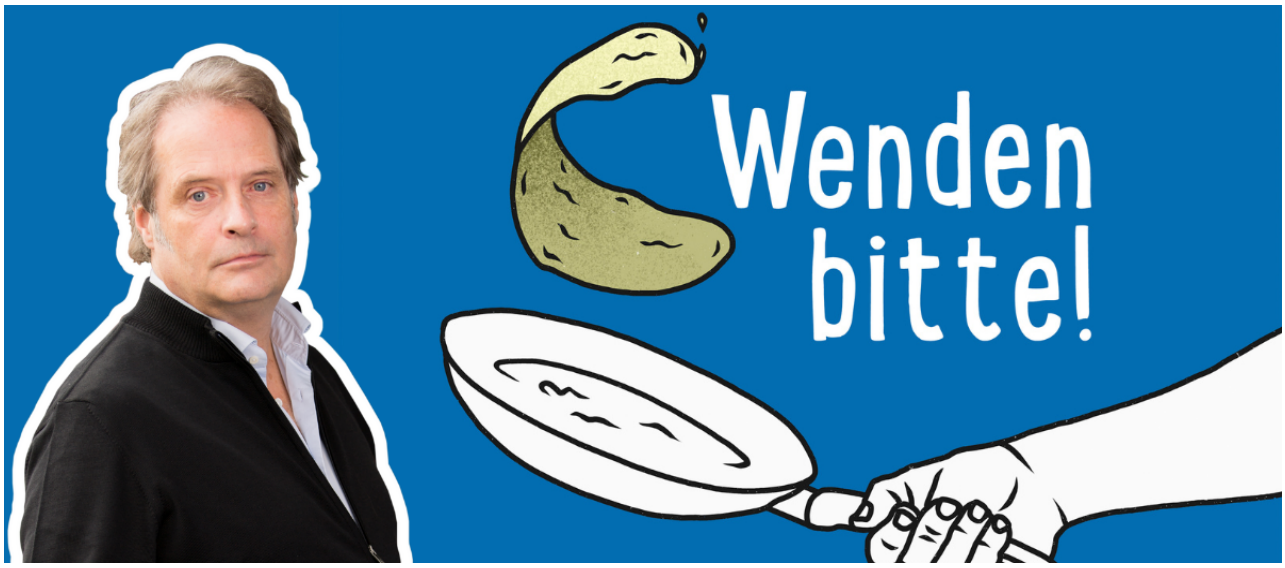

Transcript of the “Wenden bitte!” (All change please!) podcast:

Episode 16: “Sustainability through digitalisation?”

Introducing the subject and today's contributors

Nadine Kreutzer:

Hello, everyone! Today we're back with you to discuss an important topic in sustainability research with an Oeko-Institut expert. I'm Nadine Kreutzer and I'm here with Mandy Schossig from the Oeko-Institut. And once again, we have prepared a long list of questions, which we will be putting to our expert in a moment.

Mandy Schossig:

And hello from me. I am very much looking forward to our conversation today because it is about digitalisation, an area where policy-makers have fairly high expectations, not least in relation to the social-ecological transformation. It's claimed that digital tools will pick up the pace, whether it's in energy-saving or resource efficiency. But of course, the use of digital tools can also create problems for the climate – because of their high energy consumption, for example – not to mention resources, which are another issue.

So our question for today is: Sustainability through digitalisation? The question mark is deliberate. To get some answers, we have invited Carl-Otto Gensch to join us. He has headed the Sustainable Products and Material Flows Division at the Institute's Freiburg office for more than 20 years. Hello, Cotto!

Carl-Otto Gensch:

Hello!

Nadine Kreutzer:

Hello, Cotto, what a great name, I think it's terrific! Thank you for making time for us. Let's start with a quick question: What do we mean by material flows? Can you give us a brief insight into your working world so that we are all on the same page?

Carl-Otto Gensch:

Well, every time we use a product – or manufacture a product – material flows are involved. Resources have to be extracted from the environment, processed and converted into primary inputs, which are used to fabricate other materials, which are then processed again. In essence, that's what we study in our Division, particularly the associated ecological footprint, the greenhouse gas emissions that are generated, and other environmental impacts. And of course, we look at how these effects can be mitigated and avoided.

Nadine Kreutzer:

You've been with the Oeko-Institut for a good many years. Mandy is responsible for inviting all the experts and I am always struck by how many of them there are – and how many are long-serving team members at the Institute, such as yourself.

Mandy Schossig:

Yes, it's by no means a rarity at the Oeko-Institut.

