MeMo: KI
Meinungsmonitor
Künstliche Intelligenz

SUSTAINABILITY

Factsheet No. 6 – March 2022

Environmental Sustainability of Artificial Intelligence

How does the public perceive the environmental footprint of artificial intelligence?

Sarah Yasemin Akyürek, Kimon Kieslich, Pero Došenović, Frank Marcinkowski, Esther Laukötter

The German population tends to view AI positively in terms of environmental sustainability aspects, even as an opportunity in the fight against climate change.

In a special survey, the opinion monitor artificial intelligence (Meinungsmonitor Künstliche Intelligenz [MeMo:KI]) investigated how the German population perceives the relation between artificial intelligence (AI) and environmental sustainability. By and large, a view of AI that sees it as part of the solution rather than part of the problem predominates: Accordingly, AI is seen more as an opportunity to achieve environmental sustainability goals; the ecological costs caused (e.g., through energy and water consumption) are perceived as less serious. Overall, the results suggest widespread ignorance about the relationship between AI and environmental sustainability. This also results in an undifferentiated perception when attributing responsibility. Nevertheless, compliance with environmental sustainability goals is understood as a task for society as a whole. As possible measures for an informed and democratic discourse on the ecological opportunities and risks of AI, we suggest broader media attention and educational offerings that specifically convey competence in the subject matter.

Environmental sustainability has been an important topic in media coverage for decades. In recent years, its relevance has increased due to debates about the effects of climate change, the more frequent occurrence of natural disasters, and an active protest culture on the topic, for example through the activist movement Fridays for Future. Survey data shows that climate change is also continuously perceived by the population as one of the most serious problems in Germany (Forschungsgruppe Wahlen, 2022). Public discourse increasingly points to technologies as a possible solution to the climate crisis. A look at the research literature on artificial intelligence (AI) shows that environmental sustainability plays an exceedingly important role in the context of developing and commissioning AI systems. On the one hand, AI can help promote sustainable structures by changing and adapting practices of groups or individuals to minimize the consumption of resources (Nishant et al., 2020). On the other hand, there are also immense environmental costs associated with the development and use of AI (Crawford, 2021). Despite these intersections the connection between AI and environmental sustainability is remarkably rarely reported on in the media (Fischer & Puschmann, 2021; MeMo:KI, 2022). The extent to which AI is seen by the public as a part of the solution to ecological sustainability problems or primarily as a cause of ecological costs has not been examined yet. Based on a population-representative survey of 1,013 people conducted in October 2020, this factsheet provides initial answers to this question.

We first look at opinions on the role of AI in the context of environmental sustainability. In doing so, we are guided by a distinction made in the research literature between "AI for sustainability" and "sustainability of AI" (van Wynsberghe, 2021). The former refers to the function of AI as a tool for conserving limited resources, reducing climate-damaging emissions, and

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Meinungsmonitor Künstliche Intelligenz

Method:
Online survey

Executing institute:
forsa Politik & Sozialforschung GmbH

Base population:
German population aged 18 and older who use the Internet at least occasionally

Sample:
Weighted random sample (N=1,013)

Weighting criteria:
Age, gender and region (federal state)

Survey period:
2020, October 19-23

Additional information:
Detailed methodology overview for the MeMo:KI project

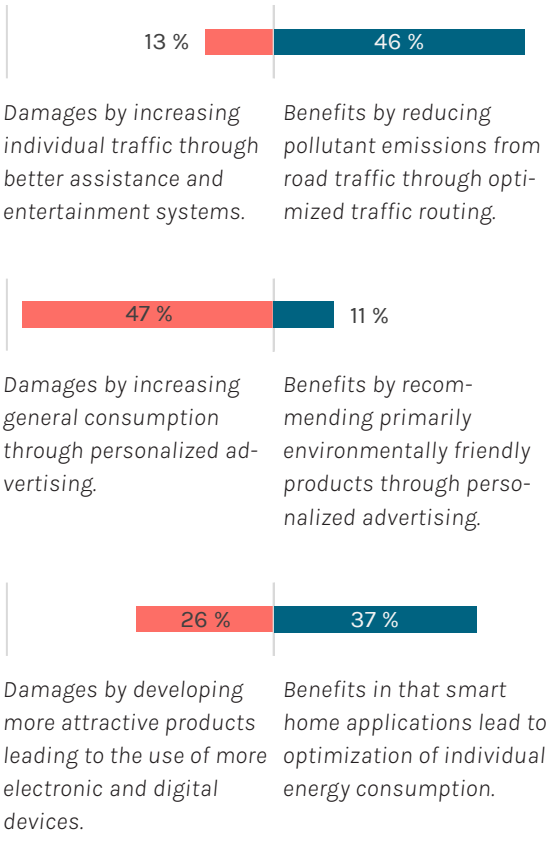
changing behavior towards more sustainable (consumption) behavior. The second perspective is about environmental costs such as the consumption of electrical energy, water, or rare earths that result from the development, diffusion, and use of AI. Is AI more likely to be part of the solution or part of the problem in the eyes of the public? Previous research conducted as part of MeMo:KI shows that AI is perceived with rather low skepticism overall (MeMo:KI, 2022). In a second step, we explore the question to whom the public attributes responsibility for ecologically sustainable development and use of AI, since technologies like AI are always developed and can only have an impact as a result of human decision-making. We therefore examine from whom those potentially affected expect action to make the technology sustainable.

