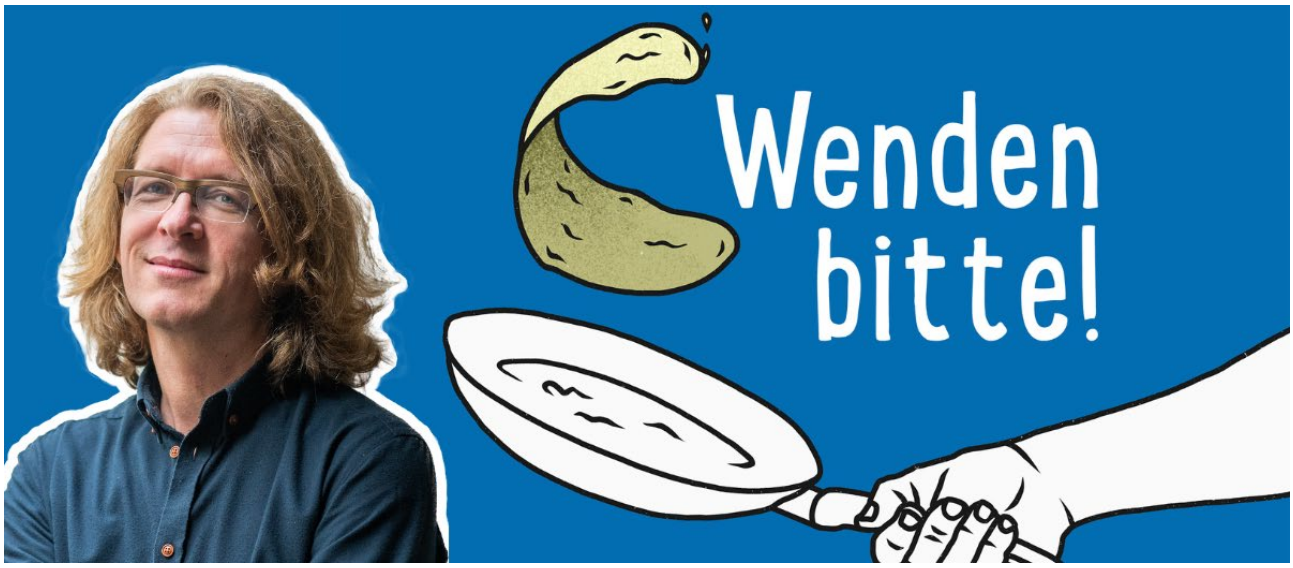

Transcript of the “All change please!” podcast: “How sustainable is artificial intelligence?”

Introducing the subject and today’s contributors	2
Sound clip (brief subject overview)	3
Definition and history of artificial intelligence	3
Environmental impact of artificial intelligence	5
First-order effects	6
How the direct environmental impact of AI can be minimised	9
Second-order effects	11
Third-order effects	14
AI and ethics	14
Governance	15
Outlook and conclusion	16

Introducing the subject and today's contributors

Mandy Schossig:

Hello and welcome to a new episode of "All change, please!". Today we're starting with a brief in-house announcement, because we'd like to invite you to our 2024 science forum on the topic of circular economy. In three digital forums from 23 to 25 September, we'll be discussing the topic of the circular economy and how the transformation to a circular economy can succeed. And also this year, on 5 November, we will meet for a final forum in Berlin at which we'll take a look at what political levers need to be set.

The German federal government has presented a draft for the circular economy strategy. This is an important step, but we want to see what happens next as far as the sectors are concerned. We'll be discussing this topic with many great speakers from Oeko-Institut and external organisations. And we'd like to cordially invite you to it.

You can register and find all the information on our website at oeko.de/wissenschaftsforum2024. We'll also link to it in the show notes. You'll find everything there and can register directly via our website.

So, today we're going to be talking about artificial intelligence. We're not yet able to prepare the whole podcast with ChatGPT, though we did try. Maybe you've had better experiences with it, but of course we're not just talking about ChatGPT and these applications, but about AI – that is, artificial intelligence as a whole. And as befits an institute specialising in climate protection and environmental issues, we're particularly interested in whether AI is sustainable. My colleague Hannah Oldenburg will be joining us again today; you already heard her in the last episode. She is our social media expert and edits the podcast. Hello Hannah!

Hannah Oldenburg:

Hello Mandy, nice to be here again! For the sake of completeness, and especially for our new listeners who we're delighted to have here, I'd like to briefly introduce you again. Mandy Schossig is head of communications at Oeko-Institut and the two of us sit together in the Berlin office, where all this magic happens.

Mandy Schossig:

Right. And when it comes to AI, Hannah, what comes to your mind?

Hannah Oldenburg:

A few years ago, I would probably have said robots or self-driving cars. But now digital applications are much more prominent and are already being integrated here and there. For example, chatbots, ChatGPT (which you've already mentioned) and AI image generators, all that kind of stuff. That's what comes to my mind when I hear "AI". What I find exciting is not only how differently AI is already being used, but also how it affects the environment and the climate. I wouldn't think that the huge energy consumption of AI comes to most people's mind when they think of AI.

