Ökologisches Wirtschaften

01
2021
36. Jahrgang

www.ökologisches-wirtschaften.de
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Online-Ausgabe

Digitalisation and Sustainability

Future technology between resource consumption and opportunities for socio-ecological transformation

i|ö|w INSTITUT FÜR ÖKOLOGISCHE WIRTSCHAFTSFORSCHUNG

VÖW

oekom verlag

CONTENTS O1.2021

IMPRESSUM

*Ökologisches*Wirtschaften *Online-Ausgabe* O1.2021, 36. Jahrgang | www.ökologisches-wirtschaften.de

HERAUSGEBER
Institut für ökologische Wirtschaftsforschung (IÖW) gGmbH,
Vereinigung für ökologische Wirtschaftsforschung (VÖW) e. V. |
Potsdamer Straße 105 | D-10785 Berlin | Tel.: +49-30-884594-0 |
Fax: +49-30-8825439 | E-Mail: kommunikation@ioew.de

REDAKTION
Redaktionsleitung: *Christopher Garthe* (verantwortlich)
Redaktionsassistenz: *Clara Heinrich*
Tel.: +49-30-884594-0 | E-Mail: redaktion@ioew.de

Schwerpunkt: *Tilman Santarius, Maike Gossen, and Friederike Rohde*
(Kontakt über die Red.)

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Editorial

An Ecological Economics Perspective on Digitalisation

By Tilman Santarius, Maike Gossen and Friederike Rohde

The various economic and social implications of "digitalisation" have been discussed in many scientific disciplines and regarding manifold aspects. For instance, early analyses on the digital economy began with Tapscott (1994) and Rochet and Tirole (2003), while publications on digital capitalism date from Schiller (1999) to Staab (2019).

Yet, ecological economy research has only marginally touched upon the issue of digitalisation so far. Despite a surge in publications regarding *Green IT* already in the 2000s and attempts to research *ICT for Sustainability* from a comprehensive and interdisciplinary perspective more recently, a particular focus on challenges related to governing economic activities linked to digitalisation in a way that these promote sustainability, is still emerging.

Increased digitalisation

This special issue wants to contribute to this endeavor. The articles combined in this volume all comprise interdisciplinary approaches that address the overarching questions that are key to ecological economics: How is the interdependence and coevolution of human economies and natural ecosystems affected by increased digitalisation? How can comprehensive governance arrangements and especially policies shape digitalisation in a sustainable way?

The publication appears timely, because the series of "Corona Shutdowns" in 2020 and 2021 have provided prime examples for this: As remote working from home, video conferencing, digital meetings and e-learning have greatly advanced due to politically imposed measures for social distancing, this has – at least intermittently – significantly reduced energy and resource consumption as well as greenhouse gas emissions from manufacturing, consumption and particularly, the transport sector. While it can be doubted whether such developments will last after the COVID-19-virus will be banned, the example highlights that the question whether digitalisation serves as a leverage or rather as an impediment to a sustainable economic transformation is of high relevance to ecological economy research.

Bits & Bäume

The articles in this special issue ground in several years of public and science-policy debates in Germany. The research group *Digitalization and Sustainability* [1], which jointly conceptualized this journal issue, prepared the ground with some early events and publications, including the book *Smart Green World* (Lange/Santarius 2020). This significantly raised attention and fostered public debate on the issue, which achieved a first climax with the large networking conference *Bits & Bäume*.

The conference brought together close to 2.000 civil society and scientific actors from the tech and "hacker" communities on the one hand, and the environmental and sustainability communities on the other hand. The research group *Digitalization and Sustainability* continued this fruitful interdisciplinary networking by way of a public event series, the *Forum Bits & Bäume*, throughout 2019 and 2021. The articles in this volume directly address the five topics of this event series and hence, provide insights not only from up-to-date research, but also incorporate ideas and feedback from transdisciplinary actors from policy and civil society which participated in the events.

Annotation

[1] The research group was established in 2016 as a cooperation project between the Institute of Ecological Economy Research (IÖW) and the Technical University Berlin.

References

Tapscott, D. (1994): The Digital Economy. Promise and Peril in The Age of Networked Intelligence. New York, McGraw-Hill.
Rochet, J.-C./Tirole, J. (2003): Platform Competition in Two-Sided Markets. Journal of the European Economic Association 1/4: 990–1029.
Schiller, D. (1999): Digital Capitalism. Networking the Global Market System. Cambridge, The MIT Press.
Staab, P. (2019): Digitaler Kapitalismus. Markt und Herrschaft in der Ökonomie der Unknappheit. Frankfurt, Suhrkamp.
Lange, S./Santarius, T. (2020): Smart Green World. Making Digitalization Work for Sustainability. Abbington, Routledge.

AUTHORS + CONTACT

Tilman Santarius is Professor of Social-Ecological Transformation and Sustainable Digitalisation at the Technical University of Berlin and the Einstein Center Digital Futures.

Technical University of Berlin, Marchstraße 23, 10587 Berlin. E-mail: santarius@tu-berlin.de, Tel.: +49 30 31478838

Maike Gossen and ***Friederike Rohde*** are researchers at the IÖW.

Institut für ökologische Wirtschaftsforschung (IÖW), Potsdamer Str. 105, 10785 Berlin. E-mail: maike.gossen@ioew.de, friederike.rohde@ioew.de, Tel.: +49 30 8845940

*Ökologisches*Wirtschaften *Online-Ausgabe* O1.2021 (36) | DOI 10.14512/OEWO36013

A Marriage Story of Digitalisation and Sustainability?

Can digitalisation be part of the solution to pressing sustainability challenges? Or are current developments going to impede a socio-ecological transformation? The answer is not black and white; it is complex and cross-cutting. We analyse key problems and give an outlook on possible solutions.

By Maike Gossen, Friederike Rohde and Tilman Santarius

The *United Nations Sustainable Development Goals* (SDG) provide a guiding framework for worldwide policies that ensure a good life for present and future generations. If the SDG are to be met, resource consumption, greenhouse gas emissions, poverty and inequality have to be reduced as far as possible, while education, welfare, climate protection, and biodiversity should be promoted to expand and flourish in future years. Digitalisation, here understood as the permeation of various information and communications technology (ICT) devices and applications (hard- and software) into diverse areas of everyday life, society, and economy, may have significant implications on how the SDG can be achieved.

On the positive side, digital tools and applications may serve as levers and can trigger dynamic sustainability transformations in various sectors. For instance, several reports outline the potentials of digitalisation to increase energy efficiency, avoid resource waste, improve access to sustainable services, and innovate new sustainable practices (e.g. Digital Future Society 2020; GeSI/Accenture 2018; Hilty/Bieser 2017).

On the negative side, digitalisation can aggravate ongoing trends that are polarizing income or education level, and encouraging further economic growth that demands additional energy and resource consumption. This, in turn, could affect certain consumption patterns to become more instead of less energy or resource intensive (e.g. WBGU 2019; Lange/Santarius 2020). And with filter bubbles and echo chambers in digital space buttressing polarized discourses on climate change (Williams et al. 2015), successfully arguing sustainability cases is likely to become increasingly difficult. These examples suggest what has been found by more solid studies (e.g. Hilty/Aebischer 2015; Santarius et al. 2020): It is hard to draw an overall conclusion on how digitalisation impacts sustainability. Instead, politics, companies, and individuals must actively shape societal digitalisation processes to maximize their potentials for sustainability. Opportunities, risks and options for policies and actions need to be analysed in more detail.

This journal volume contributes to the endeavour to dive deeper into certain topics and to explore further the nexus of digitalisation and sustainability. In the following, we present the problems and challenges associated with digitalisation for sustainable development in infrastructure and services, hardware and software, energy systems and Artificial Intelligence (AI). Noticeably, the high expectations of digitalisation as a panacea have not yet been fulfilled and they depend heavily on the social, economic and political framework conditions. In particular, the question of what policies for a sustainable digitalisation can look like in distinctive fields of action is examined in the articles of this journal volume.

Digital services and infrastructures

Many of the digital services on the internet today have the character of public goods. Search engines, Social Media, video portals, and online shops and marketplaces provide key infrastructures and services to society and the economy. They are, by and large, non-excludable and generate common value to society, for instance by providing easy access to information anywhere and anytime. However, particularly the large service providers such as Google, Facebook, or Amazon are run by private actors and hence, follow commercial interests. Their data-based business models use data to create private goods and sell personal information to third parties, particularly to adver-

*Ökologisches*Wirtschaften *Online-Ausgabe* O1.2021 (36) | DOI 10.14512/OEWO36014

tising and profiling companies. The use of machine learning and large data sets (Big Data) further perfects such procedures. These uses generate challenges regarding privacy, data protection, and data tracking.

Another problem is the organization of many digital platforms as multi-sided markets that facilitate transactions between different user groups for free. In turn, these digital platforms also make money of data collection and extraction and selling data to third parties such as advertising companies (Srnicek 2017). To intensify data extraction, platforms employ algorithms promoting content that is more likely to trigger user engagement. As a result, information is assessed regarding its utility for the platform, not for the user. A second major problem for platform users relates to platform markets' monopolization tendencies. Today, data, capital and power are increasingly centralized in the hands of a few platform incumbents. This increased market power gives the major platforms a "too big to fail" status, often rendering them additional leverage against social and environmental protection legislation.

"The high expectations of digitalisation as a panacea have not yet been fulfilled and they depend heavily on the social, economic and political framework conditions."

Private actors with commercial interests

Moreover, basic internet infrastructures (data centres and broadband networks) are currently run by private companies. For instance, more than half of the ocean cable data capacities are owned by four content providers (Alphabet, Microsoft, Facebook, Amazon). Further, dependence has grown immensely on cloud platforms that provide the infrastructure to store, analyse, and utilize ever larger parts of companies' and individuals' private data (Staab/Nyckel 2019). That these services are largely controlled by US and Chinese companies is not only alarming from a geopolitical point of view but is also problematic concerning compliance with data protection law; for instance, the European General Data Protection Regulation (GDPR) does not apply abroad and is partly contradictory to foreign legislation, e. g. to the US Cloud Act. Besides, online marketing for commercial purposes is being increasingly used not only on platforms serving digital public goods but throughout the internet. Techniques such as Big Data analytics and the personalization of advertisement make marketing more effective, but also more manipulative. They create unnecessary buying needs and promote unsustainable and excessive consumption.

To summarize, privatization, lack of data protection, online advertising, and digital business models bring challenges for distributive justice, digital self-determination, democratic participation, and ecological sustainability. What policy perspectives and possible actions are there for policy makers, companies and consumers to treat these challenges to nurture rather than contradict global sustainable development? Two articles in this volume deal with these questions. Vivian Frick, Maike Gossen, Jonas Pentzien, Dominik Piétron und Rena Tangens outline how the state could build a sovereign digital infrastructure and counter the centralization tendencies of the platform economy. The authors make suggestions for protecting informational self-determination and civil and consumer rights, for example, by continuing to develop EU regulations such as the GDPR and ePrivacy. The second article, by Harriet Kingaby, focuses on digital advertising and its role in shaping the internet as a commercial space and as a space in which misinformation and hate speech can flourish. She deals with what Artificial Intelligence and algorithmic decision-making do for the pervasion of digital advertising and the manipulation of users through digital advertising. Her problem analysis leads to proposing policy interventions known from offline spaces to reduce overconsumption, disinformation, and hate speech on the internet.

Hardware and software are interdependent

The production, use, and disposal of ICT devices (hardware) as well as the design and use of software and the associated data traffic have ecological and social impacts. Digitalisation's material and immaterial basis must, therefore, be thought of more closely together. Design criteria such as longevity, reparability, and frugal use of resources play a decisive role in the endeavour to make producing and using hardware more sustainable. Open standards and licenses can establish important foundations for more sustainable software and hardware.

A large part of the environmental impact of ICT hardware occurs in the production phase. Therefore, the continued use of existing hardware is preferable to the purchase of new devices. A device's lifetime can be prolonged, for example, by modular design and options for repairability. However, without suitable software, a hardware's life span is often limited. For example, current operating systems are geared to current hardware configurations and can no longer be used securely once the manufacturer stops supporting them. A newly released operating system, on the other hand, may not be able to run on an older device. A lack of interoperability of software and (older) hardware in combination with the early end of software support means that still functional hardware is increasingly replaced before the end of the product life cycle (Manhart et al. 2016). Software, too, can often not be used in the long term as a result of an artificially enforced reduction in the life cycle of ICT systems through proprietary licenses and vendor lock-in.

Even though devices and applications are becoming relatively more efficient, the absolute consumption of energy and resources is rising due to the increasing size and higher performance and screen resolution of consumer electronics devices (Prakash et al. 2017). Any declining energy consumption on the part of end users is being far more than neutralized by higher energy intensities in hardware production and by an increasing demand for computational capacities and digital services in virtual clouds. To curb these countervailing effects, efficiency improvements must be flanked by strategies that improve hardware consistency so as to ensure compatibility with natural cycles, use fewer toxic materials, and increase the share of renewable resources in energy supply. At the same time, the countervailing effects can be treated by measures targeting more sufficiency-oriented use of hard- and software, e. g., using devices longer, or using less data-intensive services. The environmental impact of software results from the use of hardware and transmission processes (computing power, memory, networks) during its development, use, and deinstallation. Although the share of software-related energy consumption in the total energy consumption of ICT has not yet been reliably quantified, studies have shown that different software products that fulfil the same functional requirements can differ significantly in their power consumption (Gröger et al. 2018; Naumann et al. 2011).

Another challenge is posed by increasing resource requirements for producing terminal devices, servers, and networks. Digital devices consist of various metals, which are classified as conflict raw materials (INKOTA-netzwerk e. V. 2016) and are mined mainly in countries of the Global South under hazardous working conditions and massive violations of labour laws. In addition, there is considerable environmental pollution through for example contaminated soils, rivers and water reservoirs, deforestation, and air pollution (Pilgrim et al. 2017). Moreover, the product life cycle of many devices often ends with electronic waste when the products are not brought back into production as recycled resources.

On the waste disposal sites in countries of the Global South people live and work under inhumane conditions and health hazards to obtain recyclable raw materials from e-waste (Höfner/Frick 2019). Moreover, these processes lack transparency, as the production and disposal locations and conditions are often not traceable. What is a challenge for hardware, to some extent also applies to software. The production and programming of software is also often characterized by a lack of transparency. Proprietary software development delivers readily compiled and sealed code to users who have no way of checking whether the software is doing what it claims to be doing. Knowledge about the software is kept secret by companies, resulting in dependencies and knowledge monopolies.

These challenges are addressed by two articles in this volume that shed new light on the problems and discuss possible solutions. Johanna Pohl, Anja Höfner, Friederike Rohde, and Erik Albers show that the growing number of digital devices not only entails growing energy and resource demands but can elicit massive human rights violations as well. Therefore, the authors argue, the interdependency of hardware and software has to be considered if sustainability challenges are to be met. Free and open-source software and open and repairable hardware could address many issues deriving from resource depletion and short product-lifetimes. Policy measures that enable and foster transparent production, longevity, and the "right to repair" as well as adjusted public procurement rules should be implemented to ensure sustainable hard- and software. Maximilian Voigt points out that the potentials of open hard- and software can only be realized if people's competences move beyond simply using digital technologies. Open education and collective reconfigurations of digital technologies should be a core focus in education. Makerspaces (open working and learning spaces) that foster knowledge about technical functions and promote self-determined use of technology can serve as places for new ideas and empowerment and thus contribute to digital literacy and sustainable practices of technology use.

Digitalisation and transforming the energy system

Renewable energies currently account for 42.1% of gross electricity consumption in the German electricity mix (UBA 2020). This significant share of renewables already poses challenges for grid operation at both distribution and transmission levels. Enabling a supply of 100% renewable electricity and, eventually, 100% renewable total energy consumption requires the intelligent control of load flows in the energy system. Digitalisation is an important prerequisite for a successful energy turnaround (dena 2016). Automatic control and networking possibilities are expanding the role of prosumers in the energy market. As digitalisation continues, small-scale players at the household level can be networked to create new organizational forms that fundamentally change existing value chains and even market structures.

In addition, intelligently connected energy systems are becoming increasingly important: So-called smart grids are expected to reduce energy system complexity and ensure power grid stability. For example, digital power transformers allow unexpected situations in the network to be recognized and controlled from the network control centre (Jendrischik 2020). However, a number of legal and technical questions are still open with regard to smart grids. For example, there are rules that allow network operators to switch off individual producers or consumers in the event of network bottlenecks in order to avoid a power outage. Yet, it is still unclear according to which criteria the regulation functions in a complex context of a multitude of flexibilities. What are needed are clear definitions of economic and technical criteria so as to enable algorithms and digital devices to provide support. Although grid level in the current energy system have been distributed between distribution system operators and transmission system operators, these responsibilities can change if complex interactions between grid levels occur. It is also unclear who owns or should have access to the large amount of data collected for operators. And this excessive data leads to a further ecological challenge since the high-resolution data from the grid causes additional emissions with each transfer.

A complete switch to renewable energies in industrial countries (such as Germany) is only realistic if the absolute energy demand is significantly reduced – roughly by 50% by 2050 (Prognos et al. 2020). It is largely undisputed that the digitalisation of the energy system will play an important role in this reduction. But does it make sense to completely digitize the energy system? Or would the energy and resources required for such a full-fledged digitalisation countervail any savings and efficiency gains? Particularly in the electricity sector, digitalisation processes aim to achieve positive environmental effects not only through direct savings by consumers but also at the systemic level of network control. Yet the effects on the system as a whole are currently not quantifiable. For some applications, it is unclear whether the high negative environmental impacts caused by producing and operating sensor technology, measuring devices, and ICT, and by transferring and using data, can be offset by the positive effects. Hence the pivotal question arises: How much digitalisation of the energy system is appropriate? Furthermore, the digitalisation of the energy system may increase its vulnerability. Against the background of far-reaching, potentially catastrophic and thus economically and socially hardly tolerable consequences such as power outages or the hacking of energy systems, it is key to design power supply systems as resilient as possible.

Again, two articles of this volume cover those challenges. Astrid Aretz, Swantje Gährs, Friederike Rohde, and Hendrik Zimmermann provide an overview of current environmental and social challenges regarding the digitalisation of the German energy system and argue for a more differentiated consideration of the relevant issues. A digitalised energy system should be ecological, resilient, inclusive, and open to diverse technologies. These aims should be realized by appropriately regulating market rules and technical standards and by measures to financially support consumers and enhance their relevant knowledge. Only appropriate framework conditions can enable decentralized structures and the coordination between the different actors from the energy system and other sectors (such as mobility). Saving energy with or despite digitalisation is a question that is covered in the article by Irmela Colaço. Current developments impede an ecological supportive use of digital energy technologies, and the repairability and durability requirements in the EU Eco-design Directive do not go far enough. There is a lack of political actions for strengthening prosumers, sharing communities and other forms of decentralized energy transition and digital sufficiency should be developed as a guiding principle for energy system transformation.

"Digitalisation can aggravate trends that are polarizing income or education, and encourage economic growth that demands energy and resource consumption."

Expectations of Artificial Intelligence ...

AI is the current "buzzword" when it comes to increasing efficiencies through digital applications. Additional positive contributions from AI-based systems are expected from networked energy and transport infrastructures, highly precise earth observation for climate change, new weather warning and forecasting systems, or improved solutions for waste and resource management, to mention but a few. And in fact, numerous projects for monitoring, modelling and managing ecosystems and biodiversity, for example in forestry, agriculture, and fisheries already use AI.

When discussing the sustainability contributions of AI applications, however, the energy and resource intensities of AI-based computational processes need to be taken into account. AI applications are often more energy intensive than conventional mathematical methods (e. g. regressions), even when the increasing energy efficiency of data centres is taken into account. For instance, deep learning algorithms, which analyse large amounts of data in artificial neural networks in order to recognize patterns and generate forecasts, consume particularly large amounts of energy. Moreover, AI applications indirectly affect resource consumption since they use an increasing share of hardware in data centres and terminal devices. Producing sensors and circuit boards involves metals such as tin, silver, platinum, or tungsten associated with ecological and social problems, especially in the Global South (see above).

... exceed the actual environmental protection potential

At the same time, positive environmental impacts of AI often depend on whether and in what form social transformation processes take place in parallel. For example, an AI-based optimization of the energy system provides limited value to reaching sustainability goals if renewable energies are not expanded. This expansion is, in turn, linked to a variety of societal factors that cannot be managed by technical means alone; various impediments have to be overcome, such as public scepticism about wind power plants or the dominance of lobby power by large conventional electricity providers. Hence the question is key: In which socio-economic framework conditions are AI-based solutions applied, by which actors and according to which guiding interests? Hence, besides technical opportunities and risks, the political economy of AI needs to be considered.

In the first corresponding article, Friederike Rohde, Maike Gossen, Tilman Santarius and Josephin Wagner reveal the diverse ecological, social, and economic challenges related to applying AI-based systems. They identify attempts to address those issues through regulation, rules, and guidelines for responsible AI. However, in current or prospected regulations, ecological impacts of those deep learning algorithms are not considered at all. Green cloud computing with energy efficiency standards for data centres could be one possibility to address the negative ecological impacts. Indeed, most effective would be measures such as taxes on carbon emissions, resources, and appropriate public procurement guidelines. And above that, AI-based applications have to be used with caution and in areas where it really makes sense, as Sarah-Indra Jungblut argues. Her article focuses on AI-based applications and their contribution to environmental or climate protection. These applications can be used to reduce energy consumption or food waste, or for predictive maintenance. However, regarding their ecological impacts and possible ethical problems, those technologies must be implemented with due precaution and in a reasonable manner to avoid overkill.

The last two articles of this volume deal with the overarching question of how digitalisation can contribute to the socio-ecological transformation, and in this sense take a bird's eye view. Josephin Wagner and Steffen Lange discuss whether digitalisation can support growth independence and sufficiency-oriented lifestyles. Sarah Ganter provides an overview of how the discourse on a digital tax for financing the socio-ecological transformation has developed in recent years. She explains the weaknesses in the taxation of multinational corporations in the digital economy and attempts by the OECD to reform the international tax system.

References

dena (2016): Grundsatzpapier der Plattform Digitale Energiewelt. www.dena.de/fileadmin/dena/Dokumente/Presse___Medien/2016-06-06_Grundsatzpapier_der_Plattform_Digitale_Energiewelt.pdf

Digital Future Society (2020): Risks and opportunities of emerging tech in the climate decade. https://digitalfuturesociety.com/report/risks-and-opportunities-of-emerging-tech-in-the-climate-decade/

GeSI/Accenture (2018): Enabling the Global Goals: Evidence of digital solutions' impact on achieving the Sustainable Development Goals (SDGs). https://etno.eu/datas/press_corner/press-releases/2018/GeSI_AS_2018_Digital_Enabling_the_Global-Goals.pdf

Gröger, J./Köhler, A./Naumann, S./Filler, A./Guldner, A./Kern, E./Hilty, L./Maksimov, Y. (2018): Entwicklung und Anwendung von Bewertungsgrundlagen für ressourceneffiziente Software unter Berücksichtigung bestehender Methodik. Abschlussbericht. Dessau-Roßlau, Umweltbundesamt.

Hilty, L. M./Aebischer, B. (eds.) (2015): ICT Innovations for Sustainability. Cham, Springer.

Hilty, L. M./Bieser, J. (2017): Opportunities and Risks of Digitalization for Climate Protection in Switzerland. Zurich, University of Zurich.

Höfner, A./Frick, V. (2019): Was Bits und Bäume verbindet. Digitalisierung nachhaltig gestalten. Dokumentation der Konferenz "Bits & Bäume". München, Oekom.

INKOTA-netzwerk e. V. (2016): INKOTA-Infoblatt 2: Konfliktrohstoffe. https://webshop.inkota.de/produkt/download-inkota-infoblaetter/inkota-infoblatt-2-konfliktrohstoffe

Jendrischik, M. (2020): Digitale Trafos: So macht E.ON aus Stromnetz steuerbares Smart Grid. www.cleanthinking.de/digitale-trafos-eon-smart-grid/

Lange, S./Santarius, T. (2020): Smart Green World? Making Digitalization Work for Sustainability. München, Oekom.

Manhart, A./Blepp, M./Fischer, C./Graulich, K./Prakash, S./Priess, R./Schleicher, T./Tür, M. (2016): Resource Efficiency in the ICT Sector. Final Report. Hamburg, Greenpeace.

Naumann, S./Dick, M./Kern, E./Johann, T. (2011): The greensoft model: A reference model for green and sustainable software and its engineering. In: Sustainable Computing: Informatics and Systems 1/4: 294–304.

Pilgrim, H./Groneweg, M./Reckordt, M. (2017): Ressourcenfluch 4.0: Die sozialen und ökologischen Auswirkungen von Industrie 4.0 auf den Rohstoffsektor. Berlin, PowerShift.

Prakash, S./Gröger, J./Hipp, T./Rodem, I./Borgstedt, S./Schlösser, A./Stobbe, L./Proske, M./Riedel, H./Chancerel, P., et al. (2017): Ermittlung und Erschließung des Energie- und Ressourceneffizienzpotenzials von Geräten der Unterhaltungselektronik. Dessau-Roßlau, Umweltbundesamt.

Prognos/Öko-Institut/Wuppertal-Institut (2020): Klimaneutrales Deutschland. Berlin, Agora Verkehrswende und Stiftung Klimaneutralität.

Santarius, T./Pohl, P./Lange, S. (2020): Digitalization and the Decoupling Debate: Can ICT Help to Reduce Environmental Impacts While the Economy Keeps Growing? In: Sustainability 12/18: 7496.

Srnicek, N. (2017): Platform Capitalism. Cambridge, Polity.

Staab, P./Nyckel, E. (2019): Digitaler Kapitalismus und Unternehmenssoftware – Herrschaft der Betriebssysteme? In: WISO Direkt 08/2019.

Umweltbundesamt (2020): Erneuerbare Energien in Zahlen. www.umweltbundesamt.de/themen/klima-energie/erneuerbare-energien/erneuerbare-energien-in-zahlen#uberblic

WBGU (2019): Unsere gemeinsame digitale Zukunft. Berlin, WBGU.

Williams, H. T. P./McMurray, J. R./Kurz, T./Lambert, F. H. (2015): Network analysis reveals open forums and echo chambers in social media discussions of climate change. In: Global Environmental Change 32: 126–138.

AUTHORS + CONTACT

Maike Gossen and ***Friederike Rohde*** are researchers at the IÖW.

Institut für ökologische Wirtschaftsforschung (IÖW), Potsdamer Str. 105, 10785 Berlin. E-mail: maike.gossen@ioew.de, friederike.rohde@ioew.de, Tel.: +49 30 8845940

Tilman Santarius is Professor of Social-Ecological Transformation and Sustainable Digitalization at the Technical University of Berlin and the Einstein Center Digital Futures.

Technical University of Berlin, Marchstraße 23, 10587 Berlin. E-mail: santarius@tu-berlin.de, Tel.: +49 30 31478838

Decommercialising the internet

Policies to Transform the Internet from Marketplace to Public Space

The internet has become characterized by deficiencies in data protection, distributive justice and sustainability. They result from commercialization, privatization and the dominance of a few tech companies. We present policy measures to retransform the internet into a public space designed for the common good.