"AI for sustainability" - Perception of the ecological usefulness of AI

"AI for sustainability" refers to applications that use AI to technologically counteract the societal problem of the climate crisis (Rohde et al., 2021). This is done, for example, through the prediction of weather data for disaster prevention, the improved use of energy in industrial production, or the measurement of traffic data for intelligent control of road traffic. The potential of such applications to bring about large-scale change has already been recognized politically and is financially supported, for example, by the AI lighthouse projects of the German Federal Ministry for the Environment (BMU, 2021). In addition, AI can also raise awareness in individuals about environmental and resource friendly behavior by thought-provoking impulses for climate-neutral practices or by illustrating conceivable consequences (Coeckelbergh, 2020). However, efficiency-enhancing innovations are often accompanied by greater production and consumption after all. This results in the so-called rebound effect and an additional consumption of the resources that were originally to be saved (Binswanger, 2001). A smart home can reduce emissions by intelligent control of heating systems, but will also increase CO2 emissions through increased power consumption. This holds true for a number of AI-supported applications in the smart home and elsewhere (see Dauvergne, 2020; Nishant et al., 2020).

For three application examples (road traffic, online advertising, smart home), we asked to what extent a benefit is expected from the use of AI in the sense of greater resource conservation or whether, in the sense of the rebound effect, an increase in consumption is more likely to be anticipated due to more consumption. For two of the three areas, the respondents rather expect an ecological benefit than harm from a rebound effect (see Figure 1). Both the optimization of traffic management (59%) and energy use in the smart home (37%) contribute to more savings, according to the respondents assessment. In the area of mobility in particular, only around one in ten think that innovations in individual traffic lead to increased traffic volumes and consequently to more environmental damage. The result is different for the effect of personalized online advertising. 47 percent of respondents believe that AI is not beneficial to environmental and climate protection in this case, as personalized advertising would increase general consumption. Only 11 percent state that AI benefits environmental and climate protection goals by recommending environmental friendly products. This is in line with the generally rather skeptical attitude towards effects of AI in online shopping (Kieslich, Došenović et al., 2021). The results also show once again that AI is assessed by the population in a context- or application-dependent manner and that there is no uniform opinion about "the AI". Though at this point it cannot be conclusively clarified what share AI has in the assessment of the individual applications. It remains unclear whether a rather problem-oriented perception of AI in personalized online advertising is not

Figure 1: Weighing up the harms and benefits for environmental sustainability through AI (in %)



primarily due to a generally skeptical attitude of the population toward advertising. Since advertising aims to convince people of the value of a product or service, it is obvious that any suspicion of manipulation perceived by the public - even for the purpose of environmentally friendly behavior - will result in rejection.

Overall, it is striking that for all three pairs of statements between 31 and 42 percent of respondents indicated "don't know" as their answer. These high values indicate a lack of knowledge, which is discussed in more detail at the end of the factsheet.