Mandy Schossig:

Yes, I have the same impression. And we want to take a closer look at that today. As always, we've invited an expert from Oeko-Institut, our colleague Jens Groeger. Jens works in the Products and Material Flows Division at our Berlin office and specialises in digital applications. Jens Groeger

analyses the environmental impact of software and hardware and compiling carbon footprints. Hello Jens, nice to have you here!

Jens Groeger:

Hello Mandy, hello Hannah.

Hannah Oldenburg:

Hi Jens, it’s great that we can sit together in the studio again. That something we can’t take for granted – we also have a lot of experts working outside of Berlin. And before we dive deeper into the world of artificial intelligence and drill you with questions, we've put together a brief overview of the topic for our listeners. So let's go.

Sound clip (brief subject overview)

Artificial intelligence is already being used in many areas of life. Language models help with texting, chatbots answer questions and your favourite music is played at your command. AI also helps companies improve their production processes and large amounts of data can be analysed in a targeted manner in research. So there are many benefits for our society. But also for the environment and climate? What are the opportunities and risks of artificial intelligence for a more sustainable future? Like any digital system, AI consumes energy when it is used and therefore has an impact on the environment. At the same time, AI can also ensure that energy is saved if processes are accelerated as a result. In addition to environmental factors, chatbots and the like also change society and our individual behaviour. So how can AI contribute to the sustainable development of the environment and society and how can negative effects be prevented?

Definition and history of artificial intelligence

Hannah Oldenburg:

Jens, before we delve deeper into the topic with you, one question first. You told us in our preliminary discussion that you read a book about AI about 40 years ago? Is that when it all started?

Jens Groeger:

As a teenager, I actually read the book “Goedel, Escher, Bach,” which is about the mathematician Goedel, the artist Escher and the musician Bach. And it was about the question: To what extent can art be calculated mathematically? To what extent are there corresponding systems behind it? The transition to artificial intelligence is fluid. The question has been around ever since computers have existed. Artificial intelligence or, so to speak, machines that imitate human behaviour. That's been around forever. As early as 1700, someone developed a chess computer that claimed it would respond automatically. Chess and games like this are, in any case, a problem that AI people have been dealing with for a long time. That one was trickery because there was a human inside operating the chess pieces.

But people have been trying to build machines that imitate humans for a very long time. So it’s no wonder that artificial intelligence has been on everyone’s lips ever since people started talking about artificiality and automata.

Mandy Schossig:

And the narrower concept of AI that we have experienced it in recent years? Historically speaking, let's draw a timeline. How long has AI been around and in what form? How has it roughly developed over the last few years and now?

Jens Groeger:

As early as 1950, a mathematician called [Alan] Turing was already working on the question of when a machine or a computer can be described as intelligent. He invented the Turing test. He described how it could work by comparing a person sitting in the next room with a computer sitting in the next room and asking it questions. Can I tell whether I am talking to a person or a computer? And if I can't tell the difference – for better or worse you have to talk about intelligence.

Josef Weizenbaum took this idea further and developed a computerised psychotherapist, Elisa was its name. Elisa could be asked questions and the users of this psychotherapist had the impression that there was finally someone who understood them, responded to them and repeated questions, just as we have learnt from listening attentively. In other words, people fell for it and even when it was pointed out that it was an automaton, people said: "Yes, anyway, I feel really well understood and guided." It seems to be the human need to project something on to this machine and then see the reflection that the machine offers as it being alive.

I think the term "artificial intelligence" is more or less a marketing term. We realise that a machine cannot think for itself, but can only reproduce the algorithms that have been programmed into it. It may appear intelligent to us as outsiders, but in practice it has no consciousness of its own behind it. When did it all begin? As soon as the computers began to run.

And the fact that people are so surprised at what they can do is only because computers have quasi "learnt to talk." At the end of 2022, when ChatGPT came out, people were surprised at what computers can do these days. But a long process preceded it. The washing machine that recognises how much laundry is in it or how often I wash and so on. Self-learning systems have been around for a long time.

Hannah Oldenburg:

You've already listed a few things. Can you mention a few more areas in which artificial intelligence is already being used?

Jens Groeger:

Where artificial intelligence is a further development of digital technology, you mean?

Hannah Oldenburg:

Exactly.

Jens Groeger:

As part of the European Artificial Intelligence Act, an attempt was made to identify a definition of artificial intelligence, because you first have to define what you want to regulate. In the end, it emerged that it has to be self-learning systems which extract information from the experiences gathered by the machine and save it for future decisions. Something like this has been around the whole time, for example in process control; when I control machines, the machines learn over time that they don't have to do so much to save time.

In principle, every control system – for example every heating control system – has intelligent components in it. It knows when it's cold outside, it has to switch on and if the night was particularly cold, it has to heat up for longer so that the cold walls dethaw again.

Mandy Schossig:

You've just said that AI only became prominent in the public arena in 2022. Where is research at the moment and what else is in the pipeline?