Nadine Kreutzer:

Tell us, when did it all start? And above all, did you yourself begin by working on material flows or was it a longer journey?

Carl-Otto Gensch:

No, in fact, this focus matched my training quite well. I started out in 1988, after graduating. I studied process engineering. That's the branch of engineering that looks at how materials are converted, how they are broken down, vaporised and then condensed again. How two substances can be converted into one – that kind of thing.

Mandy Schossig:

You and your colleagues were already conducting research on digitalisation in the 1990s. There was a study entitled "Environmental Protection in Cyberspace". What has changed in our cyberspace since then?

Carl-Otto Gensch:

If you look at the study and what we were investigating back then, and then you look at the current situation, you'll see that not much has changed. Back then, we looked at teleworking and telematics; in other words, the influences on traffic flows. Both are still highly topical issues in today's digital debate. What has changed is ubiquitous networking. Previously, there was still a reliance on stand-alone solutions. The few networks that existed had very narrow bandwidths. There was barely any mobile telephony and no real mobile networks or data networks. So much has happened since then. But fundamentally, is a technology per se sustainable or not? Does the technology itself promise to lessen the impact on the environment, and can these benefits be realised? These are still topical issues today.

Nadine Kreutzer:

And so our question for today is: Sustainability through digitalisation? That's what we'll be discussing. Let's start with a brief insight into the topic.

Sound clip (brief subject overview)

Germany aims to be climate-neutral by 2045. In the discussion about the transitions that will be needed for this, the potential of digitalisation is often emphasised. It is claimed that it will help to reduce emissions in various sectors and speed up the process of social-ecological transformation. But digital technologies are also associated with very high energy and resource consumption. Every laptop requires scarce resources; every data centre needs a power supply; and every time a video is streamed, carbon dioxide is emitted. Annual data transmission in mobile telephony alone increased from 156 million gigabytes to more than 5,000 million gigabytes between 2012 and 2021. This drives up energy consumption, as well as greenhouse gas emissions from power generation. So it's about capitalising on the opportunities associated with these new technologies while also identifying risks and creating a regulatory framework to deal with them. In short, the role of digitalisation in relation to sustainability is contentious. Some people emphasise the additional environmental impacts from digitalisation, while others focus on the opportunities created by new technologies.

So what can be done to reconcile digitalisation with sustainable development? Which problems are associated with digital technologies, and how much of a contribution can they really make to more climate change mitigation?

General overview and environmental impacts

Mandy Schossig:

Yes, all of these are issues that we will be discussing today. After all, many people are convinced that we can only achieve the climate targets with more digitalisation. What do you say to that?

Carl-Otto Gensch:

I wouldn't agree with such a sweeping statement. There is a study by the Bitkom industry association which says that if we want to reach the interim targets for 2030, we will actually need an accelerated digitalisation scenario. That's all well and good, but of course, we need to be aware that they selected emissions-intensive sectors and for each one, they picked out the applications where they assumed that, under optimal conditions, everything would be achieved.

But if you look more closely, it is not only about digitalisation; the issue of thermal insulation of buildings also plays a role, as does the issue of renewable energies and increasing the renewables share in our electricity networks. So a whole range of factors come into play. And of course, the logic of the digital industry association dictates that these factors will be subsumed under digitalisation, even though they are only partly connected to digitalisation. That's something that we should always keep in mind.

And these scenarios are always relative: they are always viewed in relation to a reference scenario, a baseline. And what we have observed over many years is that the baseline is invariably calculated as a relatively undesirable scenario in order to leverage the maximum potential. That's what the industry association is doing, but it isn't really good practice, in my view.

Mandy Schossig:

You also mentioned a moment ago in the introduction that there are various environmental impacts. Before we go into more detail here, can you give us an overview of what they are?

Carl-Otto Gensch:

Let's start with the manufacturing of the devices – the semiconductors, the circuit boards, all the electronics and the sensor technology. They all require a great many rare metals, technology metals, whose extraction, production and processing leave a large environmental footprint.

And on top of that, there is the energy that is consumed when the devices are in use. Granted, the devices themselves are far more efficient overall compared with 20 years ago, but the number of devices has increased at the same time, so the bottom line is that final energy consumption has remained unchanged; if anything, it has increased slightly. Screens are bigger nowadays as well, so any efficiency gains made by using efficient flatscreens have been cancelled out by the larger screen sizes.

And that is what we are seeing again and again in this sector: we have technological progress that could be used to reduce the environmental footprint, but this is not being achieved in the marketplace.

