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GENERATIVE AI IN POLICY-ORIENTED TECHNOLOGY ASSESSMENT

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KEYWORDS

Generative AI, potential applications, parliamentary policy advice, quality criteria, guidelines

ABSTRACT

Generative Artificial Intelligence (Generative AI) promises to facilitate text creation, explorative research, content analysis and idea generation in policy-oriented TA. However, the question arises to what extent specific quality criteria of policy-oriented TA can still be fulfilled. This article outlines possible fields of application for Generative AI, explores the challenges and prerequisites for application, identifies applicable framework conditions and discusses possible voluntary commitments. Existing guidelines call for traceability and transparency regarding use, but do not address the specific field of application. There is, therefore, an urgent need for an exchange of experience on potential applications of Generative AI in TA practice and the development of recommendations.

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1 INTRODUCTION

Generative Artificial Intelligence (Generative AI) is a relatively young technology that is spreading rapidly due to its ease of use, free access and wide range of possible applications. This AI technology is attracting a lot of attention from the public and, due to specific applications, also in the media, education and science sectors (Albrecht, 2023).

The term Generative AI refers to software that can generate new content based on machine learning with extensive data sets (text, images, videos, audio), using statistical methods and artificial neural networks. Generative AI models create content that is based on the training data without reproducing the original data. From a technical point of view, these are usually transformer models that use data sequences and not just individual data points (Wolfram, 2023). As a result, they have significantly advanced the automated processing of natural language, which cannot occur word for word, but in full sentences. Transformer models are the basis for large language models (LLMs). A well-known example is ChatGPT, whose quality of text is now remarkably high in some languages, while the correctness of the content often remains questionable (Löser et al., 2023).

LLMs can also be used multimodally to generate image, audio or video content (e.g., GPT-4o from OpenAI or Gemini from Google). Besides, other AI technologies can also generate audio-visual content. For instance, autoencoders and generative adversarial networks (GANs) (Goodfellow et al., 2014) are used to generate deepfakes, and diffusion models (e.g., Stable Diffusion from Stability AI) are used as image generators. Generative AI models can also be integrated into a variety of downstream systems or applications. This results in a broad spectrum of different possible uses.

For users, it is particularly important to understand how Generative AI models arrive at their results. Knowledge of how the systems work is a prerequisite for being able to interpret the answers received. The output of text generators such as ChatGPT is created after receiving the input (the so-called "prompt") with a word order statistic of consecutive words (or word parts, called tokens) based on the text corpus used for training (Wolfram, 2023). Thus, the result is a kind of linguistically plausible text that is based on probabilities and not on semantic understanding, knowledge or ethical reflection (Taecharungroj, 2023); LLMs do not generate knowledge (Heil, 2023). As such, abstraction or logical problem-solving should not be expected from LLMs (Bender & Koller, 2020). Even if used as intended, the output can contain freely invented text parts (so-called hallucination) (Ji et al., 2023). Valid outputs from Generative AI systems cannot be reproduced and the results cannot be formally explained. In contrast, such AI systems perform well when editing or structuring texts quickly and largely automatically

Since the publication of ChatGPT in November 2022, the use of Generative AI for text and image creation has triggered an intense public debate about the potential and limits of AI. This is in part due to the accessibility of the relevant programmes that generally are open and free of charge, and which are expected to have far-reaching effects on society. For example, this technology is already changing the work of people who are professionally involved in the creation of texts, audio-visual content or communication (see also section 3.3). Generative AI can also be misused to influence the formation of opinion, create disinformation or fraudulent intent and thus pose a threat to the economy and democracy (Bieber et al., 2024; Nentwich et al., 2025).

But what does this mean for practical application in science and research? This article explores this question using the example of policy-oriented technology assessment (TA). TA is generally concerned with observing and analysing trends in science and technology and the associated social developments, in particular the assessment of opportunities and risks. Furthermore, TA is intended to formulate political options for action (Böschen et al., 2021; Grunwald, 2022). The "explicit orientation towards political decisions" represents the traditional core of TA (Nentwich, 2023), whereby scientific methods with specific quality standards are applied. TA scholars have a particular multi-perspective role to play in the investigation and assessment of Generative AI: firstly, to consider these AI systems as an object of investigation. Secondly, to potentially use them in developing assessments and recommendations. Third, TA scholars reflect on the conditions under which methods should be used in TA (see also Albrecht, 2024).

This article focuses primarily on this third reflexive perspective and the quality requirements derived from it. The context of parliamentary policy advice, as it is practised at the Office of Technology Assessment at the German Bundestag (TAB) and the Institute of Technology Assessment (ITA) of the Austrian Academy of Sciences, will be considered as an example. The remainder of the text is structured as follows. First, we present the specific methods and requirements of scientific policy advice, and then we describe potential applications for Generative AI (Section 2). Challenges of using Generative AI for TA practice and the quality of science-based policy advice will be reflected upon in Section 3. Finally, an overview of the legal regulatory approaches and guidelines will be used to examine the question of whether specific guidelines are necessary for TA (Section 4).

2 OPPORTUNITIES OF GENERATIVE AI FOR POLICY-ORIENTED TA

As outlined in the introduction, TA is explicitly geared towards providing support for political decisions. 'Policy-oriented' TA comprises those sub-areas of TA whose main purpose is to advise policy-makers (e.g., ministries, parliaments, agencies) and thus to prepare scientific findings for political decisions. The issues tackled in TA projects originate from politics and are developed either by observing the political or social discourse or are directly commissioned by policy-makers (Nentwich, 2023). An important part of policy-oriented TA is parliamentary TA, which is carried out in many countries in the form of institutionalised *Parliamentary Offices of Technology Assessment* – modelled on the US OTA (Cruz-Castro & Sanz-Menéndez, 2005; Nentwich, 2016).