Jens Groeger:

The fact that it's a hot topic at the moment means that everyone is trying to implement artificial intelligence somewhere. This is also due to the respective research programmes. A lot of money is being spent. The [German] Ministry of the Environment is also spending a lot of money to promote all kinds of AI pilot projects. AI is being trialed everywhere. It can be used to count insects, to determine the condition of water or to predict flood events.

In principle, enhanced computing, i.e. increased computing power, can be used more or less everywhere. It is important to say that artificial intelligence or machine learning differs from traditional computing in that traditional computing is linear. This means that I work through one process after the other. I push everything through a central processing unit, which can then process everything one after the other. With machine learning, I process a lot of data in parallel. I consolidate and draw parallels and also have trigger thresholds where I say: this image I've just scanned here is similar to this collection of different images that all represent a cat, which is why it is likely that it is a cat. And I can only do that if I don't work through this image point by point, but if I capture the image as a whole and continue to cluster it to find out what can be seen.

Hannah Oldenburg:

Okay, we've heard a lot about AI and machine learning and so on. Our focus today is also on the environmental impact of such AI models. And with all these great applications and areas of AI, I wonder whether and in what ways AI can also make our lives more sustainable. If you think about all those servers that AI needs, the energy balance doesn't look so rosy. Can you say something about that?

Environmental impact of artificial intelligence

Jens Groeger:

For example, Microsoft is in the process of building a large AI data centre along motorway 61 in North Rhine-Westphalia. One of them is to be 200,000 square metres large. Then they want to build a second one. I've made a rough estimate and this data centre will need about as much energy as 125,000 households. In other words, that's the size of a city like Aachen or Freiburg if two people live in each household.

Mandy Schossig:

We've already touched on the topic of data centres and the energy balance. Perhaps we should take another half step back. On what levels do you see the consequences of AI coming about in terms of the environment and sustainability?

Jens Groeger:

We try to cluster the environmental effects and speak of three effects at this point. First-order effects are the direct effects that are directly attributable to digital technology. These are the production of computers, data centres, data lines, devices as well as the use of these devices, i.e. the energy consumption associated with the devices. We refer to these as first-order effects. The nice thing with first-order effects is that they can be quantified quite well. You can say that to use a service, I need an end device and I sit in front of it for 20 minutes, send data through the network and something is processed in the data centre. That's all easy to quantify.

Then there are second-order effects. These are indirect effects that are related to the use of digital technology or AI. If I order pizza using an online service, something is triggered indirectly, namely the pizza is baked and a driver drives off and uses fuel. These are indirect effects that are related to AI. We can go into this in more detail later.

And then there are third-order effects. We also call these systemic effects that affect society as a whole. If I suddenly have digital applications, job profiles change: there are no more translators because Deepl does the translating; there is no more high-street retail because I order everything online. These effects are connected with [the use of AI]. They describe a social change. These systemic effects also include rebound effects – for example when I have more time thanks to the use of digital technology. I no longer have to drive to work because I can work from home, so I have more time and in my free time I might go shopping more or do online shopping or drive around in my car. That means the rebound effects are even more indirect because on the one hand I have savings but on the other hand there are rebounds. That's why rebound means that I then consume more. Exactly. The challenging thing about these third-order effects is that they are quite difficult to quantify. How much people really consume more or drive more by working from home can really only be estimated very approximately.

Hannah Oldenburg:

Yes – interesting nonetheless. We'll certainly get into that more towards the end. Let's begin with the first-order effects you mentioned. You said these are the direct effects on the environment. As you diligent listeners probably know, we had your colleague Carl-Otto Gensch on an earlier podcast episode and talked to him about the fact that digital technologies consume a lot of energy. Is that also the case with AI? You've already touched on the incredibly huge server that's needed.

First-order effects

Jens Groeger:

The fact is that data centres are experiencing an enormous boom. Data centres in Germany already consume 1.5 percent of the electricity consumed in this country. And due to the hype around AI, there is a trend towards building more and more of them. I mentioned this Microsoft data centre in North Rhine-Westphalia, but data centres are also springing up like mushrooms in Berlin, Frankfurt and Munich. And in Frankfurt too, for example; around half of the electricity in Frankfurt is already consumed by data centres there. To be fair, it has to be said that the internet exchange point is in Frankfurt, which is why they all want to be there. The financial sector is there. In other words, they want to access the data centres with short latency times. That's why it's an attractive location, but electricity is already in short supply locally. 1.5 per cent is not that much, but the problem is constantly growing. And in this respect, the direct effects are increasing mercilessly.

Mandy Schossig:

And how do you measure these direct effects? You've already mentioned electricity, which is easy to calculate. What else is there and how do you measure it?

Jens Groeger:

We take a life cycle assessment approach. This means that we analyse products from raw material extraction to production, transport, use, disposal and so on. And by looking at this life cycle, there are even more environmental impacts than if you were to look at electricity consumption in the utilisation phase. There are the raw materials that are needed. There are emissions in the factories and land and water consumption and greenhouse gas emissions. We made a life cycle assessment of data centres and took a look at what it takes to manufacture and operate this entire data centre. And we related this to the services offered in the data centre, server capacities, storage capacities, data transmission and were able to identify Key Performance Indicators for Data Centre Efficiency, which is also the name of the study, KPI4DCE, that we conducted on this topic.