Nadine Kreutzer:

So there are direct and indirect environmental impacts.

Carl-Otto Gensch:

Yes, in fact, we identify three separate levels of environmental impact for digitalisation. The direct impacts include everything related to the end devices, but also to data centres and telecommunications networks. And that's based on a holistic approach, in other words: manufacturing, use and disposal.

And then there are the indirect impacts on the second level. These are impacts that reflect the use of digitalisation, such as energy savings resulting from a better home heating control system, let's say. However, they can also go in the other direction and lead to additional environmental impacts. This can occur, for example, if rebound effects come into play – in other words, if cost savings resulting from the use of devices or technologies are used to generate additional demand. In practice, what we are seeing, again and again, is that the savings potential that can theoretically be achieved is realised only in the rarest of cases.

There is a third impact level as well, which is perhaps the most difficult to describe and quantify. These are systemic effects such as changes in consumer behaviour or changes in the home or workflows and travel to work, which may be influenced by digital technologies, and of course, there is the whole e-commerce sector.

Potential for more climate action and environmental performance

Mandy Schossig:

This all sounds quite ambivalent, in my view. To what extent, then, does digitalisation offer potential for more sustainability or more climate change mitigation or resource-saving? And what makes a difference?

Carl-Otto Gensch:

Well, in principle, it starts with the question: Which sustainability problems do I have? And are technologies being developed and utilised with the specific aim of overcoming the challenges that exist? We are looking at this in a project funded by the German Federal Ministry of Education and Research, where we are examining a whole range of green technologies and greentech developments related to digitalisation. The researchers are monitoring the development process and identifying which SDGs and which of the related targets tie in with these developments and how these technologies that are being developed make a contribution here. Specifically, how do they count towards the SDGs?

Nadine Kreutzer:

Could you give us an example?

Carl-Otto Gensch:

One of the funded technologies is used to identify trace substances in wastewater in order to facilitate their targeted removal from the wastewater load. Reducing inputs of these trace substances can make a direct contribution to four targets identified for the SDGs, namely SDG 6.3 on improving water quality; SDG 3.9 on reducing illnesses from hazardous chemicals; SDG 14.1 on reducing marine pollution; and SDG 12.4 on environmentally sound management of chemicals. In other words, this can be quantified as measurable contributions to achieving the SDGs.

Nadine Kreutzer:

Would you say that progress has genuinely been made in recent years and that this is becoming more widely established and that many of the SDGs – the Sustainable Development Goals – can be achieved? Is it genuinely helpful and will it continue?

Carl-Otto Gensch:

Well, I would put it diplomatically and say that it can be helpful. But this kind of ambitious accompanying research is not standard practice yet. A great deal of support is being provided for technological development in areas where this kind of accompanying research does not exist and where we are not yet seeing any linkage between the use of these technologies and achieving the Sustainable Development Goals.

Policy measures

Mandy Schossig:

I suspect, yet again, that this is where politics comes in, when you say that this is not yet standard practice. What should smart politics be doing to promote it?

Carl-Otto Gensch:

This is exactly where smart politics should come in. For example, milestone plans always have to be submitted for research projects; in other words, the researchers have to specify when they think the technology will have reached a given level of maturity. Research funding could be linked in a similar manner to quantified contributions to sustainability goals.

Mandy Schossig:

Let's be specific: are there any examples of policy interventions here?

Carl-Otto Gensch:

Well, one area where some thought is already being given to this is the introduction of the digital product passport, which would describe a product's lifecycle, with related data, from a holistic perspective. This would provide actors along the supply chains with data that would enable them to guarantee better reusability, better recycling and better refurbishment.

But this isn't just a technical issue. I think it could be accomplished relatively quickly at a technical level. But it is also about the data economy, data governance and who has the right to access data – and which data? – along the supply chain. How will the people who collect the data and make them available for the passport be recompensed for their costs? There are still a great many unanswered questions here, not to mention the negotiations that are required in order to genuinely deliver what policy-makers are striving for, namely non-discriminatory access to these data. But this won't happen of its own accord; on the contrary, it is a very typical – indeed, prototypical – example of what lies ahead for policy-makers and the kind of tasks that will need to be addressed.

Nadine Kreutzer:

This phrase "digital product passport": you can clearly imagine going to the supermarket and scanning a QR code to find out about the product lifecycle. But it has nothing to do with that, has it?

Carl-Otto Gensch:

Well, that may be a part of it: the product passport may enable us to find out about the past life of a product so that you know or can check whether its components come from responsible supply chains and so on.