2.1 THE SPECIFICITY OF POLICY-ORIENTED TA

The specific nature of organisations that conduct policy-oriented TA results from their function as *boundary organisations*. This concept was established by Guston (2001) to describe functions or organisations that mediate independently between politics and science. They have the task of bridging the – socially constructed – boundary between politics and science (Cash et al., 2002). To do so, they assess both the scientific aspects of social issues and the social consequences of technological developments at an early stage and identify options for action (Lentsch, 2014). The assessment, processing and interpretation of scientific knowledge on socio-technical developments comprise the core of the work (Petermann, 2014).

In contrast to a linear model of policy advice, the *boundary organisation* model emphasises that the interaction between politics and science is a dynamic and collaborative process with mutual dependencies (Gustafsson & Lidskog, 2018). *Boundary organisations* mediate between science and politics and provide services for both sides. On the one hand, their success is strongly influenced by the fact that they are neutral, non-partisan and therefore independent from both science and politics. On the other hand, however, there are also dependencies: for example, on science and its findings, as well as on the issues raised in political or social discourses (Guston, 2001). Managing this tension between neutrality and dependencies is crucial to the success of boundary organisations (Cash et al., 2002; Guston, 2001).

2.2 QUALITY CRITERIA FOR POLICY-ORIENTED TA

In the literature on boundary organisations and policy-oriented TA, three key factors have emerged as decisive for the long-term success of these organisations: Credibility, salience, and legitimacy (Cash et al., 2002; Gustafsson & Lidskog, 2018; Hoppe & Wesselink, 2014). The work processes and results of policy-oriented TA must, therefore, be (scientifically) credible, relevant to the policy-making process, and socially legitimate. Based on these success factors, several specific requirements for the practice of policy-oriented TA can be derived, which are also relevant to using Generative AI. In the following, those quality criteria are presented, that apply to parliamentary TA at the Office of Technology Assessment at the German Bundestag (TAB) and the Institute of Technology Assessment (ITA) of the Austrian Academy of Sciences (Figure 1).

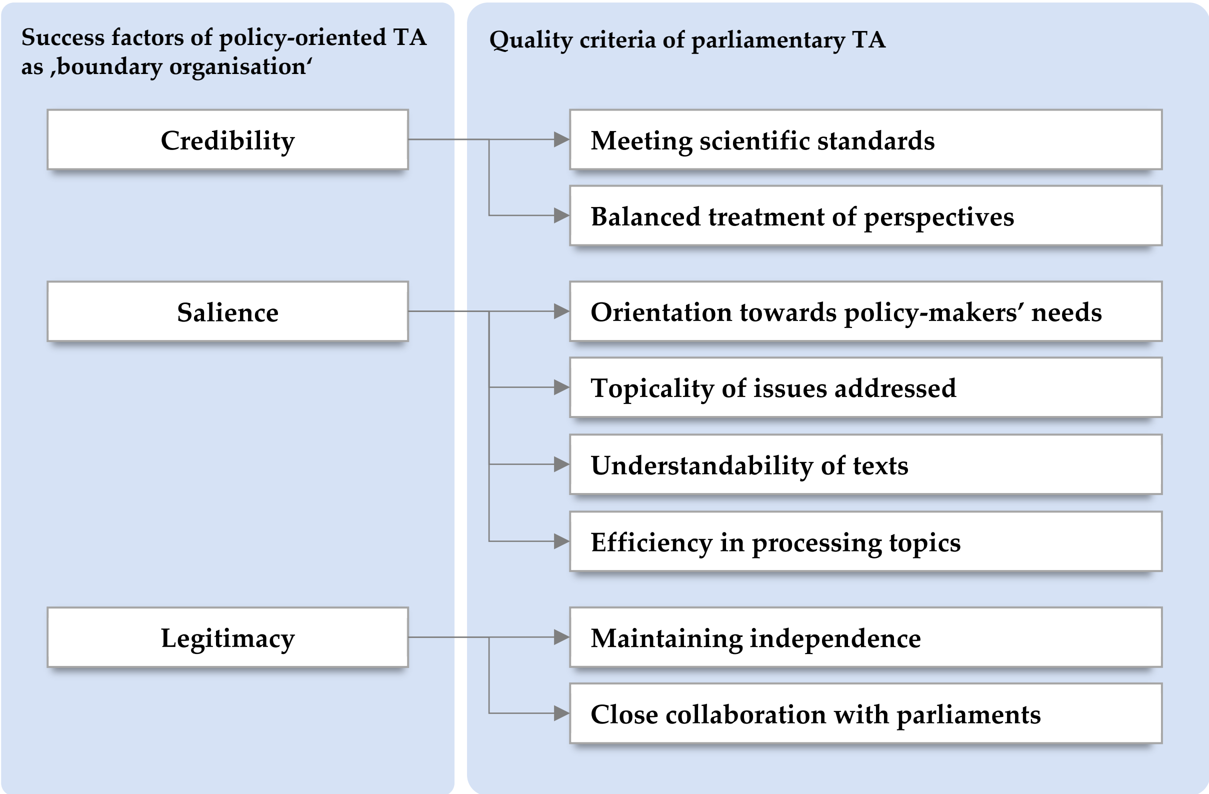

Figure 1: Quality criteria for parliamentary TA (own illustration)

Credibility refers to the necessity for methods and results to meet scientific standards. The sources of knowledge, theories, facts and explanations that an analysis relies upon, must be trustworthy in order to guarantee the scientific quality of the advice (Cash et al., 2002). *Meeting scientific standards* is central, as the core task of parliamentary TA is to prepare and categorise scientific findings (Grunwald, 2022). This also includes transparency of methods, impartiality and openness of results, reflection on and further development of methods, linguistic accuracy and the disclosure of uncertainties in scientific knowledge and regarding plausible future developments (Petermann, 2014). In addition, the *balanced treatment* of different scientific perspectives is a central criterion, whereby normative assumptions of the respective positions should be made transparent to reduce bias, integrate different perspectives into a larger overall picture and point out political options for action (Cruz-Castro & Sanz-Menéndez, 2005).