Mandy Schossig:

Always these abbreviations!

Hannah Oldenburg:

Very catchy!

Jens Groeger:

In this way, you can evaluate this data centre by forming parameters. And as the operator of this data centre, you can ask: How can I manage to operate it in a more optimised way by leaving out the servers or having lower losses in the air conditioning? There are various tricks I can use to optimise a data centre. But the first thing I need are indicators, i.e. figures that give me information. And we've refined the description of this entire data centre by breaking it down to individual cloud services in the Greencloud Computing project. In principle, the cloud service could also be the operation of a ChatGPT or another language model. A cloud service, for example, one hour of video streaming or the use of Office 365 or storing 1 terabyte of space in the cloud. Such a cloud service can be quantified and we can say how much energy it requires, how many CO_2 emissions it has, how many raw materials, electronic waste and water consumption are associated with it. And so I can put a sticker on every cloud service and every digital service and say that this service requires this amount.

Hannah Oldenburg:

Okay, AI in particular is a type of software. How do you measure the entire carbon footprint, the entire environmental footprint?

Jens Groeger:

Artificial intelligence is just a special software application, a self-learning software application. And the thing about artificial intelligence is that it not only consumes a lot of energy in the delivery phase, but also in the training phase. Training an artificial intelligence model can take up a lot of server capacity. If you do a life cycle assessment, you have to include the production phase of the software.

I've heard that ChatGPT has emitted 500 tonnes of CO_2 in its third version. But this training is not the worst thing of all; rather it's the inference, i.e. the delivery of the service. Especially with intensive use, as is the case with ChatGPT. In other words, after I have created and installed it in the data centre, this thing continues to run, consuming energy and collecting data. In terms of the order of

magnitude, the delivery (i.e. inference) phase requires ten times as much energy as in the training phase.

To make this more vivid, journalists always ask me: “How bad is a Google request?”. And the answer is: “1.5 grams”. The question is whether you can do anything with that. ChatGPT consumes 4.5 grams. Each ChatGPT request consumes three times as much CO_2 as a classic database request. A Google query is also highly complex; a lot of data has been collected and categorised. There is an intelligence behind it that makes certain suggestions and ranks them accordingly.

In other words, I have tripled this carbon footprint simply by using AI. And you can imagine that if intelligence is built into all search engines and in the future, Google queries are no longer made but rather only voice queries, this will quickly increase.

Mandy Schossig:

Yes, I've honestly caught myself asking ChatGPT because the answers are better.

Jens Groeger:

I also know people who no longer ask people at all. They only ask ChatGPT.

Hannah Oldenburg:

Yes, you can have a nice chat with it.

Mandy Schossig:

How can its carbon footprint be improved? If you say there are so and so many grams. I would like to ask the journalist question. If I'm more precise in my prompts, am I more energy efficient?

Jens Groeger:

In principle, yes, but I'll bet you that if you set out to spend an hour optimising the text you're writing and keep prompting until you have an optimal text, even if you prompt more precisely, you're investing that hour. That’s a classic rebound. Even if I communicate much faster by writing emails, it's not like I spend less on correspondence per day. Because it's quick, you simply do more. Every technical system can be optimised, models can be trained, there are ways to do it better during training.

One of them is precision. If I don't want it to be accurate to the fifth decimal place, but the first decimal place is enough for me, then I need much less computing time or training time. Or I use pre-trained models in which certain things are pre-sorted. There are lots of tricks. But if you talk to AI or machine learning developers, they have no idea what they’re doing, they might have a flat rate in a university data centre. They can then use it however they want or have a quota of “machine time” that they can use up, and they do.

Mandy Schossig:

Before we get into how this can be improved – e.g. software efficiency – I would like to pick up on the 4.5 grams. That doesn't sound like much. Can you categorise that? How many such requests are there? How quickly does it add up? Can you say something about that?

Jens Groeger:

With this technique, it is always important to look at the absolute and not the relative numbers. This means that it’s of no use if this one request is not so high, because it’s the number of requests that

counts. 4.5 grams is like smoking a cigarette. You may only make 50 requests, but Hannah, who is sitting at the next table, does the same. That means all your colleagues are doing it and all the people running around outside are doing the same. In other words, the comparison with 1.5 grams for classic Google queries was sufficient. Now you need the answer for ChatGPT multiplied by three. And that's enormous if I use three times as much power in one go due to a new technology for my data processing.

And if in the past the power consumption of data centres in Germany was 1.5 percent, then suddenly it's 4.5 percent due to such a technological leap. And there are indeed gloomy forecasts that our IT-related electricity consumption will rise to half of our total electricity consumption by 2040. These are gloomy forecasts, but if you are not careful and, above all, have no idea, as a developer or user, what environmental impacts are caused behind the cable, then it can quickly mushroom out.

Hannah Oldenburg:

So, is the solution to stop using it? Or do you have another solution? How can we reduce this consumption? How can we reduce electricity consumption?