But there's much more to it than that. Let's take the example of consumer goods such as domestic appliances. Here, a frequent question is: How are they actually used? And when would I need to get the appliance serviced in line with predictive maintenance? When should I get it repaired in order to preserve its lifespan? This can be done with digital interfaces. Many domestic appliances are already fitted with a WLAN interface and if business models that prioritise these practices are supported, digitalisation and the digital product passport could be used very effectively to extend products' useful life.

Nadine Kreutzer:

You have just mentioned the demands on policy-makers. I am thinking back to 2000, when the Federal Environment Ministry launched the Digital Policy Agenda for the Environment, accompanied by a large number of projects and initiatives. Do you know what action has been taken since then? Has our government set any specific targets for climate action through digitalisation? In 2023?

Carl-Otto Gensch:

The Federal Government presented its new Digital Strategy at its "away day" in Meseberg in late August 2022. Some elements that appear at some places in the text echo what we previously saw in the coalition agreement but a lot more ground is covered or presented in far more detail. What I particularly like is that they have also identified interim targets for 2025 in order to measure progress. One of these interim targets deals with data centres, for example.

Mandy Schossig:

We will come back to them in a moment. But since we are talking about the issue in general terms right now: you have already mentioned the rebound effects, although I don't think you used that phrase. In other words, there are many new and efficient devices that save energy – we might think of televisions here, which you have just mentioned. But TVs are much larger nowadays, so ultimately, they don't save energy. These are rebound effects. How does this tie in with digital tools and how is this effect felt across the board?

Carl-Otto Gensch:

Well, rebound effects always come into play when you have technologies that are capable of creating energy or resource efficiency. Economic modelling shows that efficiency reduces the cost of a product, especially if purchasing power remains unchanged, so people use the product more often, cancelling out the savings. We can differentiate between direct and indirect rebound effects. For example, if I have saved money by using an energy-efficient appliance, I can use the extra cash to pay for a holiday. This would be an indirect rebound effect.

Mandy Schossig:

And on the other side of the equation, there are the induction effects. Perhaps you could briefly explain them to us as well?

Carl-Otto Gensch:

Induction effects don't really come into play in this economic framework, where cost savings are the driver. These effects tend to arise in relation to questions such as: What has technology enabled us

to do, and what does this evolving technology mean in terms of how I organise my life? For example, if I can make more bookings online and no longer have to make the effort to visit the travel agent, this lowers the threshold for me to travel more frequently.

Mandy Schossig:

And that probably produces more emissions.

Carl-Otto Gensch:

It can produce more emissions, depending on what kind of trip I arrange. That comes into play as well, of course. At any rate scientists differentiate between induction and rebound effects, which have different drivers. The induction effects have more to do with the options that become additionally available due to technology.

Data centres

Nadine Kreutzer:

We have already said that consumption of energy and resources is a major problem. In which specific sectors is this apparent?

Carl-Otto Gensch:

What we have seen in recent years is that energy consumption in data centres has increased dramatically and is still on a steep upward trajectory. One reason is that much of the processing that was previously done at the local level now runs through data networks and is carried out in data centres. Data are stored in these data centres so that they are immediately accessible to customers on all their devices at all times.

One term which describes this quite well is the cloud. But the cloud is not a nebulous entity that does not involve any major material flows. Quite the contrary: for the cloud to function at all, we need fast data networks – mobile and wired. And we need data centres to store and process the data and to transmit them next time they are accessed. This is a continuous process.

If we look at how data and the volume of transmitted data have developed over the last 10 years in both the wired and the mobile networks, we are easily talking about an increase of a factor of 10, and 15 in some cases. To some extent, this has been covered by more efficient data networks and data centres. But because there has been such a substantial rise, efficiency increases have been unable to keep pace, with the result that energy consumption has risen in absolute terms and there has been an upsurge in related greenhouse gas emissions.

Nadine Kreutzer:

Which factors or indicators do you look at to calculate that? Which metrics are used?

Carl-Otto Gensch:

Well, in order to describe data centres and their effectiveness, there is one metric that has been in use for a very long time, namely power usage effectiveness (PUE). It is an indicator which measures facility overhead in the data centre in relation to IT performance. If you operate a data centre, you need an independent power supply, air conditioning and other support services to keep the servers and the data disks and the storage modules running.

