know and help the cultural community navigate this new territory.



WHAT DO WE MEAN BY ‘DIGITAL TRANSFORMATION’?

Digital transformation is the integration of digital technology into areas of an organisation fundamentally changing how it operates and delivers content. It includes using analytics, smart devices and social media, to automating and virtualizing services and processes. Digitalising ways of working can improve efficiency and interactivity and, in the case of arts, culture and entertainment, offer new distribution opportunities and audience/fan experiences.

In the arts, culture and creative industries, ‘going digital’ can refer to anything from e-tickets to art work. Digital art is a practice that uses digital technology as part of the creative process or final presentation; it is now widely used as a creative medium, and a platform for sharing and creating content.

We have already witnessed the digitalisation of the music industry. Now, galleries, theatres, museums (and more) are streaming their work and digitalising their content, products and collections, using technology to reach audiences.

Environmental considerations

Digital technology comes with a range of environmental consequences and impacts, from the obvious (e.g. energy consumption), to the hidden (e.g. mining for materials and e-waste dumps). The music industry provides a case in point: whilst plastic consumption is declining as CD sales plummet, the use of streaming is growing exponentially around the world, increasing energy use and carbon emissions from devices, network infrastructure and data centres.

Although it is assumed that the carbon impact is relatively modest when compared to other activities and sectors – and there have been rapid improvements in the infrastructure's energy efficiency[1] – there remains a host of environmental challenges, from growing e-waste to new energy demands from emerging technologies like Artificial Intelligence (AI) and Blockchain.

The life cycle carbon footprint of the Information and Communications Technology (ICT) sector is equivalent to 1.4% of global greenhouse gas emissions, and around 4% of global electricity use. The entertainment and media sector (TV, gaming, streaming, entertainment, newspapers) accounts for an additional 1.2% of global emissions and 3% of global electricity consumption.[2]

Translated, if the Information Technology (IT) sector were a country, it would be the 3rd highest consumer of electricity after the USA and China.[3] If the internet was a country, it would be the sixth largest greenhouse gas polluter[4], or the equivalent of Australia, Denmark and the UK combined.[5]

Largest global producers of greenhouse gas emissions from fuel combustion, 2018

Rank	Country	CO_2 emissions from fuel combustion in $MtCO_2$, 2018[5]
1	China	9.5 thousand
2	United States	2.9 thousand
3	India	2.3 thousand
4	Russian Federation	1.6 thousand
5	Japan	1.1 thousand
6	Democratic Republic of the Internet	830
7	Germany	696

1 Carbon Brief (2020) https://www.carbonbrief.org/factcheck-what-is-the-carbon-footprint-of-streaming-video-on-netflix

2 Malmodin & Lunden, 2018, The Energy and Carbon Footprint of the Global ICT and E&M Sectors 2010–2015. Sustainability. vol. 10, no. 9. https://www.mdpi.com/2071-1050/10/9/3027

3 Greenpeace, 2017, Click Green Report, http://www.clickclean.org/uk/en/

4 Digital Detox, The Green Report, 2020, https://blog.digital-detox.co.uk/digital-pollution-solution-green-report/?inf_contact_key=3f31704198c74156a47cf5a930328569

5 IEA, 2018, World Energy Atlas, online: http://energyatlas.iea.org/#!/tellmap/1378539487, accessed 13/10/2020

Looking ahead

Best-case scenario: predictions suggest that renewable energy production should exceed data centre consumption by 2030. Worst-case estimates suggest electricity usage by communications technology could contribute up to 23% of global greenhouse gas emissions by 2030.[6]

Policy signals:

- The new ITU standard requires the Information Communications Technology (ICT) industry to reduce emissions by 45% in the next ten years in line with the Paris Agreement, prioritising a shift to renewable technology as well as greater operating efficiencies.
- The EU Commission has decreed that data centres must be carbon neutral by 2030. If the whole ICT sector switched to renewable energy sources, its footprint could be reduced by 80%.[7]

Learn more

Digital impacts:

- Climate Care Infographic on the carbon footprint of the internet;
- Curiously Green: a monthly newsletter by Wholegrain Digital exploring digital impacts;
- Erjjio's blog: the internet's environmental impact and what you can do;
- Ellen Macarthur's Guide to Circular Consumer Electronics.

Sustainability and web service providers:

- White paper by the Coed:Ethics Community gives an overview of energy use in data centres worldwide and their strategies over the next five years;
- Greenpeace Click Green report provides company scorecards assessing the sustainability of online service providers, from music streaming platforms, social messaging through to cloud computing platforms.

Practical action:

- Design and build a green website with help from this blog by Whole Grain Digital;
- Digital Detox are launching a new service – the green report which advises customers on how to make digital processes more efficient and advise on cutting digital pollution;
- Green Electronics Council: Advocate for sustainable IT by supporting both manufacturers and large-scale purchasers.