By Vivian Frick, Maike Gossen, Jonas Pentzien, Dominik Piétron and Rena Tangens

The internet was initially developed as a tool primarily for the military and science to communicate and transfer information. In the early 1990s, it was opened to civil society and transformed, mainly through two user groups. First, a civic online community evolved, one in which services and information were – and still are – jointly developed and shared as free and open-source software. Software, data and algorithms are nonrival goods that, albeit with updates, can be used indefinitely without losing their value. Thus, non-commercial and commons-oriented practices, such as Mozilla Firefox or the Linux Kernel, have been able to flourish and achieve global recognition. Second, a commercial interest group quickly emerged to match, if not supersede, those civic interests. In Germany, it was especially the 1998 liberalization of the telecommunication market that led to the internet's infrastructure no longer being maintained by public actors. Also, private companies started to treat the internet as a marketplace for profit. This commercialization created the basis for numerous issues concerning social inequality, democratic principles and environmental degradation (c.f. Kingaby this issue). Dealing with these issues has become urgent as a result of the growing importance placed on technology-driven phenomena such as big data, cloud computing, artificial intelligence and the platform economy. Not just industry but also the state is heavily subsidizing these technological developments. The social and ecological issues arising with these developments, and how these issues could be politically resolved, are addressed in the following sections.

Build a sovereign digital infrastructure

The basic internet infrastructure consists – in our understanding – of data centres, mostly referred to as cloud platforms, and the connection between them via broadband networks. Both are currently run by private companies. Due to this dependency on private business, internet access is unfairly distributed as especially in rural areas, it is not profitable, and expansion is coming to a standstill. To address this particular market failure, the state is called upon to apply regulatory measures to secure a substantial expansion of fibre optic and mobile networks and to provide everyone with non-discriminatory internet access. The expansion by the state is logical since the networks are a public good that can best be operated within the framework of a non-profit, public law institutions – much like roads, water supply and energy networks. To guarantee this security of supply, all legal means must be exhausted in promoting the expansion under state supervision. In addition, government support should be available for organizations that provide free, decentralized internet access as a public good.

Further, developments in cloud computing have led to a growing dependency on cloud platforms. They provide the infrastructure to store, analyse and utilize the increasing bulk of companies' and individuals' private data (Staab/Nyckel 2019). This increasing dependency makes cloud platforms a critical infrastructure on which the data sovereignty of individuals, companies and public actors increasingly rely. In this respect, it is not only a matter of competitive concern that US and Chinese providers (e.g. Amazon, Microsoft, Google, Alibaba) are largely controlling this market. To reduce dependency on quasi-monopolistic cloud providers, German state and industry players initiated the Gaia-X certification project. The initiators claim to create a secure, state-certified network of data centres. However, consumers and workers have hardly benefited so far, as companies are still monetizing personal data without hindrance due to legal loopholes in the General Data Protection Regulation (EU GDPR). To improve the situation for the general public, the Gaia-X project must be brought under democratic control: Trade unions and civil society organizations for data and consumer protection must be involved in supervising the cloud platforms and the enforcement of Gaia-X rules.

A second important part of basic internet infrastructure is search engines, through which web content is mostly accessed. Regarding these, Europe is currently at the mercy of an oligopoly, of which all providers are located outside the EU: Google (USA), Bing (USA), Yandex (Russia) and Baidu (China). These four have each built up their own vast search index – a database in which all findable websites with content and links are

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analysed and systematically stored. Other, new search engines currently have no chance on the market, no matter how good their search algorithms, design or business model are. A single small company cannot match the lead of the "big four" with their databases. Europe should therefore use public funds to build its own search index and make it available to the public. With access to this European search index, European companies could finally set foot in the search engine market, even with a limited budget.

Third, internet browsers, cloud applications and software of all kinds, which increasingly only work with an internet connection, are also part of important digital infrastructures. Here, the state should generally provide financial support for the free and open source (FOSS) movement, which makes software available non-commercially and freely. Open-source software is now built into almost all digital applications and thus also represents a public good that must be protected and promoted. In contrast to proprietary, commercial software, open-source preserves the technological sovereignty of its users, since no vendor lock-in effects can occur. In addition, open code also enables better security auditing of critical software.

Curtail platform-power

Digital platforms not only function as providers of essential digital infrastructures; they also double as business models. This platform-based business model exhibits two functions. First, platforms are multi-sided markets that facilitate transactions between different user groups. In this process, value is extracted by way of commissions or user fees. However, second, platforms collect the data created in those transactions. Extracted user data is subsequently aggregated, evaluated and access to it is sold or leased to third parties, for example, for advertising purposes (Srnicek 2017). To intensify data extraction, platforms employ algorithms that promote content that is more likely to trigger user engagement. As a result, information is assessed regarding its utility for the platform, not for the user. The reason is simple: The longer a user remains on a platform, the more behavioural data and personal information is generated, in turn, increasing the revenue stream. Put simply, platforms are about profit, not people – even though some of them are called "social" media.

A second major problem for platform users relates to platform markets' monopolization tendencies. The more users a platform has, the more attractive it is (the so-called network effect) – for both users and platform owners. Resultingly, the major platform incumbents such as Google, Facebook, Weibo and Amazon have worked intensely in recent years on getting their networks to grow, capturing more and more share of their respective industries in the process. This growth has led to the number of marketplaces, search engines or smartphone operating systems considerably diminishing, leaving only a few global corporations able to provide competitive products (Statista 2019 b). Today, data, capital and power are increasingly centralized in the hands of the platform incumbents, which leads to smaller and non-commercial platform providers being crowded out of their respective industries (Zuboff 2019). This increased market power gives the major platforms a "too big to fail" status, often rendering them additional leverage against social and environmental protection legislation.

Level the playing field for cooperatively-run platforms

Two things are urgently needed to counter this centralization and its adverse effects on platform users: Stronger regulation of the platform incumbents (Morozov/Bria 2018; Srnicek 2017) and direct support for alternative, commons-oriented platforms (Scholz 2016; Schneider 2018). On the regulatory side, the focus needs to be on making competition law fit for the platform economy context. Even though recent revisions on both the German and the European level have taken a relatively progressive approach towards platform markets (for example by defining platform gatekeepers), at least two important tools are still lacking to substantially counter platform-power. First, competition law should take a page from the US-American book and introduce the possibility of breaking up the incumbent tech companies into individual parts. Fines alone will not suffice to level the playing field let alone build a thriving commons-oriented internet (Digitalcourage e.V. 2020). Second, policymakers need to strengthen both interoperability and open data approaches if they want to break up data silos and create a level playing field for new privacy-preserving services (Piétron 2019). With the Digital Services Act and the Digital Markets Acts, the European Commission has recently presented draft regulations for stricter rules for online platforms (European Commission 2020). The legislative initiatives are supposed to regulate personalised advertising, recommendation systems, and rankings, to establish interoperability, and to specify liability rules for illegal content. For the initiatives to become law, they still have to pass through the European Parliament and the European Council. Until then, fierce lobbying attempts by the digital platform concerned are expected (Corporate Europe Observatory 2020).

On the alternative platforms' side, policymakers should strive to implement public platforms. These platforms could be run by either states or municipalities and provide public services in key areas such as mobility, housing, or health. The existence of such public platforms would provide users with a common-goods-oriented alternative to the extractive business models of platform incumbents. The Jelbi mobility platform, established by Berlin's public transport authority, and the Sundhed health platforms, established by the federal government of Denmark, provide examples. For municipalities and state actors to provide public platforms as digital common goods, they need access to the private platforms' data. Politicians should support uniform data-sharing standards and integrate them into all public procurement processes. Further, policymakers could provide support for existing cooperatively-run platforms with a social mission. An exemplary organization is CoopCycle from Paris, a secondary cooperative that provides software for platform-based delivery collectives across Europe. Up & Go from New York City is a cooperatively-run platform for cleaning services that provides a stable income for migrant workers. And Hostsharing from Hamburg is a cooperatively-run web hosting provider with an explicit ecological mission. Yet, because platform cooperatives are often small businesses that are unable to invest heavily in software development, their products tend to be inferior when compared with those of the platform incumbents such as Deliveroo or Helpling (Pentzien 2020 b).

Policymakers could remedy this situation. For instance, funding could be provided that actively supports software development for cooperatively-run platforms. In Germany, current guidelines make this difficult. In fact, start-up-oriented financing instruments such as *INVEST – Venture Capital Grant* or the *High-Tech Start-Up Fund* are currently reserved for companies that pursue a venture capital model. As such, public financing instruments need to be opened up to approaches beyond the shareholder-value model. In addition, public procurement guidelines could be restructured so that platforms with an explicit socio-ecological mission receive preferential treatment in public tenders (Pentzien 2020 a).

Changes in the legal framework are also needed if cooperatively-run platforms are to thrive. For example, while the GDPR is a major achievement from a data protection perspective, it does little to increase competition among platforms (Schechner/Kostov 2019). On the contrary, because the major platform incumbents already possess the resources needed to adequately implement the law's ambitious data protection requirements, current rules tend to benefit the status quo. In addition, existing cooperative statutes make life harder for the alternative platforms. In Germany, for example, it is impossible for individuals to sign for cooperative shares online. To become members, they have to print out a form, sign it manually, and then send it to the cooperative. This legally enforced media discontinuity substantially curtails the ability of German platform cooperatives to build up an international user base (SEND e. V. 2020)

Protect civil and consumer rights

Not only platforms implement a business model that makes money from data; many other allegedly free services also do. For example, free apps share personal information such as geographic location, gender or online activities directly with advertising and profiling companies (Forbrukarrådet 2020). Online media that advertise digitally do not even receive the revenues themselves as they mainly go to digital marketing and advertising companies. Especially for journalism, this leads to an enormous loss of revenue for independent quality media. As a result, quality suffers and those with a particular interest in shaping public opinion increasingly finance content. These services are, therefore, by no means free. Rather, our data represents the currency in which we pay for the use of online services. The digital marketing and advertising industry uses personal data of users to track them over time and on various devices and websites (Kingaby this issue). The use of machine learning and large data sets (big data) further perfect such procedures. In addition, search engines such as Google and commercial portals such as Amazon can easily adapt product presentation, filters or recommendations. The decision architecture of those websites is largely inscrutable for users, and the criteria providers implement in their interface design are generally incomprehensible.

"A political framework is essential to countering the problematic developments and promoting a better internet for all."

We identified three major threats evolving from these unfathomable practices (see Figure 1). First, achieving informational self-determination is almost impossible as citizens can neither fully see what their data is being used for nor protect against access. Second, online marketing for commercial purposes is constantly increasing. It primarily serves to increase sales and profits of the advertising companies. In 2018, more than 240 billion euros were spent on digital marketing worldwide, with search engine, banner and Social Media advertising being the most common (Statista 2019 a). Online marketing itself consumes a considerable amount of energy and resources, unnecessarily burdening the environment and climate (Kingaby this Issue; Pärssinen et al. 2018). In addition, online marketing aims at increased consumption levels. Thus, personalized advertisement has been shown to lead to more purchases than traditional advertising on TV, radio or billboards (Dinner et al. 2014). Instead of catering better to existing consumption needs, online marketing often evokes new consumption desires (Frick et al. 2020). Social Media further fuel this trend since their attention-seeking architecture often promotes consumerism and conspicuous consumption. Social Media are also increasingly used for self-expression and distinction. The platforms' mechanisms ("craving for likes") and algorithms (ranking of posts) further enhance these attention-grabbing dynamics. These influences may well result in excessive consumption, putting further strain on an already depleted ecosystem. Third, a kind of commercial surveillance system is put in

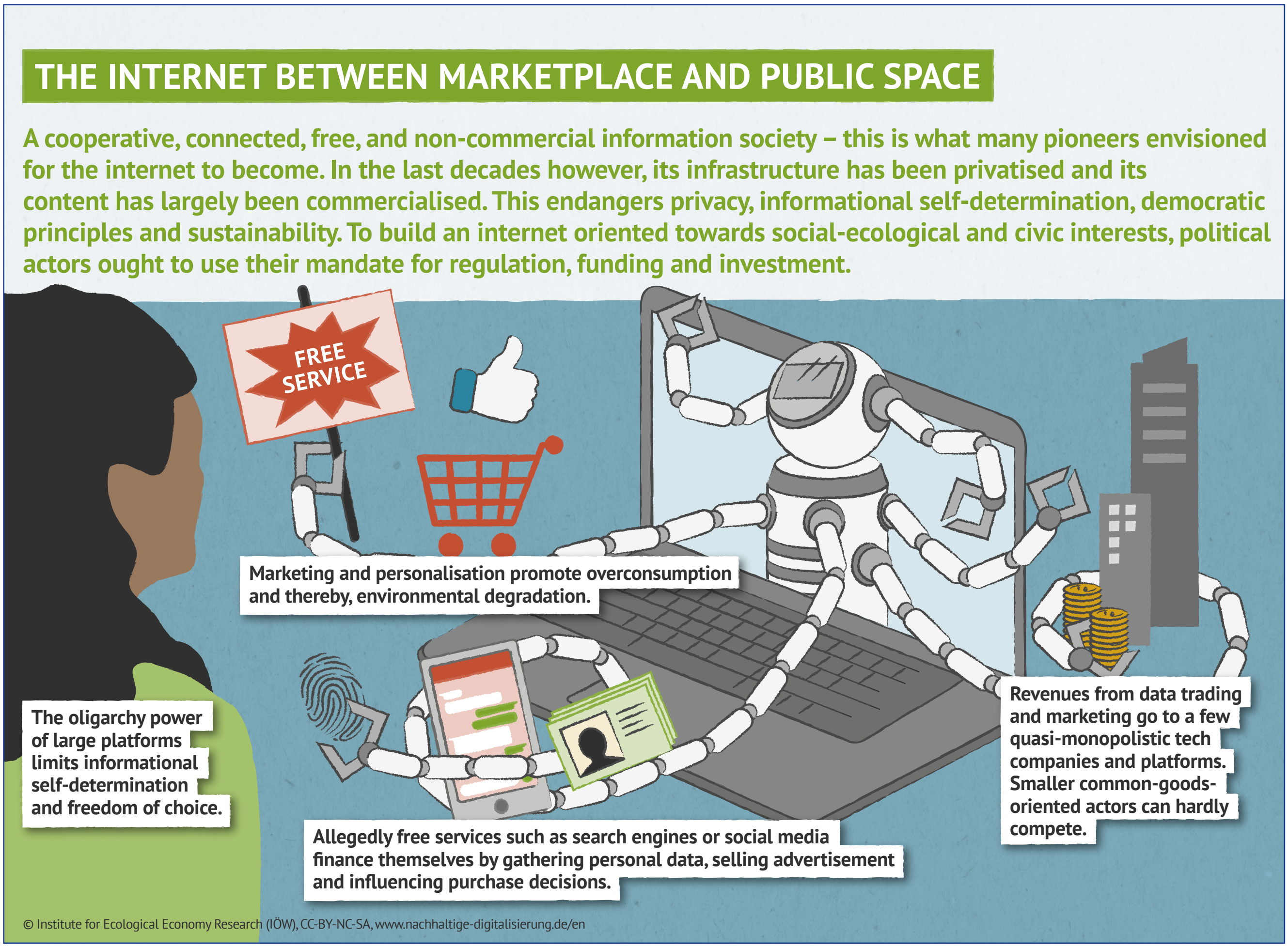

Figure 1: The internet between marketplace and public space

place. Information asymmetries resulting from these practices give the respective companies power advantages and endanger not only individual privacy but also sustainability goals and the democratic political structure (Seemann 2018).

Protecting informational self-determination is an international challenge: All companies that want to do business in Europe and address EU citizens must comply with the GDPR. Yet enforcing it requires many procedures and also fines. Conflicting laws in other countries force companies there to hand over data to their secret services (e.g. in the USA the Cloud Act and the FISA Act). This challenge will be more difficult to resolve. At the very least, digital infrastructures serving as a social utility service, such as search engines, should respect the basic right to informational self-determination. Search engines and commercial platforms have to be forced to make the criteria and priorities of their search and display algorithms visible and thus make financed placement (advertising) identifiable (Kingaby this issue). The European draft legislation Digital Services Act creates new transparency rules for users. Accordingly, platforms that use recommendation algorithms should explain in their terms of use which factors guide the recommendation, and must ensure that users can adjust these parameters, including the option to completely switch off feeds that are individually tailored to them. In addition, online tracking should be subject to approval, and "privacy by default" should be mandatory for websites – and not "privacy by making users read long text and click a lot of buttons and creatively hiding the decline button", as many websites are currently interpreting the GDPR.

The EU regulations GDPR and ePrivacy have taken important first steps in data protection. The ePrivacy regulation intends to prohibit digital groups and advertising companies from evaluating users' digital communications. For 2020, the expansion of the ePrivacy regulation has been announced. It remains to be seen whether it will lead to real improvements in data protection and legal certainty. In any case, network activists are critical of telecommunications companies' attempts to influence the reform of the regulation (Thüer 2018). In addition, the implementation of data protection acts should be monitored more closely at the political level, and any failure to implement them should be sanctioned (Wiebe/Helmschrot 2019). End-to-end encryption and restricting the (meta-)data collection of digital services should be made mandatory (as in the case of Signal or GNU Social). Similarly, legal barriers must be imposed on the currently ubiquitous tracking and centralized accumulation of personal data on the internet.

Enable sustainable business models for digital services

We have all grown accustomed to the convenience of using all kinds of apps, mail services, newspapers, magazines or Social Media without paying. Thus, service providers are often not able to make a profit through their digital service, instead offering their services to advertising companies and thus relying on a data-driven business model. Notwithstanding these models, positive examples can be found that do not make data their source of profit: Search engines such as Duckduckgo or Startpage, as well as platforms and networks such as Mastodon or the Free Software Foundation Europe and apps like Drip, set good examples: they use free and open-source software without tracking, advertising or trading personal data. Non-profit journalism such as Correctiv and The Guardian work with voluntary contributions to find ways for journalism independent of marketing. Improved models of reader financing are being applied, such as joint flat rates for different media or the amalgamation of various players, for example in cooperatives such as RiffReporter. Yet these best practices are a niche phenomenon, with few being able to seriously threaten the dominant commercial platforms and tech companies. In the current incentive system, their business models are just not as profitable as those of the established platforms. Power dynamics could be changed in important ways by levelling the playing field for platform cooperatives and strict data protection. But, for many, questions remain: How could free services be financed if selling data and advertising space is no longer an option? What could an alternative, but also successful, business model look like?

Alternative financing models for digital services must be created. One solution is to question the self-evident free nature of digital services. Examples such as the e-mail provider Posteo show that fair payment for such services can make sense. A user fee can substitute data trading and advertising. Increased payment can also help to ensure that this important work is rewarded instead of being purely voluntary. In addition, new and smaller providers will be more likely to compete with large digital companies and build a more diverse, decentralized and therefore sustainable digital market.

Developing and implementing alternative business models for digital services should be politically promoted or the state itself should provide services oriented towards the common good. For example, online media and journalism can be supported by the state. In countries with smaller markets than those in Germany, subsidising newspapers with public money has, for some time, been common practice. However, models must be found to prevent state influence on content. Independent journalism must be financed independently. This financing may also mean direct (donations, flat rates) or indirect (taxes, fees) financing by readers, listeners, and viewers. One possibility for such financing is micropayment. Micropayment refers to the payment of small amounts and enables digital services to be purchased and used. It is important that this digital payment is fast and user-friendly, does not require excessive energy and resource use (c. f. blockchain technology), prioritises data protection and preserves the users' informational self-determination. The GNU Taler payment system, for example, adheres to these guidelines. For each transaction, the customer can decide what information he/she wants to give to the seller. Transactions can be traced for revenue but not for expenditure, facilitating tax collection and preventing illegal activities such as undeclared work and payment fraud.

"The internet's infrastructure is to be seen as a public good committed not only to the self-interest of corporations but also to the common good of society."

Towards a better internet – A mandate for political action

A political framework is essential to countering the described problematic developments and promoting informational self-determination, diversity, decentralization, openness, and sustainability – in other words, a better internet for all. This corresponds with the proposed "European model" of digitalisation that puts people and the planet before profit (WBGU 2019). Data-intensive commercialization, power concentration and economic power asymmetries need to be replaced by models of fair distribution. This replacement means breaking the oligopolies that are a danger to internet resilience and democratic decision-making and then laying the ground for, or even providing, decentralized, data-secure alternatives. In an overarching approach, political design should aim to make the inherent decision-making architectures of digital spaces transparent and to renegotiate their ownership and creative power democratically. In addition, to secure the internet as a place of freedom, more support should be given to public-interest actors and applications. It tends to be forgotten that digital technologies such as the internet, the smartphone or what nowadays goes by the name of Artificial Intelligence were and are developed not only by the private sector, but to a large part with state funding (Mazzucato 2015). Funding of further developments of these technologies should be tied to public welfare and sustainability criteria. This includes that applications developed with government funding should be available for the public and in line with open data and open-source approaches (c.f. Pohl et al. this issue).

We conclude with an invitation to political actors to recognize the vast implications the internet has on society. Political governance instead of Big Tech is indispensable if the principles of a society oriented towards the common good are also to apply in digital spaces. The internet's infrastructure is to be seen as a public good committed not only to the self-interest of corporations but also to the common good of society.

References

Corporate Europe Observatory (2020): Big Tech brings out the big guns in fight for future of EU tech regulation. https://corporateeurope.org/en/2020/12/big-tech-brings-out-big-guns-fight-future-eu-tech-regulation

Digitalcourage e. V. (2020): Ungezähmte Internetgiganten – GWB-Digitalisierungsgesetz: Tippelschritte mit geringer Wirkung. Für eine digitale Grundversorgung im 21. Jahrhundert! https://digitalcourage.de/sites/default/files/2020-01/Kommentierung_Digitalisierungsgesetz.pdf

Dinner, I. M./Van Heerde, H. J./Neslin, S. A. (2014): Driving Online and Offline Sales: The Cross-Channel Effects of Traditional, Online Display, and Paid Search Advertising. In: Journal of Marketing Research 51/5: 527–45.

European Commission (2020): The Digital Services Act package. https://ec.europa.eu/digital-single-market/en/digital-services-act-package

Forbrukarrådet (2020): Out of Control. How consumers are exploited by the online advertising industry. https://fil.forbrukerradet.no/wp-content/uploads/2020/01/2020-01-14-out-of-control-final-version.pdf

Frick, V./Matthies, E./Thøgersen, J./Santarius, T. (2020): Do online environments promote sufficiency or overconsumption? Online advertisement and social media effects on clothing, digital devices, and air travel consumption. In: Journal of Consumer Behaviour 19/5.

Mazzucato, M. (2015): The Entrepreneurial State – Debunking Public Vs. Private Sector Myths. London, Anthem Press.

Morozov, E./Bria, F. (2018): Rethinking the Smart City. Democratizing Urban Technology. New York City (NY), Rosa-Luxemburg-Foundation.

Pärssinen, M./Kotila, M./Cuevas, R./Phansalkar, A./Manner, J. (2018): Environmental Impact Assessment of Online Advertising. In: Environmental Impact Assessment Review 73: 177–200.

Pentzien, J. (2020 a): Vom Plattform-Kapitalismus zum Plattform-Kooperativismus? Potenziale und Grenzen kooperativer Unternehmungen in der Plattformökonomie. In: Dück, J./Altenried, M./Wallis, M. (eds.): Plattform-Kapitalismus und soziale Reproduktion. Münster, Westfälisches Dampfboot.

Pentzien, J. (2020 b): Political and Legislative Drivers and Obstacles for Platform Cooperativism in the United States, Germany, and France. In: ICDE Research Reports. New York City, Institute for the Cooperative Digital Economy, The New School.

Piétron, D. (2019): Digitale Souveränität durch Interoperabilität – zur Möglichkeit dezentraler sozialer Netzwerke in der Plattformökonomie. In: WISO Direkt 24/2019.

Schechner, S./Kostov, N. (2019): GDPR Has Been a Boon for Google and Facebook. www.wsj.com/articles/gdpr-has-been-a-boon-for-google-and-facebook-11560789219

Schneider, N. (2018): An Internet of Ownership: Democratic Design for the Online Economy. In: The Sociological Review 66/2: 320–340.

Scholz, T. (2016): Uberworked and Underpaid – How Workers Are Disrupting the Digital Economy. Cambridge, Polity.

Seemann, M. (2018): Was ist Plattformpolitik? Grundzüge einer neuen Form der politischen Macht. www.ctrl-verlust.net/was-ist-plattformpolitik-grundzuege-einer-neuen-form-der-politischen-macht/

SEND e. V. (2020): Positionspapier – Genossenschaften Im Digitalen Zeitalter. www.send-ev.de/uploads/Positionspapier_Genossenschaften.pdf

Srnicek, N. (2017): Platform Capitalism. Cambridge, Polity.

Staab, P./Nyckel, E. (2019): Digitaler Kapitalismus und Unternehmenssoftware – Herrschaft der Betriebssysteme? In: WISO Direkt 08/2019.

Statista (2019 a): Teuerste und wertvollste Marken weltweit 2018. https://de.statista.com/statistik/daten/studie/6003/umfrage/die-wertvollsten-marken-weltweit/

Statista (2019 b): Digitale Werbung – weltweit | Statista Marktprognose. https://de.statista.com/outlook/216/100/digitale-werbung/weltweit

Zuboff, S. (2019): The Age of Surveillance Capitalism – The Fight for a Human Future at the New Frontier of Power. New York, PublicAffairs.

Thüer, L. (2018): Bericht über Lobbyismus – Wie die Datenindustrie die EU bearbeitet. https://netzpolitik.org/2018/bericht-ueber-lobbyismus-wie-die-datenindustrie-die-eu-bearbeitet/

WBGU – Wissenschaftlicher Beirat der Bundesregierung Globale Umweltveränderungen (2019): Unsere gemeinsame digitale Zukunft. Berlin, WBGU.

AUTHORS + CONTACT

Vivian Frick, ***Maike Gossen*** and ***Jonas Pentzien*** are researchers at the IÖW. They are PhDs in the research projects *Digitalization and Sustainability* and *platforms2share*.

Institut für ökologische Wirtschaftsforschung (IÖW), Potsdamer Str. 105, 10785 Berlin. E-mail: vivian.frick@ioew.de, maike.gossen@ioew.de, jonas.pentzien@ioew.de, Tel.: +49 30 8845940

Dominik Piétron is a researcher at the Humboldt University Berlin.

Humboldt-Universität zu Berlin, Institut für Sozialwissenschaften, Unter den Linden 6, 10099 Berlin. E-Mail: dominik.pietron@hu-berlin.de

Rena Tangens is an artist, net activist and co-founder of Digitalcourage e. V.

Digitalcourage e. V., Marktstraße 18, 33602 Bielefeld, E-mail: mail@digitalcourage.de, Tel.: +49 521 16391639

Reducing impacts of personalized advertising

Promises and Environmental Risks of Digital Advertising

Advertising is the web's main funding model, and has shaped it in its image. As well as funding products and services, advertising also funds hate speech and disinformation, while contributing to overconsumption. This paper calls for policy interventions which address these shortcomings.

By Harriet Kingaby

Digital advertising is a booming industry, which is rapidly incorporating Artificial Intelligence (AI) into its technological mix. Advertising subsidises products and services, but it also creates funding models for hate speech and disinformation, while contributing to overconsumption. The integration of AI presents its own issues: Environmental protection and human rights are frequently not considered, or considerations are overridden by commercial concern. The most alarming threat, however, is how both advertising and AI enable the spread of climate mis- and disinformation throughout the web. This paper calls for policy interventions which centre mis- and disinformation and learn from offline Planning and Environment laws. In all cases, interventions must consider the systemic effects on the web from digital advertising itself.

The rise of digital advertising

Digital advertising is a booming industry, growing from 162 billion USD in 2015 to 333 billion USD in 2019 (Enberg 2019), making it the primary business model sustaining the web. As with many other industries, the digitalisation of advertising has created side effects that go far beyond ad-revenue and the advertising sector. Until the mid-2010s, legislation, guidance and regulation had focused on the content and messaging contained within adverts themselves. However, the process of buying and selling advertising online is shaping the development of our online spaces, and seriously impacting individuals and societies.