Salience refers to the adequacy and usefulness of information from advisory projects to support the policy-making process. Information must be available at the right time and in the right level of detail to make it relevant for political decisions (Cash et al., 2002). An *orientation towards the needs* of policy-makers is a key criterion here. Topics and content need to be geared towards policy problems and need to be usable by decision-makers. An important prerequisite for this is usually interaction and communication with the addressees (Petermann, 2014), which is the German Bundestag in the case of the TAB, and the Austrian National Council for ITA. In addition, the *topicality* of the issues addressed is important, i.e. the focus should be on topics that are politically and socially relevant now or should become relevant in the near future (ibid). Other criteria include the *understandability* of texts, which should be written for specific target groups and therefore largely avoid technical jargon (Grunwald, 2022), as well as *efficiency* in processing topics. Relevant aspects of a debate should be quickly recognised, understood and processed in time.

The **legitimacy** criterion focuses in particular on transparent cooperation with both science and politics (Cash et al., 2002). Maintaining *independence* – especially from political parties and interest groups, often also referred to as neutrality or non-partisanship (Grunwald, 2022) – is central to this. Institutionally anchored independence plays just as important a role here as, on a more practical level, the absence of political influence on concrete work results. Therefore, the institutional organisation of the *cooperation with parliament* is also crucial for the legitimacy of parliamentary TA. The transparent documentation of the interaction and the open, joint discussion of different positions serve to create trust, ensure quality, and prevent an excessive instrumentalization of results.

The following section briefly examines how these quality criteria can be fulfilled in the TAB's work process. Quality assurance measures are distributed throughout the entire process to achieve a result that fulfils the criteria of scientific credibility, salience, and legitimacy: [1]

1. *Selection of topics*: Members of parliament can submit applications for an investigation. At the TAB, a group of MPs specifically responsible for TA, the TA Rapporteur Group of the Committee on Education, Research and Technology Assessment, decides by consensus on the topics to be worked on. The close cooperation between these MPs and the TA scientists throughout the topic identification and selection process ensures the work programme's social and political scientific salience.
2. *Project implementation and report preparation*: Once the parliament has passed a resolution, TAB is responsible for conducting and managing the projects. The project team begins with intensive research and expert discussions to specify the focus of the project. Collaboration with external experts from various disciplines forms a core part of the project work. In addition, the project team conducts its own research and attends relevant events to obtain a comprehensive and balanced picture of the topic. A discussion of preliminary results may then be organised in parliament. The results of the various activities are compiled by the authors and summarised in a written report, including options for action. The TA rapporteur group thoroughly comments on the reports, which then might be revised by the authors. The rapporteurs finally approve the report by consensus, which guarantees that the results are non-partisan and neutral.
3. *Science communication and public relations:* Once the results are available, they are communicated to the Parliament and the wider public. This includes summaries of the results, press releases, and social media communication. In addition, events may be presented in or outside of Parliament.

Adhering to scientific standards while at the same time maintaining political and social relevance and legitimacy in all these phases is a central condition for the long-term success of *boundary organisations* such as the TAB or the ITA (Guston, 2001; Wesselink & Hoppe, 2020).

2.3 POTENTIAL FIELDS OF APPLICATION OF GENERATIVE AI IN POLICY-ORIENTED TA

Since the launch of ChatGPT, there has been much discussion about the potential applications of Generative AI in science, especially LLMs. The applications of LLMs could also significantly change policy-oriented TA (Tyler et al., 2023), although there are still hardly any scientific studies on concrete use cases in TA. The concrete opportunities of different AI models for typical tasks has so far only been systematically investigated in neighbouring fields such as the social sciences (e.g., Ziems et al., 2024). In the following, we outline these opportunities along four central fields of application: Text and image production, explorative research, qualitative content analyses and idea generation. The associated risks are discussed in the following section and will be ignored here for now.

Text and image production: The original application area of LLMs, such as ChatGPT, is text production. Accordingly, LLMs are primarily associated with the potential to spend less time on redundant tasks and more time on creative, challenging tasks (Malliaraki, 2023; Tyler et al., 2023; Ziems et al., 2024). For instance, notes taken on publications can be compiled into coherent texts more effectively (Mittelstadt et al., 2023). In

[1] See ***tab-beim-bundestag.de/arbeitsweise-und-bereiche.php***.

addition, results could be summarized for various target groups based on their specific realities and interests much more easily and quickly (Tyler et al., 2023). Creating simple images (e.g., infographics) or even more complex representations, such as interactive graphics, could also become much easier with LLMs. The concept of *living reviews* has recently gained renewed importance. Here, AI methods could be used to (semi-) automatically identify relevant publications and to continuously update existing evidence syntheses based on new research findings (Martin et al., 2023).

Exploratory searches: LLMs are associated with the hope of sifting through and summarising large amounts of information – including information in foreign languages – which would be almost impossible to process manually, or only with very high effort, time and manpower (Tyler et al., 2023). Numerous AI-supported search engines specifically developed to analyse scientific literature are now available (e.g., SciSpace, Elicit, ScopusAI). They offer support in the search for scientific articles and the evaluation of their relevance. Specific questions can be asked to a text and articles can be screened and selected along specific criteria or interests (e.g., risks of a particular technology) (Pividori, 2024). Generative AI-supported search engines that make sources transparent and outputs traceable could be valuable supplementary tools for exploratory searches.