How the direct environmental impact of AI can be minimised

Jens Groeger:

At this point, I would not pass the responsibility on to the users and say: "Save more energy!". Instead, I think the responsibility lies with the developers of such technology, or rather those who have the corresponding business models behind it.

The fact is that you can earn an incredible amount of money with the digital economy. You can get your own clicks right away and earn even more money with them. In other words, I can earn an incredible amount of money with it and the systems are optimised exclusively for this purpose. To maximise profits or earn more money. In other words, it's the companies that have a responsibility to look not only at money as the only indicator, but also at the environmental impact. And to report on the environmental impact in the first step, to report on how high the environmental impact is, and to start reducing the environmental impact – at the latest in the second step.

A popular strategy is to say: "Yes, these CO_2 emissions in the utilisation phase are a bit of a nuisance, so we will use renewable energy and then be at zero". That's not how it works, because electricity is still consumed and as long as the entire energy supply is not renewable, I can't argue that I'm CO_2-free. And rare and valuable raw materials are used for the hardware and end up as electronic waste afterwards.

Mandy Schossig:

On the subject of the environmental footprint and software, I'm thinking of a project that you're involved in. It's the eco:digit project. It's about the environmental footprint of software. Would you like to explain it to us a bit? What exactly is it about? What are you doing in this project?

Jens Groeger:

Yes, sure. Let me go back one step further. We've actually developed a methodology for assessing software, along with the University of Zurich and Trier University of Applied Sciences; we developed indicators for evaluating software. Based on this, we developed the Blue Angel ecolabel for software. The ecolabel indicates that certain measurements have been carried out and that the software fulfils certain characteristics and can be described as sustainable software. At this point, we developed a

methodology with which it is possible to determine the environmental footprint or environmental impact of software.

And in the eco:digit project, which is a research project funded by the German Ministry of Economic Affairs and carried out with partners such as Siemens, Adesso, the German Informatics Society, the Open Source Business Alliance and a few others, we have a large project in which we're looking at the life cycle assessment of digital services by analysing the environmental impact along the entire digital supply chain. The digital supply chain means, for example, that when I visit a website, I sit in front of my laptop with a router and a telecommunications network connected to it, which then goes on to a data centre. My enquiry is answered there or the website is generated and sent back again. There are many small instances in between that consume electricity, have to be produced and have an environmental impact.

When we do a life cycle assessment – unlike analysing a T-shirt, for example – we not only have to look at the production and use of the T-shirt, but also at all instances along the entire digital supply chain. The first difficulty is that these instances are not fully, but only partially utilised. If I send something via the telecommunications network, I don't need the entire telecommunications network, just a bit of it. This means that I have to break down the environmental impact of the telecommunications network to the corresponding data stream and do the same with the website that is delivered to the server, which also does all sorts of other things.

Afterwards, I can add it up and because the whole thing becomes very complex and nobody can reasonably be expected to understand it, it is virtualised on a platform – we call it a test bench – as part of the eco:digit project. So that a developed software with a local load, for which you need a device that causes something in the network and in the data centre, can be simulated on this digital test bench. I can install the software on the platform interface, select which infrastructure components I use and the software then calculates how large my footprint is. And not only that, but I can also vary it. I can decide whether I want to do a lot of calculations locally, for example on my laptop, or whether I prefer to do them in the cloud and move more data back and forth. And I can compare the variants with each other in order to optimise my software in the second step and make it more data-efficient or energy-saving.

Hannah Oldenburg:

That would be the goal of the whole thing, so to speak. I can then check the footprint and look at each part of the supply chain to see where savings can be made.

Jens Groeger:

Exactly. Oeko-Institut does the methodology; the project partners practically supply the data for their infrastructure components and Adesso are the ones who programme an interface, which is also made available as an open source. This means that anyone who can do this on their own can install it on their own computer, thereby giving developers a corresponding simulation environment with which they can predict the environmental impact of their software.

Mandy Schossig:

And can this also be used for AI applications?

Jens Groeger:

I said that with AI, training is still very important. With our Blue Angel label for software, for example, we've said that we look at the software when it is finished and not at the production of the software,

because that's a separate issue. It's an allocation issue in particular: How do I allocate these 500 tonnes that ChatGPT consumed during training? How do I allocate it to the individual user? It depends very much on how many ChatGPT requests are made. You don't know that from the outset.

These are the further methodological difficulties associated with the training. In this respect, we have been rather modest. In principle, the training could also be understood as running the software, except that it is not traceable in the simulation environment, so it is wiser to see how much energy is consumed within the data centres.

Hannah Oldenburg:

Looking back together, first-order effects sound very negative. These are environmental impacts that we just need to minimise as much as possible. If we look at whether AI can make us more efficient and also save energy. Are those already second-order effects?