6 Anders S. G., Andrae and Edler, T., 2015, On Global Electricity Usage of Communication Technology: Trends to 2030, Challenges 2015, 6(1), 117-157; https://doi.org/10.3390/challe6010117

7 NGI Forward, 2020, Internet of Waste: The Case for a Green Digital Economy, online: https://media.nesta.org.uk/documents/Sustainability_1.pdf

What you can do: the basics

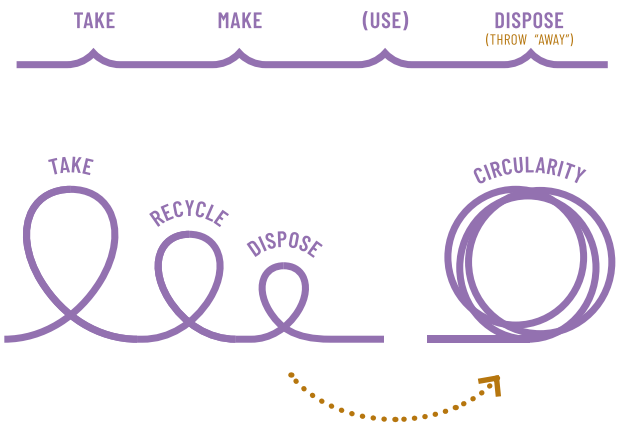
1. ONLINE PROCUREMENT

- **Move data to the cloud** – according to Microsoft, the cloud delivers 72-93% carbon savings in comparison to conventional computing.

- **Switch to web hosting** – switch to web hosting and cloud services which are renewably powered, and service providers which are transparent and accountable on their energy sources, greenhouse gas emissions and targets e.g. having a net zero commitment. Greenpeace have comprehensively assessed tech companies on their energy transparency, policy, renewable procurement and their report is a great place to start informing decisions. Beware of misleading claims. Companies that are reducing impacts by offsetting are much less effective that companies that are investing in renewables. This is because new renewable capacity needs to be added to the grid.

2. THINK CIRCULAR: CHOOSE AND USE DEVICES WISELY

- When it comes to devices, follow the circular economy approach and wherever possible opt for a refurbished device rather than a new one. Use devices for as long as possible, repair whenever you can, pass them on to a new user or recycle them at end of life.



3. DEVELOP UNDERSTANDING, PLAN THE APPROACH AND MEASURE THE IMPACT

- Build more understanding of the issues by reading and speaking to suppliers and service providers. Fully understanding your digital impacts will require collecting data including:
    - the carbon intensity of the local grid
    - the power consumption of devices
    - operational emissions where possible (your choice of type of browsers, websites and applications used can influence the overall carbon footprint).
- Start by mapping where the digital impacts are occurring. Consider: are you looking to understand the footprint of one digital project or to reduce the digital footprint relating to your daily activities, or perhaps create a procurement/circular strategy for digital devices?
- Look to see what options are available to measure digital impacts. Erjjio provide free website health checks and the Green Web Foundation app checks the credentials of host providers showing whether a website is hosted "green or grey". Other tools such as Wholegrain Digital's calculator measures a website's carbon footprint and Ecometer allows its users to design and build more sustainable web services.

4. ADVOCATE FOR CHANGE

Start talking about digital impacts, use your art to inspire change, join existing campaigns or start your own.

- **Ask** – speak to technical and digital providers for their environmental and energy reports and what they are doing to address their impacts. Get involved with existing campaigns such as Greenpeace's Tell Netflix to Go Green campaign.
- **Inspire** – use digital art to engage audiences in environmental and sustainability issues - and remember to share the practical actions taken to reduce the digital impacts. Exit Productions 'Eco-Chambers' used online theatre to engage their audiences in debating what a sustainable, just society future should look like. Apocalypse Reading Rooms is an online world of 'talking stories in the face of environmental and social collapse, a gathering of all the books we might need to change the end of the world.'
- **Encourage** – lead by example and switch to a renewable energy provider such as Good Energy, and encourage home-working colleagues and friends to do the same.
- **Share with others** what you are doing by signing up to Whole Grain Digital's Sustainable Web Manifesto for a greener internet.

5. DESIGN ONLINE FOR EFFICIENCY AND DO A DIGITAL SPRING CLEAN

- Choose a green hosting page for websites or art work and ask your designers to be as efficient as possible for the user. Techniques to consider include: reducing the amount of code transferred to a users' computer; using static content rather than rebuilding pages; minimising the computation needed to render web pages; and improving audio and video codecs (i.e. a device or computer program which encodes or decodes a digital data stream or signal).[8]
- Delete all the apps, email subscriptions and online services you don't use or need, they require data and energy.