In the past five years, digital advertising has been implicated in some of the more troubling offline events that result from our race to get online. Shoshana Zuboff (2015) dubbed the data harvesting and processing techniques which have come to define our relationship with many tech companies, advertisers, and publishers, as 'surveillance capitalism' (the commodification of personal information). Meanwhile, Tim Berners-Lee has warned of the "perverse incentives" (commercial incentives which have little to no user benefit) created by ad-reliant business models that shape the internet as we see it today. These incentives have fundamentally changed the way information is presented by our media and led to addiction-based design to be incorporated into platform design (Orlowski 2020).

On one hand, advertising funds the online content, services and journalism that make the internet accessible for the masses, on the other, advertising can degrade user experience, discriminate against marginalised communities, and create a funding model for the hate and disinformation which threaten democracies and our environment (Avaaz 2019). The sheer opacity of the internet and its obsession with performance metrics is allowing it to be exploited by fraudsters, hate preachers and opportunists peddling disinformation.

„*Large parts of the adtech industry operate in the shadows ... This creates a significant power asymmetry, where any given adtech company may be armed with thousands of data points about an individual and a large arsenal of insights derived from behavioural psychology, while the individual has no idea about the company even existing*" (Forbrukerrådet 2020).

Regulation of this sector has been slower than the adoption of the technology itself, in part due to the complicated nature of the technology itself and complicated language surrounding it. This lag has embedded behaviours and precedents which are contrary to consumer protection best practice, and do not live up to advertisers' purported brand values.

Artificial Intelligence in digital advertising

Algorithmic decision-making has been used in advertising for over a decade, and a mainstream adoption of Artificial Intelligence (AI) is imminent according to a recent survey by Statista. Only 15 % of US advertisers were using some form of AI in 2018 but use of the technology was predicted to grow by 149 % in 2020 (Guttmann 2019), even if those advertisers suspected that the hype around the technology currently outweighs the actual results. AI is being used in efforts to make advertising more personalised, efficient, and interactive (Pemberton 2017), which advertisers claim will benefit users by providing them with more helpful, relevant, and entertaining ads. However, there is good reason to suspect that consumer and environmental protection is not being properly considered in the design and implementation processes of these technologies.

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Both advertising and AI can play huge roles in our fights against environmental degradation. From the potential efficiencies created by machine learning in energy distribution (c. f. Jungblut this issue), or CO_2 removal (Rolnick 2019), to the ability of advertising to influence hearts and minds, both can, and should, be integrated into our collective toolkits for change. This paper, however, focuses on the major harms and issues caused by AI-enabled digital advertising, from a consumer and citizen perspective. [1]

Advertising encourages unsustainable consumption

„Materialistic values and goals, the consumption driving work & spend cycle, and the consumption of two illustrative products (beef and tobacco) are each a) encouraged by advertising and b) implicated in causing various forms of environmental damage" (Badverts 2020).

Advertising's main purpose is to sell products and services, which, unsurprisingly, puts it at loggerheads with Sustainable Development Goals (SDGs). Most higher income countries already consume more than the Earth can provide and regenerate in a year, to the point of five times the capacity of the earth in the USA, and 1.7 times the Earth's production capacity globally (Global Footprint Network 2019). The proliferation of smartphones allows advertisers to target customers at an increasing number of points during the day. This leads to strategies that seek to reach users at the exact "micro-moment" when they are uniquely receptive because they need or want something. However, despite the increase in the levels of sophistication in targeting, the jury is out as to whether this makes advertising more effective. What is concerning, however, is that 50 % of the world's population is yet to come online (UNCTAD 2018) and when they do, they will be met with sophisticated advertising.

This persuasion power can also create great benefits and opportunities for the climate movement. Advertising generally involves attempting to create some form of attitude or behaviour change, or encourage a repeat behaviour, which can work both for or against climate action depending on how it is applied. Industry initiatives, such as the Advertising Association's Net Zero, highlight the potential opportunity in Action 5, which calls for: "Harnessing advertising's power to support consumer behaviour change" (Advertising Association 2020).

Indeed, professionalising communications and embracing the power of paid media to reach new audiences is extremely important for mainstreaming climate action. Many climate movements do not invest in advertising on social networks, meaning that their messages are only seen by their own fans and others in the environmental movement. Social media newsfeeds have been engineered to favour paid for content over organic, and the movement's understandable resistance to paying social networks is not mirrored by the opposition, who are demonstrably using advertising techniques to test and learn about which denial messaging works. Ironically, the climate movement is forced to increasingly embrace advertising to compete on a level playing field with those who work against them.

Funding model for climate disinformation

The WHO have declared society as in the middle of an "infodemic" (World Health Organisation 2020), a sentiment echoed by The UK Lords Select Committee on Democracy and Digital Technologies, who reported that we face a "pandemic of misinformation" that poses an existential threat to our way of life.

Key to this rise in mis- and disinformation is online advertising: advertising monetises online spaces. Failure to police where it is placed (and therefore, ultimately, what it funds) has created funding models for both hate and disinformation (Digital Shadows 2017). The famous "Pizzagate" scandal, for example, which spread spurious claims about Hillary Clinton during the 2016 US elections, involved Macedonian teenagers earning thousands of dollars a day from creating "fake news" sites which were funded through adverts and shared via social media (Metaxas/Finn 2019). In fact, The Global Disinformation Index estimates that at least 235 million USD in revenue is generated annually from ads running on extremist and disinformation websites (The Global Disinformation Index 2020), and studies from Avaaz (2019) found misinformation networks spanning at least five countries generated an estimated 3.8 billion views on Facebook over one year.

The issue here is that the advertising supply chain is opaque, and advertisers frequently do not know where on the web their advertising ends up. This creates a thriving market for fraud, hate and disinformation, as some actors exploit this lack of accountability. Disinformation also spreads online spaces faster than truth (Vosoughi et al. 2020). Reports by Avaaz (2020) found a disturbing dynamic: Climate disinformation was being funded by advertising, and then prioritised by AI-driven social media recommendation engines. These algorithms are designed to keep users on platforms for longer, and often prioritise content with high engagement rates, such as inflammatory disinformation.

Disinformation has also previously derailed multilateral agreements, making it concerning in the year of COP26. The 2018 UN Global Compact on Migration was undermined with a barrage of false information, perpetrated by far-right groups, which implied criminal sanctions for those who criticised migration, or even linked the Compact to EU policies (Read 2018). A media furore followed, with severe consequences for the Compact, as countries from Brazil to Israel pulled out, and the Belgian government collapsed amid infighting (Birnbaum 2018). The most chilling impact of this campaign was noted in New Zealand, where the handle of the gun used in the Christchurch massacre was found to be marked with the phrase "Here's your Compact on Migration" (Doyle 2019).

Steps have since been taken by social media platforms and advertisers to defund and deprioritise dangerous disinformation, but solutions are not perfect, and it is incredibly important that the environmental movement engages with such issues. For more information on the different types of climate disinformation, including corporate greenwash, which has been well documented elsewhere.

“Advertising is the business model underpinning the web, and a key force in shaping the information environments which also shape public opinion.”

Digital advertising increases the carbon footprint of the internet

Advertising is demonstrably increasing the internet’s carbon footprint, and digital advertising’s carbon footprint is increasing with the introduction of AI. Between one half and one third of internet traffic is fake, much of it linked to ad fraud. Advertising fraud can take several different forms, but each involves the creation of illegitimate, non-human traffic (bots) to deliberately attempt to extract money from advertising budgets (IAB UK 2017). Researchers estimate that the tech sector will contribute 3.0–3.6 % of global greenhouse emissions by 2020 (AI Now Institute 2019), and the estimated 2020 global footprint is comparable to that of the aviation industry (ATAG 2020). The electricity consumed to power online advertising generated approximately 60 MT of CO_2 in 2017 (Pärssinen et al. 2018). As digital advertising spend increases, so will its energy consumption.

The failure to halt growing levels of ad fraud is also increasing the amount of processing power and ad load online, increasing energy consumption and contributing to climate change. Adobe (2018) found that potentially 28 % of web traffic came from bots or other non-human actors, and Botlab used a figure of 23 % when estimating that ad fraud contributed approximately 13.87 million tonnes of CO_2 to the atmosphere annually, roughly equivalent to the yearly emissions of Ghana (Botlab 2017).

Policy interventions

Tackling the issues created by online and AI-driven advertising requires bold and a long-term vision which enables the transition towards internet business models that are more rights-respecting, and environmentally friendly. Regulators must act fast because this is not just about the web as we know it. Advertising stands at the brink of widespread adoption of AI, but as an industry, has little appreciation of how to embed and account for human rights and environmental protection. Failure to change this thinking risks ingraining excessive data collection habits, inadvertent environmental degradation, and flawed metric-driven decision-making in our technologies and society for years to come. The time for a broader consideration of consumer protection, human rights and environmental impact within AI decision-making is now.

As online and offline environments become increasingly entwined, the harmful practices we see online risk sweeping into ever more connected offline spaces. Just as the home has become the latest frontier for data mining, so will public spaces. This risks the creation of worrying precedents – for surveillance, the erosion of non-commercial space, and a lack of accountability or transparency when things go wrong. Environmental protections and planning laws in many countries contain provisions such as the “Precautionary Principle” and requirements for investment in public services alongside development; these are designed to protect our commons from “free riders” and correct market failures and externalities. Yet few equivalents exist for digital and online spaces (Kaltheuner/Kingaby 2020). It is vital to protect our digital spaces in this way, as this is where people do so much more than communicate: they are where social movements form, where people learn about the news, and where we form perceptions of the world around us.

Creating accountability for digital and physical supply chains

Creating a more transparent advertising sector will bring about benefits for all. Since the 1990s, corporations have worked on their physical supply chains, mapping and improving them in line with international coalitions and standards such as ISO14001. An organisation’s digital advertising supply chain should be subject to the same level of accountability, including suppliers and partners, and its governance integrated with their sustainability and consumer protection targets and obligations. Requirements for transparency and accountability in the digital advertising supply chain are already being enshrined in law, for example, France’s Loi Avia requires companies to report their advertisement site lists every month to the public in a move christened the “Sleeping Giants” amendment (Jammi/Atkins 2020). A site list is a breakdown of the domains where ads have been served, which can be scrutinised by researchers. This public accountability creates an imperative for brands to ensure that their site lists do not include hate speech or disinformation. Mandating that all advertisers should declare the placement of their advertising in the public interest would contribute to defunding fraud and hate speech and creating the transparency which is needed to encourage collective responsibility for digital advertising supply chains.

„Creating a more transparent advertising sector will bring about benefits for all.“

Imposing restrictions on advertising high carbon industries

In many places, advertising regulators and the platforms themselves, place restrictions on what advertisers can advertise, where, and to whom, to protect vulnerable groups, or discourage harmful behaviours such as gambling (Facebook 2018). However, evidence suggests that consistency of enforcement is key to these measures working, and there is strong evidence to suggest that enforcement and detection is inconsistent (UNCTAD 2018). Given the issues with corporate and state disinformation, it is recommended that:

- We develop legal definitions of disinformation, so that international standards and understanding can be reached.
- Those legal definitions to include climate denial and delay (Lamb et al. 2020) messaging, and information containing these definitions should be banned from monetisation across mediums and platforms, and from being prioritised in platform recommendation algorithms.
- High carbon industries should be classified as harmful, in the same way as tobacco and alcohol, and subject to restrictions on how and where they advertise.

Investing in cross industry and civil society forums

Underpinning all these recommendations is one for dialogue and forums to develop between digital rights and environmental protection groups, consumer protection experts, advertising stakeholders, and tech providers, many of whom will be grappling with similar issues from different perspectives. Planning must become proactive, rather than reactive. It is recommended that digital rights groups and consumer protection organisations engage with individual advertisers and advertising reform groups who can act as champions or sponsors of issues such as misinformation, and environmental sustainability, as well as advertising bodies themselves. Initiatives such as The Conscious Advertising Network form proof of concept.

These forums should be mediated and designed to:

- Create accountability, shared understanding and solutions to the issues of internet health – including new charters of online rights for citizens to escape surveillance capitalism.
- Include active participation from civil society groups directly affected by discrimination, or other market failures, to ensure that human rights have equal weight to corporate interest in discussions and solution building.
- Form new industry initiatives and guidelines that create leadership beyond regulation, and a proactive approach to assessing AI implementation against human rights.
- Suggest new regulatory interventions or call for enforcement where necessary.
- Identify and swiftly deal with the “unknown unknowns” which will undoubtedly arise as a result of the implementation of new technology.

Conclusion

Advertising is the business model underpinning the web, and a key force in shaping the information environments which also shape public opinion. With that great power should come great responsibility. However, the development and governance of the role advertising plays in shaping online spaces is being left to industry to decide on and to police. Legislative interventions are piecemeal, often unenforced, and lack an understanding of the role that advertising can play in the development of safe and citizen-focused online spaces. Only by considering the development of our online space in the same ways as we think of our offline ones – as something to be carefully stewarded, protected and planned – will we be able to make decisions regarding the responsibilities of the various actors involved in the funding and development of our online world. Systems thinking will be essential to avoiding further, greater online harms.

Annotations

[1] For more details on methodology, see *AI & Advertising, A Consumer Perspective* (Kingaby 2020), on which this analysis is based.

[2] For more details, see the *Change The Narrative* report (Cheq, Media Bounty, Pulsar, The Conscious Advertising Network 2020), which contains further examples.

References

Advertising Association (2020): Ad Net Zero, All For None. www.adassoc.org.uk/ad-net-zero/

AI Now Institute (2019): AI and Climate Change: How they’re connected, and what we can do about it. https://medium.com/@AINowInstitute/ai-and-climate-change-how-theyre-connected-and-what-we-can-do-about-it-6aa8d0f5b32c

ATAG (2020): Facts & Figures. www.atag.org/facts-figures.html

Avaaz (2019): Why is YouTube Broadcasting Climate Misinformation to Millions? https://secure.avaaz.org/campaign/en/youtube_climate_misinformation/

Avaaz (2020): How Facebook Can Flatten The Curve Of The Coronavirus Pandemic. https://avaazimages.avaaz.org/facebook_coronavirus_misinformation.pdf

Badverts (2020): Advertising's role in climate and ecological destruction. www.badverts.org/reports-and-publications
Birnbaum, M. (2018): Belgium's Ruling Coalition Collapses over U. N. Pact on Migration. www.washingtonpost.com/world/europe/belgiums-ruling-coalition-collapses-over-un-pact-on-migration/2018/12/09/e9740cc2-fbc9-11e8-a17e-162b712e8fc2_story.html
Capgemini (2019): Why addressing ethical questions in AI will benefit organisations. www.capgemini.com/gb-en/research/why-addressing-ethical-questions-in-ai-will-benefit-organisations/
Cheq/Media Bounty/Pulsar/The Conscious Advertising Network (2020): Changing The Narrative, Smart Climate Campaigning In An Adversarial World. https://mediabounty.com/news/how-to-win-against-climate-misinformation/
Democracy & Digital Technology Committee (2020): Lords Select Committee. www.parliament.uk/business/lords/media-centre/house-of-lords-media-notices/2020/jun-20/democracy-under-threat-from-pandemic-of-misinformation-online-lords-democracy-and-digital-technologies-committee/
Digital Shadows (2017): The Business Of Disinformation, A Taxonomy. https://resources.digitalshadows.com/whitepapers-and-reports/the-business-of-disinformation-fake-news
Doyle, J. (2019): New Zealand mosque attacker's plan began and ended online. www.reuters.com/article/us-newzealand-shootout-internet-idUSKCN1QW1MV
Enberg, J. (2019): Global Digital Ad Spending 2019: Digital Accounts for Half of Total Media Ad Spending Worldwide. e-Marketer. www.emarketer.com/content/global-digital-ad-spending-2019
Facebook (2018): Restricting Ads for Addiction Treatment Centers and Bail Bonds. www.facebook.com/business/news/restricting-ads-for-addiction-treatment-centers-and-bail-bonds
Forbrukerrådet (2020): OUT OF CONTROL: How consumers are exploited by the online advertising industry. https://fil.forbrukerradet.no/wp-content/uploads/2020/01/2020-01-14-out-of-control-final-version.pdf
Global Footprint Network (2019): Earth Overshoot Day Stats. https://www.overshootday.org/content/uploads/2019/05/How_many_Earths_2019_English.pdf
Guttmann, A. (2019): AI use in marketing – Statistics & Facts. Statista. www.statista.com/topics/5017/ai-use-in-marketing/
Jammi, N./Atkins, C. (2020): France's new 'Sleeping Giants' law. https://branded.substack.com/p/frances-new-sleeping-giants-law
Jobin, A./Ienca, M./Vayena, E. (2019): The global landscape of AI ethics guidelines. In: Nature Machine Intelligence 1: 389–399.
Kaltheuner, F./Kingaby, H. (2020): An Adbreak For Europe. www.harrietkingaby.com/reports
Kingaby, H. (2020): AI & Advertising, A Consumer Perspective. www.harrietkingaby.com/reports
Lamb, W./Mattioli, G./Levi, S./Roberts, J. T./Capstick, S./Creutzig, F./Minx, J. C./Müller-Hansen, F./Culhane, T./Steinberger, J. K. (2020): Discourses of climate delay. In: Global Sustainability 3: 1–5.
Metaxas, P./Finn, S. (2019): Investigating the infamous #Pizzagate conspiracy theory. https://techscience.org/a/2019121802/
Orlowski, J./Coombe, D./Curtis, V. (2020): The Social Dilemma. Netflix.
Pärssinen, M./Kotila, M./Cuevas, R./Phansalkar, A./Manner, J. (2018): Environmental impact assessment of online advertising. In: Environmental Impact Assessment Review 73: 177–200.
Pemberton, C. (2017): Simple Questions to Assess AI Risks and Benefits. www.gartner.com/en/marketing/insights/articles/simple-questions-to-assess-ai-risks-and-benefits
Read, C. (2018): Britain WILL SIGN United Nations proposal to make immigration human right. www.express.co.uk/news/politics/1053064/United-nations-Global-Compact-for-Safe-Orderly-and-Regular-Migration-Alistair-Burt-italy
Rolnick, D. et al. (2019): Tackling Climate Change with Machine Learning. https://arxiv.org/pdf/1906.05433.pdf
The Global Disinformation Index (2020): Ad-funded COVID-19 Disinformation: Money, Brands, and Tech. https://disinformationindex.org/research/
UNCTAD (2018): Working Group on Vulnerable and Disadvantaged Consumers, 3rd SESSION 9–10 July 2018. Intergovernmental Group of Experts on Consumer Law and Policy. https://unctad.org/meetings/en/Presentation/WG%20Vulnerable%20and%20Disadvantaged%20Consumers%20.pdf
Vosoughi, S./Roy, D./Aral, S. (2018): The spread of true and false news online. Science 359/6380: 1146–1151.
World Federation of Advertisers (2018): WFA releases full version of Global Media Charter to reform digital ad ecosystem. https://wfanet.org/knowledge/item/2018/06/21/WFA-releases-full-version-of-Global-Media-Charter-to-reform-digital-ad-ecosystem
World Health Organisation (2020): Managing the COVID-19 infodemic: Promoting healthy behaviours and mitigating the harm from misinformation and disinformation. Available online at: www.who.int/news/item/23-09-2020-managing-the-covid-19-infodemic-promoting-healthy-behaviours-and-mitigating-the-harm-from-misinformation-and-disinformation
Zuboff, S. (2015): Big other: surveillance capitalism and the prospects of an information civilization. In: Journal of Information Technology 30: 75–89.

AUTHOR + CONTACT

Harriet Kingaby is a researcher working at the intersection between digital advertising technology, AI, human rights and climate change. She is currently the co-chair of the Conscious Advertising Network, and works at advertising agency, Media Bounty, on climate misinformation.

E-mail: hello@harrietkingaby.com, Tel.: +44 754 7288236

Making IT-products sustainable

Design Options for Long-lasting, Efficient and Open Hardware and Software

High energy consumption and data traffic, critical production conditions and proprietary software ensure that the production and use of digital technologies and applications have so far been environmentally and socially problematic. We present basic approaches and policy measures for a sustainable design of hardware and software.
By Johanna Pohl, Anja Höfner, Erik Albers and Friederike Rohde

The production and use of digital technologies and services is associated with environmentally and socially problematic developments. These are related both to the way Information and Communications Technology (ICT) devices are produced, used and disposed of, and to the design and use of software and the associated volume of data traffic. It is therefore essential that the material (energy and resources for the production, operation and disposal of hardware) and immaterial foundation of digitalisation (e. g., software, information, knowledge, etc.) are more closely integrated. Aspects such as modular product design, repairability, transparent supply chains and the use of public and free source codes and licences play a decisive role in making hardware and software sustainable. This article outlines the basic approaches that must be considered for a sustainable design of hardware and software and illustrates the political options.

Longevity of hardware and software

Most of the environmental impacts of hardware (e. g., in the impact categories global warming, acidification, freshwater eutrophication or human toxicity) occur during its production. The production of electronic components in particular is very environmentally intensive (Hischier et al. 2015) and often takes place at locations with a high proportion of coal in the electricity mix (Manhart et al. 2016). At the same time, the absolute number of digitally networked devices is increasing worldwide with ever shorter recycling cycles of these devices. From an ecological perspective, it is always preferable to continue using existing hardware rather than buying a new notebook or smartphone. The provision of a new device in particular entails a high consumption of resources. In some cases, newer models also require more energy in the utilisation phase due to increased computing power (Prakash et al. 2017). A central adjustment factor for making hardware ecologically sustainable is to extend the service life of the devices. On the hardware side, this can for instance be supported by a modular design and the most complete repairability possible. This means taking repairability into account as early as the product design stage, ensuring access to spare parts and maintaining the warranty in the event of repairs (c. f. Voigt this issue). Recyclability must also be incorporated into the design of the equipment, e. g., to allow metals to be extracted during recycling. The use of open-source hardware means that blueprints can be viewed at any time and individual spare parts can be reproduced, which supports the repairability of devices.

Moreover, hardware is always used in conjunction with software, both elements being mutually dependent. Hardware can often no longer be used without suitable software and vice versa. Current operating systems, for example, are adapted to current hardware configurations. However the instance, the manufacturer discontinues support for this operating system, it can no longer be used safely. This means that the underlying hardware is also left without a safe operating system. A newly released operating system, however, may not be able to run on the old hardware. The lack of interoperability of software and (older) hardware in combination with the early discontinuation of software support means that functional hardware is increasingly being replaced before the end of the product's life (Manhart et al. 2016). If hardware that is still technically functional can no longer be used due to (missing) software updates or new software concepts, this is also referred to as software obsolescence (Prakash et al. 2017). The longevity of software and its availability in the future consequently also has a direct influence on the future usability of existing hardware. This also concerns the sustainable availability of the software as a resource itself. Today, many documents from previous decades can no longer be opened or the associated software can no longer be made to run, even though at the same time the hardware is becoming more and more powerful. This is usually the result of an artificially enforced shortening of the lifespan of our ICT systems through proprietary licences and vendor lock-in. A sustainable solution is the use of Free and Open Source Software

*Ökologisches*Wirtschaften *Online-Ausgabe* O1.2021 (36) | DOI 10.14512/OEWO360120

(FOSS). Free licenses grant everyone the right to use the software without restriction and for an unlimited period of time as well as access to its source code. This means that no entity can force an "end of support" for a FOSS-licensed software or prevent its availability or archiving for the future. Open interfaces also ensure interoperability. Inside and outside the FOSS ecosystem, free licensing allows full or modular integration of specific software solutions in interaction with other systems. Furthermore, the technically and legally flawless archiving and reuse of digital resources in terms of digital generational equity is guaranteed.

"It is possible to achieve a sustainable design of digital devices and applications by safeguarding the frugal use of resources and the respect for labour rights along the life cycles of hardware and software."

Energy- and resource-saving hardware and software

Devices, digital infrastructure and applications are becoming relatively more efficient, e. g., through LED screen lighting, decreasing energy intensity per computing power and improved power management software (Koomey et al. 2011; Prakash et al. 2017). Some technical devices and applications already have legal requirements for electricity consumption or assessment criteria for environmental relevance. The EU Ecodesign Directive, for example, sets out minimum legal requirements for the energy consumption of electrical appliances. Labels such as Energy Star or Blue Angel assess electronic devices according to their energy efficiency class and therefore also provide consumers with transparent decision-making aids. For data centres, however, the assessment in efficiency classes is still in its infancy. Factors such as waste heat utilisation, type of cooling technology or server utilisation are decisive when assessing the energy efficiency of data centres (Hintemann/Hinterholzer 2018), and initial methods for calculating the energy efficiency of data centres have been developed (Schödwell et al. 2018).

The environmental relevance of software results from the use of hardware and transmission capacities (computing power, working memory, networks) during its development, use and deinstallation. Although an absolute quantification of the relevance of software to the total energy consumption of ICT is still in its infancy, studies have shown that different software products that fulfil the same functional requirements can differ significantly in their electricity consumption (Gröger et al. 2018). With a view to energy and resource-saving software, it is therefore important to design it in a way that minimises the power and resource requirements during the utilisation phase. Software design principles should take this into account at the very beginning of the software life cycle. The German Federal Environment Agency has already presented initial criteria for sustainable software design (Gröger et al. 2018). Criteria such as autonomy of use, which includes FOSS licensing, offline capability and absence of advertising, are important starting points that can already help consumers and industry achieve a great deal with little effort.

Despite the development of criteria that should actually result in a decrease in the environmental relevance of digital technology, it can currently be seen that consumer electronics devices are getting bigger and bigger, and functions, performance and screen resolutions are increasing. In absolute terms, this leads to increasing energy and resource consumption (Prakash et al. 2017; Proske et al. 2020). At the same time, the absolute increase in the number of devices (e. g., in the Internet of Things) as well as rising energy consumption due to ever more efficient and thus cheaper electronic components can also be observed – a classic rebound effect. This is also reflected in the overall energy consumption of the digital sector, which for years has not been decreasing but has remained stable or even increased as the sector has grown faster than energy efficiency has increased (Lange et al. 2020). Energy- and resource-saving hardware and software is therefore distinguished not only by being relatively resource-efficient, but also by reducing the consumption of energy and resources in absolute terms. It is necessary to flank efficiency measures with consistency and sufficiency strategies (c. f. Colaço this issue). This includes questions about the appropriate size of screens as well as the intensity of use of digital technology by consumers, or the question of the design of digital applications that takes into account the principle of data frugality, i. e., the lowest possible data production and processing.