Second-order effects

Jens Groeger:

Absolutely. I don't want to deny that AI can be useful. Production processes can be optimised with AI or by using digital technology. For example, waste can be sorted using image recognition. This means that unpleasant activities that require people to rummage around in the waste can be replaced by robotic arms that recognise the items and pull them out. Or I can promote the circular economy. For example, a pilot project funded by the German Ministry for the Environment is scanning old textiles and recognising what the resale value is and whether it is worth pulling it out of the pile. This means that waste streams can be scanned in order to extract reusable items. And there are thousands of other applications: optimising the energy system so that I know when the sun is shining. I can find out that too, but when the wind is blowing and how I can switch on the machines or fridges accordingly on the other side if I know that there is a corresponding supply of solar energy in the grid. I can brilliantly optimise systems and there are many other applications.

But that's also exactly why the digital economy always says: "Let's not look so closely at these first-order effects, we're doing so much good." That's why these positive effects are often a little overrated; we don't know whether the positive effects really outweigh the negative effects in terms of production and electricity consumption during the utilisation phase.

Instead, we are involved in another project, again with Trier University of Applied Sciences and an industrial partner. The project is called KIRA, artificial intelligence, reference model and a practical application. It's about designing a model or setting up an accounting framework when I have artificial intelligence applications. In our case, our practical partner is called BITO, which operates a warehouse in the logistics sector. They have forklift trucks that drive around and stack things on shelves. They can use artificial intelligence to analyse this: How do I store the items so that I don't have to drive back and forth so often? What items that are ordered particularly frequently are then perhaps at the front? Or, how can I make this route within the warehouse such that I cover as few forklift kilometres as possible?

So we have all three things. We have the use of artificial intelligence. We have the environmental impact of providing this artificial intelligence, installing cameras and sensors. And we're relieving the burden on the environment by means of optimised storage processes. Along with Trier University of Applied Sciences, we are creating the methodological framework for this. We define all the points that need to be included in the footprint and then weigh up the positive and negative aspects. We

initially limited ourselves to the environment, but the nice thing about the reference model is that other sustainability dimensions, such as social or economic effects, can be added so that I can then say: "Okay, now I've optimised this with AI, but I've cut five jobs."

Hannah Oldenburg:

And what's the footprint in this case? Is there still a positive effect for the storage centre?

Jens Groeger:

We don't know the answer yet.

Hannah Oldenburg:

Then we'll ask again at a later date.

Jens Groeger:

We're trying out different things with shelves that react to pressure. Perhaps one or two will fall through and others will prove to be efficient.

Mandy Schossig:

At this point, I would like to pick up on a comment that we received on a big social media platform, formerly Twitter. We asked whether there were questions and received the comment: "Yes, that's a typical German debate". What we heard in the undertone of that comment was the suggestion that we're being sceptical and that in Germany people always fear the worst. Is it different in other countries or how do you see it? You've already suggested there are positive effects, there are negative effects, and you have to weigh them up. What would you say to someone if they said this is a typical German debate?

Jens Groeger:

The message is: people just want to play around – let them play, and everything will be fine. Unfortunately, it's not the case with digital technology or AI that you can just give it a go and then it will go in the right direction. Instead, it can strongly go in the wrong direction.

And that's why we need a technology impact assessment. In other words, you have to be able to assess the consequences of releasing it on to the market and on to humanity. And I think that's just as stupid as building nuclear power plants and not having thought about it beforehand: What do I do with the waste? And then saying afterwards: "Oops, now we've got trash. Where do we put it?".

In other words, you have to think about what happens to it beforehand. And this is not a purely German debate, there is this AI regulation at European level precisely because the potential that AI has to put society in a precarious position has also been clearly recognised at that level. In the beginning, it was all about AI-supported decision-making systems. Do I use AI to rank people, in selecting personnel, in searching for criminals or in mass surveillance? In other words, decisions that I delegate to the computer without the ability of a human being to understand what it's all about. And I would say that it would be foolish not to have concerns. You can say, "let them play first and then we'll try to clean up the mess afterwards." But we see with nuclear power plants that this can lead to almost unsolvable problems.

Hannah Oldenburg:

Let's stay with the social media platform that you mentioned for a moment. There was also another comment on it and what you're saying made me think of it. It was a question in the comments about second-order effects and the positive effect that AI could possibly have. And it was said that it should also be possible to run comprehensive simulations on questions of nutrition in order to assess whether we can all be supplied with organic food, for example. Can you say in very practical terms whether you think something like that would work and can provide support?

Jens Groeger:

In principle, at Oeko-Institut we've already done a lot of modelling and simulations. We have already considered whether there is enough agricultural land to supply everyone with organic food. AI can help with this. Above all, if AI makes it possible to obtain real-time data or a lot of data, for example on the quality of the soil, but perhaps also on people's health due to the use of pesticides. You can already predict a lot with such data models.

But here, too, it's like the studies we do at Oeko-Institut. Even if the insight is there, it doesn't mean that anything will change or that people really believe what has been calculated using this model. In principle, it can support simulations and models very well – it already does – but the link to implementation is still missing.

Mandy Schossig:

Exactly, and the companies that are already making use of it say their application requires a bit of energy for this use of AI, but the bottom line is that it has a positive effect. How can this be verified or how do you calculate these second-order effects?