8 Ericsson, 2020, The Footprint of Data and Telecoms, online: https://www.ericsson.com/en/reports-and-papers/industrylab/reports/a-quick-guide-to-your-digital-carbon-footprint, accessed 06/10/2020

JARGON BUSTER

The Cloud

In tech terms, the cloud refers to software and services that are run over the internet as opposed to on your computer itself. The cloud can be accessed via any internet browser and includes services that run online such as Netflix as well as storing your data, emails, photos, files etc. on services such as Dropbox or Google Drive. Contrary to the images of the cloud being light and fluffy, it is very much a physical thing which relies on energy and networks of servers to run it.

Data Centre

A building which houses all the computing equipment that makes our online activities possible. According to Tech UK: "A data centre is there to manage, store, process, transact, manipulate or transmit digital data at scale, within a controlled, protected, resilient environment. If it isn't doing any of those things then it isn't a data centre."[9]

Power Purchase Agreement

A long term contract between a business and a renewable energy provider, where the business agrees to purchasing renewable energy, which means the renewable energy provider has the financial security to add additional renewable energy capacity to the grid.

Server

A server is in simple terms, a computer which provides data to other computers. In a data centre, servers run remotely and are usually assigned to perform a specific function.

Internet of Things

Refers to all the objects that are connected to the internet, from wearables to lightbulbs, sensors and smart phones. As technology becomes more sophisticated it is expected devices will become increasingly connected, sharing more data and helping to make things easier and more efficient.

Life Cycle Analysis

Understanding the impacts associated with a product or service, from cradle to grave.

9 Tech UK, 2013, Er, What is a data centre? Online: https://www.techuk.org/insights/reports/item/273-er-what-is-a-data-centre?utm_source=http%3a%2f%2fmarketing.intellectuk.info%2flz%2f&utm_medium=email&utm_campaign=Climate+Change+update+12+March+2015&utm_term=Climate%20Change%20Update%2004%20March%202015%20&utm_content=44, accessed 13/10/2020

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FOREWORD

In just over half a century, the digital revolution has changed the world beyond recognition. From the invention of the transistor, to mobile technology, the dot-com bubble, and now the proliferation of automation and Artificial Intelligence, the digital age is one of the most pivotal and rapid transformations in our short history on earth. We are networked on an extraordinary scale.

An estimated 2.5 billion people world-wide are connected to the web[10] and global smartphone sales have rocketed from 300 million in 2010 to an eye-watering 1.56 billion in 2018[11]. This means big business: the digital sector is nearly six times larger than growth across the UK economy as a whole, contributing £149 billion to the UK economy in 2018[12].

For the creative and cultural sector, digital art and media have generated completely new platforms to tell stories, reach audiences and fans and distribute cultural content. Investment in the sector's digital infrastructure, literacy and skills was accelerating change, but Covid-19 has catapulted technology as an essential cultural tool; to entertain, educate and connect with others. During this time, many cultural organisations are offering creative work online in order to connect with their communities and audiences during lockdown, a practice that is becoming hard-wired into arts practice and will certainly sustain beyond the constraints of Covid 19. The global pandemic has also highlighted the inequity in digital provision, and how good connectivity and hardware are huge advantages, from home working to children's education.

But whilst our digital world thrives, our natural world is failing.

10 CustomMade https://www.custommade.com/blog/carbon-footprint-of-internet/

11 Statista https://www.statista.com/statistics/263437/global-smartphone-sales-to-end-users-since-2007/

12 UK Government https://www.gov.uk/government/news/digital-sector-worth-more-than-400-million-a-day-to-uk-economy

The Anthropocene - the era in which human activity became the dominant influence on climate and the environment - is marked by both rapid technological development and the exponential rise in energy consumption and carbon emissions. The story of the Anthropocene is, in short, a love affair between human beings and intensive resource extraction – from fossil fuels, to mining and farming. This toxic relationship has resulted in record levels of environmental destruction, particularly since the mid-twentieth century.

There is a growing appetite for digital products and services and the power-hungry data centres and servers which sit behind them. Business models reliant on consumption require products to break after a certain amount of time, to feed the endless hunger of an insatiable market (referred to as planned obsolescence). This might be via dysfunctional coding kicking in, battery failure, or worn out parts.

The limited opportunities for deconstruction and recycling are key to driving market demand. Many of our electronics are made using conflict minerals[13] - natural resources, often extracted in – and driving - conflict zones – and end their working lives in toxic, often illegal, electronic waste dumps.

Furthermore, as often happens, digital innovation has outrun mechanisms for good governance and accountability; and issues of surveillance, privacy and market-manipulation have never been so prevalent. Barely governed and easily co-opted, the online world has upended 20th century versions of democracy, providing abundant knowledge as well as disinformation, propaganda and fake news.

Digital technology should be a tool for positive change, expanding creativity, connectivity and contributing to the health of the planet. Positive environmental impacts, such as virtual experiences replacing high carbon travel, are real solutions.