Transparent and fair product cycles

End devices, servers and networks consist of a multitude of finite resources (Hischier et al. 2015; Pilgrim et al. 2017). As the total number of devices increases, so does the need for resources for their production. In addition to plastic, glass and ceramics, digital devices consist of various metals that are classified as conflict raw materials or of concern. Tantalum, tungsten, gold, tin or cobalt are mined primarily in countries of the Global South, including Congo, South Africa, Rwanda, Peru and Chile, often under hazardous working conditions, lack of protective clothing, massive labour law violations and sometimes with the use of child labour. Furthermore, there is considerable environmental impact through river pollution, deforestation and air pollution (Pilgrim et al. 2017). Massive violations of labour and hu-

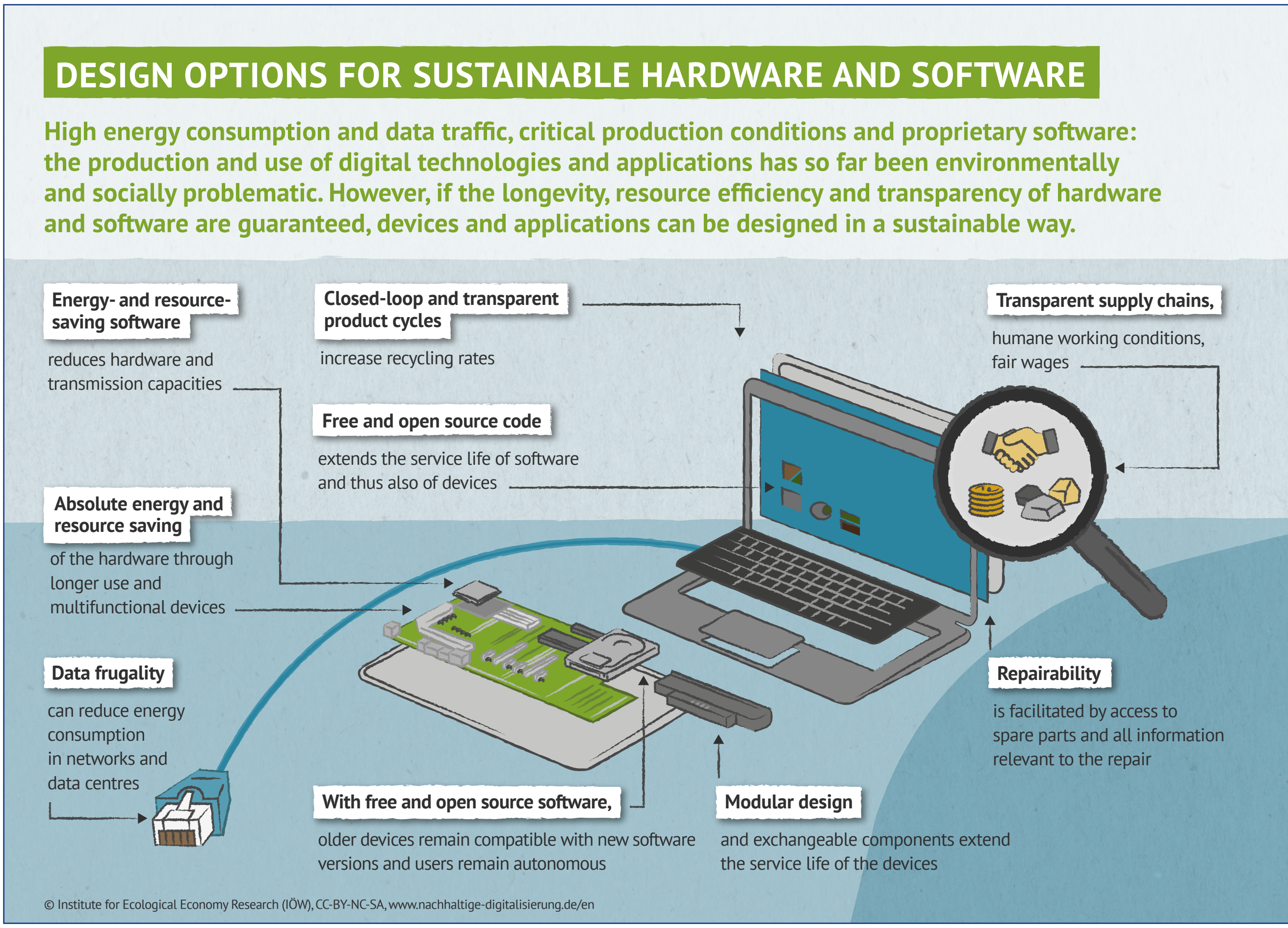

Figure 1: Design options for sustainable hardware and software

man rights are also known to occur in the production of digital devices, e. g., in Chinese factories (Chan 2019). The product life cycle of many devices in the Global South ends as it began, such as in Agbogbloshie in Ghana, on the largest landfill site on the African continent. There too, people live and work under inhumane conditions and face health hazards in order to recover recyclable raw materials from electronic waste (Höfner/Frick 2019). The recycling potential for e-waste is currently largely untapped: Only 20 % of the e-waste generated in Europe is recycled at all. The majority either ends up in residual waste, where it is later incinerated, or is exported illegally, mostly to countries in the Global South (Baldé et al. 2017). The production process is also characterised by a great lack of transparency and it is often not possible to determine which components were produced or disposed of where and under what conditions.

The production and programming of software is also often characterised by a great lack of transparency. Proprietary software development delivers fully compiled and locked code to users. This means they have no way of checking whether the software is doing what it claims to be doing. Companies keep their knowledge of the software secret, so new versions can be published, and old versions can be declared obsolete. This creates dependencies which not only impair the autonomy of the users, but can also affect the lifespan of hardware, as already described above as “software obsolescence”. These knowledge monopolies mean that the bankruptcy of a private-sector enterprise could not only result in an enormous loss of knowledge but could even lead to the breakdown of entire infrastructures.

In order to safeguard sustainability in all dimensions, it is therefore essential that hardware and software are fully transparent and traceable throughout the entire manufacturing process. For hardware this means transparent supply chains as well as humane working conditions and fair wages throughout the entire supply chain, for which the manufacturing companies are responsible. The prerequisite for the reuse of valuable components of ICT equipment is a functioning recycling system. Transparent software development means that the original source code with all subsequent changes is publicly accessible. Freely licensing the source code allows it to be used by all, even for business purposes. This prevents the monopolisation of knowledge and at the same time the monopoly position of individual (private-sector) actors. Free licenses allow knowledge to be archived and reused. As in the model of a circular economy, already developed programs or versions can be revived or further developed. Transparent production cycles, in which every single code contribution is traceable, also ensure responsible and independent users (c.f. Voigt this issue).

"The public sector has a prominent role to play in implementing the policy recommendations for sustainable hardware and software."

Policy options for sustainable hardware and software

It is possible to achieve a sustainable design of digital devices and applications by safeguarding the frugal use of energy and resources, longevity as well as transparency and respect for human and labour rights along the life cycles of hardware and software (Fig. 1). The following section outlines how these sustainability goals can be incorporated into policy-making.

Conservation of resources

In order to contribute to absolute resource frugality in the sector and to prevent rebound effects, efficiency measures of digital technology must be flanked by consistency and sufficiency strategies that encompass all areas of the product life cycle. Modularisation and standardisation of hardware contributes to reducing electronic waste and thus to saving resources. At EU level, this can be achieved by means of mandatory specifications for the standardisation of electronic accessories (including charging cables) and electronic components. Another requirement is a functioning recycling system that fully utilises its potential through efficient collection (e.g., a deposit system for equipment or a low-threshold return system in shops) and the further development of recycling technologies so that the valuable contents of digital equipment can be reused (Handke et al. 2019). Mandatory requirements to design software in a way that minimises electricity and resource consumption during the utilisation phase must continue to be introduced. The German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety has already presented starting points for this with the Blue Angel for software. There are also criteria for assessing energy efficiency in data centres. This label should be extended to include criteria that assess environmentally sound planning, operation and disposal. The implementation of the requirements should become mandatory in public procurement procedures. Furthermore, compulsory info-labels for resource-saving products and applications can help consumers to make informed choices. In the case of digital services such as video streaming, platform operators should ensure that the standard resolution of videos is always adapted to the size of the terminal equipment and that automatic playback is deactivated ("Sufficiency by default").

Longevity

The longest possible service life of the devices and applications also contributes to the absolute conservation of resources, and this means that the repair and update capability of hardware and software must be ensured. This includes several aspects that can be implemented at EU level, for example by extending the Ecodesign Directive, as has long been demanded: The "right to repair" of appliances must be enshrined in law and includes the mandatory publication of all information relevant to the repair as well as non-discriminatory and permanent access for all (commercial) repairers and end-users to all means and tools relevant to the repair. Full rights of use as well as warranty must be maintained, even if the repair is carried out by independent certified repair companies and alternative software or operating systems are used. This includes designing equipment in such a way that it can be repaired ("Design for Repair & Upgrade"). Free licensing of hardware and software after the end of production also contributes to the longest possible service life. For hardware, this means that the rights of use or ownership for building instructions and spare parts after the end of production are made available to the general public under a free licence so that users and workshops can reproduce spare parts themselves. With regard to software, this means introducing a mandatory publication of the source code under a free licence once a software or electrical device is no longer supported ("Upcycling of software"). This, together with the unrestricted right to install alternative software and operating systems, provides a powerful instrument against planned software obsolescence.

Transparency

The sustainable production of hardware requires transparent supply chains as well as humane working conditions and fair wages throughout the entire manufacturing process. Companies must be legally obliged to ensure transparency in supply chains and to exercise due diligence on both human rights and environmental issues, as currently demanded by various civil society organisations in the "Initiative Lieferkettengesetz" (Supply Chain Law Initiative). Failure to comply with these so-called due diligence obligations must result in sanctions under public law such as fines or exclusion from public procurement procedures. Businesses must also be held accountable for human rights violations resulting from failure to comply with due diligence obligations, including internationally (Initiative Lieferkettengesetz 2019). Electronic waste must not, as it is currently the case, be disposed of in an obscure way and, in case of doubt, be exported to the countries of the Global South. The export ban must be enforced more strongly here (Handke et al. 2019).

Transparency is also crucial in the development of software. In order to promote public and sustainable digital infrastructures (c. f. Frick et al. this issue), a legal obligation is required that hardware and software developed with public money should be published under an open-source licence ("Public Money Public Code" or "Public Money Public Hardware"), because developments paid for by all should also be available to all. It remains essential to create long-term structures that promote the development of sustainable and open hardware and software and contribute to digital sovereignty, such as the establishment of a European Open Technology Fund.

Sustainable public procurement

The public sector has a prominent role to play in implementing the policy recommendations for sustainable hardware and software: Tendering and procurement criteria for public authorities should be structured in a way that ensures that comprehensive environmental criteria are taken into account. This means that it gives preference to free and open-source software and devices as well as to those that provide open interfaces and modular designs. The production processes should take place under fair conditions, be transparent and traceable. Second-hand equipment should be used wherever possible. The use of environmental criteria and open standards must become mandatory in all public services and outstanding regulations and standardisation processes must be supported by public authorities. A paradigm shift towards free and open-source software is particularly important in the area of critical infrastructure. At EU level, for example, it is necessary to derive and implement concrete measures from the EU Commission's open-source strategy. For European projects such as the creation of a trustworthy cloud environment (GAIA-X), it is also imperative to include binding sustainability criteria (an example here is the Blue Angel for data centres) in the call for tenders, thereby setting technological standards at European level that give high priority to environmental protection.

References

Baldé, C. P./Forti, V./Gray, V./Kuehr, R./Stegmann, P. (2017): Global E-waste Monitor 2017. Bonn/Geneva/Vienna: United Nations University (UNU), International Telecommunication Union (ITU) & International Solid Waste Association (ISWA).

Chan, J. (2019): Biss in den sauren Apfel: Zu den Arbeitsbedingungen vom Apple-Lieferanten Foxconn in China. In: Höfner, A./Frick, V. (eds.): Was Bits und Bäume verbindet: Digitalisierung nachhaltig gestalten. München, oekom. 19–22.

Gröger, J./Köhler, A./Naumann, S./Filler, A./Guldner, A./Kern, E./Hilty, L. M./Maksimov, Y. (2018): Entwicklung und Anwendung von Bewertungsgrundlagen für ressourceneffiziente Software unter Berücksichtigung bestehender Methodik. Dessau-Roßlau, UBA.

Handke, V./Hross, M./Bliklen, R./Jepsen, D./Rödig, L. (2019): Recycling im Zeitalter der Digitalisierung: Spezifische Recyclingziele für Metalle und Kunststoffe aus Elektrokleingeräten im ElektroG: Regulatorische Ansätze. Berlin, NABU.

Hintemann, R./Hinterholzer, S. (2018): Technology radars for energy-efficient data centers: A transdisciplinary approach to technology identification, analysis and evaluation. In: World Congress on Sustainable Technologies. Cambridge, Institute of Electrical and Electronics Engineers (IEEE).

Hischier, R./Coroama, V. C./Schien, D./Ahmadi Achachlouei, M. (2015): Grey Energy and Environmental Impacts of ICT Hardware. In: Hilty, L. M./Aebischer, B. (eds.): ICT Innovations for Sustainability. Cham, Springer International Publishing. 171–189.

Höfner, A./Frick, V. (2019): Was Bits und Bäume verbindet. Digitalisierung nachhaltig gestalten. Dokumentation der Konferenz "Bits & Bäume". München, oekom.

Initiative Lieferkettengesetz (2019): Anforderungen an ein wirksames Lieferkettengesetz. https://lieferkettengesetz.de/wp-content/uploads/2019/09/Anforderungen-an-ein-wirksames-Lieferkettengesetz_Februar-2020.pdf.

Koomey, J./Berard, S./Sanchez, M./Wong, H. (2011): Implications of historical trends in the electrical efficiency of computing. In: IEEE Annals of the History of Computing 33/3: 46–54.

Lange, S./Pohl, J./Santarius, T. (2020): Digitalization and energy consumption. Does ICT reduce energy demand? In: Ecological Economics 176: 106760.

Manhart, A./Blepp, M./Fischer, C./Graulich, K./Prakash, S./Priess, R./Schleicher, T./Tür, M. (2016): Resource Efficiency in the ICT Sector. Final Report. Hamburg, Greenpeace.

Pilgrim, H./Groneweg, M./Reckordt, M. (2017): Ressourcenfluch 4.0: Die sozialen und ökologischen Auswirkungen von Industrie 4.0 auf den Rohstoffsektor. Berlin, PowerShift.

Prakash, S./Gröger, J./Hipp, T./Rodem, I./Borgstedt, S./Schlösser, A./Stobbe, L./Proske, M./Riedel, H./Chancerel, P., et al. (2017): Ermittlung und Erschließung des Energie- und Ressourceneffizienzpotenzials von Geräten der Unterhaltungselektronik. Dessau-Roßlau, Umweltbundesamt.

Proske, M./Poppe, E./Jaeger-Erben, M. (2020): The smartphone evolution – an analysis of the design evolution and environmental impact of smartphones. Berlin, Electronics Goes Green.

Schödwell, B./Zarnekow, R./Liu, R./Gröger, J./Wilkens, M. (2018): Kennzahlen und Indikatoren für die Beurteilung der Ressourceneffizienz von Rechenzentren und Prüfung der praktischen Anwendbarkeit. Dessau-Roßlau, Umweltbundesamt.

AUTHORS + CONTACT

Johanna Pohl is a researcher at Technische Universität Berlin, Department of Social Transformation and Sustainable Digitalization.

Technische Universität Berlin, Marchstr. 23, 10587 Berlin.
E-mail: johanna.pohl@tu-berlin.de, Tel.: +49 30 31470191

Anja Höfner works at Konzeptwerk Neue Ökonomie e. V.

Konzeptwerk Neue Ökonomie e. V., Klingenstr. 22, 04229 Leipzig.
E-mail: a.hoefner@knoe.org, Tel.: +49 341 39281686

Erik Albers is programme manager at the Free Software Foundation Europe (FSFE).

Free Software Foundation Europe, Schönhauser Allee 6/7, 10119 Berlin.
E-mail: eal@fsfe.org, Tel.: +49 30 27595290

Friederike Rohde is a researcher at the Institut für ökologische Wirtschaftsforschung (IÖW).

Institut für ökologische Wirtschaftsforschung (IÖW),
Potsdamer Str. 105, 10785 Berlin.
E-mail: Friederike.rohde@ioew.de, Tel.: +49 30 8845940

Empowering people

Open Education and Open Source for Sustainable Economic Activity

Open education and open-source are essential foundations for enabling civic engagement with technologies and sustainable use. Makerspaces can lead the way for structural change through local learning and economic development.
By Maximilian Voigt

Resource-efficient living requires changes on numerous levels. These changes include, in particular, the use of technology, which is decisively shaped by individual skills, political framework conditions and the availability of open technologies and infrastructures. This is shown by juxtaposing the sustainability mantra of "reduce, reuse, recycle" with excerpts from the definition of "Open": "Open means anyone can freely access, use, modify, and share for any purpose." Without technical-technological competences, which at their core includes practical skills and systemic understanding that go beyond the application level, without open technologies such as open-source software and hardware, and without makerspaces that enable repair and self-learning by the general public, technology is always just a fast-moving consumer object that is difficult to adapt to new circumstances and to integrate into sustainable local cycles.

A need for open technology teaching

At the same time, competence development is not about disseminating in-depth engineering or IT skills more broadly. Rather, it is about understanding functional relationships that allow the assessment of technology, which is transferable to different concrete contexts. It is about basic craftsmanship, on a physical and digital level. And it is about the understanding and critical reflection of systemic contexts and political dimensions.

Current developments in education are at risk of falling short of these goals. Technology is equated with digital tools and skills that are largely limited to application. Skills that go beyond this are rarely in focus. What is therefore needed is teaching technologies openly, meaning methods that place the technical function at the centre and promote a self-determined approach to technology. Using a vacuum cleaner as an example, it is a matter of opening the plastic housing and understanding the mechanism behind it. Because only on this basis we can really make sustainable consumption decisions and repair to a certain degree by ourselves.

This is also about power. After all, in a society that is thoroughly permeated by technology, those who possess the knowledge of technologies can influence processes. This is not only evident in debates around the "Netzwerkdurchsetzungsgesetz" [Network Enforcement Act] or data retention, where an understanding of the subject matter is necessary to be able to evaluate arguments. It is also about framework conditions for the development of technology, for example with regard to the right to repair. This is where fundamental decisions on the repairability of objects are made. Should members of the public be able to obtain spare parts themselves, or only authorised dealers? Do spare parts have to be kept in stock at all? And should manufacturers design their equipment so that it is easy to repair? A broad response to these questions requires a basic understanding and awareness of technical issues.

Taking open-source into the mainstream

In addition to these individual competences, open technologies are also required. Thus, open technology development and repair is only feasible when the documentation of technical objects and software solutions are made available. This includes an open and modifiable design of technical devices. This also applies in particular to the sustainable development of technology. Open-source software and hardware solutions make it possible to re-use resources that have already been used, by collectively developing existing technology and improving faulty designs. A free licence ensures decentralised modification. It also enables integration into local cycles, as the technology can be easily adapted to needs and integrated into infrastructures. In order to ensure this, the basic rule with regard to design is that the application should be structured into a generic core with open interfaces. This covers cross-platform basic functions and enables adaptation to different requirements by facilitating the development of connectable applications.

While open-source is a widespread topic in the realm of software and enriches large parts of software development, open-source hardware is still in its infancy. Worse: Anyone who remembers the 50s and 60s knows that the circuit diagram was often an integral part of purchased devices. Nowadays, technical connections disappear more and more in sealed casings that are supposed to give as few reasons as possible for opening them – the technical documentation of the devices only pro-

*Ökologisches*Wirtschaften *Online-Ausgabe* O1.2021 (36) | DOI 10.14512/OEWO360125

"Makerspaces are places for raising and spreading new ideas, for self-empowerment and participation in open-source."

vides the bare minimum of information. This has to change and, at minimum, connections relevant to the repair must be documented.

It is clear that widespread implementation of open-source would have profound implications for the way our economy is creating value. It is therefore necessary to develop new business models that are not limited to the sale of proprietary knowledge and rights of use. Developments such as dual licensing, software-as-a-service, freemium, Patreon or Open Collective can be seen as starting point. One hardware example of dual licensing is demonstrated by Xyc Cargo bikes. These are based on a construction system developed by Xyz Spaceframe Vehicles, which makes stable frames possible solely by bolting together aluminium elements. A basic structure is documented and available under the constrained Creative Commons licence BY-NC-SA 3.0, which is restricted for commercial purposes. Further developments, especially variations in the form of other superstructures, are closed. This is not yet ideal, but knowledge of the core system facilitates repairability and allows modifications to be made.

While the consumer sector is still experimenting, the research sector is already little further along. Although it is the exception rather than the rule that publicly funded projects make their developed technologies available under a free licence and documented, this becomes more common. Dedicated funding guidelines should reverse this proportion. Separate documentation funding is one way of ensuring subsequent use. Beyond this, however, the number and use of technologies published as open hardware is increasing. Business models are regarded in the scientific context, especially in servicing the elaborate systems, for example by providing spare parts or custom-made products (Pearce 2017).

As already mentioned, open-source in the software sector has a big head start over hardware. Besides the obvious economic aspects, this goes hand in hand with challenges in terms of documentation. "The biggest problem is not writing documentation, but keeping that documentation up to date" (Austic et al. 2020). Hardware consists of numerous knowledge resources, which places special demands on tracking changes. It is therefore necessary to further develop dedicated versioning systems.

Another challenge is the question of when hardware is really documented for re-use. This is because reconstructing physical objects requires very different resources, such as technical drawings, parts lists or assembly plans. The DIN SPEC 3105 (Meyer 2020) and the OPEN! project provide initial answers, by developing frameworks and evaluation criteria.

Makerspaces

When seen through the magnifying glass of the pandemic, the decades-long failings in adapting the education system to the needs of the postmodern age are particularly evident. Teaching digital, technical and technological skills is still in its infancy. This, along with the division of labour, has also resulted in an intellectual decoupling from the technical infrastructure, which we as consumers are now blindly at the mercy of (Simondon 2012). This creates numerous problems, especially when it comes to resource-saving use. Technical-technological competences are an essential basis for leading a self-determined and resource-saving life. Fostering these and not putting undue strain on educational institutions requires open spaces where learners and teachers can engage with technology in a self-determined way, to develop their own approaches. Such access is provided by numerous extracurricular places of learning throughout Germany, such as makerspaces.

The character of a makerspace emerges when comparing it to a vocational training workshop. There, the focus is on concrete job profiles with a productive character. There are teachers who imbue trainees with knowledge or make them fit for a certain branch of work or a specific job profile. The goal is therefore a certain level of qualification. This stands in contrast to makerspaces. Such experts may also be on hand there, but they are not the centre of attention. Rather, it is about the mutual empowerment of equals. This does not have the primary aim of producing a qualification certificate, but is about the practical hands-on knowledge itself. Makerspaces bring together people who are interested in learning by doing, in passing on their experiences to others and in becoming a social community. This self-determined learning enables very individual access to technical objects and in this way also promotes the responsible use of technology in everyday life.

Interfaces for local learning and economic development

In addition to social and technical engagement, makerspaces are also learning spaces in which the sharing of knowledge, which is the fundamental practice behind open-source, becomes tangible. As hubs of regional learning networks, they can bring together numerous knowledge resources and promote exchange. In this way, innovations from civil society and extra-institutional contexts are transported into formal institutions and an open learning culture is established that focuses on collaboration and instils a culture of knowledge sharing.

Makerspaces also play a prominent role with regard to local economic spaces, such as circular systems. They enable customised one-offs or spare parts that are no longer available to be produced (rapid manufacturing), as well as the further development and repair of existing technologies. Typical equipment in addition to common hand tools, typical equipment includes a 3D printer, laser cutter and other CNC machines to process different materials and workpieces. True to the motto: make almost everything (Bergner 2017).

Visions for structural change

Embedded in local contexts, makerspaces are places for raising and spreading new ideas, for self-empowerment and participation in open-source. Emancipation from outmoded structures and the search for new ways of doing business are particularly important in rural areas. The context of makerspaces gives rise to a resilient civil society that is largely independent of global structures and taps into its own, local resources (Lange et al. 2016). Open-source hardware and software, solution-oriented action, infrastructures of mid-range technologies that improve independent experimentation and locally situated economies enable promising visions for a resource-efficient life.

References

Bergner, A. (2017): Make-Design-Innovate. Das Potential des Maker-Movements für Innovation, Kreativwirtschaft und Unternehmen. Coburg, Hochschule für angewandte Wissenschaften Coburg.

Austic, G./Stirling, J./Molloy, J. (2020): Open Hardware Distribution & Documentation Working Group: Introduction to Documentation and Quality Assurance Frameworks. https://journalopenhw.medium.com/open-hardware-distribution-documentation-working-group-introduction-to-documentation-and-5543bc978eec

Lange, B./Domann, V./Häfele, V. (2016): Wertschöpfung in offenen Werkstätten. Eine empirische Befragung offener Werkstätten in Deutschland. Berlin, IÖW.

Meyer, C. (2020): DIN SPEC 3105: Normungsvorschlag für Open-Source-Hardware. www.heise.de/news/DIN-SPEC-3105-Normungsvorschlag-fuer-Open-Source-Hardware-4868528.html

Pearce, J. M. (2017): Emerging Business Models for Open Source Hardware. In: Journal of Open Hardware 1/1: 1–14.

Simondon, G. (2012): Die Existenzweise technischer Objekte. Zürich, diaphanes.

AUTHOR + CONTACT

Maximilian Voigt works as a project manager for educational projects and the topic of open hardware at the Open Knowledge Foundation Germany and is a board member of the Association of Makerspaces in Germany.

Open Knowledge Foundation Deutschland e. V., Singerstr. 109, 10179 Berlin. E-mail: maximilian.voigt@okf.de

Transforming the energy system

Digitalizing the Energy System in a Sustainable Way

The energy transition requires a restructuring of the energy system and, as a result of decentralisation, also increasing digitalisation to integrate all actors and make them more flexible. However, digitalisation can be shaped and should happen under ecological and social premises.

By Swantje Gährs, Astrid Aretz, Friederike Rohde and Hendrik Zimmermann

Germany has set itself the goal of making its entire electricity supply greenhouse gas neutral by 2050 and reducing its energy demand by 50%. Both goals together form the basis of a sustainable energy supply. The share of renewable energies in the German electricity mix is currently 42.1% of gross electricity consumption (UBA 2020), which poses challenges for grid operation at both distribution and transmission grid level. This is because the availability of energy is no longer constant but fluctuating. Many small, spatially distributed generation units create the need for greater flexibility in the energy system. This energy transition is associated with a growing number of actors that are participating in the energy system for example by generating their own electricity or heat with photovoltaic systems, wind turbines or heat pumps, and in some cases also feeding it into the grids. This decentralisation and diversity of actors, however, also increases the complexity of the energy system and thus the requirements to coordinate actors and regulate market and grid activities. For a supply with almost 100% renewable energies to be possible at all, the energy must be balanced intelligently. The opportunities offered by ICT-devices, big data, machine learning as well as the business models based on them, are envisioned as an important step towards a successful energy transition (dena 2016). There is need for more and more information on grid conditions and operations, as additional storage facilities have to be integrated into the electricity system and the coupling with other sectors such as mobility and heat needs to be coordinated. The overarching vision is that digital technologies will enable energy flows to be measured, controlled and traded in real time. However, the physical changes in the energy system also require new forms of coordination (e. g., electricity market design) and new regulatory frameworks. This vision is thus strongly interrelated with political strategies and regulatory processes (e. g., the Climate Protection Plan 2050 or the Act on the Digitalisation of the Energy Transition), actors on the market who endeavour to open up new business areas or automate and flexibilise processes (cf. e. g., Maier 2018, Lied 2017), and also a strong civil society that not only accepts the changes but also promotes them through political pressure and new ideas and cooperation.

Flexible consumers and new forms of coordination

The Renewable Energy Sources Act (EEG) provides the opportunity for consumers to participate actively in the electricity market as producers of renewable electricity. Initially, the role of these so-called prosumers was limited to generating the electricity and feeding it completely into the grid. However, the self-consumption of self-generated electricity has significantly increased the scope for action. Consumers themselves could control the times at which they switch on electrical appliances in their household and thereby help to regulate their own consumption in a way that is more economical than feeding the electricity into the grid. Automatic controls and electricity storage have increased this scope even further. Digitalisation can create new forms of organisation and additional flexibility options from individual actors at household level through their networking and aggregation at district level. Developments such as local self-consumption (peer-to-peer or community electricity trading) as well as local or regional electricity markets, in which operators sell their surplus electricity directly to other consumers, are currently difficult to realise due to the regulatory condition. However, their implementation has already been successfully demonstrated in pilot projects.