This power usage effectiveness metric does not tell us about the efficiency of the data centre per se; it merely measures the efficiency of the facility's technology. So back in 2016/2017, in a project for the German Environment Agency, we began to develop a more ambitious system of metrics, known as key performance indicators (KPIs) for data centres. We looked at the ICT benefits delivered by data centres. Specifically, they store data, they process data and they transmit data. And then we looked at how these uses can be viewed in relation to environmental impacts. Which indicators are relevant here? We're talking about greenhouse gas emissions, abiotic resources depletion and water consumption. And then there is the consumption of energy resources, the cumulative energy expenditure. And we related these usage figures to the environmental impact data in order to quantify data centres' performance more precisely.

Mandy Schossig

And if data centres are now meant to be climate-neutral by 2027, how will that work?

Carl-Otto Gensch:

Well, it won't really work.

Nadine Kreutzer:

That's only four years away!

Carl-Otto Gensch:

Well, theoretically, it would work if there were enough renewable energies available. But what we need to keep in mind, or not lose sight of, is that we are also supposed to be converting our heating systems to electricity, as well as our mobility, and that in the base chemicals sector, far more substances will be based on hydrogen produced using renewables-generated electricity. In other words, there's going to be a run on power from renewable sources. So this strategy, this belief that electricity from renewable sources can be used solely to power the data centres … the figures don't add up.

Nadine Kreutzer:

So how can the climate footprint be reduced if it is already clear that time is running out and that we won't accomplish this so quickly?

Carl-Otto Gensch:

Well, first of all, we need to know more about the data centres and how efficient these centres are – the ones that are already established, as well as the new ones that are being added. And so there is now an initiative for a data centre register, which is also included in the German government's Digital Strategy. It will look at various questions: What is the state of the technology? What is available on the market? It will also provide efficiency figures so that major corporations that buy data centre services in the marketplace, although perhaps not individual consumers, will be able to choose the data centre that has the most efficient technology.

And what we know from discussions with colleagues who advise data centres on energy-saving and resource efficiency is that many data centres are designed to be far too large and have far too much redundant capacity. For example, if the servers in a data centre are not achieving good capacity utilisation, the effects of low utilisation on energy consumption are minimal as the fixed inputs are always there. Even a processor with 0% capacity utilisation in the server still has a 50% energy requirement.

So what is needed here is a raft of management rules, which need to be developed and implemented in order to realise the potential for efficiency gains on a practical level. Developing a system of indicators and making efficiency visible and measurable can certainly lead to changes in the market.

Mandy Schossig:

And in that context, you have also developed a methodology, green cloud computing. Can you briefly explain what it means?

Carl-Otto Gensch:

Green cloud computing is a continuation of the study in which we developed the KPIs for data centres. We defined typical data centre services such as video streaming, video conferencing and online storage and we looked at how this translates into data centre service used, let's say for one terabyte of data or for an hour of video streaming. In this way, we can quantify the associated energy and resource consumption for the cloud services we use.

This also enables us to establish comparability in future. Building on this, one option that we might consider is that before we start downloading or streaming a video, we could get a message giving us the relevant figures. How much resource consumption results from this use of digital services? What about greenhouse gas emissions?

The digital lifestyle's climate footprint

Nadine Kreutzer:

That brings us to our next question. It is about the people who use these services – streaming and so on – which is all of us. If we think about our digital lifestyle, with our mobile phones, laptops, etc., this is quite interesting. So the first question is: How large is our climate footprint? What about our digital devices? You touched on this a moment ago. Perhaps you could say a little more about it – and perhaps about another aspect as well, which many people are not aware of. You have your device, and there's the computer on the table and you have a quick look at something and then a video starts playing even though you didn't want to watch it, and then something else pops up. All of this has an influence on what you're describing.

Carl-Otto Gensch:

I should mention my colleague Jens Gröger here; he is doing a lot of work on this topic. He has defined or estimated average consumption of digital services: in other words, television, video streaming, laptop, perhaps also a tablet, and Google search queries. From this, he calculated what an average citizen in Germany produces in terms of greenhouse gas emissions through the production, use and disposal of their devices and the use of data centre infrastructure.

And he arrived at a figure: depending on assumptions about the equipment used, he calculated a total carbon footprint per person of 850 kilograms per year – that's 0.85 tonnes of CO_2 emissions. Bearing in mind that a German citizen causes CO_2-equivalent emissions (CO_2e) of around 10-12 tonnes per year on average, this figure can no longer be ignored, especially considering that the target scenario for a more or less climate-neutral lifestyle is around two tonnes of CO_2 emissions. So you can see the challenge that we face, because this item on the climate balance sheet will continue to grow over the next few years. We can see very clearly that there is still work to be done on genuinely reconciling sustainability, climate change mitigation and digitalisation.