Qualitative content analyses: The identification of scientific publications during exploratory searches may also include the distillation and processing of their contents. Yet, both steps can also be carried out independently from one another. LLMs could be used to analyse a corpus of selected publications. Initial studies show that LLMs can successfully perform language processing tasks in the social sciences without additional training data. For example, Ziems et al. (2024) found that LLMs can significantly accelerate text analysis by automatically annotating documents. Some LLMs have achieved good results not only in topic identification and sorting in documents (*labelling*), but also in the coding of new constructs, analyses and production of summaries. Qualitative content analyses of documents supported by Generative AI are also relevant for TA, especially when it comes to identifying knowledge gaps and emerging research areas for R&D policy, assessing the maturity of a technology and identifying factors that inhibit or promote progress in research and technology development and dissemination (Malliaraki, 2023). LLMs could also support the initial, faster identification of options for action discussed in the literature or the search for information on solutions to a specific problem (Tyler et al., 2023). Furthermore, Generative AI could be used to continuously collect relevant information on events organised by political groups, committees and MPs (GAO, 2024) to better match *policy briefs* to existing knowledge interests and ongoing political discussions and improve the timeliness of scientific advice.

Idea generation: Generative AI could support the generation of ideas or creative tasks, for example, by using the model to create different personas (Pividori, 2024). These fictitious but realistic characters represent typical groups of people and can help to reflect the requirements of a product or technology. In TA, personas could be used to specifically simulate different perspectives on technology, for example, to gather information on potential normative biases in an analysis. The simulation of a sample of the population could help to assess the impact of political decisions (e.g., in the area of R&D). LLMs could also support the exploration of possible futures by simulating plausible future scenarios based on different influencing factors, e.g., emerging technologies, socio-economic trends, political measures or environmental changes. By changing the values of individual variables, a wide range of possible future scenarios could be generated, what-if scenarios and alternative realities could be explored (Malliaraki, 2023). New LLMs are currently being developed to support decision-making (e.g., Rasal & Hauer, 2024), but these developments are still in their infancy.

In order to evaluate the opportunities of LLMs for policy-oriented TA, which has so far only been described in theory, Generative AI tools currently available on the market are being used experimentally at various (parliamentary) TA institutions, in particular at ITAS and ITA. The aim is to document and scientifically evaluate the effects on practices and results.

3 CHALLENGES AND REQUIREMENTS OF GENERATIVE AI FOR POLICY ADVICE

Besides possible applications of Generative AI, the literature also describes the consequences for science, politics, business and society from the perspectives of different disciplinary contexts. From the perspective of policy-oriented TA, potential risks arising from the application of Generative AI technologies are addressed in studies at the European and national levels (Albrecht, 2024; Karaboga et al., 2024; Nentwich et al., 2025; van Huijstee et al., 2021). A comprehensive discussion of the risks cannot be provided in this article. We refer in particular to a recent meta-review on AI risks including Generative AI by Slattery et al., (2024). This publication summarises the risks for different addressees in varying degrees of detail and provides a systematic *risk repository* as a database on an interactive website[2]. Furthermore, the consequences are categorised according to causal factors and risk areas. In the following, we take a closer look at the consequences of Generative AI for epistemic quality (Section 3.1) and scientific integrity (Section 3.2) and discuss aspects of the use of Generative AI in TA that are particularly worthy of consideration (Section 3.3)

3.1 CONSEQUENCES FOR THE EPISTEMIC QUALITY OF GENERATED CONTENT

The epistemic quality of the outputs of Generative AI is questioned by the following five major challenges: the black box problem, the selectivity of the training data, the possibility of bias, the non-reproducibility of the results and finally the occurrence of hallucinations, i.e., invented or confabulated content.

Black box problem: Learning AI systems such as Generative AI derive their outputs independently from the training data. The relationships generated between input and output are usually highly complex and cannot be directly reconstructed by humans. This opacity is also known as the "black box" problem and makes it difficult to judge or verify the accuracy or factuality of the output. For example, predicting how such systems will behave in a specific application or how individual content will be generated is impossible. Methods and techniques are therefore being developed to improve the explainability of outputs, particularly for applications in which AI decisions directly impact human welfare, such as in healthcare or the justice system. The extent to which the explainability of the results is also required in the context of parliamentary TA depends on the specific area of application, the respective quality criteria and legal requirements. For knowledge searches and automated summaries, this problem plays a decisive role, especially when processing longer texts or a large number of documents (Retkowski, 2023). If Generative AI is used as a supplementary explorative tool, to stimulate one's own creativity in developing hypotheses or to reflect on one's own biases, these methods can complement TA practice by providing insights into large data sets that would otherwise be unmanageable. When used to improve the writing process, there are also fewer limitations due to the black box problem. But Generative AI is much less suitable for the analysis of smaller data sets, a typical case in TA where new and, as yet, unpublished topics are analysed (Sietsma et al., 2024).

2 *airisk.mit.edu*.

It is vital to use specialised tools for specific tasks wherever possible and to check the results using conventional methods (see, e.g., Pividori, 2024; Wilson, 2024).