These developments strengthen the role of consumers in the energy market. This is in line with the targets of the EU's Clean Energy Package, which are to be implemented in national law by all EU member states by the end of 2020 (European Parliament 2019). At the same time, it enables consumers to provide flexibility that can contribute to stabilising the electricity system. It makes sense for larger electricity consumers in particular to manage their own consumption and adjust it to market signals. This flexibilization must be supported more strongly. Additional storage facilities, such as those provided by electromobility, would significantly increase this potential. However, this requires enormous coordination efforts between

*Ökologisches*Wirtschaften *Online-Ausgabe* O1.2021 (36) | DOI 10.14512/OEWO360128

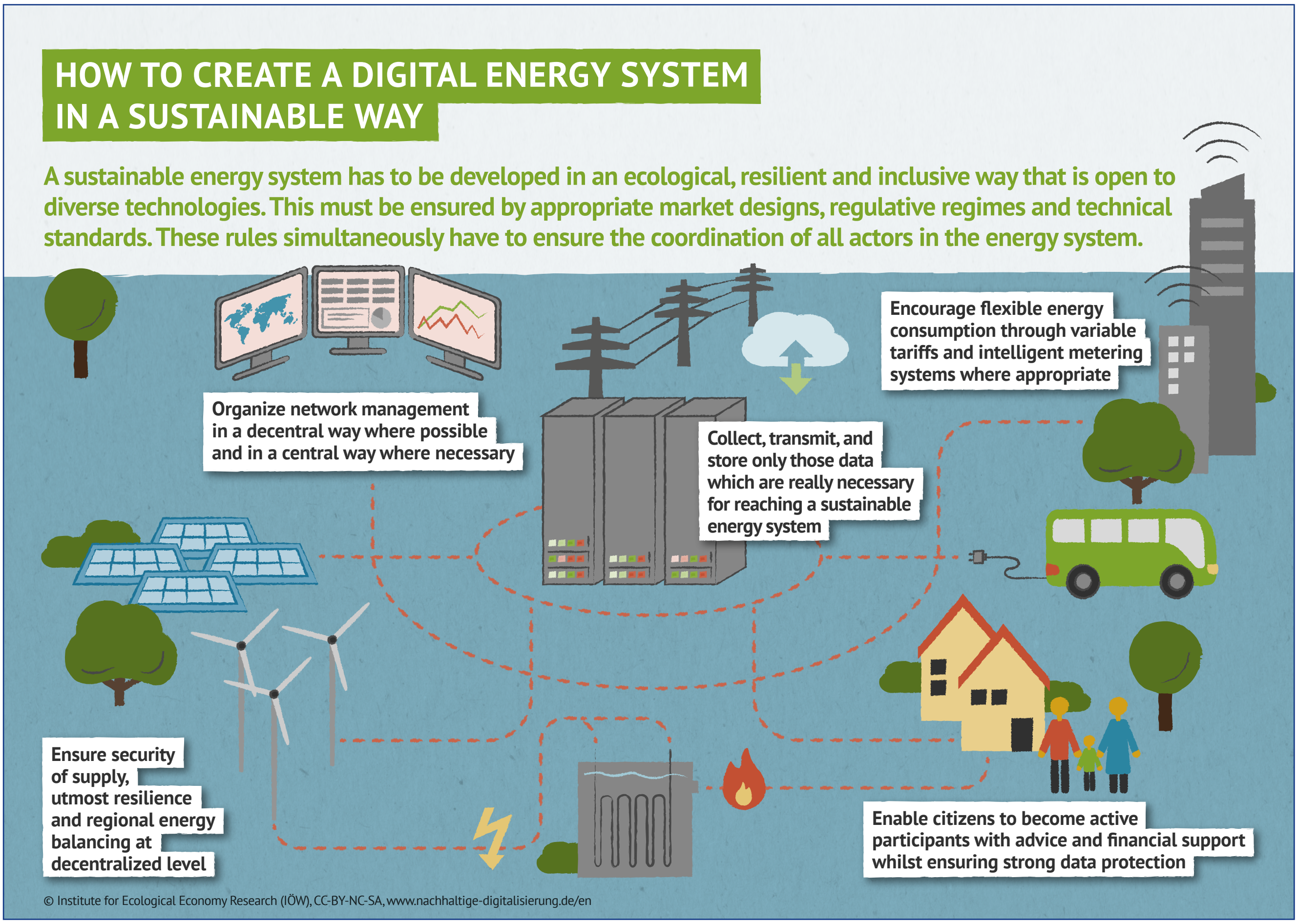

Figure 1: How to create a digital energy system in a sustainable way

the actors in the energy system, which cannot only be facilitated by digital solutions, but also requires changes on different levels such as a new electricity market design and decentralised organisation (see Figure 1).

Digitalised grid control in the smart grid

The increased complexity in the energy system resulting from distributed and fluctuating energy supply is making it more and more challenging to balance the supply and demand of energy within the distribution and transmission grids. The risk of unstable grid conditions increases. Intelligent electricity grids (smart grids) are intended to help overcome this complexity and ensure the stability of the electricity grids. A smart grid transports not only energy, but also data that enables grid operators to obtain information on electricity production, transport, storage, and consumption at short intervals. For example, they are able to know exactly when and where a decentralised generation plant feeds electricity into the grid. The greater availability of data through sensor technology (in particular through smart metering systems) allows grid operators to better record their grid and, if actuators are available, also to intervene in a controlling manner. This means that a stable grid situation can be ensured at all times, even with a high proportion of decentralised electricity generation, and existing grids can be utilised to a greater extent (Expertengruppe Intelligente Energienetze 2019).

However, significant challenges are remaining with regard to smart grids that have not yet been addressed in a reasonable way. For instance, there are rules that allow grid operators to switch off individual producers or consumers in the event of grid bottlenecks, in order to avoid a power blackout. It remains unclear though, which economic and technical criteria should be used to select the shutdowns in a complex context from a multitude of options. This is where algorithms and digital tools should provide support. It is also true that, in principle, the responsibility between distribution system operators and transmission system operators has been clarified according to grid levels in the current energy system. But the changing roles when there are multi-layered interactions between these levels are still being negotiated. It is also unclear how access to the collected data is organised and which platforms are suitable for this.

"The fundamental transformation of the electricity system opens up the possibility of integrating resilience strategies and promoting social balance."

The material foundation of smart energy systems

Reducing absolute energy consumption is imperative for achieving climate protection goals. Only a reduction of 50% by 2050 makes a complete switch to renewable energies "at all realistic" (Prognos/Öko-Institut/Wuppertal-Institut 2020). But do the resources, data flows and possibly additional energy requirements necessary for digitalisation justify the savings that can be achieved as a result? Especially the production of digital devices requires some energy. For example, according to our own calculations based on Sias (2017), the production of an advanced metering system (iMS) (without smart meter gateway) produces 91 kg of CO_2 equivalents, while a Ferraris meter comes in at around 8 kg of CO_2 equivalents. The power consumption in operation is also somewhat higher with an iMS including the smart meter gateway. A comprehensive assessment of the environmental impact also requires consideration of the lifetime, energy consumption of data centres and production conditions (see Pohl et al. this issue).

The consumption of energy and resources must now be contrasted with the positive effects of digital technologies. These are to be expected first and foremost where digital technology has been installed and may relate to expected efficiency gains. For example, electricity savings when using a weather forecast control system in a multi-family house range between 4 and 20% annually (Hengstenberg 2018; Oschatz/Mailach 2017) and between 2.5 and 5% when using online efficiency monitoring (Hermann et al. 2019). However, the expected efficiency gains can be overcompensated if additional digital devices are acquired.

Particularly in the electricity sector, digitalisation often aims at positive effects on a higher level. An important level of impact, however, is in grid control, which should enable better utilisation of the electricity grids through knowledge of grid conditions and energy demand, while at the same time increasing the share of renewable energies. A similar systemic effect is expected for remotely controllable loads such as heat pumps. The expectation for the control of flexible loads is that digitally coordinated load shifting will have a positive effect on the grids on the one hand, whilst on the other hand reducing renewable energy curtailment.

The intended effects of a digitalised energy system can therefore be very diverse. At the same time, they are still very uncertain in many places. Nevertheless, initial studies indicate that in the area of smart energy systems, the savings achieved are greater than the negative environmental impacts caused by the production and operation of sensor technology, measuring devices and ICT and the data transfer (Ipsen et al. 2019).

New vulnerabilities

Future life and economic activities with a growing number of electrical and electronic devices depend to a large extent on a stable and reliable power supply. Digitalised electricity grids harbour risks for cyberattacks that can endanger security of supply. This increases the system's vulnerability. Against the background of such potentially catastrophic, economically and socially hardly sustainable consequences, the question of the vulnerability and resilience of the power supply system is of central importance.

The fundamental transformation of the electricity system that is currently underway opens up the possibility of integrating resilience strategies into the design of the electricity system. A major focus here is on the granularity of the system architecture. This refers to the size of the smallest network element of the power supply that is to be stabilised. Whether granular systems are inherently more resilient is currently a matter of debate among experts (e.g., Hirschl et al. 2018). There is agreement that central systems can have different vulnerabilities than decentralised systems: Central components are highly vulnerable because their failure can have far-reaching consequences for system stability, whereas smaller components in a decentralised system do not have such far-reaching consequences. On the other hand, vulnerability is seen in the large number of similar system components (such as parts, software, protocols and standards) that may be less well secured or maintained and therefore represent a target for attack in their entirety. Diversification of system components and software is therefore seen as a strategy to reduce vulnerability (acatech 2017). In this context, the use of open standards and open-source software is also discussed (Pohl et al. 2020). Likewise, the provision of redundancies is an important additional measure to ensure security of supply. This does, however, go hand in hand with increased resource requirements. The topics of IT security, data protection and data security are also important in a digitalised energy system. In Germany, the Cybersecurity Act regulates how metering point operators must protect their systems from manipulation and unauthorised access. From the consumers' perspective, better data protection could be ensured through clearer T&Cs with privacy-by-design and privacy-by-default and through a strict e-privacy regulation.

Social aspects of a digitalised energy system

The social aspects of a digitalised energy system are evident at various levels. Digitalisation initially has an impact on the costs for consumers. Intelligent grid control can, for example, reduce the costs of grid operation and thus the grid charges by contributing to grid stabilisation. Since grid charges account for a large share of electricity prices and electricity prices have a regressive effect, equipping the grids from medium to extra-high voltage with sensors and actuators is particularly worthwhile.

The digitalisation of grid operations can also promote social balance: For example, a calculation algorithm that keeps transaction costs low could enable a favourable horizontal equitable distribution of grid charges. This can provide financial relief for people in rural areas (with few grid connections in the neighbourhood) or in regions with a high share of renewable energies in electricity generation (and resulting strong fluctuations in grid status).

The use of smart meters in low voltage also has the potential to reduce overall system costs in the long term and consequently also costs for socially disadvantaged people (Faruqui et al. 2010). Smart meters are currently most profitable for people with energy technologies such as solar systems, home storage or electric cars, or with particularly high electricity consumption, which is why the costs of these consumption groups are reduced more in relative terms. From a social point of view, the costs of smart meters for households with low consumption should therefore be (partly) financed by the state. Smart meters should enable and incentivise flexibility through sufficient sensor and actuator technology, and exploit the physical potential of flexibility. This requires variable price signals on the market side, which can be implemented, for example, by means of variable grid charges. Smart meters can enable consumers to regulate their electricity consumption in a more cost-oriented way. So-called pre-payment meters (PPM) with an advance payment function can, for example, help to relieve the burden on companies' payment arrears departments (Kopatz 2012). These are currently used mainly by the socially disadvantaged and frequently part of the charge is used to pay off debts. This is to prevent the socially disadvantaged from getting (further) into debt. However, especially in energy-poor households, energy saving potentials are low. Debt repayment and electricity consumption are usually not perceived separately, which is counterproductive to improved control of one's own consumption (Berger 2017). As PPMs shift the responsibility for supply to consumers, so-called "self-disconnections" can occur in financial emergencies (Coutard/Guy 2007). Where previously humans could exercise leniency, technology then decides without empathy (Ingram et al. 2007). In addition to lighting, however, refrigerators, cooking facilities or the internet are also turned off. A lack of electricity and light can be noticed in the neighbourhood and result in stigmatisation. The subsequent costs are often borne by society (Reibling/Jutz 2017). The use of PPMs should therefore be opposed from a social point of view.

Beyond this cost issue, digitalisation enables the integration of decentralised renewable energy systems and consequently often also the participation of members of the public in the energy supply. Digital technologies facilitate new supply structures that enable everyone to participate, if not as a producer, then at least as a consumer. However, to ensure that not only house- or landowners benefit, the framework conditions for tenant electricity must be significantly improved. Other promising models that could become increasingly important in the future are communal self-sufficiency or peer-to-peer trading. This strengthens the role of members of the public. At the same time, it opens up the opportunity to increase participation in the energy system and acceptance for the transformation requirements of the energy system (e. g., expansion of renewable energies).

Political governance …

The digitalisation of the energy system brings new challenges in terms of political governance. The complexity of control in the interplay between highly regulated grid operation and a liberalised energy market is increasing.

Important regulatory foundations were laid with the White Paper *An Electricity Market for Germany's Energy Transition* (BMWi 2015), the Act on the Digitalisation of the Energy Transition (BMWi 2016) and the Green Paper on Energy Efficiency (BMWi 2017) resulting from consultation processes at the German Federal Ministry for Economic Affairs and Energy (BMWi). Significant challenges at regulatory level exist in the areas of digital metering, flexibility of end consumers and the creation of framework conditions for new business models (e.g. flexible tariffs). For instance, during the smart meter rollout it became apparent that there were initially no devices on the market that met the high security requirements of the Federal Office for Information Security (BSI). Progress has since been made here, for example in that the question of who may access which data from smart metering systems, and when, will in future become part of the principle of point-to-multipoint communication. It involves processing the metering data in the smart meter gateway and making it directly available to the relevant actors using end-to-end encryption.

… between energy market and grid regulation

Furthermore, there are still many unresolved legal issues in the area of flexibilization of the consumption side, which are currently being discussed in the context of a revision of Section 14a EnWG. This concerns in particular questions of the design of grid-friendly flexibility. However, there must not be too much emphasis on small, private consumers and the focus must be on regions with a strong expansion of renewable energy. There are also open questions concerning the regulations of storage facilities as consumption facilities and the harmonisation of the Renewable Energy Sources Act (EEG) with the Me-

"The digitalisation of the energy system brings new challenges in terms of political governance."

tering Point Operation Act (MsbG), which are currently being worked on (Ernst & Young 2020).

The future challenge for the digitalisation of the energy system is to bring policymaking in line with technical developments, whilst keeping in mind not only the security of supply, reliability and affordability of the energy supply, but also climate and resource protection, data protection and social justice. These sustainability aspects should be at the centre of the design of a digitalised energy system.

References

acatech (2017): Das Energiesystem resilient gestalten: Maßnahmen für eine gesicherte Versorgung. www.acatech.de/publikation/das-energiesystem-resilient-gestalten-massnahmen-fuer-eine-gesicherte-versorgung/

Berger, T. (2017): Energie prepaid. Sozio-technische Implikationen im Management energiearmer KonsumentInnen durch Prepayment-Meter. In: Großmann, K./Schaffrin, A./Smigiel, C. (Eds.): Energie und soziale Ungleichheit. Wiesbaden, Springer. 403–424.

BMWi (2015): An electricity market for Germany's energy transition. Berlin, Federal Ministry for Economic Affairs and Energy.

BMWi (2016): Gesetz zur Digitalisierung der Energiewende. www.bmwi.de/Redaktion/DE/Downloads/Gesetz/gesetz-zur-digitalisierung-der-energiewende.html

BMWi (2017): Green Paper on Energy Efficiency: Evaluation report on the public consultation. Berlin, Federal Ministry for Economic Affairs and Energy.

Coutard, O./Guy, S. (2007): STS and the City Politics and Practices of Hope. In: Science, Technology, & Human Values 32/6: 713–734.

dena (2016): Grundsatzpapier der Plattform Digitale Energiewelt. www.dena.de/newsroom/publikationsdetailansicht/pub/grundsatzpapier-der-plattform-digitale-energiewelt/

Ernst & Young (2020): Barometer Digitalisierung der Energiewende. www.bmwi.de/Redaktion/DE/Publikationen/Studien/barometer-digitalisierung-der-energiewende-berichtsjahr-2019.html

European Parliament (2019): Regulation (EU) 2019/943 of the European Parliament and of the Council of 5 June 2019 on the internal market for electricity. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32019R0943

Expertengruppe Intelligente Energienetze (2019): Nutzen und Anwendungen Intelligenter Energienetze. Berlin, Expertengruppe Intelligente Energienetze.

Faruqui, A./Sergici, S./Sharif, A. (2010): The impact of informational feedback on energy consumption – A survey of the experimental evidence. In: Energy 35/4: 1598–1608.

Hengstenberg, J. (2018): Die vorausschauende Steuerung von Heizanlagen – Vortrag von Johannes Hengstenberg. www.senercon.de/2018/10/02/video-vortrag-zum-thema-vorausschauende-steuerung-von-heizanlagen/

Hermann, L./Hennig, P./Metzger, S./Köhrer, M./Pauser, L./Yanev, D./Homburg, A./Knauff, M. (2019): Energiemonitoring und Informationsaustausch bei Geräten und Anlagen (Zählerstudie). Final Report. Berlin, BAFA/BMWi/UBA.

Hirschl, B./Aretz, A./Bost, M./Tapia, M./Gößling-Reisemann, S. (2018): IKT und Stromversorgung: Potenziale und Risiken der Kopplung in Bezug auf Vulnerabilität und Resilienz. Final Report. Berlin, Bremen.

Ingrim, J./Shove, E./Watson, M. (2007): Products and Practices: Selected Concepts from Science and Technology Studies and from Social Theories of Consumption and Practice. In: Design Issues 23/2: 3–16.

Ipsen, K. L./Zimmermann, R. K./Nielsen, P. S./Birkved, M. (2019). Environmental assessment of Smart City Solutions using a coupled urban metabolism – life cycle impact assessment approach. In: The International Journal of Life Cycle Assessment 24/7: 1239–1253.

Kopatz, M. (2012): Energiearmut lindern: Prepaid statt Sperre. In: Energiewirtschaftliche Tagesfragen 62/11: 90–92.

Lied, A. (2017): Studie zur Digitalisierung der Energiewirtschaft. München, Becker Büttner Held Consulting AG.

Maier, M. (2018): Metaanalyse: Digitalisierung der Energiewende. Renewable Energies Agency. www.unendlich-viel-energie.de/mediathek/publikationen/metaanalyse-die-digitalisierung-der-energiewende

O'Sullivan, K. C./Howden-Chapman, P. L./Fougere, G. (2011): Making the connection: The relationship between fuel poverty, electricity disconnection, and prepayment metering. In: Energy Policy 39/2: 733–741.

Oschatz, B./Mailach, B. (2017): Kurzstudie Energieeinsparungen Digitale Heizung. Dresden, Institute for Building Systems Engineering Dresden.

Pohl, J./Höfner, A./Albers, E./Rohde, F. (2020): Nachhaltige Hard- und Software – für eine bessere (IT-)Welt. www.heise.de/hintergrund/Missing-Link-Nachhaltige-Hard-und-Software-fuer-eine-bessere-IT-Welt-4851588.html

Prognos/Öko-Institut/Wuppertal-Institut (2020): Klimaneutrales Deutschland. Zusammenfassung im Auftrag von Agora Energiewende, Agora Verkehrswende und Stiftung Klimaneutralität. www.agora-energiewende.de/veroeffentlichungen/klimaneutrales-deutschland-zusammenfassung/

Reibling, N./Jutz, R. (2017): Energiearmut und Gesundheit. Die Bedeutung von Wohnbedingungen für die soziale Ungleichheit im Gesundheitszustand. In: Großmann, K., Schaffrin, A./Smigiel, C. (Eds.): Energie und soziale Ungleichheit. Wiesbaden, Springer VS. 157–184.

Sias, G. G. (2017): Characterization of the Life Cycle Environmental Impacts and Benefits of Smart Electric Meters and Consequences of their Deployment in California. Los Angeles, University of California.

UBA (2020): Erneuerbare Energien in Zahlen. www.umweltbundesamt.de/themen/klima-energie/erneuerbare-energien/erneuerbare-energien-in-zahlen

AUTHORS + CONTACT

Dr. Swantje Gährs, ***Dr. Astrid Aretz*** and ***Friederike Rohde*** are researchers at the Institut für ökologische Wirtschaftsforschung (IÖW).

Institut für ökologische Wirtschaftsforschung (IÖW), Potsdamer Str. 105, 10785 Berlin. E-mail: swantje.gaehrs@ioew.de, astrid.aretz@ioew.de, friederike.rohde@ioew.de, Tel.: +49 30 8845940

Hendrik Zimmermann is an Energy Transition Researcher and Digital Transformation Policy Advisor at Germanwatch.

Germanwatch e. V., Stresemannstr. 72, 10963 Berlin. E-mail: zimmermann@germanwatch.org, Tel: +49 30 288835672

Achieving absolute reductions

Digital Sufficiency as a Principle for Energy Transition Policies

The energy transition will only succeed if digital tools are used under the guiding principle of digital sufficiency. Using only as much digitalisation as necessary to bring sufficient momentum to the urgently needed socio-ecological transformation of society.

By Irmela Colaço

Discussions about digitalisation often follow the narrative that "digitalisation" brings progress per se and should therefore be implemented as quickly as possible. Critical questions about where and what kind of digitalisation is necessary and will bring added value to society as a whole are often dismissed as technophobic.

Such perspectives distort discussions about digitalisation. Digital applications should be understood as tools. Depending on the goal and skill of the user, they can bring benefits or harm to society as a whole. It is therefore important to consider both the advantages and disadvantages and to define clear guidelines for the use of the tools.

Those guidelines should follow the principle of "digital sufficiency" in the sense described by Lange et al. (2019): Digital technologies should be designed thriftily as regards the use of energy, natural resources and data (technical and data sufficiency). In addition, they must be applied for the objectives of user sufficiency and economic sufficiency, which means that digital applications should aim to enable a way of life and an economy that is preferably based on local structures and freed from the pressure to grow. In a nutshell, digital sufficiency means as much digitalisation as necessary to bring sufficient momentum to the urgently needed socio-ecological transformation of society, but as little as possible to protect the environment and people from negative impacts.

Using the example of energy transition policy, this contribution outlines what this guiding principle could mean and where positive approaches, but also contrary movements and decisions, can already be observed.

Saving energy thanks to digitalisation

In order to transform the energy system towards 100% renewable energy sources quickly and in a resource-conserving, environmentally and socially compatible manner, energy consumption needs to at least be halved. However, the energy efficiency policy has so far not resulted in the necessary savings.

Many digital applications for visualising energy consumption, for automation and for monitoring the operation of production, heating and ventilation systems can exploit new energy-saving potential (Colaço et al. 2019). The German Federal Ministry for Economic Affairs and Energy (BMWi) would like to bring such applications into the mainstream with the funding programme "Einsparzähler" (Eng.: "Savings Meter"). Provided that a smart meter is used to monitor success, companies and actors in civil society receive a grant for innovative programmes that help to save energy through technical solutions or behavioural changes in target groups of their choice.

The funding programme partially fulfils the sufficiency criteria mentioned above. Firstly, the majority of the grant is only paid out if absolute energy savings can be proved. This success control ensures the effectiveness of the measures and curbs rebound effects, which can support user sufficiency defined by Lange et al. (2019). Smart meters and thus digitalisation facilitates this performance-based approach, which should be included in further funding programmes such as the KfW grants and loans for energy efficient construction and refurbishment. Secondly, the programme explicitly strengthens small actors and the use of open-source software. This supports local energy transition activities and community value creation (economic sufficiency). Thirdly, the installation of the smart meter is associated with a concrete added value and not only with a theoretical potential that may never be addressed. This is a right step in the sense of technical sufficiency.

Other criteria, however, such as using as few technical resources and as little data traffic as possible, are missing from this funding programme and should be included in its further development. This also counts to other funding programmes for "smart" technologies. It should be clarified for which parts new digital technology is necessary at all, where intelligence in a single unit of a system or facility is sufficient and where networking of different devices with each other or with third parties to the outside is necessary. If networking is advantageous, it would be necessary to check how long it has to be in place and what kind of data has to be transmitted how often in order to achieve energy-saving effects.

In addition to suitable funding and advisory programmes, however, there's an urgent need for legal requirements in order to reliably achieve the energy-saving goals and activate the

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"There is great innovation potential in digital products and services for both the decentralised organisation of the energy transition and the frugal use of energy."

innovation potential of new business models based on digitalisation. This includes the obligation for energy management in larger buildings or the mandatory commissioning measurement of heating systems, in which digital services can provide added value because errors in operation and their causes are more easily detected (Pehnt et al. 2016). Furthermore, legally defined energy saving targets are necessary to increase the pressure to take action across all sectors in order to contain the increasing energy consumption resulting from digitalisation (cf. Pohl et al. this issue).

Saving energy despite digitalisation

In Germany alone, data centres are expected to consume about 40% more energy by 2025 than in 2015 (Stobbe et al. 2015). Policymakers are primarily focusing on increasing energy efficiency in data centres, transmission networks and end devices. This is a basic prerequisite for the success of the energy transition and political regulations to this end should be put in place as quickly as possible. However, it is doubtful that a mere increase in efficiency is sufficient to reduce energy consumption reliably, quickly and sufficiently.

A huge environmental challenge in private households is that "smart" homes serve perfectly for companies to provide new consumption options. The associated narrative promotes the "smart" home with a view to a sophisticated, digital energy management system as ecologically advantageous. But it is neglecting that other components of the "smart" environment which promise comfort or security will at the same time weigh down the ecological footprint of a household heavily. Advertising and even the *Smart Living Business Initiative* supported by BMWi do not distinct between "smart" lifestyle products and "smart" offers that serve the socio-ecological transformation. Sustainability criteria are not discernible. This is a missed opportunity to make Germany's economy and households fit for the future since the number of digital end devices has a crucial influence on the digital carbon footprint of private users (Gröger 2020).

An essential lever for a sustainable digitalisation is to ensure durable, repairable and recyclable products (cf. Pohl et al. this issue) which can, amongst other positive environmental effects, reduce energy consumption in the industrial sector. First steps to anchor requirements for repairability and durability in the EU Ecodesign Directive are not far-reaching enough. Software-related obsolescence is neglected, which is disastrous in view of the rapidly increasing availability of "smart" products. Repair services offered by small crafts enterprises or civil society organisations are hindered because they have limited or no access to construction manuals and spare parts. Yet it is precisely the proliferation of such local repair initiatives and Makerspaces that could make an important contribution to the socio-ecological transformation (cf. Voigt this issue). This must be remedied as soon as possible and applied to further products.

Furthermore, in order to minimise energy consumption in the use phase, the trend towards more and more functions, larger screens and higher resolution must be stopped. This can be achieved by setting absolute energy consumption limits and progressive efficiency requirements in the Ecodesign Directive. Data frugality (cf. Pohl et al. this issue) and further aspects of sustainability for software and digital services, should be operationalised and included as a new requirement.

Besides the efficient and sufficient design of devices and infrastructure, however, it is also necessary to look at the system as a whole. After all, in an economic system dependent on growth, it should for example be feared that longer-lasting products will not mean that fewer products are put into circulation overall. A sufficient reduction in energy consumption requires overarching measures that pave the way to a social economy ("Gemeinwirtschaft") without the pressure for growth, very much in the spirit of the economic sufficiency mentioned at the beginning.

Digitalisation and decentralisation

An important pillar of a social economy is not only the release from the pressure for growth, but also the re-regionalisation of value creation, as ensured by a decentral organised energy transition. For decentralised infrastructures distribute the benefits and financial profits amongst municipalities, public utilities and citizens, instead of leaving them in the hands of large energy suppliers, mineral oil and state-owned companies in oil-rich countries. The regional balancing of supply and demand also minimises energy losses as well as costs and resources for transport and storage.