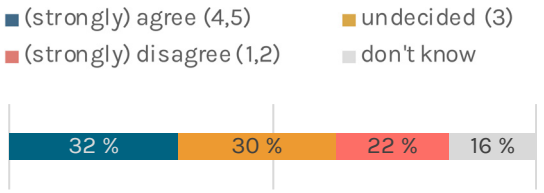
"Sustainability of AI" - Perception of ecological costs of AI

AI is not only related to ecological sustainability as a tool to combat ecological problems. In the development and use of AI, ecological costs are also incurred through the consumption of electrical energy, water or rare earths. So far, we can only speculate on what the German population thinks about the topic "sustainability of AI" (Rohde et al., 2021; van Wynsberghe, 2021). Hence, we explore what environmental problems citizens recognize in the first place. The problem areas addressed include the entire AI cycle, i. e., the complete process from idea to development to implementation of an AI (Rohde et al., 2021; van Wynsberghe, 2021). Researchers assess the environmental sustainability balance of AI systems as problematic: in addition to the mining of rare earths, which subsequently leads to massive pollution of the surrounding environment, the development and commissioning of AI involves large electricity and water consumption (Crawford, 2021; Dhar, 2020). According to current estimates, algorithmic systems could account for one-tenth of global electricity consumption by 2025 (Hao, 2021). Much of this energy will come from coal as well as nuclear power, as sustainable electricity currently makes up only a fraction of the AI industry's electricity mix (Crawford, 2021; Strubell et al., 2019). The large environmental costs can be attributed to the computational capacity required to train AI models: According to a study by Strubell et al. (2019) a single Natural Language Processing model (NLP) - an AI method that serves as the basis for smart speakers - generates as much CO2 as five cars (including manufacturing) over their entire lifetime. The large amounts of water used to cool computing systems are also missed elsewhere, dramatically impacting local vegetation (Crawford, 2021). However, these types of environmental costs are barely perceptible to the general population. Consequently, Crawford (2021) assumes that a large proportion of consumers have little knowledge of these costs.

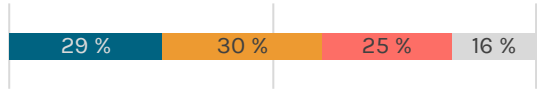
In order to capture how the costs of AI in terms of the consumption of energy, raw material, water and emissions of climate-damaging substances are perceived by the German population, we asked our respondents to assess four statements (see Figure 2). The respondents should estimate whether the ecological costs incurred by AI are offset by savings elsewhere.

The greatest costs are seen in the general consumption of raw materials. Around one third of respondents believe that more of the already scarce resources would be consumed by AI-developing than can be saved by using AI in industrial production. In addition, 29 percent of respondents expect increased energy demand from the operation of data centers, which cannot be offset by AI-related savings. Only one-fifth of respondents fear an increase in emissions of climate-damaging substances through AI-development and production and around one-third of the respondents even believe that emissions of pollutants can be offset by AI through intelligent energy production. Only around 15 percent of respondents consider water consumption, which occurs in the production of AI, to be an ecological cost

Figure 2: Perception of environmental sustainability costs of AI (in %)

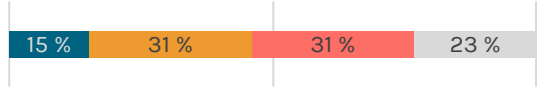


The development of AI consumes more raw materials (e. g. rare earths) than can be saved by the usage of AI in industrial production.



Operating data centers to store necessary data sets will consume more energy than can be saved by using AI elsewhere.

Emissions of climate-damaging substances will be higher as a result of AI production than can be saved through intelligent energy production.



Water consumption in the production of AI is higher than can be saved by AI elsewhere.

item; here, too, the view that AI can help to save water costs, dominates. Once again, there is a comparatively large proportion of respondents who do not answer the questions - between 16 and 23 percent of respondents indicate that they cannot give an estimate. Overall, the German population believes that the ecological costs incurred by the production and operation of AI can be offset by savings elsewhere. We do not make any statement as to whether the cost side or the possibility of savings actually dominates at present or in the future. We can only show that the majority of respondents rate the benefits higher than potential harms caused by the use of AI.

Perceived responsibility for sustainable AI development

A look at guidelines on the ethical design of AI published by policymakers and industry shows that "social and environmental well-being" is often identified as an important goal, and the link between AI and environmental sustainability has thus been recognized by some actors (Jobin et al., 2020). However, in an analysis of 22 such guidelines on the ethical design of AI, Hagendorff (2020) notes that the issue of ecological costs is almost never explicitly discussed and that especially concrete measures to achieve these goals are not named. In particular, the ecological balance of AI systems, i.e. "sustainability of AI", is ignored. It is therefore not surprising that many AI systems are currently still being developed and used without being tested for environmental sustainability (Rohde et al., 2021).