Selectivity of the training data: The selection of data, the training process and the fine-tuning of the systems are determined by the technology developers, which gives them a gatekeeper role. However, most providers of AI models, such as OpenAI, reveal little about the data they use to train. In most cases, large, unadjusted and publicly accessible data sets from the internet are automatically collected and processed. It is only possible to have access to past information that was available until the programme was last updated (Biancotti & Camassa, 2023). Particular challenges, therefore, arise when the focus is on new technologies or technical terms for which the model has not been trained (Yao et al., 2021). It should also be noted that the unspecific database selected for training is not designed towards TA purposes. This means that chatbots can overlook important information (Pividori, 2024). In addition, most LLMs are largely based on English-language data, even though developers now aim at creating multilingual and more balanced text corpora. However, the development of a universal language model faces the challenge of requiring significant computational resources to train and run multilingual models (Peissl, 2024).[3] The heterogeneity of the data poses a central challenge for the evaluation with Generative AI, especially in qualitative content analyses. While scientific publications are comparatively homogeneous in terms of length and structure and can therefore be summarised well with specialised tools, this is not the case when evaluating heterogeneous data sets – also a typical case for TA (Retkowski, 2023; Sietsma et al., 2024).

Bias: The training data of AI models can contain problematic distortions (*bias*) not only from a linguistic but also from an ethical point of view. For example, this can be the case if social groups are represented differently in the training material. Certain patterns are then recognised and repeated, which can create or reproduce systematic biases. For example, several authors detected sexist or racist statements or representations in text or image outputs (Ananya, 2024; Dale, 2021; Davey, 2022; Stokel-Walker & Van Noorden, 2023). When LLMs were used to simulate responses in social research, the opinions generated were more homogeneous than those of corresponding groups of people (so-called "algorithmic monoculture") (Argyle et al., 2023; Santurkar et al., 2023). Distorting effects can also be amplified if the generated content becomes the basis for future training data. Thus, Generative AI could not only perpetuate stereotypes and structural biases but also reinforce them in the future if no countermeasures are taken (Martínez et al., 2024). Conversely, countermeasures can lead to discrimination or misleading or unbalanced content. In ChatGPT, for example, a left-liberal political bias was identified in the texts generated (Rozado, 2023). On the other hand, in the medical context, it has been shown that ChatGPT-3.5 and ChatGPT-4 can more systematically respect scientific standards and guidelines and evaluate data more impartially than some individuals (Levkovich & Elyoseph, 2023). Adherence to quality assurance mechanisms, as is common in advisory processes without using Generative AI, is crucial to counteract possible biases.

Non-reproducibility: The way text generators work also means that the outputs are not reproducible, i.e. the generated content varies when the same queries are repeated. In addition, the answers from text generators are dependent on the wording of the prompt and therefore on the user (Biancotti & Camassa, 2023; Government Accountability Office GAO, 2023). The ability to formulate a question in a way that context-specific, appropriate and relevant answers are generated, is also referred to as *"prompt engineering"* (UNESCO, 2023). Accurate and targeted *prompting* strongly impacts the quality of results, at least for certain tasks, and must be done with appropriate care (Pividori, 2024; Ziems et al., 2024).

Hallucinations: The answers of previous LLMs can contain fictitious content or sources if, for example, the training data do not contain any suitable matches to the questions asked (so-called "hallucination") (Ji et al., 2023). A distinction is made between intrinsic hallucinations, which contradict the training data, and extrinsic hallucinations, which are not factually incorrect but cannot be attributed to the sources used. Hallucinations are misleading and, therefore, question the scientific accuracy and credibility as a central quality criterion of policy-oriented TA. Generative AI results should only be trusted if they have been reviewed by

[3] ***unite.ai/de/the-state-of-multilingual-llms-moving-beyond-english/***.

competent persons (Pividori, 2024), which reduces efficiency gains or time advantages (Wilson, 2024; Ziems et al., 2024). The problem with such fictitious results is exacerbated by the fact that results from computer systems are often ascribed particular credibility anyway. This so-called *automation bias* (Strauß, 2021) is particularly pronounced in LLMs with their output texts, which are usually eloquent in language and content but only seem factually correct (Albrecht, 2023, p. 57).

In this context, it should also be mentioned that there may not only be unintentional misinformation due to the functioning and architecture of AI models, but also a deliberate misuse and abuse by malicious actors. So-called indirect *prompt injection attacks* attempt to hide prompts in data accessed by Generative AI (Greshake et al., 2023). If corresponding malicious data is stored in the original training data, this is called *data poisoning* (Yao et al., 2024). If such attacks are successful, they can generate false information (see also Nentwich et al., 2025). It is unclear whether this is already happening, but it does not seem easy to prevent this potential further threat to output quality due to the open interfaces of LLMs. In any case, there is an additional risk for policy-oriented TA, similar to the hallucinations described above.

These challenges are directly linked to the underlying technology of text generators, and they will continue to be difficult to solve.

3.2 CONSEQUENCES FOR SCIENTIFIC INTEGRITY

The use of Generative AI should not only be viewed critically in terms of the epistemic quality of the content generated. It can also conflict with ethical principles of behaviour and standards in research explained in section 2. This refers not only to the quality of scientific practices and their output but also to the integrity of policy advisors. Scientific integrity is not only an indispensable prerequisite for acquiring and exchanging knowledge but also for the reputation of science in business, politics and society. It forms the basis of trustworthy science and thus for the acceptance of policy advice.

The International Centre for Academic Integrity (ICAI) defines academic integrity as a commitment to six fundamental values, even in the face of adversity: Honesty, trust, fairness, respect, responsibility and courage (ICAI, 2021). These values result in principles of behaviour for academic communities and the responsibility of scientists for the honesty and quality of their scientific work (Lee 2021). Ensuring academic integrity plays a major role in the context of the use of Generative AI technologies, especially in the context of examination law and for the reputation of universities (Moorhouse et al., 2023)

Due to the way LLMs work, it can happen that the text contains sentences that are word-for-word identical to previously published texts. Not all LLMs document their sources reliably and comprehensibly enough, so plagiarism cannot be ruled out with certainty if the texts generated in this way are used as such and without closer scrutiny.