A local and regional electricity trade as well as balancing the temporally fluctuating energy supply with the energy demand will require many digital interfaces and services. The political strategy in Germany currently envisages equipping larger consumers with a smart meter across the board and thereby creating a technical basis for such services. The catch is that the added value of the smart meters for the energy transition is not yet guaranteed. Moreover, political practice leaves considerable doubt as to whether the federal government actually has an interest in strengthening prosumers, landlord-to-tenant electricity supply ("Mieterstrom"), peer-to-peer sharing and other forms of a decentralised design of the energy transition. Energy citizenship has already been massively stifled with the switch to tenders. In course of the revision of the Renewable Energy Sources Act at the end of 2020, the BMWi planned to phase out subsidies for renewable energy systems that are more than 20 years old and to establish an obligation to install a smart meter even for small systems, which would have made them economically highly inefficient. These and other proposals would have worsened the situation for small citizen-operated renewable energy plants and were prevented only at the last minute. However, fair and appropriate framework conditions in order to boost the energy transition "revolution" by citizens, as demanded by the European Union, are still missing.

Using the energy transition for transformation

From Friends of the Earth Germany's point of view, the essential question for the advancement of the energy transition is therefore not whether sufficient digital solutions are available for the decentralised organisation of the energy transition. Instead, the focus is on the question of whether the energy transition will remain in the hands of large corporations or whether it will be shaped by citizens and digital applications will therefore contribute to social and economic change.

When designing the technical infrastructure for the energy transition, it should be considered that upgrades and data collection should only take place where proven added value can be expected. For example, there is reason to doubt the vision that everyone should contribute to the success of the energy transition by remotely controlling their washing machine so that it runs when the sun is shining, and the wind is blowing. In order to minimize data traffic and complexity it should rather be discussed where standard load profiles will be sufficient for the balancing of energy supply and demand. Those visions rather reinforce dominant narratives of the industry as mentioned previously, that promote "smart", networked devices as good for the energy transition and thus create new needs for consumption.

The ecological price for this narrative can be high. Across Europe, the networked standby consumption of household appliances could increase to up to 14 terawatt hours per year by 2025 (Hintemann/Hinterholzer 2018), which is equivalent to the annual electricity consumption of all households in the Czech Republic. Above that, short product lifetimes and software restrictions could lead to increasing resource consumption.

In summary, there is great innovation potential in digital products and services for both the decentralised organisation of the energy transition and the frugal use of energy. What has been lacking so far are guidelines and regulatory conditions oriented towards digital sufficiency to steer this potential in the right direction and to constrain it where it impedes the resource-conserving, socially acceptable and environmental-friendly success of the energy transition.

References

BMWi (2015): Entwicklung des IKT-bedingten Strombedarfs in Deutschland: Abschlussbericht. www.bmwi.de/Redaktion/DE/Downloads/E/entwicklung-des-ikt-bedingten-strombedarfs-in-deutschland-abschlussbericht.pdf?__blob=publicationFile&v=3

BMWi (2020): Smart Living: Die Digitalisierung der Wohn- und Lebensumgebung: Chancen für die deutsche Wirtschaft. www.smart-living-germany.de/SL/Redaktion/DE/Publikationen/2018-flyer-sl.html

Colaço, I./Brischke L.-A./Pohl, J. (2019): „Smartes" Zuhause – Zum Beitrag vernetzter Haushalte für den Klima- und Ressourcenschutz. In: Höfner, A./Frick, V. (eds.): Was Bits und Bäume verbindet – Digitalisierung nachhaltig gestalten. München, oekom. 28–31.

Gröger, J. (2020): Digitaler CO_2-Fußabdruck – Datensammlung zur Abschätzung von Herstellungsaufwand, Energieverbrauch und Nutzung digitaler Endgeräte und Dienste. https://bund.net/studie_digitaler_fussabdruck

Hintemann, R./Hinterholzer, S. (2018): Smarte Rahmenbedingungen für Energie- und Ressourceneinsparungen. https://bund.net/kurzstudie_smarthome

Lange, S./Santarius, T./Zahrnt, A. (2019): Von der Effizienz zur digitalen Suffizienz – Warum schlanke Codes und eine reflektierte Nutzung unerlässlich sind. In: Höfner, A./Frick, V. (eds.): Was Bits und Bäume verbindet – Digitalisierung nachhaltig gestalten. München, oekom. 112–114.

Pehnt, M./Mellwig, P./Wehrle, M. (2016): 13 Maßnahmen gegen Energieverschwendung im Heizungskeller – Kurzgutachten zur Stärkung von Instrumenten für Energieeinsparungen im Bestand: Beispiel Heizkessel. https://bund.net/kurzgutachten_heizung

AUTHOR + CONTACT

Irmela Colaço is Project Manager for Energy Saving at Friends of the Earth Germany.

Friends of the Earth Germany (BUND), Kaiserin-Augusta-Allee 5, 10553 Berlin. E-mail: irmela.colaco@bund.net, Tel: +49 30 27586466

Discussing implications of Artificial Intelligence

Sustainability challenges of Artificial Intelligence and Policy Implications

Automated decision-making based on Artificial Intelligence is associated with growing expectations and is to contribute to sustainable development goals. Which opportunities and risks for the environment, economy and society are associated with Artificial Intelligence-based applications and how can they be governed?
By Friederike Rohde, Maike Gossen, Josephin Wagner and Tilman Santarius

Advances in Artificial Intelligence (AI) effectiveness have made its application ubiquitous in many economic sectors. Whether speech or facial recognition, computer games or social bots, medical diagnostics or predictive maintenance, or autonomous driving, many actors expect opportunities not only for product innovations and new markets but also for new research perspectives. Economic and political actors alike expect AI-based systems and applications to contribute positively to sustainability goals (Jetzke et al. 2019). These include, for example, the opportunities offered by AI for improving the management of smart grids (Jungblut this issue), and transport infrastructures, for conducting more precise earth observation, for creating new weather warning and forecasting systems, or for enhancing solutions for waste and resource management.

Do we really talk about Artificial Intelligence?

AI is generally used to describe machines (usually computers) that mimic cognitive functions, for example by reproducing human decision-making structures through functions with trainable parameters. AI research typically addresses problems of reasoning, knowledge representation, planning, learning, natural language processing, and perception. While the comprehensive reproduction of human intelligence, usually referred to as "strong AI" (e.g., CogPrime, cf. Goertzel et al. 2014), is still far from real-world application, "weak AI", such as deep learning, is now increasingly found in numerous applications. These forms of "weak AI" are also described as computational intelligence (Poole et al. 1998) or intelligent agents (Russell/Norvig 2003) as they allow decision preparation, and even implementation, to be delegated to computers. Those algorithmic decision-making processes can include anything from highly complex neural networks to quite simple software applications that calculate, weigh up and sort data based on simple rules (cf. AlgorithmWatch 2018). In this arcticle, we focus on weak AI, for example decision-making with more or less complex data-learning algorithms.

Yet even weak AI-based systems and applications (in the following we will only use the term AI) allows computers to partly take over human decision-making and to fully automate systems' management as, for example, when supporting architects in constructing new buildings, doctors in making medical decisions, recruiters in selecting new employees or assigning Uber-drivers to trips. However, AI uses data and algorithmic reasoning to make recommendations that are not transparent – and that in many cases not even AI-researchers fully understand. Therefore, the current rise of AI raises questions of what form of comprehensive political rules are needed to ensure the human-centred and ecological use of those technologies. This article helps to shed light on the social, ecological, and economic implications of AI and on what guidelines, rules and regulations need to be discussed and implemented to address sustainability concerns.

There are two interlinked perspectives of how to relate AI to sustainability. The first one refers to employing AI in areas that contribute to socially and ecological desirable developments, such as climate protection or education (AI for sustainable development; see Jungblut, this issue). We investigate the second perspective, which refers to developing, implementing, and using AI in a way that minimizes negative social, ecological and economic impacts of the applied algorithms (sustainable AI).

Rules for responsible Artificial Intelligence

Over the last decade, several issues concerning the societal implications of AI and the respective Algorithms have been discussed intensively, mainly under the concept of ethical AI guidelines (see Jobin et al. 2019 for an overview). Aspects such as transparency, trustworthiness, autonomy, and data protection are discussed – while the consideration of ecological and equitable aspects of AI is, by and large, still lacking. The AI Ethics Global Inventory (AlgorithmWatch 2020) identifies more than 160 rules or guidelines published by diverse actors including not only NGOs, business associations and trade unions but also various governments and intergovernmental organizations such as the United Nations and the European Union (EU). The rules for using AI can range from recommendations

*Ökologisches*Wirtschaften *Online-Ausgabe* O1.2021 (36) | DOI 10.14512/OEWO360136

over voluntary commitments to binding regulations, some of which are currently developed at the EU-level.

For example, the NGO iRights Lab developed the *Algo.rules*, a catalogue of nine rules that should be adhered to in order to enable and facilitate a socially beneficial design and appropriate use of Algorithmic Systems. These rules include aspects such as strengthening competencies of those who develop, operate and/or make decisions regarding the use of algorithmic systems or define responsibilities in a transparent and reasonable way and not transfer the responsibility to the algorithmic system itself, users or people affected by it. Other rules define that objectives and expected impact of the use of an algorithmic system must be documented and assessed prior to implementation, the application must have been tested, and the use of an algorithmic system must be identified as such (Bertelsmann Stiftung/i.Rights Lab 2020). The compliance with these rules should be ensured by design when systems are being developed.

The EU has published a White Paper providing a general regulatory regime for developing and implementing AI. The White Paper is based on recommendations from the High Level Expert Group on AI, which published its Ethical Guidelines for a Trustworthy AI in April 2019 (AI HLEG 2019). The White Paper focuses on creating "ecosystems for excellence", as well as on trust and a safe and trustworthy use of AI. An "ecosystem for excellence" mainly refers to the cooperative action of EU member states to maintain Europe's leading position in research, promote innovation, expand the use of AI, and achieve the objectives of the European Green Deal. The "ecosystem for trust" is based on existing law, in particular on the provisions of the General Data Protection Regulation (GDPR) and the directive on data protection in law enforcement.

The White Paper's intended EU regulatory regime would apply extended regulation only to AI that contains a particular risk potential regarding protection of safety and consumer and fundamental rights (European Commission 2020). The White Paper proposes defining high risk cumulatively: AI used in "high risk" sectors such as health, transport, police or jurisdiction and AI application that poses significant risks, i. e., the purpose of the respective AI. Regarding for example the health sector there is a difference between using AI for appointment scheduling in hospitals or using AI for medical diagnosis. The commission states that AI for the purpose of "remote biometric identification and other intrusive surveillance technologies would always be considered high-risk" (European Commission 2020: 18). In Germany, the Data Ethics Commission advocates a five-level risk-based regulatory regime, ranging from no regulation for the lowest risk AI to a complete ban for the highest risk AI, such as autonomous weapon systems. Finally, the EU announced in the White Paper it would foster the development of AI for climate change mitigation and for the protection of natural resources. Considering AI as an enabler, the EU aims to combine the European Green Deal with the development of "Trustworthy AI made in Europe" (European Commission 2020).

Sustainability challenges for Artificial Intelligence

Two questions are particularly relevant with regard to sustainable development and AI. First, are the data sets generally used to train AI algorithms at all useful for transforming existing production and consumption patterns towards sustainability? The challenge here is that existing data sets provide diverse information about the past but hardly any information about desired futures. Therefore, AI trained on historical data sets may be biased to reproduce the unsustainable status quo. To give an example: AI algorithms can optimize traffic flow management in cities or in logistics and thereby contribute to reducing fuel consumption per kilometre driven. But (how) can existing data sets train AI to help sustainably transform the transport system as a whole, e. g., to make it less car-dependent? Every weak AI or algorithmic system is only as good as the utility function it seeks to optimize and the data that it is based upon. That is, sustainability goals, such as reducing car traffic not only have to be implemented into the utility function of the respective algorithms but in the political regulations and conditions, as well.

Second, how can AI-supported sustainability transformations of production and consumption patterns be democratically legitimized? To stay with the transport example: Should AI-based recommendations be trimmed to inscribe preferences for ecological means of transport (bicycle, bus and train) over less ecological means of transport (car, taxi, plane)? Little doubt, other criteria such as travel time or safety are decisive for users when choosing a mode of transport. A situation may arise in which users cannot clearly understand which criteria (i. e., which specific set of preferences) are used in an AI-based recommendation system to make or propose decisions. To avoid sustainability transformations becoming visible only through the output of the systems, the algorithms must be as transparent as possible, as should information on the algorithm training data. This inclusion could prevent the data analysis from reproducing the discriminatory and unsustainable patterns existing in society (Wolfangel 2018).

Resource and energy intensities of Artificial Intelligence

The discussion about AI opportunities and risks has only recently begun to take into account how much energy and resources AI itself consumes for computing. The training period of an artificial neural network (ANN), devour particularly large amounts of energy. A study using BERT, an ANN used for speech recognition, found that the training period alone resulted in 0.65 tons of CO_2 being emitted (Strubell et al. 2019). This amount corresponds to the emissions generated from a return flight between Berlin and Madrid. However, the study's frequently cited result that "training a single AI model can emit as much carbon as five cars in their lifetimes" (Hao 2019) is in-

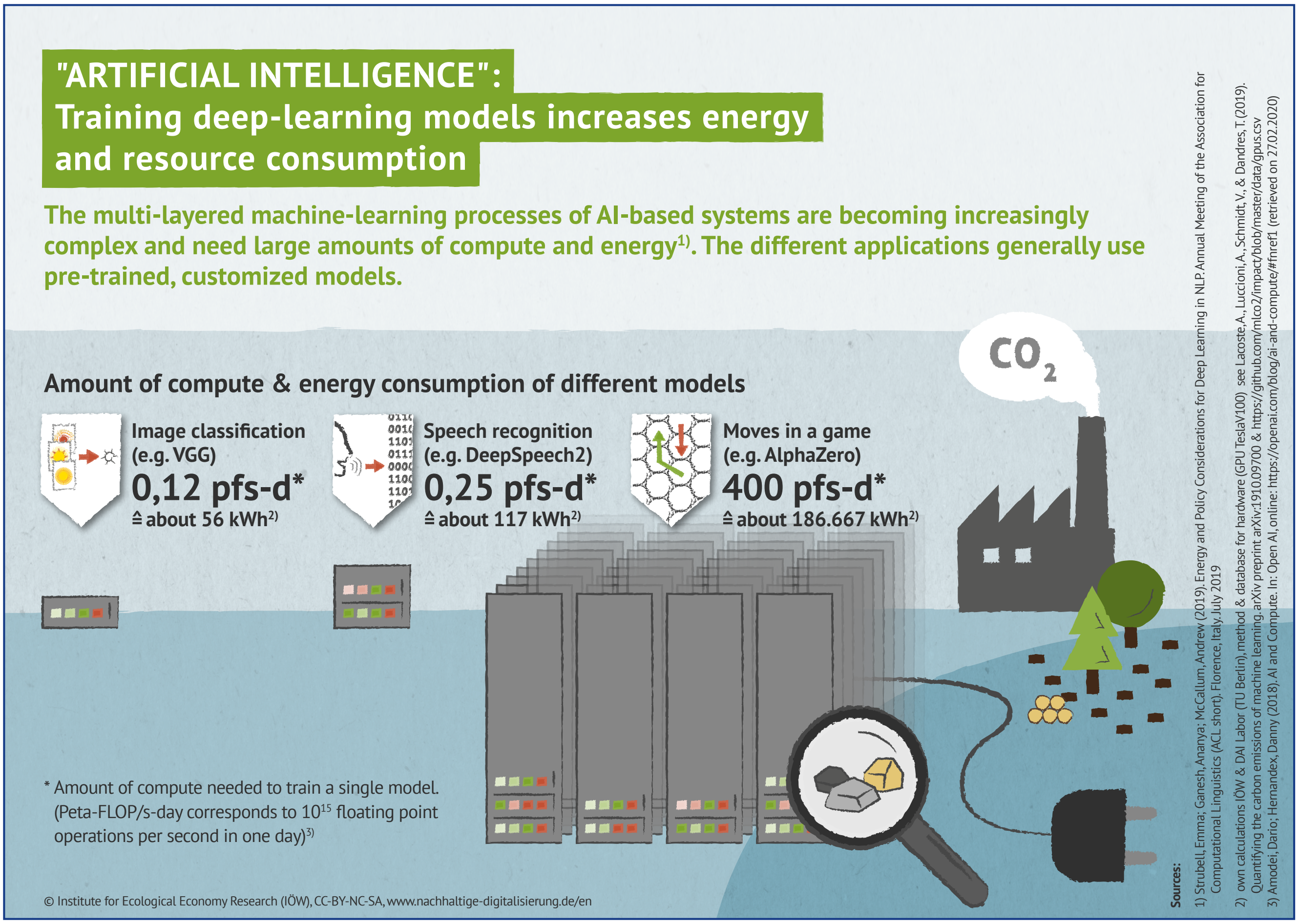

Figure 1: "Artificial Intelligence": Training deep-learning models increases energy and resource consumption

correct (cf. Lobe 2019). This often-cited amount of 313 tons of CO_2 refers to neural architecture search, very different from training a "typical" ANN. Notwithstanding, the training of increasingly complex deep learning models can be expected to require more compute and hence even more electricity (see figure 1).

Ensuring that AI – particularly those used for sustainability purposes – generate net benefits by reducing energy and emissions requires assessing whether the energy consumed in the training and use phases justifies the intended effects. Until now, most AI has not been used solely to improve sustainability but applied in other fields ranging from optimizing online advertising to industrial production or medical technology. That is, the impact which derives from this energy intensive training process is highly dependent on the application. How much additional energy consumption of future, yet-to-be-developed, AI can societies justify when, at the same time, they have committed to the UNFCCC Paris Declaration and want to achieve the 1.5 °C climate change goal? It appears evident that AI development must be related more strongly to socially and ecologically relevant challenges (Jetzke et al. 2019; see Jungblut in this issue).

Moreover, the development of applications for automated decision-making, data processing, tracking, or recommendation systems should take into account alternative methods and tools to calculate, predict and classify data. For example, the accuracy of an ANN for learning a new task involves an energy-intensive trial-and-error process (Strubell et al. 2019) that sometimes only leads to a comparatively small increase in network performance. In certain applications that currently use AI, statistical analysis methods, such as linear regressions, with a significantly lower energy consumption can lead to similar results. In addition to high power consumption, the AI's material requirements pose further ecological challenges due to the hardware used in data centres and end-user devices whose production is extremely resource-intensive (see Pohl et al. in this issue).

Ecological sustainability of Artificial Intelligence

Concerning general sustainability criteria for software, Naumann et al. (2011) developed a comprehensive catalogue of criteria that take into account an application's entire software life cycle – from the original coding, over its use, to deinstallation.

Moreover, the software criteria cover the kind of hardware a certain software requires. These considerations were further developed and extended to modern software architectures by also taking into account the electricity load on a remote server, the local client, or the network as a transport medium (Gröger et al. 2018). Applying a whole-system approach allows for sharpening the view for indirect effects, also referred to as higher order effects of ICT (Pohl et al. 2019) which relate to behavioural and structural changes, that occur due to new business models or the transformation of everyday practices, such as online shopping.

Schwartz et al. (2019) propose criteria that are suitable for assessing the ecological effects of AI and include criteria such as CO_2 emissions, power consumption, training duration, number of parameters, and number of floating-point operations (FLOP). However, these criteria raise the question of the type of measurement as different computers consume different amounts of energy for the same operation. The current project "Sustainability Index for Artificial Intelligence" [1], a cooperation between the advocacy organisation AlgorithmWatch, the Institute for Ecological Economy Research (IÖW) and Distributed Artificial Intelligence Laboratory (DAI) at TU Berlin, aims to develop a comprehensive set of sustainability criteria for AI-based systems and establish particular guidelines for sustainable AI-development.

In addition to guidelines for developing and applying AI, politics can set appropriate regulatory frameworks. Oftentimes, their focus is not specifically on AI only, but include wider technological developments that are AI-related, such as the GDPR, ePrivacy directive, energy prices, or the pricing of carbon emissions. Thus, CO_2-taxes on electricity could make the development of less complex and energy-saving models more attractive – incentivizing software developers and their clients to balance energy costs with performance benefits. One of the most relevant steps, not only for the development of AI but also for developing data-based applications in general, is the promotion of green cloud computing and green data centres, as argued by Köhn et al. (2020). Data centres should be legally bound to provide energy certificates that provide information on their energy consumption and performance. By collecting this information in a central data register, establishing and expanding new data centres can be better planned and promoted. Furthermore, cloud services should provide information on their ecological impact by way of a CO_2-footprint per service unit (e. g., per hour, per year). AI-developers should be obliged to report on the CO_2 emissions of the AI-models used, e. g., by way of initiatives such as the "CO_2 Impact Calculator" [2]. Creating greater transparency would also incentivize cloud providers to offer more climate-friendly services.

Finally, overarching incentive instruments for reduced energy and resource consumption, such as taxes on CO_2 or resource, a sustainability-oriented national (or EU-wide) resource policy, or public procurement guidelines could provide further incentives to enhance the development and use of the most energy- and resource-efficient AI, and for consumers to choose alternatives to AI where possible.

Regulation of market power and monopolies

The interests of actors driving the creation of new AI applications and markets will considerably determine whether and to what extent AI actually supports a transition towards sustainable production and consumption patterns. The majority of AI today pursues the aim to personalise services, forecasting customers' purchasing interests and optimizing online marketing and advertisements (Heumann/Jentzsch 2019). These applications intend to increase both individual and societal levels of consumption, which in many countries are already unsustainably high.

The marketing of AI-based technologies generates high revenues. For example, in the market segment of multi-purpose assistants such as Siri or Alexa, revenues of USD 11.9 billion are forecast for 2021 (Hecker et al. 2017). Large tech companies leading these markets are currently using AI to enhance their market power and competitive advantages. The related dominance of a few global tech corporations, first and foremost Google, Amazon, Facebook, Apple, Microsoft and a few others, will most likely continue with the development and commercialization of AI in the future (c. f. Kingaby, this issue; Staab/Butollo 2018). Due to the high importance of big data for AI, tech corporations are reluctant to make "their" data openly available to competitors, while using mergers and acquisitions to gain access to further data sources. Because the control over large amounts of data functions as a central barrier to AI market entry (Wiggerthale 2019), existing competitive challenges associated with large platform monopolies are likely to be aggravated in coming years. Since all large tech corporations are shareholder-owned, and hence have to service capital interests on financial markets, it is questionable whether increasing market concentration will help AI business models that place people and the planet over profits. Today's antitrust laws are not suited to counteracting this development. Since monopolies are legal under competition law, antitrust laws only take effect when companies abuse their market power to deprive competitors, exploit market partners, or raise unjustifiably high consumer prices.

Large concentrations of data in the hands of few actors are by no means a topic for antitrust and competition laws. If they were a topic, large tech companies would no longer be able to take over AI competitors and start-ups. Antitrust law worldwide should be reformed accordingly. For example, the initiative "Restrict Corporate Power" [3] urges the German government to prohibit dangerous monopolies in the digital economy under cartel law and to create legislation allowing them to be disbanded. To counteract the concentration of power on a few large platforms, independent data collaborations are being discussed (Heumann/Jentzsch 2019). According to research by the Stiftung Neue Verantwortung (engl. Foundation New Responsibilty) [4], numerous approaches already exist for jointly using data platforms or pools, but so far with little success. The state can support data cooperation by providing a distinct regulatory regime and more legal security, for example with regard to liability and data protection. Moreover, to curb data monopolies and, at the same time, make data more openly accessible for socially- and sustainability-oriented companies and other causes, governments could establish public data trusts to function as intermediaries between those actors that generate data and those that intend to use it (Staab 2019). Different data trusts could be established for energy-related, mobility-related, or (smart) city-related data.

To protect the interests and safety of consumers, necessary regulatory frameworks could also include liability issues (European Commission 2020). Due to the difficulty of tracing potentially problematic decisions made by AI, individuals harmed by an AI may not have access to evidence crucial for a court case. Relevant EU legislation should be adapted, and AI standardization should ensure that processes are comprehensible and accessible for evidence (German Bundestag 2020).

Finally, discussions are underway about a digital tax at the national or European level that would ensure value creation in the digital economy also contributes to financing public tasks (see Ganter, this issue). From a sustainability perspective, a further step would be discussing the allocation of funds solely for sustainable AI.

It is key to ensure that the broad application of AI-based systems, which opinion leaders expect in the future, will be implemented in a sustainable way. Modern data-driven architectures and specialized hardware and the peculiarities of machine learning and AI still lack suitable sustainability criteria. Achieving sustainable AI needs comprehensive guidelines, rules, and regulations. These should ensure a reasonable and purposive use of AI with regard to the desired objectives, ecologically sustainable, transparent and free from exclusion and discrimination.

Annotations

[1] www.ioew.de/projekt/sustain_nachhaltigkeitsindex_fuer_kuenstliche_intelligenz
[2] https://mlco2.github.io/impact/
[3] www.forumue.de/projekte/konzernmacht-initiative/
[4] www.stiftung-nv.de/

References

AI HLEG – High Level Expert Group on Artificial Intelligence (2019): Ethics guidelines for trustworthy AI. https://ec.europa.eu/digital-single-market/en/news/ethics-guidelines-trustworthy-ai

AlgorithmWatch (2018): Atlas der Automatisierung – Automatisierte Entscheidungen und Teilhabe in Deutschland. https://atlas.algorithmwatch.org/wp-content/uploads/2019/07/Atlas_der_Automatisierung_von_AlgorithmWatch.pdf

AlgorithmWatch (2020): Global Invetory. https://inventory.algorithmwatch.org/?sfid=172&sort_order=_sfm_i_date+asc+alpha

Bertelsmann Stiftung/i.Rights Lab (2020): Praxisleitfaden zu den Algo.Rules – Orientierungshilfen für Entwickler:innen und ihre Führungskräfte. www.bertelsmann-stiftung.de/fileadmin/files/alg/Algo.Rules_Praxisleitfaden.pdf

European Commission (2020): White Paper on Artificial Intelligence: A European approach to excellence and trust. commission-white-paper-artificial-intelligence-feb2020_en.pdf

German Bundestag (2020): Unterrichtung der Enquete-Kommission Künstliche Intelligenz – Gesellschaftliche Verantwortung und wirtschaftliche, soziale und ökologische Potenziale. Bundestags-Drucksache 19/23700.

Goertzel, B./Pennachin, C./Geisweiller, N. (2014): A Brief Overview of CogPrime. In: Goertzel, B./Pennachin, C./Geisweiller, N. (Eds.): Engineering General Intelligence, Part 1. A Path to Advanced AGI via Embodied Learning and Cognitive Synergy. Paris, Atlantis Press. 21–40.

Gröger, J./Köhler, A./Naumann, S./Filler, A./Guldner, A./Kern, E./Hilty, L./Maksimov, Y. (2018): Entwicklung und Anwendung von Bewertungsgrundlagen für ressourceneffiziente Software unter Berücksichtigung bestehender Methodik. Abschlussbericht. Dessau-Roßlau, Umweltbundesamt.

Hao, K. (2019): Training a single AI model can emit as much carbon as five cars in their lifetimes. www.technologyreview.com/2019/06/06/239031/training-a-single-ai-model-can-emit-as-much-carbon-as-five-cars-in-their-lifetimes/

Heumann, S./Jentzsch, N. (2019): Wettbewerb um Daten – Über Datenpools zu Innovationen. Berlin, Stiftung Neue Verantwortung e.V.