Umbrelliums Assemblance at DigitalRevolution, Barbican Centre
Photo credit: Duncan McKenzie

13 Greenpeace https://www.greenpeace.org/usa/reports/greener-electronics-2017/

UNDERSTANDING THE ENVIRONMENTAL IMPACTS OF DIGITAL

What's the carbon footprint[14] of digital?

The total life cycle carbon footprint of the Information and Communications Technology (ICT) sector is equivalent to 1.4% of global greenhouse gas emissions, or 830 million tonnes of carbon dioxide[15], approximately equivalent to the annual CO_2 emissions from Australia, Denmark and the UK combined[16]. It would be the sixth largest emitter if it were a country. Furthermore, the emissions from the Media and Entertainment sector account for an additional 1.2% of global emissions.

Carbon emissions that result from our digital infrastructure can be divided into four areas:

- **Devices (34%)** - energy used to power our phones, tablets, desktops, wearables etc.
- **Manufacture (16%)** - energy for making all the equipment.
- **Communication Networks (29%)** - construction, operation and maintenance of networks for both mobile and fixed networks.
- **Data Centres (21%)** - construction, manufacture and operation of the centres that store the data on the internet. [17]

14 A carbon footprint measures the greenhouse gas emissions caused by an individual or organisation directly or indirectly and is measured in tonnes of carbon dioxide equivalent (tCO_2e).

15 Climate Care, 2020, Carbon Footprint of the Internet by Custom Made, online: https://climatecare.org/infographic-the-carbon-footprint-of-the-internet/ accessed 6/10/2020

16 Our World in Data, 2020, Annual CO_2 emissions 2018, online: https://ourworldindata.org/grapher/annual-co2-emissions-per-country, accessed 06/10/2020

17 Greenpeace, 2017, Click Green Report, online: http://www.clickclean.org/uk/en/ accessed 06/10/2020

Devices and manufacture

Our appetite for devices is growing exponentially. We now ship around 1.5 billion smart phones around the world per year, selling about sixty per second[18]. Beyond the energy consumption and emissions generated from using our devices, producing them also involves mining, manufacturing and transportation; all of which have social and environmental impacts.

ENVIRONMENTAL IMPACTS:

- Manufacturing is energy intensive. Smartphone manufacture produces 130 million tonnes of CO2[19] - the equivalent emissions of the Philippines every year.[20]
- Mining on a local scale is a water intensive process and causes deforestation and land degradation. On average it takes 716 cubic meters of water to produce a tonne of gold[21] and rising global demand for metal commodities will increase the industry's impact on water resources.
- For each smartphone manufactured, approximately 30 kilos of rock are mined in order to extract 100g of minerals[22], and a typical smartphone can contain around 50 different kinds of metals.[23]

ECONOMIC IMPACTS:

Many of the minerals used in our smart devices (as well as other environmentally important technologies such as renewables, electric vehicles and energy efficient lighting) are defined as 'Critical Raw Materials' i.e. raw materials which are economically and strategically important for the European economy, but have a high-risk associated with their supply. They are concentrated in a few geographic areas meaning the UK and EU are almost entirely reliant on imports. For example, according to the EU, China provides 98% of the continent's supply of rare earth elements. The EU has acknowledged that critical raw materials are essential in industrial leadership and necessary for resilience and autonomy (read more about the EU's Action Plan on Critical Raw Materials).

SOCIAL IMPACTS:

Critical Raw Materials also include 'Conflict Minerals': minerals which are mined in conditions of armed conflict and human rights abuses. Many of these minerals are sourced from the Democratic Republic of the Congo (DRC) which holds a significant proportion of the world's mineral wealth (such as coltan and cobalt). In 2010, it was regulated that companies listed on American stock markets must disclose whether their products contain conflict minerals. The was mandated in response to growing concern regarding exploitation and trade of conflict minerals by armed groups was helping to finance conflict in the DRC region and contributing to its emergency humanitarian crisis. However, the regulation (Section 1502) does not require firms to actually avoid DRC conflict minerals — just disclose the source of the minerals in their products.[24]

18 Gartner, 2018, World-wide device shipments, online: https://www.gartner.com/en/newsroom/press-releases/2018-01-29-gartner-says-worldwide-device-shipments-will-increase-2-point-1-percent-in-2018 accessed 06/10/2020

19 Our World in Data, 2020, online: https://ourworldindata.org/co2/country/philippines?country=~PHL, accessed 26/09/2020

20 The Restart Project, 2020, Mobiles: the global carbon footprint, online: https://therestartproject.org/the-global-footprint-of-mobiles/

21 Mudd, G. 2008. "Sustainability reporting and water resources." Mine Water Environment. 27:136-144. DOI 10.1007/s10230-008-0037-5.