The “Guidelines for Safeguarding Good Scientific Practice” of the German Research Foundation (DFG) enshrines the culture of scientific integrity in the German scientific landscape. Appropriate standards for scientific work are described in 19 guidelines as part of a voluntary commitment, including guidelines on authorship (DFG, 2019). Transparency and traceability of the research process and the knowledge gained from third parties are essential basic principles of scientific integrity. In the DFG’s view, Generative AI significantly changes the entire scientific, knowledge-generating and creative work process. However, using Generative AI cannot release scientists from their responsibility in terms of content and form (DFG, 2023).

3.3 NOTEWORTHY ASPECTS OF THE USE OF GENERATIVE AI IN TA

While the previous paragraphs of this section specifically addressed the epistemic risks of using Generative AI in policy-oriented TA as well as questions of scientific integrity, we broaden the perspective in this chapter. When considering the question of whether or under what conditions Generative AI should be used in policy advice, also more general aspects have to be considered, which do not only affect science or policy advice in the narrower sense but are relevant for the reputation, credibility and thus the integrity of TA institutions. Even if all the challenges outlined in the previous sections could be solved in the short term, this would not necessarily mean a "green light" to use them in TA, precisely because the TA community always cultivates a multi-perspective approach and does not only focus on efficiency gains. The following four aspects are briefly described: Environment, labour, law and digital sovereignty (for more detail, see Nentwich et al., 2025).

Environmental aspects: Training AI models requires large amounts of resources. Three issues are particularly problematic: greenhouse gas emissions, water and land consumption. LLMs are among the most comprehensive machine learning models, reaching trillions of parameters in size. They require millions of GPU hours for training and produce *CO_2 emissions* in the process (Luccioni et al., 2023; Wu et al., 2022). It is estimated that the entire ICT sector was already responsible for around 1.4 to 2.0% of global greenhouse gas emissions in 2020 (International Telecommunication Union ITU, 2020), and the trend is rising. The infrastructure for machine learning contributes increasingly to this, but the exact impact cannot be precisely determined. Microsoft originally wanted to become carbon neutral by 2030, but according to its sustainability report, Co^2 emissions increased by 30% between 2021 and 2023.[4] AI models and their data centres also consume enormous amounts of *water* for off-site power generation and on-site cooling. Li et al. (2023) estimate that 700,000 litres of clean, fresh water were directly evaporated during the training of GPT-3 in Microsoft's data centres and that the global water demand for AI will increase to 4.2 to 6.6 billion cubic metres by 2027. This amount is equivalent to 4 to 6 times the annual water consumption of Denmark or half of the United Kingdom. Another aspect is the increasing *use of land* for data centres. Criticism of the development of this industry relates to the fact that the demand for land is increasing solely for this expanding industry, without regard for the needs of the local population, their culture and the previous use of the land. In this context, authors speak of *"land grabbing"* (Bresnihan & Brodie, 2023).

Working conditions: AI, and Generative AI in particular, raises further questions regarding changes in labour markets (job types and profiles, reorganisation of work, deskilling, etc.). Particularly relevant from an ethical perspective are the poor working conditions of employees in areas of the global AI industry. A recent report on AI and the future of work (Rodel et al., 2024) points out that essential tasks related to AI training (data labelling, content moderation) are outsourced to low-income countries in the Global South. In the AI "sweatshops", no fair wages are paid, no secure jobs are offered, and no formal employment contracts are concluded. The jobs themselves are not only monotonous but also extremely psychological.

Data protection and copyright: Large data sets are used to train Generative AI models, whereby developing companies generally do not disclose details of the training material that is used**.** According to recent findings, the enormous amounts of text, images, etc. were compiled in a "generous" manner. According to recent findings, a "generous" approach was taken to compiling the vast amounts of texts, images, etc., and practically all material available on the Internet and accessible databases were used (Murray, 2023). This includes copyrighted material in many cases, as this use was not foreseeable, which may be considered *copyright infringement*, although this does not yet appear to have been definitively clarified (Murray, 2023). Also, the sources processed by Generative AI often contain sensitive or personal information, including that of minors, which is protected by *data protection law*. Infringements may occur if, for example, the dataset has

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4 *query.prod.cms.rt.microsoft.com/cms/api/am/binary/RW1lMjE*.

not been adequately anonymised (Wang et al., 2023). The use of data without consent or from sources that may not have been intended for this purpose thus raises ethical questions regarding respect for the rights of the individuals concerned and the potential threat to privacy (Golda et al., 2024). The training of Generative AI, therefore, operates in a legal grey area.

Digital sovereignty: The use of Generative AI has effects on the digital sovereignty of individuals and our societies as a whole that are worth considering. It is foreseeable that users, including TA practitioners, will more and more not only rely on the new tools as a support, but also as the basis for their work, thus becoming increasingly dependent on them. This may lead to gradually unlearning previous skills (*deskilling*). In the long run, dependence on tools that can seemingly effortlessly take over even creative and analytical activities could lead knowledge workers (including technology assessors) to losing control of their field of work. No less severe is the impending loss of society's digital sovereignty (cf. Nentwich et al., 2025). Due to the advances of companies from the USA and China, most LLMs are mainly non-European. Apart from the language and cultural problems already mentioned elsewhere, Europe is currently entering into a new dependency on players over which European legislation can only exert limited influence.