Jens Groeger:

Firstly, it is important to create transparency. Just as I said earlier about green cloud computing. Putting a sticker on an hour of video streaming or a terabyte of online storage or making a statement about it, you could also call it a product passport, that an environmental statement is made about the respective service. This puts companies in a position to optimise and determine where there is a problem or where the greatest environmental impact is. Something like this has to be done.

A small ray of hope is the Energy Efficiency Act, which has been in force in Germany since November 2023. Data centres are now obliged to provide their customers with information on how much energy they consume. This means that if I run Dropbox in the cloud, I can ask my provider: How much energy did this Dropbox use? I haven't yet received much feedback on how often this obligation to provide information has been utilised.

And above all, I very much doubt that the data centres are set up in such a way that they can provide these answers. But it's sad that they can't. With so much data being collected everywhere. So much is known about me as an internet user – what series I like to stream, where I like to shop and where I go. A lot is known about each individual user. But the data centres claim: "We have no idea how much electricity we consume or how busy our servers are. We don't have the appropriate monitoring tools." And that is a total misconception.

Hannah Oldenburg:

I think we can make a statement once again: In the second order, there are bright spots and also a few positive applications through AI and effects. The third order includes rebound effects, but overall it's about effects which our consumer behaviour can change or something similar. Can you briefly explain that again? What does that mean?

Third-order effects

Jens Groeger:

Yes, these are systemic effects that have an impact on society as a whole. These are changes that affect us all and can be observed, for example increased working from home, but also at all other possible levels. Choosing a partner no longer takes place in person, but rather through the use of platforms. Or other decisions are practically induced by the internet or the use of correspondingly intelligent systems.

In other words, society itself is changing and the direction in which it is going is again a question of how the framework conditions are set. Does it boil down to the human resource being tapped more and more? Or does it boil down to digital technology and artificial intelligence being driven or steered in such a way that it contributes to a social benefit? And the debate about social media is also induced by using digital technology. In this respect, these are changes which we can view with amazement, but we can also consider what we as a society can do to counteract them in order to ensure that they don't get completely out of hand.

Mandy Schossig:

And specifically with regard to AI, what changes can you envisage?

Jens Groeger:

One initiative was the European AI Act or the AI Directive, which aims to prevent AI from being used against humans or even tending to be used against humans. It was about algorithm-based decision-making systems. And I have something like that all the time, if I'm looking for a new employee or a tenant for my flat, I could use AI to find the best match. The AI regulation has set certain requirements that there must at least be transparency.

Unfortunately, this AI regulation has been overrun by technical developments, which is why something like ChatGPT came as a surprise. At least there was something about general purpose AI, i.e. for general applications, because in principle I can of course do anything with ChatGPT. I can not only call up specific decisions, but also say: "Here, take this information and do something with it". There are all kinds of problems that result from this. And that's where the legislator has reacted. Copyright is a hot topic in relation to AI. In other words, who owns the information that is generated when learning has taken place with generally available knowledge or proprietary knowledge? Who actually owns the results that are generated? And that will become interesting – at the latest when a number of jobs (e.g. journalists, graphic designers, creative professions) become redundant because they are replaced by such intelligence.

Hannah Oldenburg:

It occurs to me that concerns often mentioned in connection with AI also relate to topics such as ethics and morality. Questions come up like: What is AI allowed to do? Where are the limits? What does an AI decide? Is that also a critical point in your opinion? And how can you set limits? Are there any suggestions?

AI and ethics

Jens Groeger:

We can at least say that we need to set boundaries, because it is important to keep this in mind. Transparency helps here. As with electricity consumption, if I have an AI model, it's important to know the purpose for which it was programmed, what data went into it and what applications it's there for. In other words, the first step is to make the motivations behind it transparent. And if it then becomes clear that an AI is being misused or used to the detriment of humanity, there must be appropriate sanctions in place.

Mandy Schossig:

Yes, and in addition to transparency, I think trust is also an important keyword. If you think about how trustworthy the statements made by language models such as ChatGPT are. We have a project that we were able to finance through donations, which is still ongoing and is analysing the credibility of AI on environmental statements. One example was the information on heat pumps - a big issue in this country - and the question is: can't AI also help to provide more information or promote environmentally-conscious behaviour? Or are we getting the wrong information? Are there any initial findings from our donation project?

Jens Groeger:

As far as I have followed this donation project, the results have been peculiar. The problem is that it's a moving target, that AI or ChatGPT are of course constantly evolving and perhaps getting better or getting worse in other areas. But it's basically the case that you can't trust ChatGPT's statements. I have heard a figure that the hit rate is 70 per cent, which means that 30 per cent are still wrong.

And what I found was an interesting observation: on our software project, the results were scrutinised closely, including the question: "Where did you actually get that from? And give me your sources". And the amazing thing for me was that even the sources were made up. The names were correct, they worked in this field, but the sources they gave were fictitious. And that is very dubious. In this respect, I would initially distrust statements or a text generated by AI. But if a real person looks at it who has a corresponding overview, you can then identify the largest gaps and eliminate them.