22 Greenpeace, 2017, Guide to Greener Electronics, online: https://www.greenpeace.org/usa/reports/greener-electronics-2017/, accessed 12/10/2020

23 European Commission, 2020, Critical Raw Materials, online: https://ec.europa.eu/growth/sectors/raw-materials/specific-interest/critical_en accessed 07/10/2020

24 Harvard Business Review, 2017, Supply Chain: 80% of Companies Don't Know If Their Products Contain Conflict Minerals, online: https://hbr.org/2017/01/80-of-companies-dont-know-if-their-products-contain-conflict-minerals, accessed 07/10/2020

Whilst efforts are ongoing to improve supply chain transparency by ensuring proof of origin, the complexity of global supply chains makes it difficult for companies to say with confidence that their products are conflict-free.[25]

As with their renewable energy commitments, Apple is also acting on sourcing conflict free minerals; Google, HP and Microsoft are also making progress but still have some way to go. Fairphone is a company that uses Fairtrade Certified Gold in all their devices, as well as working with initiatives to source conflict-free tin, tungsten and tantalum.

CHALLENGES WITHIN THE DIGITAL INDUSTRY

Improving the environmental credentials of digital technology presents a number of challenges.

Design challenges:

- **Complexity** - with little standardisation between different device models, repairing or replacing individual components can be difficult to impossible.
- **Built in obsolescence** - devices are designed purposefully to decline in functionality over short time scales to encourage more consumer purchases.
- **Expense of repairs** - it can be cheaper to buy a new product rather than repair the current one.

Waste management challenges:

- **Recyclability** – the use of rare, difficult to recycle elements means smartphones are often landfilled and create toxic conditions.
- **Legal issues** - the complex range of materials and hazardous substances in electronics means we have specific European and UK laws that govern how we dispose of them (The WEEE Directive- see below).
- **Recovery** – there is a need to develop effective systems to recover products[26] for example, lease/buy back models which encourage the return of devices and more advanced technologies for treatment, extraction and material re-use.

Behaviour challenges:

- **Awareness** of product sustainability and the environmental impacts - the market lacks environmental labelling and information to help consumers make more environmentally conscious choices.
- **Consumption practices** - many people, driven by advertising, culture and fashion, want to have the latest technologies, and will buy new devices before their old ones have reached end-of-life.
- **Repurposing** – there is a tendency for people to hang on to devices they no longer use, possibly due to emotional attachment, data security concerns, or uncertainty around how to dispose of them correctly.

25 Ibid.

26 Weetman, C., 2016, A circular economy handbook for businesses and supply chains: repair, remake, redesign, rethink

DEALING WITH WEEE (WASTE ELECTRICAL AND ELECTRONIC EQUIPMENT)?

In Europe discarded electronic devices present a material loss of 500 million USD annually[27]. Around 75% of our electronic devices can be recycled, however they are often hoarded at the bottom of desk drawers, or disposed of incorrectly. An estimated 2 million tonnes of WEEE items are discarded by homes and businesses in the UK each year, including items such as TVs, IT equipment, toys and medical equipment.

WEEE recycling is a specialised type of waste management, due to the wide variety of materials and hazardous substances commonly contained in products, including arsenic, lead, mercury and fire retardants which can pose both environmental and health risks.[28] Electronic waste is particularly problematic when it is illegally exported to the global south, where people dismantling electronics for recycling can be exposed to hazardous chemicals without appropriate protective gear, and recycling facilities can contaminate local soil or water.

WEEE regulations (2013) cover most items that have a plug or need a battery. They are in place to reduce the amount of WEEE being incinerated or sent to landfill. Read more about UK Government regulations on waste electrical and electronic equipment (WEEE).

27 Ellen MacArthur Foundation, 2020, InDepth-Mobile Phones, online: https://www.ellenmacarthurfoundation.org/news/in-depth-mobile-phones, accessed 07/10/2020

28 HSE, 2020, Waste and Electrical Equipment, online: https://www.hse.gov.uk/waste/waste-electrical.htm, accessed 07/10/2020

Communication networks and data centres

A vast network of infrastructure such as cables, communication towers, data centres and servers are required to fuel the world-wide web. Every piece of data stored in the cloud, every email we send, and every website we visit requires energy to power them. That supporting physical infrastructure is powered continuously, even though the impact is rarely tangible.

Carbon emissions from internet usage is also based on the energy mix of the country the data centre is located. Energy mix refers to how the energy consumption in a given region breaks down by primary energy source (e.g. oil, natural gas, coal, nuclear, wind, solar, geothermal).

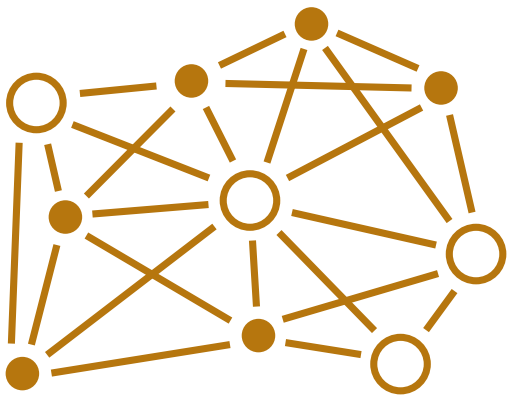
The largest data centres in the world are located in Northern Virginia, USA, where a rapidly expanding city of data centres called "Data Centre Alley" runs 24 hours a day, in a state where the energy mix is dominated by fossil fuels.