From a TA perspective, the interim conclusion is that, even without considering the serious epistemic challenges discussed in 3.1, there are serious ethical issues to be considered when using Generative AI for purely utilitarian purposes, especially in TA itself. These tools are ethically questionable because the potential benefits of their use are accompanied by possible environmental problems, legal grey areas, the outsourcing of jobs to countries with poor labour protection and unacceptable working conditions, and a weakening of digital sovereignty.

4 ON THE ROAD TO SELF-REGULATION

Due to the challenges and concerns associated with the use of Generative AI, it is essential to formulate obligations when developing the models and conditions of use. It is beyond the scope of this article to provide a detailed description of the dynamically developing legal situation for developers, providers and operators of Generative AI technologies at the EU and national levels. In the following, we will focus on how the general regulations are being concretised or expanded through self-regulation and voluntary behavioural measures by the user communities (here: in particular, the scientific and policy advisory communities).

The development and application of AI are subject to a complex system of European regulations, particularly in product safety, data protection and copyright protection, which have been partially transferred into national law. The AI Regulation of the European Union (the so-called "AI Act": Regulation (EU) 2024/1689 of 13 June 2024) is of particular importance because it explicitly addresses LLMs and generated content. The main aim of the AI Act is to ensure that the AI systems used in the EU are safe, transparent, traceable, non-discriminatory and environmentally friendly. Furthermore, the term "trustworthy" is a significant criterion in this legal framework (Recital 1 of the AI Act). The provisions set out obligations for providers and deployers of AI systems based on the risk posed by the AI system itself (so-called risk-based approach). For example, specific transparency requirements apply to AI systems with limited risk. This includes Generative AI systems that generate synthetic audio, image, video or text content. The outputs of these systems must be labelled by the provider in a machine-readable format to be recognised as artificially generated or manipulated content. However, no further obligations are formulated for users of these models, such as policy advisors, unless they fall under the definition of a provider or deployer under Article 3 No. 3 or 4 of the AI Act.

In addition to these binding regulations, there are voluntary commitments from AI developers, international bodies, universities and publishers, as well as scientific and policy-oriented organisations.

AI developers: AI model developers' self-commitments and usage regulations are relevant to users. For example, OpenAI formulates standards, conditions of use and instructions in its General Terms and Conditions, which inform users that the outputs must be checked conclusively, as incomplete or incorrect content may be generated. In addition, special requirements are set for use in the healthcare, financial and educational sectors (OpenAI, 2024).

International bodies: There are also voluntary codes of conduct and guidelines from various international organisations and bodies for the development and application of AI. One example is the Ethical Guidelines for Trustworthy AI of the independent High-Level Expert Group on Artificial Intelligence set up by the European Commission (EC, 2019). They include non-binding ethical principles that should help to ensure that AI is trustworthy and ethically defensible. The principles include human oversight, technical robustness, safety, privacy and data governance, transparency, diversity, non-discrimination and fairness, social and environmental well-being and accountability (see also Recital 27 of the AI Act). Applying these principles should, as far as possible, be incorporated into the design and use of AI models. They also serve as a basis for developing codes of conduct for different stakeholders, including industry, academia, civil society, and standardisation organisations.

Universities and science: Various national and international guidelines have already been developed for using Generative AI in universities (Moorhouse et al., 2023) and for the scientific sector (DFG, 2023; EC, 2024). These guidelines are ethical principles or binding framework conditions for the use of Generative AI in science and research. The European Commission has formulated common basic principles for scientists, research organisations and funding organisations regarding reliability, honesty, respect and responsibility for research from idea to publication. These principles address both the quality of research and the integrity of scientists and are intended to limit possible intended and unintended consequences of the use of Generative AI. The European Commission also favours a discussion on the possibilities and limits of the use of Generative AI in research (EC, 2024, p.4).

The German Research Foundation (DFG) has also published initial guidelines for using generative models for text and image creation. A statement formulates framework conditions for their use and basic principles of scientific integrity and authorship (DFG, 2023). The use of generative models should "*by no means be ruled out*" but requires the disclosure of their use, including the purpose and scope, and the authors' guarantee that plagiarism and infringements of intellectual property can be ruled out. This is justified by compliance with transparency and traceability of the research process as essential fundamental principles of scientific integrity.

In the Code of Conduct on Guidelines for Safeguarding Good Scientific Practice, the DFG specifies that the use of Generative AI has to be disclosed (DFG, 2024). For example, their use "in the preparation of the research status, in the development of a scientific method, in the evaluation of data or in the generation of hypotheses" should be labelled. Only those AI applications "that does not affect the scientific content of the application (e.g., grammar, style, spelling check, translation programmes) does not have to be documented." Concerning applications in policy-oriented TA, it is also significant that the DFG prohibits using confidential documents (such as texts to be reviewed) as input for generative models. To illuminate the opportunities and challenges presented by Generative AI, the statement also calls for "gain and share experience of the use of generative models. Only this will enable a discursive and science-based process." (DFG, 2023, p. 3).

Publishers: Scientific publishers and editors such as Cambridge University Press, Elsevier, Science, Springer Nature, Taylor & Francis or Wiley also comment on using AI and Generative AI (Dwivedi et al., 2023; Spanjol & Noble, 2023). For the publishers mentioned, Generative AI models do not fulfil the authorship requirements. Furthermore, the use of Generative AI models to create images or videos is not permitted by any of the publishers analysed, apart from a few specific exceptions. The use of LLMs for text generation must be disclosed except for formal editing or formatting tasks. The manner of disclosure is prescribed in the particular *policies.*

Policy advice organisations: As far as the use of Generative AI for the specific context of science-based policy advice is concerned, the German National Academy of Sciences Leopoldina has developed guidelines for the use of LLMs that detail permissible and impermissible uses (German National Academy of Sciences Leopoldina, 2023). Permitted uses include:

- Linguistic text improvements
- Evaluation (e.g., identification of inconsistencies)
- Support with the creation of text modules and illustrations in particular

LLMs or related technologies for the latter purpose "must be explicitly labelled and sufficiently documented." The responsibility remains with the (human) authors regarding content, compliance with copyright and the avoidance of plagiarism.