Environmental impacts of streaming

Mandy Schossig:

Let's look at some examples in more detail. There's a question which journalists often ask our team in the press office, which I'd like to put to you now. You have already mentioned streaming. How high are the greenhouse gas emissions from streaming?

Carl-Otto Gensch:

Within this figure of 850 kg annually, video streaming accounts for 62 kg per year, based on assumed average use. In other words, around 8%.

Mandy Schossig:

That doesn't sound like a lot.

Carl-Otto Gensch:

True, but it very much depends on individual consumption habits. If someone spends all their time streaming videos, their contribution would be higher. We have also provided an online calculator so that you can work out your own digital carbon footprint. That will depend on your digital consumption behaviour.

Mandy Schossig:

If I see that I'm streaming quite a lot, what can I do on a practical level to reduce my digital emissions here? Do you have any tips for us?

Carl-Otto Gensch:

If the option exists and you know that you don't need the best HD resolution, I would suggest that you select a lower resolution as this will reduce the data flow quite significantly.

And apart from that, there is still linear TV, which dates back to the old analog or almost analog world. If you can revert to old-style consumption habits, which means watching the news at 8 p.m. and using an aerial rather than a digital stream, you can also make savings. So there are still a few options, and the use of linear TV is an example. If the infrastructure is in place, this would reduce the amount of video streaming.

Nadine Kreutzer:

It would be interesting to find out about the infrastructure. In fact, we don't have a TV at home any more, and I know a lot of people who no longer own a TV. Wherever the trend is heading, there are so many variables that come into play. Cotto, it's quite remarkable how carefully one has to break down the whole issue; that is a major challenge.

Carl-Otto Gensch:

It is indeed!

Nadine Kreutzer:

What if there were rules on streaming? You have just mentioned smaller bandwidths. But are there any rules to ensure that a message pops up that says: "Do you really need the highest resolution?" or policy measures, something along those lines? Is any action being taken here?

Carl-Otto Gensch:

Not that I know of; I don't think anyone wants to go that far. I mean, we know how it works in mainstream product policy: the first step is to provide better consumer information which describes the impacts of the use of the product or service in quantitative terms, either in absolute figures or in relative terms on a scale from A to E, which is the system we are familiar with from energy efficiency labelling.

Environmental impacts of software

Mandy Schossig:

And what about software? Software also produces emissions – a fact that very few of us have on our radar. How do we find out how much damage software does to the climate or what kind of footprint there is here?

Carl-Otto Gensch:

A few years ago, we had an interesting project that is now continuing in a follow-up project. In the previous project, we investigated or commissioned studies of popular software products by drawing up a typical usage profile for each software product – a word processing package, web browser, etc. And what was interesting was that products with identical functionality differed by a factor of four in their specific energy consumption.

Mandy Schossig:

How is energy consumption calculated? After all, in software, so much happens on a micro scale.

Carl-Otto Gensch:

Yes, but there are tools which make it possible to calculate the use of the network resources, the IT resources.

Nadine Kreutzer:

That brings us to our steak question, which fits in very well here. There is a popular myth that 10 Google queries produce the same emissions as a steak. That raises the issue of search engines as well.

Carl-Otto Gensch:

This is one of those areas where there are always so many statistics and you can never quite work out where they came from. We once tried to factcheck this and we came up with fairly high bandwidths. According to our latest calculations, we estimate that it works out at around 1.45 g per search query; that's 1.45 g of CO_2-equivalents per query. So 100 queries would amount to around 145 g CO_2-equivalents. And of course, the next question is: How heavy is the steak?

Mandy Schossig:

And how can we reduce consumption here, if we want to adopt a more considered approach?

Carl-Otto Gensch:

Well, of course, behind the search queries, there are data centres and software programmes that keep the data centres running. So we could think about how to make these search queries more

efficient. But based on recent debates and reports, it is questionable whether this is the direction in which conventional search queries are heading.

Let's say your search takes you to ChatGPT. Initial reports are talking about very high resource consumption here. This means that we are dealing with a development that could actually take us in a very different direction, according to all our estimates so far. So for now, there is more likely to be an increase than a decrease. And another point which I should mention is that the complexity of the search query is, of course, a further factor that determines usage in a data centre.

Nadine Kreutzer:

We will come back to ChatGPT when we talk about AI in a moment. But just briefly to conclude our discussion of software and, in this context, obsolescence, it would be good to look at the connection between the two. And perhaps you could also explain precisely what obsolescence means, also in relation to software. I am sure that many people are unaware that there is an underlying problem here as well.