Despite many tech companies making renewable energy commitments, only a fraction of data centre energy capacity is powered by on-site renewable projects (with the exception of Apple)[29]. In recent years, data centres and network operators have begun to make Power Purchase Agreements with renewable energy companies so that new renewable capacity is added to the grid to match their energy demand. As large amounts of energy are needed for cooling data centres, strategies such as locating data centres in climatically cooler countries or even under water - something which Microsoft have successfully trialled - may become important measures in the future.

Despite a growing interest and commitments to sustainability, the sector still has a long way to go with some companies meeting their objectives through offsetting - a far less effective contribution to reaching our global decarbonisation goals.

Example tech company commitments:

- Microsoft has committed to reach net zero carbon by 2030 and offset the damage caused by their greenhouse gas emissions since their beginning in 1975.
- Orange made a commitment in 2015 to reduce carbon emissions by 50% for each customer-usage between 2006 and 2020. In September 2020, they launched a Sustainability Bond of 500 million euros, with 60% of that fund targeted at energy efficiency and circular economy projects.



29 Greenpeace, 2019, Clicking Green Virginia, The Dirty Energy Powering Data Centre Alley, online: https://www.greenpeace.org/usa/reports/click-clean-virginia/#executive-summary, accessed 07/10/2020

RECOMMENDATIONS

Despite the complexities, there are plenty of opportunities to understand and reduce the impacts of digital devices.

1. ONLINE PROCUREMENT

- **Move to the cloud** - moving from enterprise-based data servers to the cloud is likely to dramatically cut emissions. According to Microsoft, the cloud delivers 72-93% carbon savings in comparison to conventional computing.[30] This is because centralised data servers tend to be more efficient and it is easier to choose a cloud provider using renewable energy sources. Understand the carbon impacts of the cloud and how to make an informed procurement decision by reading this guide by Tech UK.
- **Find a green host** for your webpage, art or applications (apps) through the Green Hosting Directory.
- **Switch to web hosting** - switch to web hosting and cloud services which are renewably powered, and service providers which are transparent and accountable on their energy sources, greenhouse gas emissions and targets. Opt for a provider that has committed to Science Based Targets, are a member of RE100, or have a clear renewable energy strategy. It is important to understand company renewable energy claims, for example, whether the energy is generated on site, is adding capacity to the grid though a Power Purchase Agreement (PPA) or whether it has been achieved by less effective means such as offsets. Greenpeace's Company Scorecards for digital services describes which companies and apps are living up to their green claims and a paper by the Coed Ethics Community analyses the pros and cons of the top six providers.

30 Microsoft, 2018, The Carbon Benefits of Cloud Computing: a study of the Microsoft Cloud, online: www.microsoft.com/enus/download/confirmation.aspx?id=56950, accessed 07/10/2020

2. THINK CIRCULAR: PROCUREMENT AND DEVICE USE

Thinking carefully about which devices to purchase can have a big impact on a digital footprint. The best way to make informed choices and reduce impact is through considering sustainability at each stage of the lifecycle, from sourcing the materials, manufacture, transport and thinking ahead to what options there are for reuse, remanufacture and recycling.

Follow these principles:

- **Avoid** - use devices for longer, pass it on or get it fixed before buying a new one.
- **Avoid** - consider buying a refurbished device. They can work just as well, are often cheaper and come with a warrantee. This will avoid the need to mine, transport and manufacture new devices, saving resources and energy.
- **Research** - before replacing or purchasing, find out if the company has a circular economy strategy. Fairphone for example, is built with a modular design, so component parts can be easily replaced, as well as using recycled plastics and Fairtrade metals. Some companies also provide options to trade in old for new devices.
- **Research** - the Enough Project conducts research in conflict zones, engages governments and the private sector on policy solutions, mobilizes public campaigns on human rights and breaks the links between war and illicit profit. Their 2017 report ranks 20 of the largest electronics and jewellery companies on their use and policies relating to conflict minerals.
- **Recycle** - if it can't be fixed and needs to be recycled, then the UK campaign Recycle Your Electricals gives information on how and where devices can be recycled.
- **Recycle** - consider recycling services such as Mazuma Mobile, an online phone reuse and recycling service which gives same day cash payments for mobile phones, where the handsets are refurbished and sold on. Other similar initiatives include O2 Recycle, Apple Recycling Programme or community initiatives and social enterprises such as The Restart Project or Repair Cafe which involve teaching people to fix and upcycle devices.
- **Don't hoard** - many devices sit around in boxes or drawers, never getting recycled so the components go to waste. Hidden in our homes are 370,000 tonnes of cables! Take inspiration from Cable Amnesty, a partnership between Colchester Borough Council and Colchester Arts Centre who have been on a mission to purge and recycle cables.