Hannah Oldenburg:

Okay, yes, interesting. We'll keep at it and see what else comes from it. I would like to circle back to the AI Act, which you've already mentioned several times, and ask what is regulated or required there. Transparency is also a key point. What about sustainability issues as a whole? Are there any requirements?

Governance

Jens Groeger:

Yes, the focus is on algorithm-based decision-making systems that have been categorised as high-risk AI. The AI is first defined, but then it is categorised into different classes. And depending on the class, there are transparency requirements and certain things are generally prohibited. For example, a scoring system based on the Chinese model is generally prohibited. The higher the class, i.e. the risk class of the AI, the higher my transparency obligation, so I have to provide information about how it was created and what I do with it.

The topic of the environment has fallen down the list a bit. We had also seen many proposals in the drafts on how this could be regulated. But at least this general purpose AI, for ChatGPT or other language models, is obliged to provide information on how much energy it consumes and other

parameters, such as how many arithmetic operations it has required for training. There are a few features in there, but basically the topic of the environment is still very underexposed as far as this is concerned.

Mandy Schossig:

And what do you think should happen and at what level? The EU, Germany, the world. Because many companies are not based in Germany.

Jens Groeger:

That's the beauty of this AI Act, that it's about the market, it doesn't matter whether the company is outside Europe. If it operates a market here, then that must at least be disclosed accordingly for that which it offers on the European market.

What I have in mind as a first step is that AI applications – just like the energy efficiency label on the fridge which tells me how much energy the fridge needs – I imagine that digital services that include AI would have a corresponding obligation to provide information about their environmental impact. In other words, every digital service, every AI application could be assigned a product data sheet, which would then be electronic. This would have the advantage that I could process it further. For example, as Oeko-Institut, if all my employees spend their time with ChatGPT or other automatic translators, I can include the environmental impacts generated externally by Oeko-Institut in the entity's balance sheets. I don't think Oeko-Institut is obliged to submit a CSR report, but other companies, especially listed companies, are. And they cannot externalise their environmental impact and say: "We no longer have our own data centre, we run it in the cloud. Or we don't have our own translators, the cloud or the applications do it for us". Instead, they can get this exact feedback: by translating 25 texts today, I have caused such and such a large carbon, energy or raw material footprint in the cloud and I can include this directly in the company reporting. Information is one thing, a lot of information will overwhelm most people.

But the other is that, as a company, I have an interest in reducing my external environmental footprint and not ruining all the efficiency gains I have made in production by causing external environmental impacts.

Mandy Schossig:

And that would have to be regulated at EU level?

Jens Groeger:

Exactly, so such an obligation to inform, just like the efficiency label on the fridge, would have to be implemented at EU level. Anyone who offers a service, earns money with something or has a business model – the exact parameters have yet to be agreed – must be obliged to provide certain information about their environmental impact. That is not entirely absurd. French telecoms providers, for example, are obliged to inform their customers of their carbon footprint, i.e. the customer-specific carbon footprint. That's entirely possible. We know this from our electricity bill. My electricity provider gives me the carbon footprint of the electricity mix I have purchased. This means that you can impose obligations on the provider of such services to disclose certain information to their customers.

Outlook and conclusion

Hannah Oldenburg:

So, I assume these are all points – this environmental impact label for AI – that you would tackle if you were Chancellor of Germany? We always have this nice question at the close. If you were Chancellor, what would you do?

Jens Groeger:

Yes, basically there's a great deal of euphoria about digitalisation. As the German Chancellor, I would use digitalisation *for* the people and not against people and, above all, not exclusively to increase profits. I would gear all funding or digitalisation measures within the administration towards making a contribution to people and the environment and not just to digital technology per se.

Mandy Schossig:

That sounds good. If our listeners want to find out more about AI and sustainability, do you have any tips for things to listen to, read or watch?

Jens Groeger:

I would suggest that everyone observes for themselves the extent to which they use digital technology and to which they are becoming dependent on certain digital technologies. That is much more revealing than reading something abstract; we are already so deeply involved in it that we should reflect on the extent to which we are becoming dependent. In this respect, I don't have a reading tip, but rather a tip for self-reflection.

Hannah Oldenburg:

Wow, it got psychological at the end there. Thanks for that.

Mandy Schossig:

Very, very good. Thank you very much for being here.

Jens Groeger:

My pleasure!

Mandy Schossig:

Let's take a brief look ahead to next time. The next podcast is about biodiversity. We often talk about the climate here, but protecting and preserving biodiversity is just as important for sustainable transformation. Because although our survival depends on the earth's valuable natural resources, we are not treating them particularly carefully at the moment. We are causing huge species extinction in rainforests and oceans as well as in the fields and in the air. The question next time will be: How can we ensure that ecosystems are protected and resources are conserved?

Hannah Oldenburg:

Exactly, and as always you can send any questions on this topic in advance to us at podcast@oeko.de. And as always, we'd be delighted to receive a nice rating from you, maybe a few stars or a little comment. So, I'll say thank you very much for listening and see you next time.

Mandy Schossig:

Until next time!