Jetzke, T./Richter, S./Ferdinand, J./Schaat, S. (2019): Künstliche Intelligenz im Umweltbereich – Anwendungsbeispiele und Zukunftsperspektiven im Sinne der Nachhaltigkeit. Dessau-Roßlau, Umweltbundesamt.

Jobin, A./Ienca, M./Vayena, E. (2019): The global landscape of AI ethics guidelines. In: Nature Machine Intelligence 1/9, 389–399.

Köhn, M./Gröger, J./Stobbe, L. (2020): Energie- und Ressourceneffizienz digitaler Infrastrukturen – Ergebnisse des Forschungsprojektes „Green Cloud-Computing". Dessau-Roßlau, Umweltbundesamt.

Lobe, A. (2019): KI ist alles andere als grün. www.spektrum.de/news/kuenstliche-intelligenz-verbraucht-fuer-den-lernprozess-unvorstellbar-viel-energie/1660246

Naumann, S./Dick, M./Kern, E./Johann, T. (2011): The greensoft model: A reference model for green and sustainable software and its engineering. In: Sustainable Computing: Informatics and Systems 1/4, 294–304.

Pohl, J./Hilty, L.M./Finkbeiner, M. (2019): How LCA contributes to the environmental assessment of higher order effects of ICT application: A review of different approaches. In: Journal of Cleaner Production 219: 698–712.

Poole, D./Mackworth, A./Goebel, R. (1998): Computational Intelligence: A Logical Approach. New York, Oxford University Press.

Russell, S.J./Norvig, P. (2003): Artificial Intelligence: A Modern Approach. Upper Saddle River (NJ), Prentice Hall.

Schwartz, R./Dodge, J./Smith, N.A./Etzioni, O. (2019): Green AI. http://arxiv.org/abs/1907.10597

Staab, P. (2019): Digitaler Kapitalismus – Markt und Herrschaft in der Ökonomie der Unkappheit. Frankfurt, Suhrkamp.

Staab, P./Butollo, F. (2018): Digitaler Kapitalismus – Wie China das Silikon Valley herausfordert. In: WISO direkt. Bonn, Friedrich-Ebert-Stiftung.

Strubell, E./Ganesh, A./McCallum, A. (2019): Energy and Policy Considerations for Deep Learning in NLP. In: Proceedings of the 57th Annual Meeting of the Association for Computational Linguistics.

VZBV – Verbraucherzentrale Bundesverband (2020): Weißbuch zur künstlichen Intelligenz. www.vzbv.de/sites/default/files/downloads/2020/07/27/20-06-30_vzbv_stellungnahme_weissbuch_ki.pdf

Wiggerthale, M. (2019): Konzernmacht in der digitalen Welt. Ökologisches Wirtschaften 33/1: 10.

Wolfangel, E. (2018): Programmierter Rassismus. www.zeit.de/impressum/index

AUTHORS + CONTACT

Friederike Rohde, ***Maike Gossen*** and ***Josephin Wagner*** are researchers at the IÖW.

Institut für ökologische Wirtschaftsforschung (IÖW), Potsdamer Str. 105, 10785 Berlin. E-mail: friederike.rohde@ioew.de, maike.gossen@ioew.de, josephin.wagner@ioew.de, Tel.: +49 30 8845940

Tilman Santarius is Professor of Social-Ecological Transformation and Sustainable Digitalisation at the Technical University of Berlin and the Einstein Center Digital Futures.

Technical University of Berlin, Marchstraße 23, 10587 Berlin. E-mail: santarius@tu-berlin.de, Tel.: +49 30 31478838

Gearing Artificial Intelligence towards purpose

Artificial Intelligence for Environmental and Climate Protection

There are numerous ways in which applications powered by intelligent algorithms can be used to benefit the environment and protect the climate. But to ensure an overall positive impact on the environment, Artificial Intelligence applications should be used with caution, and most importantly, only promoted in areas where they really make sense.

By Sarah-Indra Jungblut

Artificial Intelligence (AI) has long since found its place in our everyday lifes, in companies and in industry – whether it is as a search engine, a personal voice assistant or robots and autonomous machines programmed for specific activities. However, projects, start-ups, companies, and research projects that are developing and testing the use of AI to protect the environment or the climate are still an exception: A keyword search on Crunchbase by reset.org in June 2020 for the DBU-funded publication *Greenbook (1)*: *Künstliche Intelligenz – Können wir mit Rechenleistung unseren Planeten retten?* [*Artificial Intelligence – Can Computing Power Save Our Planet?]* (RESET 2020) revealed around 400 AI start-ups with a sustainability focus – compared to a total of almost 20,000 AI start-ups worldwide. A similar picture emerges in research. Even though there is an increasing number of studies that focuses on individual areas of application of AI in the context of sustainability, so far there are no studies at either a European or an international level that enable us to thoroughly evaluate research activities in this field. A short study commissioned by the German Environment Agency comes to the same conclusion (UBA 2019).

When looking at specific AI applications, it becomes clear that there is a large range of different areas where it is possible to apply AI to protect the environment and the climate, and that intelligent algorithms are in fact already proving to be highly effective (RESET 2020).

Learning algorithms for a smart energy grid

AI technologies harbour great opportunities for more effective management of the energy market, which is becoming more and more complex because of the increased use of renewable energies. Machine learning can help us, through simulations and forecasts for example, to gain a better understanding of the structure of the energy market and to better align and coordinate electricity production and consumption. AI-based systems can, for example, use data on the availability of storage, demand-side management, and power-to-X technologies to enable grid operators to use electricity from renewable energy sources instead of curtailing it as "surplus electricity". It is conceivable that this could create a kind of platform that enables transparent communication between all actors in the energy system, from citizens, local actors and municipal suppliers to grid-operating actors and energy supply companies.

The open-source project PowerTAC [1], which has developed a sophisticated AI-based simulation, shows what these approaches could look like in real life – by mimicking the interactions of energy suppliers and consumers, and providing potential avenues for balance and regulation in a system with a fluctuating energy supply. PowerTAC is now the largest open-source smart grid project in the world and the software has been downloaded over 10.000 times. It allows decision-makers and industry actors to gain a better understanding of the mechanisms required to implement and realise a decarbonised, decentralised, and digitalised energy system in the future.

For consumers, and also companies, to be able to recognise at what time electricity is produced most sustainably and to adjust their energy consumption accordingly, the British transmission network National Grid, together with Oxford University, the Environmental Defense Fund Europe and WWF, has developed a kind of "weather report" for clean electricity. The Carbon Intensity Forecast [2] uses regression models based on machine learning to predict the CO_2 intensity of electricity. This enables companies, for example, to use environmentally friendly electricity or to charge electric vehicles at times when there is a high proportion of green electricity in the mix.

Enhancing sustainable buildings with Artificial Intelligence

AI solutions can also provide forecasting, diagnosis, and control systems to help us operate existing buildings in a more energy-efficient and climate-friendly way. For example, AI can be used to link IoT (Internet of Things) data, electricity prices, weather data, data from airborne or terrestrial laser scanning, mobile mapping, RGB-D cameras (depth cameras), image matching or multi-beam echo sounding. The exchange of all

*Ökologisches*Wirtschaften *Online-Ausgabe* O1.2021 (36) | DOI 10.14512/OEWO360141

this information between the relevant components of an energy system makes it possible to adjust energy demand to energy supply. In practice, this means that heat pumps or refrigerators, for instance, start up when there is a lot of cheap electricity from renewable energies available.

Various start-ups and companies have begun to develop solutions in this area. At the heart of the approach adopted by Bractlet [3] of Austin, Texas, is the understanding that every building is a unique "ecosystem" with its own peculiarities and irregularities. Bractlet therefore pools data from different sources, such as utility bills, architectural documents, weather and real-time power consumption data, and uses machine learning algorithms to create a building's "digital twin". This is a simulation model that is almost identical to the actual building in terms of energy consumption and can be used to identify the most efficient energy-saving measures. By providing a space for digital experimentation, the company aims to minimise the risk of energy-saving products being installed incorrectly or not in the optimal location in a building's infrastructure, and ultimately being ineffective. According to the company, the suggested energy-saving measures could reduce energy costs by an average of around 30%.

In principle, the "digital twins" concept can be transferred to almost all kinds of physical objects, geographical regions or infrastructures. It is also possible that these simulation models could be used for geospatial solutions such as environmental monitoring, disaster management or urban planning (Döllner 2020).

Across all of the above examples, the more information is available, the better machine learning works. For example, to optimise the energy efficiency of apartments to fit the habits of the users, many analysis and forecasting tools collect data on how long residents or users spend in which room, when they are at home and what temperature they prefer, as the example of Leanheat [4] shows. An intelligent, self-learning control system combines the needs of the residents of an apartment building with the current weather conditions and the learned thermodynamics of the building.

Data protection and energy consumption

It is important to protect personal data in applications such as these. Leanheat uses end-to-end encryption for all data. An important approach to maintaining data protection is, of course, to collect as little data as possible from the outset (data avoidance and data economy), and also to ensure data protection-friendly technology design and appropriate default settings (privacy by design and privacy by default) (c. f. Pohl et al. this issue, Frick et al this issue). The GDPR already addresses these aspects to some extent. Data trust models, such as those proposed by the Stiftung Neue Verantwortung, go even further (Blankertz et al. 2020).

Another key aspect that influences the effectiveness of AI-based applications in terms of energy efficiency is their own energy consumption. Deep learning models in particular require large amounts of energy when being trained. It is therefore important to check in advance how much energy is being used in relation to the possible savings (c. f. Rohde et al. this issue).

Efficient use of resources

As the applications presented show, intelligent algorithms are particularly helpful in areas where a lot of data flows together and can be evaluated. This also makes Industry 4.0 a suitable (playing) field for the technology: In today's industry, production machines and industrial robots work together with planning and control software. Considerable amounts of data are generated across all processes and conventional methods of analysis quickly reach their limits. The intelligent algorithms are able to link huge amounts of a wide variety of data – giving us the opportunity to control machines and processes more efficiently and thus reduce energy consumption, resource expenditure and reject rates in the production process.

When it comes to cross-company value chains, the application of AI goes one step further. While most Industry 4.0 approaches as we know them today stop at company boundaries or direct supplier and customer interfaces, the use of AI can enable the linking of product and production-related data within (or even beyond) an industry's entire value chain. Tracking the entire life cycle of products and resource flows could prove to be an effective tool on the path towards a truly circular economy. The Environmental Digital Agenda from the German Federal Ministry for the Environment (BMU 2020), for instance, proposes the idea of developing a "digital product passport" for more transparency about the environmental impacts of different products. This would use intelligent algorithms to collect and provide information about where the raw materials come from, the working conditions it was produced under, how much CO_2 was generated in the process and information about how to recycle it.

Launched in February 2020, the REIF project [5] aims to use Artificial Intelligence to help reduce food losses in the dairy, meat and baked goods sectors by up to 90%. This involves building an AI-based system that increases communication and transparency between the different actors in the food industry and enables forecasting techniques to better match supply and demand.

The actual ecological benefit of this kind of applications is determined by how companies use the resources that they save, and it is important to avoid rebound effects. If the resources saved are only used to further increase production, this undermines the overall sustainability of the impact. However, if investments are made in more environmental technologies and processes, a positive ecological effect is to be expected. Environmental policy incentives and regulations therefore ought to be designed in a way that encourages companies to increasingly opt for efficiency instead of expansion (UBA 2019).

Applying Artificial Intelligence and avoiding overkill

In addition to the examples already mentioned, there are other areas where AI applications could boost sustainable development (see RESET 2020). These show that the potential applications of AI in the area of environmental and climate protection are diverse and that the technology can enable increased energy saving and resource efficiency. From a sustainability perspective, however, it is important not to lose sight of what actually makes sense. This does not only mean assessing whether the resource expenditure of a technology is in proportion to the resource use or resource reduction (c. f. Gährs et al this issue). Instead, we must always begin by asking which solution is the best for each particular problem. This means that in each use case we must consider whether a resource-intensive AI application is really necessary or whether a simple algorithm or a non-technical solution (such as new practices or organisational forms) might also be sufficient (c. f. Colaço this issue). The hype we are currently experiencing with regard to Artificial Intelligence reinforces the tendency to blindly believe in technology – "a new technology can only be better!" – and we run the risk of overkill.

Creating a climate of sustainability

Both the BMU's Digital Agenda and the White Paper (European Commission 2020) published by the European Commission in February 2020 already highlight the opportunities that AI offers for environmental and climate protection, as well as the regulations needed for sustainable development. But it remains to be seen whether the Digital Agenda, the White Paper and other nascent policy efforts will actually ensure that sustainability plays a more prominent role in AI development.

It is crucial to create sustainable conditions at various levels. Firstly, this includes creating further funding opportunities, as there are currently only a few funding programmes specifically geared towards sustainable AI. Funding programmes such as the "AI Lighthouses for the Environment, Climate, Nature and Resources" from the German Federal Ministry for the Environment (BMU) or programmes by Google and Microsoft are often aimed at individual projects and solutions rather than making AI development more sustainable overall.

Secondly, it is important to create new connections between research communities because there is currently (still) far too little collaboration between research communities working on AI and research communities working on climate and environmental issues. One of the organisations that has set out to build this bridge is Climate Change AI. This alliance of scientists wants to establish a platform for all those who are already working with AI technologies for positive climate impact, and those who would like to, and want to contribute to a reflected and critical discourse on the topic.

In order for AI to be used effectively to shape the complex challenges of our economy, all of the relevant actors from business, civil society, science and politics must work together, especially when it comes to generating, collecting and sharing data (Ellen MacArthur Foundation 2019). We must ensure that data can be shared openly and securely, allowing AI-based applications to be developed in a way that is accountable and involves all actors.

The lack of environmental and climate policy frameworks and incentives also means that sustainability aspects tend to be marginal issues in relation to AI-based technologies in particular, and also with regard to digitalisation in general. However, the more that sustainability is built into our entire digital infrastructure, the more sustainable AI applications will become.

Annotations

[1] https://powertac.org/
[2] www.carbonintensity.org.uk/
[3] https://reset.org/blog/fuer-mehr-energieeffizienz-bractlet-erschafft-digitale-gebaeude-klone-01062020
[4] https://leanheat.de/
[5] https://reset.org/blog/projekt-reif-kuenstliche-intelligenz-identifiziert-food-waste-entlang-der-lebensmittelkette-030

References

Blankertz, A. et al. (2020): Themenpapier Datentreuhandmodell. www.stiftung-nv.de/de/publikation/datentreuhandmodelle#collapse-newsletter_banner_bottom

BMU (2020): Digital Policy Agenda for the Environment. Berlin, Bundesministerium für Umwelt, Naturschutz und nukleare Sicherheit.

Döllner, J. (2020): Geospatial Artificial Intelligence: Potentials of Machine Learning for 3D Point Clouds and Geospatial Digital Twins. In: Journal of Photogrammetry, Remote Sensing and Geoinformation Science 88: 15–24.

Ellen MacArthur Foundation (2019): Artificial Intelligence and the Circular Economy as a Tool to Accelerate the Transition. Cowes, Ellen MacArthur Foundation.

European Commission (2020): White Paper on Artificial Intelligence: a European approach to excellence and trust. Brussels. https://ec.europa.eu/info/publications/white-paper-artificial-intelligence-european-approach-excellence-and-trust_en

RESET.org (2020): Greenbook (1): Künstliche Intelligenz – Können wir mit Rechenleistung unseren Planeten retten? https://reset.org/blog/greenbook_01_kuenstliche-intelligenz

UBA (2019): Künstliche Intelligenz im Umweltbereich. Anwendungsbeispiele und Zukunftsperspektiven im Sinne der Nachhaltigkeit. Dessau-Roßlau, Umweltbundesamt.

AUTHOR + CONTACT

Sarah-Indra Jungblut specializes in the topics of sustainability and digitalization and heads the editorial team of RESET.org. She also gives lectures and keynotes and moderates talks.

Reset gemeinnützige Stiftungs-GmbH, Neuer Wall 10, 20354 Hamburg.
E-Mail: indra.jungblut@reset.org

Realizing sufficiency-oriented lifestyles

Towards Digital Growth-independent Societies

Growth-independent areas are a prerequisite in enabling the environmental policies needed to prevent environmental depletion. Yet, digitalisation is reshaping our economy in a way that could both hamper and benefit growth-independent areas.

By Josephin Wagner and Steffen Lange

If we are to face the challenges of climate change, of biodiversity loss and of exceeding other planetary boundaries, radical environmental policies are needed. However, concerns regarding the negative impact of such policies on economic growth often impede their implementation. These concerns stem from central societal areas such as employment and social security systems depending on economic growth – at least under existing conditions (Petschow et al. 2018). To facilitate the required social-ecological transformation, these areas must be transformed to become growth-independent.

While a social-ecological transformation is still to be realized, the digital transformation is reshaping our economic and social systems. Digitalisation is fundamentally transforming production structures and consumption patterns. The application of information and communication technologies could increase efficiencies and optimize processes, lifting environmental burdens (Jungblut et al. in this issue). At the same time, digitalisation, as it is unfolding today, brings with it rising energy and resource consumption by the digital technologies themselves (Pohl et al. this issue), as well as rebound mechanisms that increase environmental throughput (Lange et al. 2020). Moreover, digital transformation could also worsen or counteract existing growth dependencies. Digitalisation therefore needs to be reconciled with growth independence and social-ecological transformation (Lange/Kristof 2020). This is illustrated in Figure 1.

In the following, we first describe the relationship between the concept of growth independence and digitalisation. In doing so, we look at the extent to which automation processes can lead to an increased dependence on growth for employment and for the financing of social security systems. In addition, we present two approaches to counteract this dependence on growth on the macro-economic level. Afterwards we turn to the micro-economic level and focus on consumption patterns. We delineate the circumstances under which the potentials of digitalisation could be reaped to support the adoption of sufficiency-oriented lifestyles in a growth-independent society.

Growth independence and digitalisation

Urgently needed strong environmental policies are being pushed back if they are considered to limit economic growth. This "put-on-hold attitude" is hampering the social-ecological transformation. For example, politicians controversially debated the pricing of climate-damaging CO_2 emissions in connection with the new climate protection law in Germany in 2019. While the federal Environment Agency estimated damage costs related to CO_2 emissions to be 180 EUR/tCO_2, the price that has been set is now 25 EUR. Arguments in favour of this low price were that a high price for CO_2 might negatively impact private consumption and Germany's international competitiveness thereby endangering companies' growth targets. In the end, these concerns outweighed the insight that a low CO_2 price does not have the necessary steering effect to avert the consequences of climate change, which are associated with considerable social costs.

But why is it the case that growth targets repeatedly dilute environmental policy decisions? One reason is that several societal areas are growth-dependent. These areas fulfil a socially desirable function and contribute to an important societal goal. But under current conditions, their functionality and contribution to society depend on continuous economic growth (Petschow et al. 2018, Zahrnt and Seidl 2009). The growth-dependent areas are, amongst others, social security systems and employment (Petschow et al. 2018). Environmental policies possibly leading to a decline in economic growth threaten the viability of these areas. Shaping the latter in a way that they can fulfil their socially desirable function even if the economy is not growing would release environmental policies from any reservations regarding limiting growth. In other words, establishing growth-independent areas is necessary if Germany, and other developed countries are to be steered onto a path towards staying within planetary boundaries.

How does digital transformation affect the establishment of growth-independent areas? At first glance, digital transformation increases the growth dependence of social security systems and employment as it enables automation processes. Overall, the automation of production processes through digitalisation increases labour productivity, which means that, for the same

*Ökologisches*Wirtschaften *Online-Ausgabe* O1.2021 (36) | DOI 10.14512/OEWO360144

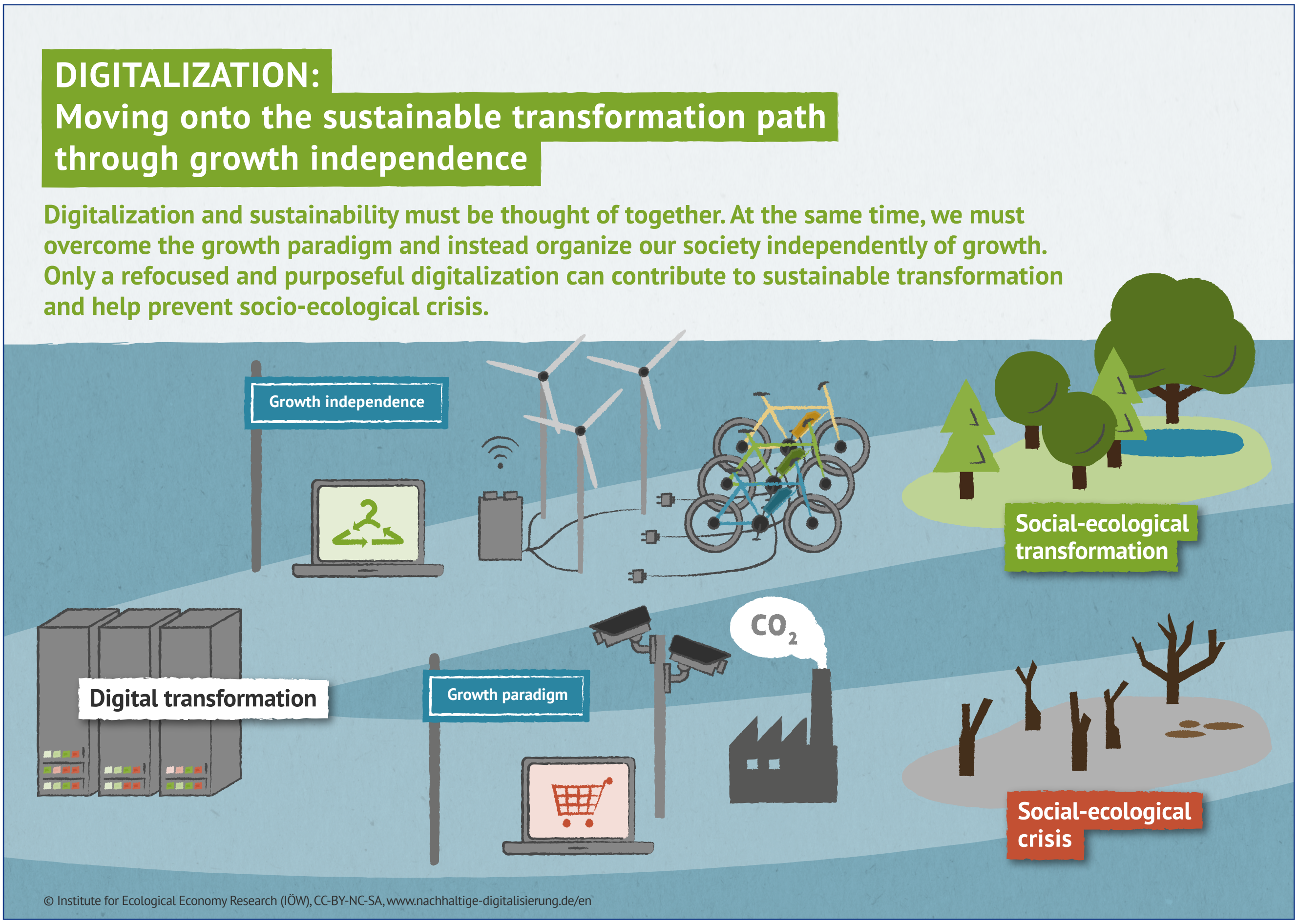

Figure 1: Digitalisation: Moving onto the sustainable transformation path through growth independence

output with the same average working time, less employees are required. This productivity increase reduces employment. It also dampens social security payments, as these primarily come from wages. Social security payments are put under pressure – in addition to the increasing unemployment – due to two additional developments related to automation. First, automation changes production structures in a way that decreases demand for certain qualifications while increasing the demand for others. Those changes in demand hit low-skilled workers particularly hard because new jobs tend to be created in higher-skilled areas. Newly created jobs for low-skilled workers are relatively more often not subject to social insurance contributions. Hence, contributions to social security tend to decline. Second, wages make up a smaller part of overall income, while the share of capital income rises. As income from capital does not contribute to social security payments under current systems in Germany and many other countries, further pressure is put on financing social security.

Economic growth under the current systems helps to prevent unemployment in the face of automation and continuing increases in labour productivity. Growth also helps finance social security systems since, by preventing unemployment, it also supports contributions, as these are directly linked to wage income. Hence, under otherwise equal conditions, automation processes increase the growth dependency of both the employment and the social security systems.

Two approaches for reconciliation

There are, however, approaches to reconciling digitalisation and growth independence. The first approach addresses the relation between employment and growth by changing the relative prices of environmental throughput and labour. It tackles the roots of rising unemployment in connection with the digitalisation processes, i. e., the rising labour productivity outlined above. Instruments such as abolishing ecologically problematic subsidies (Paech 2012), introducing environmental taxes (Daly 2008, Binswanger et al. 1981) and establishing cap and trade systems (Daly 1991) aim at increasing resource and energy costs. At the same time, labour costs could be reduced – which does not mean to reduce wages. Rather, social security payments from wages [1] and taxes, in particular on low and medium wages, can be reduced in order to make labour effectively cheaper from the firms' perspective. Both combined – higher costs for environmental throughput and lower costs for labour – would greatly change the relative prices of energy and resources compared to the price of labour. Thereby companies would be incentivized to steer their research and innovation activities towards developing resource- and energy-efficient technologies rather than to increasing labour productivity. These adjustments would lead to energy and resources being substituted by labour so that labour intensity would stop decreasing or even increase. Also, it would lead to rising costs for resource-intensive products while costs for work-intensive products would decrease, positively affecting both the environment and labour demand. Both effects – the application of different technologies and a consumption shift towards labour intensive products – would increase employment, wages and social security payments.

The second approach is to reduce average working time. Working time reduction is an instrument for coping with the consequences of increasing labour productivity. To save jobs, instead of increasing the output, employees could spend less time working. This instrument is, however, associated with concerns from both employers and employees. For employers, the proposal to reduce working time often raises concerns regarding increasing costs stemming from the time needed to coordinate working packages between employees, especially for job sharing. However, digital tools can help to address these issues: A growing number of information and communication technology (ICT) solutions can simplify collaboration processes at work, which can reduce coordination costs. From employees, fears are arising that reduced working time could lead to declining real wages. This decline does not, however, have to be the case. On a macroeconomic level, the idea is that increases in labour productivity are used not to increase wages but to decrease average working time. It does not mean that wages fall but rather that they stay constant.

The two approaches could and should be combined on the path towards social-ecological transformation. While getting the prices of environmental throughput and labour right will lead to additional employment in some sectors, other sectors will reduce production and unemployment will rise. If those people cannot find a job in another sector – be it because the employment is geographically far away or because it requires a different skill set – reducing working hours can be part of the solution. Unfortunately, the associated decline in real income can threaten livelihoods of low-wage earners. At the same time, for well-paid households, reduced working time can result in time affluence without serious financial bottlenecks. Hence, the political task would be to design working hour reductions so that low incomes increase instead of decreasing. For example, wage compensation payments that are graduated according to income and family status can distribute the financial effects of working time reductions in a socially just manner (Wuppertal Institut 2008). However, it is also clear that the two approaches outlined here do not suffice to counteract social inequalities that are already present in society and are likely to be exacerbated by digital transformation.

Sufficiency-oriented lifestyles

Turning to the micro-economic level we focus on the question of how digitalisation can transform consumption patterns towards growth independence. Such consumption patterns become necessary as meeting planetary boundaries calls for an absolute reduction in the consumption of energy and resources and the avoidance of environmental pollution (Alfredsson et al. 2018).