DEVICE USE

The type and use of a device both have a big impact on the overall digital footprint. Improve the carbon footprint by following these principles:

- **Go small** - generally speaking, the bigger a device, the more energy it consumes, so joining an online meeting or watching a video from a phone is more efficient generally than on a TV or laptop monitor.[31]
- **Connect** - when possible, use devices on Wi-Fi rather than roaming. 4G consumes around four times as much electricity as Wi-Fi.
- **Streaming** - streaming isn't as power hungry as some sources suggest.[32] Driving an electric car for about 0.6km is equal to the electricity used when streaming a two hour video to a laptop (network and data centres included).[33] However, video streaming is growing in popularity, accounting for 63% of global internet traffic demand in 2015[34] so consider not watching in HD to reduce streaming impact.

3. DEVELOP UNDERSTANDING, PLAN THE APPROACH AND MEASURE THE IMPACT

- **Build more understanding** of the issues by reading and speaking to suppliers and service providers.
- **Start by mapping** where the digital impacts are occurring. Consider: are you looking to understand the footprint of one digital project or to reduce the digital footprint relating to your daily activities, or perhaps create a procurement/circular strategy for digital devices?
- **Look to see what options are available** to measure digital impacts. Erjjio provide free website health checks and the Green Web Foundation app checks the credentials of host providers showing whether a website is hosted "green or grey". Other tools such as Wholegrain Digital's calculator measures a website's carbon footprint and Ecometer allows its users to design and build more sustainable web services.

31 Carbon Brief, 2020, Factcheck: What is the Carbon Footprint of Streaming a video on Netflix, online: https://www.carbonbrief.org/factcheck-what-is-the-carbon-footprint-of-streaming-video-on-netflix, accessed 07/10/2020

32 https://www.carbonbrief.org/factcheck-what-is-the-carbon-footprint-of-streaming-video-on-netflix

33 Ericsson, 2020, ICT and the Climate, online: https://www.ericsson.com/en/reports-and-papers/industrylab/reports/a-quick-guide-to-your-digital-carbon-footprint, accessed 07/10/2020

34 Greenpeace, 2017, Click Green Report, online: http://www.clickclean.org/uk/en/ accessed 07/10/2020

4. ADVOCATE FOR CHANGE

- **Inspire** - use digital art to engage audiences in environmental and sustainability issues - and remember to share the practical actions taken to reduce the digital impacts. Exit Productions 'Eco-Chambers' used online theatre to engage their audiences in debating what a sustainable, just society future should look like. Apocalypse Reading Rooms is an online world of 'talking stories in the face of environmental and social collapse, a gathering of all the books we might need to change the end of the world.'
- **Ask** – speak to technical and digital providers for their environmental and energy reports and what they are doing to address their impacts. Get involved with existing campaigns such as Greenpeace's Tell Netflix to Go Green campaign.
- **Encourage** – lead by example and switch to a renewable energy provider such as Good Energy, and encourage home-working colleagues and friends to do the same.
- **Share with others** what you are doing by signing up to Whole Grain Digital's Sustainable Web Manifesto for a greener internet.

5. DO A DIGITAL SPRING CLEAN

- **Efficiency** - design software, webpages, apps, digital art and audience communications to be efficient, fast and accessible. It is better for audience's attention span and better for reducing environmental impacts too. Techniques to consider include: reducing the amount of code transferred to a users' computer; using static content rather than rebuilding pages; minimising the computation needed to render web pages; and improving audio and video codecs (i.e. a device or computer program which encodes or decodes a digital data stream or signal).[35]
- **Tackle 'digital waste'** - review what is being stored digitally and where. The more stored digitally, the more energy needed to store it. Delete anything no longer in use or needed such as apps, emails and files and unsubscribe from unwanted emails. Then move remaining data to the cloud where possible as cloud data centres tend to be more efficient.
- **Use a green search engine** – such as Ecosia which turns searches into tree planting or Ocean Hero which turns searches into ocean-bound plastic bottle recovery.

35 Ericsson, 2020, The Footprint of Data and Telecoms, online: https://www.ericsson.com/en/reports-and-papers/industrylab/reports/a-quick-guide-to-your-digital-carbon-footprint, accessed 06/10/2020