Carl-Otto Gensch:

Well, broadly speaking, obsolescence means that a product or device does not reach the end of the useful life that it could hypothetically achieve. There are very many reasons for this, including psychological factors that are driven by what is on offer in the marketplace. If you have a mobile phone contract which offers you a new smartphone every two years for a very modest additional charge, that kind of thing is of course a driver of obsolescence.

But there is also software-related obsolescence, which means that older devices are no longer capable of operating with the updated software, or they perform so poorly that users soon lose patience and say: "Forget it, it's not worth it. I'll get a new device." It shouldn't be this way. There are software products and operating systems that are far less resource-intensive; by that, I mean resource-intensive in terms of the resources found in an ICT device. ICT stands for information and communication technologies. With a faster upgraded hard drive, older devices can keep running for several more years. But this option might not occur to many consumers because you do need some skills to be able to perform the installation and keep the device running.

Mandy Schossig:

What is the situation as regards political efforts to address the issue of obsolescence and software? Are there any solutions or steps being taken here? Have policy-makers come up with any ideas about reducing obsolescence, making better use of resources and saving energy?

Carl-Otto Gensch:

At European level, there is a debate on whether software can be included in the regulatory regime under the Ecodesign or follow-up directives. The question whether software can regulated at all was a contentious issue among lawyers for quite some time because software is not a tangible product. But we are a few steps further forward now.

In our national projects, too, we are at the point where we can demonstrate, with reference to case studies, that software can be classified and that it is possible to show software developers how they can design their products to be less resource-intensive and to save energy when devices are running. And I assume that these approaches can be translated into regulations in order to establish minimum standards for software products, for example as regards the issues of upward and downward compatibility and the useful life of devices on which the software is installed.

Nadine Kreutzer:

Does green coding feature somewhere in the background here? And if so, what does it mean?

Carl-Otto Gensch:

Green coding is software that has been programmed to minimise the energy consumption of the devices on which it is installed.

Environmental impacts of artificial intelligence

Mandy Schossig:

You just mentioned ChatGPT. AI – artificial intelligence – is another ever-expanding area and we are encountering it ever more frequently. Editors are already worried that AI will soon be writing the texts itself and that human input will no longer be required. But we are mainly interested in the impacts of AI on the environment. Can you give us some insights?

Carl-Otto Gensch:

We know that depending on which specific form of artificial intelligence and how many image or video files we are talking about and which functions it performs, AI can be extremely energy- and resource-intensive. It doesn't have to be, but it can be. But here, our research is still at a fairly early stage.

Right now, we're starting work on a project in which we are developing a kind of reference framework that will enable us to conduct environmental cost-benefit analyses of AI applications. It is based on a standardised or standardisable approach in order to ensure comparability. But this really is an area where we are still on the starting line.

Nadine Kreutzer:

Is it fair to say that AI or something like ChatGPT evolves far more rapidly than the research, and that the research can barely keep pace? Are there sometimes concerns that we may be overtaken by events?

Carl-Otto Gensch:

That is an accurate observation. In fact, our efforts, in terms of accompanying research, are always playing catch-up with real-world market developments; there is usually a time lag of several years. If I were granted one wish and could decide what we could do better in future, I would always say that if the government sets the framework and if the government promotes the technology – if it promotes innovation – the accompanying research must be built in from the start.

I say this because when it comes to milestone decisions on how the technology should be programmed, it is possible to set some benchmarks, firstly to make it more resource-efficient, and secondly, to maximise the environmental benefits from the use of the technology.

Mandy Schossig:

You mentioned that in relation to the climate footprint and sustainability, etc., we are still on the starting line. Which further challenges are associated with AI – political or social? What's your view?

Carl-Otto Gensch:

Well, AI can be used for all kinds of purposes. For example, AI is used to forecast the properties of chemical substances. A few weeks ago, there was an alarming report that a team of researchers had used artificial intelligence to design an array of highly toxic substances in a process which took just a few hours. This shows that these technologies have immense potential for abuse. But I would say that this is beyond the scope of the accompanying research that we have traditionally carried out here at the Oeko-Institut. Even so, we do need to keep an eye on this kind of background development.

Nadine Kreutzer:

On the issue of monitoring, we have another interesting question from a listener. She is interested in data for climate research, the keyword being image recognition. The first thought that comes to my mind here is sustainable agriculture. In other words, using AI-based image recognition to identify weeds in fields, for example, so that less plant protection product can be used, resulting in more sustainable agriculture, all thanks to AI.