In addition to an efficient use of energy and resources, it is important to promote sufficiency, which can be understood as avoiding over- and underconsumption through reducing material consumption levels in affluent societies (Princen, 2005). Social innovations such as peer-to-peer sharing or subsistence-oriented activities like "do-it-yourself" could enable sufficiency-oriented lifestyles as they facilitate an extended or more intensive use of products by swapping, gifting, reselling, co-using, lending, renting or repairing (Scholl 2018, Jaeger-Erben et al. 2017). The number of goods required to satisfy consumer needs thereby decreases (Gossen et al. 2019).

Peer-to-peer sharing, and subsistence-oriented practices also enable consumers to satisfy their needs more independently of their income. Sharing allows them to access products without buying them and repairing prolongs a product's lifecycle. Consequently, consumers do not have to buy new products as often. In this sense, these practices enhance growth independence. Making the satisfaction of needs less dependent on income could be a useful complement to working time reduction in connection with increasing growth independence of employment (see above). Peer-to-peer sharing and subsistence-oriented practices can, in turn, benefit from reducing working time, as these practices are originally connected to community building and collaboration, which require time that would be made available.

Digital tools bear the potential to support sufficiency-oriented lifestyles. For example, digital peer-to-peer platforms that act as facilitators between "peers", lower transaction costs of sharing and enable the efficient distribution of shared goods among large user communities (Benkler 2004), thereby giving more people access to shared goods and broadening the range of what is shared (Gossen et al. 2019). Moreover, digital facilitated open education (Voigt in this issue) can be used to build competencies for subsistence-oriented practices. For instance, peers can broadly share know-how on making, repairing, and upcycling on wikis or wiki-based websites such as ifixit.com. Web based community mapping projects can furthermore increase the visibility of local sites like maker spaces, community gardens or common fruit meadows which promote subsistence-oriented practices (e. g., on sharing city community maps or mundraub.org). However, the growth-dependent design of currently prevailing peer-to-peer platforms and the dominance of commercial players (often in monopoly-like positions) counteract digitalisation's potential to support sufficiency-oriented lifestyles.

Idle potentials

Wikis for subsistence-oriented practices face the challenge of animating users to share their knowledge while competing for attention with commercial providers who dominate the internet (Frick et al. this issue). Thus, it is not surprising that these kinds of wikis struggle to achieve widespread impacts and therefore cannot widely reap their potential to support sufficiency-oriented lifestyles (Frick/Gossen 2019). The inferiority of wikis is strikingly illustrated by the fact that Wikipedia is the only non-commercial website among the 50 most visited websites today (Frick et al. in this issue). A lack of funding for not-for-profit actors that aim at providing sufficiency-supporting services and are organized collaboratively adds to the challenge of catching up with the commercial players (Frick/Gossen 2019, Frick et al. this issue).

Peer-to-peer platforms (e.g. Airbnb or getaround) promote using instead of owning. However, the current state and predicted development of peer-to-peer platforms show that most of these platforms operate under a growth paradigm at risk of counteracting their potential to support sufficiency-oriented lifestyles. Increasing economies of scale, predominant venture capital funding, positive network effects and additional value creation through data collection and processing create growth pressure for peer-to-peer platform providers (Behrendt/Henseling 2018, Light/Miskelly 2019, Peuckert/Pentzien 2018, Srnicek 2018). Taken together, these factors lead to most sharing markets tending towards monopolies (Peuckert/Pentzien 2018). As peer-to-peer platforms expand, sharing between peers turns into sharing “with an anonymous general public” (Gossen et al. 2019, p. 7). Trust between peers is replaced by trust in the platform with the help of technical fixes such as rating systems (Light/Miskelly 2019). Interpersonal relationships between peers become superfluous, and the originally collaborative act of sharing turns into a cost-efficient, flexible, and spontaneous mode of consumption (Behrendt/Henseling 2018). At the same time, a growing number of consumption opportunities open up for users. These opportunities, however, have possible rebound effects in consumption behaviour that counteract the objective of lowering levels of resource intensive consumption. For instance, a study on the peer-to-peer platforms for accommodation Wimdu shows that users’ travel activities increased due to the increasing availability of cheaper accommodation provided by these platforms. As half of the destinations are reached by car, about a third by plane and a fifth by train these additional trips cause the emission of 25 kg CO_2 equivalents (Ludmann 2018).

Reaping the potentials of digitalisation

A highly commercialised internet and pressure for scaling up platform activities are obstacles to exploiting the potential of digital tools to promote sufficiency-oriented lifestyles. The question is how to tackle these obstacles.

“The digital transformation is currently reshaping economic and social practices like no other technological changes.”

A possible approach to overcome the scaling-up imperative of platforms due to their source of funding are platform cooperatives. The platform corporativism movement addresses, among other issues, the question of a platform’s ownership (Scholz 2016; Schneider and Scholz 2017), which is linked to the question of whose interests need to be satisfied. Instead of scaling up platforms to generate short-term profits for investors, platforms that are owned and governed collectively can pursue values such as sufficiency. While this freedom can be used to encourage users to reflect on their consumption levels instead of aggressively expanding reach, positive network effects also apply to collectively owned platforms. That means a peer-to-peer platform needs to gain a certain minimum reach to generate benefits for its users. Achieving the required reach is particularly difficult for new competitors entering sharing markets that are dominated by platforms in monopoly-like positions. Users who already value and seek for sufficiency-oriented consumption alternatives are likely to engage even in a small sharing community (Behrendt/Hensling 2018), which would not be able to offer the same benefits as larger ones in terms of variety or flexibility. However, users who are merely interested in the cost-efficient, flexible, and spontaneous mode of consumption that large-scale peer-to-peer platforms offer would have high opportunity costs associated with switching to smaller, sufficiency-oriented platform cooperatives and will be very likely not willing to take such a step (Gossen et al. 2019). In order to bring these platforms out of the niche competition would need to be spurred and the dominance of growth oriented commercial platforms would need to be broken. It is therefore necessary to level the playing field and generally address the prevalence of growth-oriented players in monopoly-like positions in the internet economy, e.g., by adapting funding programs and competition law (Frick et al. in this issue for more and an in-depth discussion of measures). Transforming the internet economy in such a way would also benefit the visibility and reach of wikis for subsistence-oriented practices. In addition, amplifying the platforms’ impact locally can help to embed sufficiency-oriented lifestyles in local communities. Cooperation at municipal level can be a helpful instrument to ensure that a platform addresses specific local needs and is well adapted to local circumstances (Light/Miskelly 2019, Pentzien 2021). Adaption to local circumstances might also involve reflection on the configuration of digital tools used to support a platform's activities. To foster cooperation and interpersonal relationships, digital tools should primarily be used "to support leadership, management, engagement and coordination tasks" (Light/Miskelly, p. 614), thereby making time for and not replacing valuable community labour. A tool's configuration should mirror the community members' needs and evolve over time as those needs change, which might also mean uninstalling obsolete digital infrastructure. For instance, digital tools to promote trust in systems (such as PayPal or rating systems for trusted brokering) might be replaced by actual trust between the members of the community that was built over time (ibid. 2019).

Conclusion

The digital transformation is currently reshaping economic and social practices like no other technological changes. To prevent catastrophic climate change, biodiversity loss and transgressing the other planetary boundaries, digital tools need to be propitiated with radical changes in practice. Growth-independent areas are an important prerequisite on the macro-economic level to facilitating the environmental policies needed. Hence, the digital transformation needs to be reconciled with growth independence. It is important that digitally enabled automatization processes do not exacerbate the growth dependence of employment and social security systems. We showed that working time reduction and getting the prices for environmental throughput right are two useful approaches to prevent this exacerbation. On the micro-economic level digitalisation needs to transform consumption patterns towards sustainability. Digital tools like peer-to-peer sharing platforms, wikis which share know-how on subsistence-oriented practices and web-based community mapping projects have the potential to promote sufficiency-oriented lifestyles, which are necessary to achieve at least partial independence of living standards from income and to satisfy needs even in a non-growing economy. To reap the tools' sufficiency potentials, however, growth dependencies of platforms and the commercialization of the internet must be contained.

Annotation

[1] This would reduce the social security payments and would therefore make the financing of social security more difficult. At the same time, the tax incomes from environmental taxes can be used to help finance them.

References

Alfredsson, E./Bengtsson, M./Brown, H./Isenhour, C./Stevis, D./Lorek, S./Vergragt, P. (2018): Why achieving the Paris Agreement requires reduced overall consumption and production. In: Sustainability: Science, Practice and Policy 14/1: 1–5.

Behrendt, S./Henseling, C. (2019): Zukunftsszenarien des Peer-to-Peer Sharing. In: Behrendt S./Henseling C./Scholl G. (eds.): Digitale Kultur des Teilens. Wiesbaden, Springer. 149–175.

Belk, R. (2017): Sharing without Caring. In: Cambridge Journal of Regions, Economy and Society 10/2: 249–261.

Benkler, Y. (2004): Sharing nicely: On shareable goods and the emergence of sharing as a modality of economic production. In: Yale Law Journal 114: 273–358.

Binswanger, H. C./Bonus, H./Timmermann, M. (1981): Wirtschaft und Umwelt: Möglichkeiten einer ökologieverträglichen Wirtschaftspolitik. Stuttgart, Kohlhammer.

Daly, H. E. (1991): Steady-state economics. Washington DC, Island Press.

Daly, H. E. (2008): A steady-state economy. UK: Sustainable Development Commission.

Frick, V./Gossen, M. (2019): Digitalisierung von Märkten und Lebensstilen: Neue Herausforderungen für nachhaltigen Konsum. Stand der Forschung und Handlungsempfehlungen. Dessau-Roßlau, Umweltbundesamt.

Gossen, M./Pentzien, J./Peuckert, J. (2019): What use is it really for sustainability? Potentials and impacts of peer-to-peer sharing in the domains of accommodation and mobility. In: Sustainability Management Forum 27/2: 125–138.

Jaeger-Erben, M./Rückert-John, J./Schäfer, M. (eds.) (2017): Soziale Innovationen für nachhaltigen Konsum. Wiesbaden, Springer.

Lange, S./Kristof, K. (2020): Digitalisierung, Nachhaltigkeit und Wachstumsunabhängigkeit. https://makronom.de/mit-wachstumsunabhaengigkeit-zur-nachhaltigen-digitalisierung-37011

Lange, S./Pohl, J./Santarius, T. (2020): Digitalization and Energy Consumption. To what extent can ICT reduce energy demand? In: Ecological Economics 176: 106760.

Light, A./Miskelly, C. (2019): Platforms, scales and networks: meshing a local sustainable sharing economy. In: Computer Supported Cooperative Work 28/3–4: 591–626.

Ludmann, S. (2018): Ökologische Betrachtung des Peer-to-Peer Sharing. In: Behrendt, S./Henseling, C./Scholl, G. (eds.): Digitale Kultur des Teilens. Wiesbaden, Springer. 71–93.

Pentzien, J. (2021): Vom Plattform-Kapitalismus zum Plattform-Kooperativismus? Potenziale und Grenzen kooperativer Unternehmungen in der Plattformökonomie. In: Dück, J./Altenried, M./Wallis, M. (eds.): Plattformkapitalismus und die Krise der sozialen Reproduktion. Münster, Westfälisches Dampfboot.

Peuckert, J./Pentzien, J. (2018): Kompromisse des Teilens. Nachhaltige Governance von Peer-to-Peer Sharing Praktiken. Berlin, Institut für ökologische Wirtschaftsforschung.

Princen, T. (2005): The logic of sufficiency. Cambridge, MIT Press.

Scholl, G. (2018): Systematisierung des Peer-to-Peer Sharing. In: Behrendt S./Henseling C./Scholl G. (eds.): Digitale Kultur des Teilens. Springer Gabler. 5–12.

Srnicek, N. (2017): Platform capitalism. Hoboken, New Jersey, John Wiley & Sons.

Wuppertal Institut (2008): Zukunftsfähiges Deutschland in einer globalisierten Welt. Frankfurt a. Main, Fischer.

AUTHORS + CONTACT

Josephin Wagner and ***Steffen Lange*** are researchers at the Institut für ökologische Wirtschaftsforschung (IÖW).

Institut für ökologische Wirtschaftsforschung (IÖW), Potsdamer Str. 105, 10785 Berlin.
E-mail: josephin.wagner@ioew.de, steffen.lange@ioew.de,
Tel.: +49 30 8845940

Calling for a paradigm shift

Digital Taxes for Sustainable Development?

Whether digital or not, a fundamental paradigm shift in international tax policy is overdue in order to ensure adequate taxation of multinational corporations. The revenues lost through tax avoidance are urgently needed for investments in a socio-ecological transformation.

By Sarah Ganter

Public coffers can only provide quality public services and invest in education, health, and public infrastructure if they are adequately resourced. The importance of this has once again been dramatically demonstrated to the world by the Covid-19 pandemic. But it is not only crisis management and response that cost money. Achieving sustainable development goals and transforming our economic and social systems towards less energy-intensive and lower-emission forms of production, consumption, and mobility in the course of a socio-ecological transformation poses enormous financial challenges for the global community. The question of how increased taxation of the rapidly growing digital economy could generate additional tax revenue for the necessary structural change or have an ecological steering effect in the sense of favouring more sustainable digital business models through taxation is therefore discussed again and again.

As early as the 1990s, there were considerations to impose a global tax on the then new digital forms of communication in order to finance sustainable development. Under such a "bit tax", as proposed in the 1999 United Nations Human Development Report, users would pay one US cent for 10 megabytes of email volume. Given the worldwide e-mail boom, it was calculated that the total revenue would amount to a "substantial" sum (UNDP 1999). With an estimated global data volume of 175 zettabytes in 2025 (Reinsel et al. 2018), the coffers of the United Nations would be well-filled today. However, it is also possible that the decelerating effect of this tax would have taken digitalisation down a completely different path.

A tax system from the analogue world

Such a global tax did not materialise. A lot of money is at stake in tax policy, and changes to the regulatory framework affect the national sovereignty of states. This makes it particularly difficult to bring about urgently needed reforms of the international tax system. The latter will soon celebrate its centenary: In the 1920s, the League of Nations, as the predecessor organisation of the United Nations, dealt with the issue of taxation of companies operating in several states. The aim was to find a way to prevent double taxation. Already then, the interests of the countries in which multinationals are based (countries of residence) and those in which income is generated (source countries) were diametrically opposed (Rixen 2007). The resulting compromise linked the right to taxation to the existence of a physical permanent establishment. The individual branches of multinationals should be treated as independent companies and the profit should be divided proportionately between the states for taxation using the so-called arm's length principle. The intra-company exchange of goods and services should be carried out using transfer prices, as is the case with independent companies.

Over the last hundred years and in the course of globalisation, the international financial system has become increasingly convoluted. The tax rules created at the beginning of the 20th century no longer meet the needs of today's complexity. Multinational corporations and wealthy individuals are taking advantage of the regulatory vacuum. They cleverly shift profits and assets to where they are spared from the grasp of tax authorities. This practice has been taken to extremes in recent years by companies with digital business models that can also generate profits in a country independently of their physical presence. The fact that the large multinational tech corporations in particular are enjoying huge growth on the one hand, while at the same time largely shirking their responsibility in financing the common good, is causing growing resentment among the global public and highlights the urgency of the need for international regulation. The action by the EU competition authorities against Apple's tax deal with the Irish government caused a stir in 2016. Thanks to special tax arrangements, in 2014 the group had paid only 0.005% instead of the otherwise usual 12.5% of Irish corporate taxes. The EU Commission ordered Apple to pay an additional 13 billion euros (The Guardian 2016). The question of whether these practices actually violated applicable law and whether a corresponding repayment claim is justified remains a point of contention. The EU Commission appealed a court ruling in favour of Apple in 2020. This is because many of the tax avoidance practices of the big tech companies are in a legal grey area and even if they run counter to a widely shared notion of justice, illegality is diffi-

ÖkologischesWirtschaften Online-Ausgabe O1.2021 (36) | DOI 10.14512/OEWO360149

"Tax avoidance of large digital corporations exposed the existing weaknesses of the taxation of multinational companies."

cult to prove. Google parent Alphabet, for example, reported a profit of almost 20 billion in Bermuda in 2017. The tax arrangement that became known as the "Double Irish with a Dutch Sandwich" allowed the company to shift the income of a Dutch subsidiary via Ireland to its tax domicile in Bermuda with impunity, even though the company was registered in Ireland (Der Spiegel 2019). Once again, there were calls for a digital tax.

Call for a paradigm shift

The tax avoidance practices of the large digital corporations exposed the already existing weaknesses of the taxation of multinational companies. Even previously, the arm's length principle system provided companies with traditional business models with many opportunities for "tax optimisation" by setting transfer prices between the individual business divisions. This is because it is difficult to objectively quantify which part of value creation takes place at which location along transnational production chains. In 2015, the Independent Commission for the Reform of International Corporate Taxation (ICRICT) was launched by a network of civil society organisations. It argues that a fundamental break with the principles established a hundred years ago is necessary for the international tax system to meet the needs of today's global world economy. The ICRICT Commission, which includes prominent economists from the Global South and North, proposed in its initial declaration that multinationals should no longer be treated as affiliated single enterprises for tax purposes. Instead, they should be considered as a whole and be subject to unitary taxation. This takes into account the global profits of a company and allocates taxation rights according to a formula between the countries in which the company is economically active. This formula could include factors such as sales or number of employees. In addition, a global minimum tax should counteract the international competition for lower taxes (ICRICT 2015). According to the Commission, such a reform would take the wind out of the sails of tax avoidance practices and, in the interests of greater global tax justice, would provide higher tax revenues for the countries of the Global South in particular. To implement these reforms, the Commission proposed the creation of an international tax authority at the United Nations, a UN Tax Body with universal membership.

The European interim solution

In the area of tension between countries of residence and source countries, the less location-bound value creation of the digital economy has shifted the international constellation of interests. Whereas until now it was mainly the countries of the Global South that were on the losing side of the system as source countries, the new tech companies have given European countries in particular first-hand experience of what it means when companies have a large number of users but no corresponding physical presence in the country. Since as early as 2011, there have been efforts in the European Union to create a uniform system for the taxation of multinational corporations with the so-called Common Consolidated Corporate Tax Base (CCCTB), which was not dissimilar to the idea of unitary taxation and a formulaic approach. The initiative failed due to opposition from Ireland and the UK. With its proposal for a "Fair Taxation of the Digital Economy", in early 2018 the EU Commission put forward two new reform approaches for discussion that directly targeted digital business models. The first proposal for a common reform of the EU corporate tax rules for digital activities described a virtual permanent establishment of digital platforms as complementary to the conventional physical permanent establishment. A number of criteria would have to be met, such as annual revenues of more than seven million euros and more than 100,000 users, as well as more than 3,000 business contracts for digital services in a member state. The second proposal was intended as a transitional solution until a more comprehensive reform came into force. An interim tax should cover income from activities where users are central to value creation. This includes revenue from online advertising space, digital brokerage and the sale of data and user-provided information. To protect smaller companies, a corresponding tax rate of three percent on digital services should only apply to global sales exceeding 750 million euros per year (European Commission 2018). But the initiative failed to achieve the necessary unanimity in the Council of the European Union. The fact that even among the EU member states there are countries that have a tax haven character does not make it any easier to reach a consensus. This is one reason why the EU Commission wants to gradually move to majority voting in tax matters by 2025 (European Commission 2019).

The OECD Inclusive Framework

The venue for the international reform debate beyond the European level has so far been the Organisation for Economic Co-operation and Development (OECD), in which the rich industrialised countries are organised. A large-scale project to combat base erosion and profit shifting (BEPS) already cleared up a number of weaknesses of the previous system but did not fundamentally question its principles. Here, too, the discussion about adequate taxation of the digital economy injected new momentum into the negotiation process. In 2018, the OECD promised to find solutions for taxing the digital economy by the end of 2020 in a new edition of the BEPS project. This time, non-OECD countries were invited to participate in the negotiations. Representatives from over 135 countries are discussing new rules for international taxation in the so-called Inclusive Framework on BEPS. Even if digital business models were the impetus, the point is not to formulate a special regime for the digital economy, but to formulate solutions that put a stop to tax avoidance by multinational corporations in a globalised and increasingly digitalised world. The subject of the negotiations is a new international regulatory framework in two pillars.

The first pillar deals with the issue of a global redistribution of taxation rights and the creation of a new starting point for taxation beyond the physical permanent establishment. This would give source countries more taxation rights. Low- and middle-income countries tend to be market countries, which is why a comprehensive redistribution of taxation rights would benefit the countries of the Global South. But since profits from tax havens would be redistributed, in the end everyone would benefit from such a reform. Nevertheless, more export-oriented countries like Germany fear the loss of tax revenues. As requested by the ICRICT Commission, the OECD proposal also provides for a formulary apportionment of profits. Yet while ICRICT wants to apply it to the global profits of a company, the OECD draft distinguishes between so-called routine and residual profits, which is the profit that remains after deducting the cost of capital, and only makes part of it the subject of a formulary apportionment. However, the international taxation of routine profits is to largely proceed as before via the arm's length principle. In a statement on the negotiations, the ICRICT Commission criticises the artificial division into routine and residual profits and points out that the retention of the arm's length principle for routine profits would perpetuate the weaknesses of the old system (ICRICT 2019 a).

The second pillar aims to curb the international competition for lower taxes by setting a global minimum effective tax rate. How exactly this should look like in practice is still being discussed. The OECD proposal provides two instruments to prevent companies from shifting their profits to a low-tax location. If a company subsidiary is taxed below the minimum tax rate in the country where it is based, the difference can be levied in the country where the parent company is based. This would remove the incentive for lower taxation. A second instrument has a complementary effect and taxes profits that are shifted within affiliated companies to another country if the destination country does not tax them at an appropriate level (Becker/Englisch 2019). The ICRICT Commission also favours such a global minimum tax rate but sets it at 25 %, twice

"A fundamental paradigm shift in international tax policy is needed to ensure adequate taxation of multinational corporations."

as high as discussed in the negotiations. A lower tax rate, ICRICT argues, would disadvantage smaller companies that pay the regular tax rates, which are only slightly below 25 % on average in the OECD. Developing countries, which often have a higher rate and are also particularly dependent on tax payments of multinational corporations, would be even more affected (ICRICT 2019 b). It is also important that the question of who comes first in taxation is not decided in favour of the countries of residence.

Growing pressure to act for a multilateral solution

As tax avoidance strategies exploit the blind spots of the existing system, there is little reliable data on the sums lost to public coffers. During the OECD process, multinational corporations were obliged to report their profit distribution to the tax authorities on a country-by-country basis. The question of whether these reports should be publicly accessible (public country-by-country reporting) to create real transparency is a recurring subject of political discussion, also in the European Union. Country-specific data were published by the OECD for the first time in mid-2020. With this as a basis, the civil society Tax Justice Network (TJN) calculated that the global loss of revenue due to tax avoidance by multinational corporations and wealthy individuals totals more than 427 billion US dollars per year. 245 billion of this is due to corporate tax avoidance. Against the backdrop of the Covid-19 pandemic, the State of Tax Justice report in which the figures were published calculates that the total could pay the annual salaries of more than 34 million nurses (Tax Justice Network 2020). Especially the countries of the Global South are dependent on the tax payments of multinational corporations. In the wake of the Covid-19 crisis, the pressure to reform has increased further. While the EU and OECD are struggling to find solutions, the UN Committee of Experts on Tax Matters presented a proposal in spring 2020 on how the taxation of digital services could be included in bilateral tax treaties (UN Expert Committee on Tax 2020).

"International tax policy is about weighing national self-interests against a global perspective of justice."

Time for a UN Tax Body

Digital or not, a fundamental paradigm shift in international tax policy is needed to ensure adequate taxation of multinational corporations. The lost tax revenues are urgently needed to finance efforts to overcome the crisis and to invest in a socio-ecological transformation towards a more sustainable global development model. But despite intensive efforts, it has not been possible to bring the OECD negotiations to a conclusion by the end of 2020. The USA withdrew from the process indefinitely in the middle of the same year. It remains to be seen what course the Biden administration will take. Several countries have already announced unilateral measures if no agreement is reached by mid-2021, and the EU is also continuing to discuss a digital service tax as a transitional solution. This increases the pressure on international negotiations, but carries the risk of tax and trade conflicts and ultimately does not provide a sustainable solution. The US announced only recently that it will impose 25 % tariffs on imports of French handbags and cosmetics from January 2021 in response to the French digital tax. Not even multinational corporations are interested in further fragmentation of the international tax system and the associated legal uncertainty. As with other multilateral challenges, international tax policy is also about weighing national self-interests against a global perspective of justice. Civil society organisations and countries of the Global South have therefore been calling for years for the United Nations to become the venue for the reform negotiations by creating an international UN Tax Body with universal membership, so that the countries of the Global South can participate in the process on an equal footing (Ryding 2020). Maybe now would be the right time for it.

References

Becker, J./Englisch, J. (2019): Internationale Mindestbesteuerung von Unternehmen. In: Wirtschaftsdienst 2019/9: 642–649.

Der Spiegel (2019): Google schleust 20 Milliarden Euro aus Europa auf die Bermudas. www.spiegel.de/wirtschaft/unternehmen/google-schleust-20-milliarden-euro-auf-die-bermudas-a-1246379.html

European Commission (2018): Fair Taxation of the Digital Economy. https://ec.europa.eu/taxation_customs/business/company-tax/fair-taxation-digital-economy_en

European Commission (2019): Commission launches debate on a gradual transition to more efficient and democratic decision-making in EU tax policy. https://ec.europa.eu/commission/presscorner/detail/en/IP_19_225

ICRICT (2015): ICRICT Declaration. https://www.icrict.com/icrict-documentsthe-declaration

ICRICT (2019 a): ICRICT response to the OECD Consultation on the Secretariat Proposal for a "Unified Approach" under Pillar One. https://www.icrict.com/icrict-in-thenews/2019/11/20/responses-to-oecd-pillar-one-proposal

ICRICT (2019 b): ICRICT response to the OECD Consultation on Global Anti-Base Erosion Proposal ("GloBE")-Pillar Two. www.icrict.com/icrict-documents-icrict-response-to-the-oecd-consultation-on-global-anti-base-erosion-proposal

Reinsel, D./Gantz, J./Rydning, J. (2018): The Digitization of the WorldFrom Edge to Core. An IDC White Paper. https://resources.moredirect.com/white-papers/idc-report-the-digitization-of-the-world-from-edge-to-core

Rixen, T. (2007): Das Doppelbesteuerungsregime als institutionelle Grundlage des internationalen Steuerwettbewerbs. In: Kellermann, C./Zitzler, J. (eds.): Steuern im europäischen Wettbewerb. Unterbieten oder gemeinsam gestalten? Friedrich-Ebert-Stiftung. 6–14.

Ryding, T. (2020): An intergovernmental UN tax commission – why we need it and how we can get it. https://www.eurodad.org/globaltaxbody

Tax Justice Network (2020): The State of Tax Justice 2020: Tax Justice in the time of COVID-19. https://www.taxjustice.net/reports/the-state-of-tax-justice-2020/

The Guardian (2016): Apple ordered to pay €13 bn after EU rules Ireland broke state aid laws. https://www.theguardian.com/business/2016/aug/30/apple-pay-back-taxes-eu-ruling-ireland-state-aid

UN Expert Committee on Tax (2020): Tax Treatment of Payments for Digital Services. www.un.org/development/desa/financing/what-we-do/ECOSOC/tax-committee/tax-committee-home

UNDP (1999): The Human Development Report. http://hdr.undp.org/en/content/human-development-report-1999

AUTHOR + CONTACT

Sarah Ganter is expert on Global Digital Economy at the Friedrich-Ebert-Stiftung.

Friedrich-Ebert-Stiftung, Hiroshimastraße 28, 10785 Berlin.
E-mail: Sarah.Ganter@fes.de, Tel.: +49 30 269357430