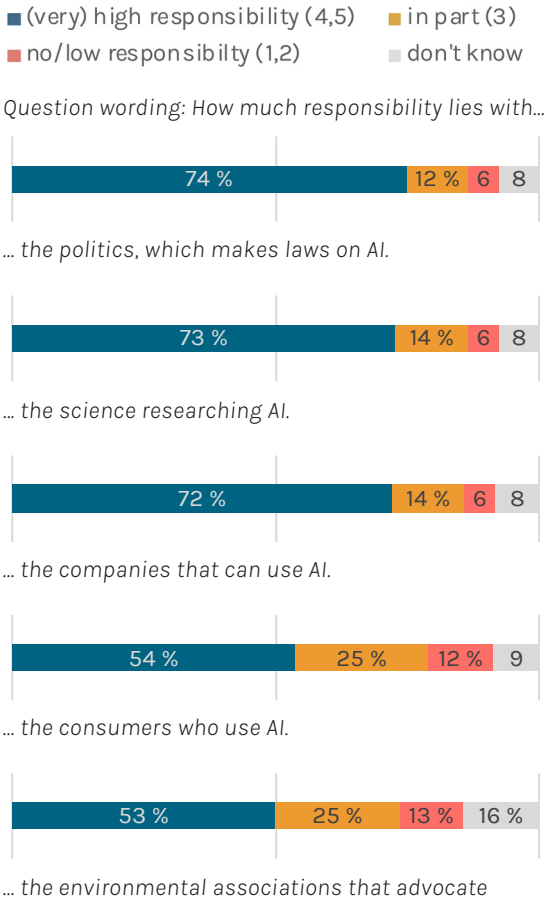
A potential driver for change in the development of AI can be the public discourse in which incentives are created for actors from business and politics (Kieslich, 2021). The main goal of economic corporations is profit, while political actors seek (to maintain) power. To a certain extent, the population can exert influence on politics and the economy by formulating demands for an ecologically sustainable AI. Thus, conscious ecological consumption puts pressure on business corporations. Additionally, politicians have to provide answers when ecological sustainability of AI becomes a relevant topic on the political agenda, for example in election campaigns. However, both will only happen if there is a public demand for such action. If, on the other hand, there is no public awareness of such issues, it is hard to imagine that economic and political actors will prioritize the topic. We therefore also asked who the population sees as responsible when it comes to formulating and implementing environmental sustainability goals in AI (see Figure 3).

“ The compliance with ecological goals with regard to AI is also seen as a broad societal task.

The German population attributes a high degree of responsibility for compliance with the ecological goals of AI to several groups of actors, but especially to actors from politics (74 %), science (73 %) and industry (72 %). They are followed at some distance by environmental associations and consumers, to whom about half of the respondents attribute responsibility.

In the form of legislation, politicians have great opportunities to set the framework for ecologically sustainable action. The high values at this point therefore are less surprising. The values for science and industry can also be explained quite plausibly by the polluter-pays principle: This means that the responsibility for sustainable AI is seen primarily with those groups that can directly influence its design. According to this, science and industry but also legislative politics should ensure attention to the ecological footprint of AI. The lower responsibility values for consumers suggest that they are seen more as secondary responsible actors. Although they are supposed to act in a responsible manner, they do not bear the main responsibility according to the German population - after all, they are not actively involved in the production of AI.

Figure 3: Attribution of responsibility for sustainable AI development (in %)



Of particular interest is whether the sustainability of AI will become the subject of political debate.

Discussion

In contrast to other large-scale technologies, the German population is not very skeptical about AI. The data from our monitor survey shows that only around a quarter of Germans are disapproving of AI, while the rest are either ambivalent (about 45-50%) or in favor of AI (about 25-30%) (MeMo:KI, 2022). This is evident not only in our monitor survey but also in surveys on specific topics. Discrimination through AI, for example, is only perceived as a moderate risk (Kieslich, Starke et al., 2021); furthermore, AI is also associated with opportunities rather than risks in the work environment (Došenović et al., 2020). Based on our previous findings as well as Crawford's (2021) observations, it can be assumed that the clean image of AI can also be found regarding the issue of environmental sustainability. This is despite the fact that, according to scientists, the development and operation of AI is associated with high environmental costs (Crawford, 2021; Hao, 2021). We therefore analyzed whether the general positive perception of AI also holds true for environmental costs. Although environmental sustainability is a current topic in the public debate and AI factually brings high benefits but also high costs in this regard, the low media attention towards this connection is surprising (Fischer & Puschmann, 2021; MeMo:KI, 2022). Accordingly, the media coverage does not provide enough information to suggest a concrete judgment on the ecological balance of AI.