Carl-Otto Gensch:

There are some interesting approaches here. In our accompanying research, as part of a project funded by the German Federal Environmental Foundation (DBU), we were commissioned to monitor and study new technologies. And there is indeed a development which enables weeds – plants that are in the wrong place – to be identified using image recognition and removed by mechanical means. This also offers scope to reduce the use of plant protection products – herbicides, in this case. But it also entails additional expense. Image recognition processes are generally associated with high environmental costs, and of course that needs to be weighed against the cost savings for plant protection products.

Nadine Kreutzer:

The key phrase here is rebound effect, right?

Carl-Otto Gensch:

Yes, although strictly speaking, according to our definition, it is not a rebound effect, but burden shifting.

Nadine Kreutzer:

Burden shifting. You will need to briefly explain that to us as well.

Carl-Otto Gensch:

In the debate, we sometimes need to be careful not to describe everything as a rebound effect. Technically speaking, if we have higher energy costs for image recognition, on the one hand, and reduced costs of herbicides, on the other, this is a typical example of burden shifting. We have to look at one environmental impact in relation to the other: more energy consumption or less toxicity in the fields?

Mandy Schossig:

And you just mentioned that you and your colleagues are studying the benefits of new technologies. You are still in the process of doing so, but can you already determine how the overall conditions would need to change in order for the use of AI to become more sustainable?

Carl-Otto Gensch:

Well, if we take the Sustainable Development Goals – the SDGs – seriously, then we would say that AI will have to contribute towards the SDG targets and that needs to be quantifiable and verifiable, and there needs to be a methodology to make this work.

We demonstrated this in a major research project, where we established a policy framework for a large number of green technologies, both in an evaluation that we carried out ourselves but also in a design for an evaluation to be carried out by researchers. And that is undoubtedly one of the paths that will need to be pursued in future because otherwise, the claim that digitalisation should contribute to achieving our sustainability goals cannot be fulfilled with any degree of seriousness.

Outlook and conclusion

Nadine Kreutzer:

We have learned a lot about sustainable digitalisation and the opportunities that it creates, but also the challenges. As always, we end the show with the Chancellor question. You have already talked about a lot of the things that you would wish for. So to conclude, as our expert, what would you wish for in order to ensure successful sustainable digitalisation?

Carl-Otto Gensch:

I hinted at this earlier, but I'm happy to repeat it here: whenever major technology projects are supported and whenever milestones are set – as in the German government's Digital Strategy, which talks about the transport and education sectors, for example – and in all these major lighthouse decisions, there needs to be a pro-active approach to accompanying research.

Mandy Schossig:

That's what you would do as Chancellor.

Carl-Otto Gensch:

Of course. In this podcast, we have talked a lot about energy and resources, costs and data centres, devices and obsolescence. But there's something else which, in my view, hasn't been identified clearly enough as an additional challenge and a major risk: What is artificial intelligence actually being used for? And these trolls, these chatbots, that we are having to deal with are being used to introduce targeted disinformation into the public debate. In my view, these risks – which are risks to our democracy and society – are just as significant as the risks posed by excessive resource consumption and greenhouse gas emissions. And that is certainly an issue which we will need to consider to a far greater extent in our future work.

Nadine Kreutzer:

Does this disinformation affect the climate targets and sustainability?

Carl-Otto Gensch:

Well-targeted disinformation may mean that the environmental information that is provided, such as product labelling, is no longer seen as credible.

Mandy Schossig:

I think what we are seeing is that there is no end to this debate. We will have to stop there; this is our first episode on digitalisation and we will come back to the issue another time so that we can

discuss the social, political and democratic issues in more detail. We may need to invite another expert along as well. Thank you, Cotto, for the hard facts. It has been a pleasure having you on the show.

Nadine Kreutzer:

Yes, thank you. It was very interesting.

Carl-Otto Gensch:

You're very welcome.

Mandy Schossig:

In the next episode, we will be looking at the future of transport. Digitalisation will undoubtedly play a role here as well. But above all, we all know that the transport sector is lagging far behind the climate targets and that more action needs to be taken here. I know that a few more electric cars will not be enough, and that worries me. That's our topic for next time; I am looking forward to it.

Nadine Kreutzer:

Exactly. So once again, the motto will be "all change please!", this time in relation to the transport sector. That's it for today; thank you very much for joining us. If you have any questions, perhaps for the next episode, you can always reach us at podcast@oeko.de. And do please think about giving us a star rating; we'd be delighted. There is also an online button that you can use. Thank you for your interest in today's topic and do join us again soon!

Mandy Schossig:

Until next time!