However, their use to create texts and text sections from a prompt text is not permitted. Leopoldina texts are "generally to be written by human authors".

The guidelines for the application of Generative AI in science and scientific policy advice are continuously adapted and differentiated and supplement the legal obligations of the developers and deployers of these technologies under the AI Act. In addition to scientific quality criteria and regulations on authorship, specific transparency obligations, in particular, play an important role.

5 CONCLUSIONS

Generative AI methods are playing an increasingly important role in science and are also beginning to gain a foothold in TA and, thus, in policy advice. The following aspects and prerequisites for application have been identified in this article:

- TA has a special role to play in the investigation, evaluation, and application of Generative AI: 1) it is a disruptive technology whose social implications need to be reflected upon, but at the same time, 2) it also has the potential to fundamentally change TA practice itself. TA thus takes on the role of a participant observer, by which it has to reflect on its own standards and practices. This reflection process is more pronounced in TA than in other fields of scientific research. Because of its tradition, TA does not only have to assess the scientific quality criteria under the light of the new challenges raised by the use of Generative AI tools, but also should evaluate the risks and opportunities of Generative AI for society as a whole.
- Possible applications of Generative AI in policy-oriented TA have so far mostly been described theoretically and have not yet been systematically tested and analysed. Existing examples of applications show opportunities in practically all use cases, such as text and image generation, knowledge research, content analysis and idea generation. The specific opportunities can vary from institution to institution, depending on the working methods and institutional framework conditions.
- When applying Generative AI, the specific quality criteria of policy-oriented TA, which complement general scientific quality criteria, must be observed. Institutions of policy-oriented TA are boundary organisations that mediate between science and politics. Therefore, the policy salience and legitimacy of the results are of particular importance, alongside scientific credibility. The independence of the advice is particularly important, especially for parliamentary TA organisations, which is ensured by their institutional setting and quality assurance procedures during project implementation.
- Given the ethical and scientific challenges, the dynamic nature of developments and the considerable gaps in knowledge and experience, there are fundamental concerns associated with the use of Generative AI. Certain risks may challenge the legitimacy of policy-oriented institutions. In particular, possible biases in the textual outputs, if unrecognised, question the independence of the advisory results. Accordingly, it is very important to maintain quality assurance mechanisms as described in section 2.2 and to examine the extent to which such mechanisms need to be adapted because of the new challenges raised by the use of Generative AI. In addition, a central scientific principle, namely to make the adoption of other people's ideas explicit, is difficult to guarantee in certain Generative AI applications, such as text production. This also raises questions about the scientific integrity and credibility of the results if the generated content is adopted uncritically.
- A key question is the extent to which the use of AI tools affects project implementation (time, costs, etc.) and the quality of results. To date, quality assurance measures have been distributed throughout the entire process to achieve a result that fulfils the criteria of scientific rigour, legitimacy (non-partisanship/neutrality) and salience (including topicality) outlined in section 2. Depending on the institution, this includes, in particular, cooperation with the target groups in parliament and interdisciplinary or transdisciplinary project implementation in cooperation with external experts and stakeholders.
- To date, there are no reliable findings on the use of Generative AI in policy advice. In our view, Generative AI should not be used without reflection in ongoing project work. Given the dynamics of development, systematic and documented experiments with all possible Generative AI tools should be conducted on a regular basis to test their efficiency and impacts on epistemic quality and scientific integrity. Because of the variety of tools, it makes sense to approach this in a distributed manner within the TA community and to involve the broader community of scientific policy advisors.

- There are already various national and international guidelines for universities and scientific research more broadly. It should be examined to what extent such guidelines, such as those of the DFG, can also be applied to TA. However, general guidelines for science are not precise enough given the explicit and implicit rules on transparency, labelling and integrity for TA and its institutions. For example, the criteria of salience or legitimacy have not yet been introduced in these guidelines.
- Specific guidelines for policy-oriented TA are therefore desirable to guarantee a responsible use of generative AI tools. However, it is unclear which body would be legitimate to issue such guidelines. In addition, scientific policy advice and TA are very heterogeneously institutionalised and organised, so it is unclear who the addressee of such guidelines would actually be. For example, the Bundestag would have to be involved in TAB-specific guidelines. We propose that generic guidelines be drawn up by the community and recommended, for example, at the EPTA (European Parliamentary Technology Assessment) level.[5] Such a proposal could subsequently be adapted for specific institutions.

It becomes evident that there is a need for exchanging and reflecting on previous experiences, possible applications, and requirements for using generative AI in the context of policy advice. In doing so, it seems necessary to fundamentally reflect on the practice of TA, its standards and basic principles and, if necessary, to develop these further (possibly also with a view to the changing political framework conditions and legitimacy criteria of policy-oriented TA). Furthermore, the serious ethical problems (environmental problems, etc.) should also be reflected upon, i.e., the potential benefits of policy advice should be weighed up against the global consequences of this technology. Finally, in the traditional approach of TA, alternatives should also be considered, and thus, the long-term influence of the use of AI on the core competencies of TA should also be considered. This article can be seen as an impetus in this direction.

[5] At the EPTA Council meeting in Oslo in October 2024, it emerged that some EPTA members are already working intensively on such guidelines (TAB, GAO, NBT, ITA, etc.), and cooperation was agreed.

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