As for other AI-related topics, a beneficial perspective tends to predominate among the German population in the context of environmental sustainability. The opportunities offered by the use of "AI for sustainability" are mostly seen and possible rebound effects are hardly expected. If concrete possible benefits and harm scenarios in an application field are set against each other, the optimistic assessment of AI predominates. The assessment of the "sustainability of AI" items indicates a low awareness of the possible consequences and problems caused by the development as well as the implementation of AI. Thus, resource costs are largely subordinated to the potential opportunities of AI. In particular, water consumption and the emission of climate-damaging substances are not considered by most respondents as a problem caused by AI.

AI is thus also evaluated rather positively in terms of ecological sustainability among the German population, even as an opportunity in the fight against climate change. Despite the demonstrably high environmental costs of AI technology, the image of a technology that solves problems rather than creates them prevails. This fits into the narrative of progress that is widely articulated in media coverage (Fischer & Puschmann, 2021) as well as in policy documents (Die Bundesregierung, 2018).

In addition, our data shows that there is a large proportion of people who do not want to or cannot answer questions on the topic. If sustainability is not discussed in the public debate on AI (Fischer & Puschmann, 2021; MeMo:KI, 2022), it also makes it difficult for the public to form an opinion on the topic.

In view of the broad application of AI as well as its ecological relevance, it would be necessary in the sense of a human-centered AI development, as the EU is striving for (European Commission, 2020), that a public discourse on AI also addresses perspectives and issues of ecological sustainability. Given that we identified a large number of individuals in our data, who do not or cannot answer the questions about environmental sustainability of AI, teaching AI skills in this area is necessary for an informed citizenry. In this context, both the opportunities and the risks of AI can be communicated transparently. Thus, a sound societal assessment of the topic can be achieved, which can also contribute to the topic gaining political relevance, i.e. being politicized. This would require educational courses that reach a broad mass of people. In order to increase the general acquisition of competencies in the area of sustainable AI, specialized courses for teaching knowledge on this issue would have to be created. At the present time, according to our research, there are no explicit courses that impart this knowledge. Even the scientific discussion on the topic of AI competencies does not include the ecological dimension (Long & Magerko, 2020).

Increased awareness and competency on the issue could lead the population to demand action from certain actors as well. Asking people directly who bears responsibility for compliance with ecological standards, a rather undifferentiated picture emerges, which could also be understood as a comprehensive call to action. It can be assumed that the social relevance attributed to the topic of climate change is also reflected in the comprehensive attribution of responsibility.

Responsibility is attributed both to organized actors directly involved in development and dissemination, and to private individuals who can exert influence through their consumption decisions. Whether the statements given are actually AI-specific or more of a general reflection on the contect, remains open.

According to Hagendorff (2020), it is unlikely that actors from politics and industry will ac-

tually put environmental guidelines - if they are formulated at all - into practice. As long as no public pressure is exerted on decision-makers, the argument of international competition in the AI race, which prioritizes economic interests over ethical or ecological design, will prevail. In order to make these guidelines more effective and efficient, binding regulations for ecologically sustainable AI are needed. This can be influenced by consumers, for example, by refraining from using climate-damaging AI. If an increased perception of environmental sustainability related to AI were to occur in the future, our data indicates that it is primarily policy makers, companies, and scientists that will be called upon to advocate for these goals.

Our findings also highlight a need for further research. So far, we only hypothesized that media coverage and other competence transfer would lead to a greater awareness of the connection between AI and ecological sustainability. Neither is expected to occur in the near future without further insertions. Here, a key event, for instance a breakthrough in the fight against climate change or else an ecological disaster caused by the use of AI, could lead to the issues of climate change being linked to AI. It also seems unclear what consequences greater awareness could have, for example, for consumers‘ expectations of AI-supported products or for the formulation of demands on policymakers. Of particular interest, therefore, is a monitoring of whether the sustainability of AI becomes a subject of political debate. Given the ongoing debate about environmental sustainability in society, it is to be expected that the topic has potential for politicization. For example, a large majority of the German population considers sustainability to be a major problem for society; 85 percent of the participating respondents state that they consciously try to make their own everyday life environmentally friendly (IWR, 2021), and 92 percent are in favor of maintaining high environmental standards (Verbraucherzentrale Bundesverband, 2021). Whether this subsequently means that AI products will also be judged according to their life cycle assessment or whether a conscious decision will be made in favor of ecologically sustainable AI products remains to be seen in the future.

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