CASE STUDIES OF GOOD PRACTICE

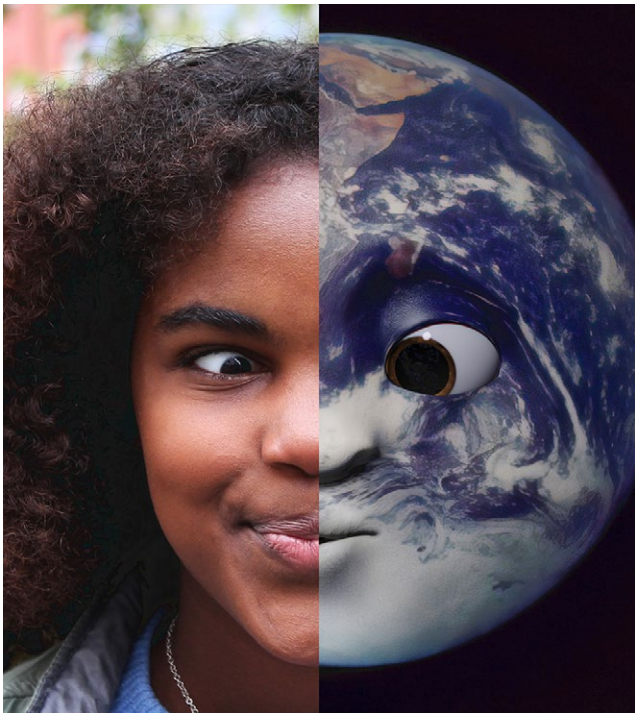
EARTH SPEAKR BY OLAFUR ELIASSON

An international digital artwork project and has worked with Julie's Bicycle to comprehensively scope the measurable aspects of its carbon footprint.

Studio Olafur Eliasson have collaborated with Julie's Bicycle to develop their understanding of the climate impacts of Earth Speakr, an international digital artwork project which invites young people to speak up for the planet using an app and interactive website, augmented reality and audio-visual presentations. The project was commissioned by the Federal Foreign Office to coincide with the German Presidency of the Council of the European Union 2020, supported by the Goethe-Institut.

To understand the climate impact of Earth Speakr, Julie's Bicycle collaborated with experts on digital technology and sustainability from the University of Bristol. Both the physical and digital impacts have been analysed:, the embedded energy of the materials used in the physical installations; the life-cycle impacts of devices used to test and develop the app, assessing user analytics; as well as calculating the energy use associated with the devices and platforms used for online meetings.

In July 2020, Julie's Bicycle calculated that the project's carbon emissions - so far - were 18.84 tonnes CO_2e. To look at the carbon footprint of Earth Speakr, read the sustainability report here.



Olafur Eliasson, Earth Speakr, 2020, for the Federal Foreign Office on the occasion of the German Presidency of the Council of the European Union 2020

Olafur Eliasson, Earth Speakr
Photo credit: Lars Borges

DIMPACT- INSIGHT TO ACTION ON DIGITAL CARBON IMPACTS

DIMPACT is a 12 month collaborative project between scientists at the University of Bristol and 9 major media companies including the BBC and ITV, to develop a pioneering carbon calculator to help the media industry understand and manage the significant carbon impacts of digital content. The aspiration is to create a calculator that is available to any company offering digital products and services, breaking down carbon impacts at each stage of the complex delivery chain, from the delivery networks through to the end user, to help the industry better manage and understand emissions from digital media. Read more about DIMPACT here.

FAST FAMILIAR AND SMOKING GUN: A ZERO CARBON DIGITAL VENTURE

Smoking Gun is a six day online immersive experience where players scrutinise evidence, follow leads, create theories and ultimately decide whether to blow the whistle on what they found, as they are drawn into a world of politics, corruption and surveillance all via an app and their mobile phones.

The only carbon impact of the project was the battery power within the player's devices. This low impact was achieved through Fast Familiar's purpose built app, ensuring effective and efficient functionality for the game, avoiding the use of the background infrastructures involved in the running of other company's websites or platforms. Modular building means that learnings relating to energy efficiency can be applied to other projects using that module, scaling up savings. Measuring energy consumption from the outset meant they could track how much energy was used for each part of the experience for each user. You can read more about their process in Fast Familiar's blog.

Fast Familiar

Fast Familiar

WOJTEK'S CARBON NEUTRAL ALBUM: ATMOSPHERE

Wojtek's new album, Atmosphere, is inspired by the climate crisis and serves as a reminder of the importance of our planet and that everyone, including a debut artist, can make a difference.

Atmosphere was recorded and produced in a carbon neutral way - working with a studio powered by renewable energy and calculating the impacts of all stages (from recording, to mixing and mastering) using a smart meter. The promotional film was made using repurposed video footage. Wojtek worked with a climate and energy expert to record and understand the album's main impacts, offsetting any that couldn't be mitigated through good practice. Wojtek's website also shares the data and practices in order to raise awareness and inspire change - read more here.

A BOUT JULIE'S BICYCLE

The creative community is uniquely placed to respond to the climate and nature crisis. Founded in 2007 by the UK music industry, Julie's Bicycle mobilises direct action across the arts and culture, harnessing the creative sector's power to communicate the reality of the climate crisis, advocate for science based solutions and take bold practical action. Julie's Bicycle's freely-available resources are the most comprehensive library of good environmental practice for culture anywhere in the world.

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