


## Article

# Goodbye Expert-Based Policy Advice? Challenges in Advising Governmental Institutions in Times of Transformation

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**Abstract:** The global transformation towards sustainability has not only increased the demand for anticipatory and reflexive knowledge to support decision making, but also raises three challenges common to all forms of scientific policy advice: to appropriately consider societal norms and values (challenge of normativity), to integrate different forms of knowledge (challenge of integration) and to organize the participation of stakeholders (challenge of participation). While new forms of scientific policy advice in the field of sustainability research (SR) have emerged in response, the role of established actors such as the Office of Technology Assessment at the German Bundestag (TAB) is increasingly scrutinized. One of the fundamental characteristics of TAB's model of scientific policy advice is a rigid boundary arrangement between politics and science that places a high value on the objectivity and authority of scientific knowledge. Based on a content analysis of digitalization-related TAB reports spanning three decades, we describe how a rather technocratic institution such as TAB has dealt with the challenges of normativity, integration, and participation, and we compare its approach with that of SR institutions. TAB has partly adapted its working mode to the new challenges, e.g., by trying out new methods to foster a stronger dialogue with stakeholders. However, TAB's response to the challenges distinctly differs from the forms of transformative research conducted in the SR community. We argue that this is not only a necessary precondition to maintain its reputation as a trustworthy actor towards the Parliament but gives TAB and similar expert-based institutions a special role in the governance of societal transformation.

**Keywords:** scientific policy advice; science–policy interface; technology assessment; sustainability research; responsible research and innovation; transformation



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## 1. Introduction

As the fundamental influence of technologies on social as well as natural systems became more and more tangible in the 1960s and 1970s, the demand of policymakers for anticipatory and reflexive knowledge about research and innovation (R&I) increased [1]. Accordingly, the role of scientific policy advice has changed from instrumental provision of factual evidence to more reflexive and problem-oriented forms [2,3].

The institutionalization of technology assessment (TA) in the parliamentary system reflects this development and marks one important step. The pioneering foundation of the Office of Technology Assessment (OTA) at the U.S. Congress in 1972 served as a model for parliamentary TA (PTA) institutions that were established in Western Europe in the course of the 1980s and 1990s. While these institutions share the rationale to build capacity to meet parliamentarians' information and knowledge needs in light of contentious scientific and technological issues, their institutional designs vary strongly—from predominantly expert-based to participatory and deliberative approaches [4–7].

The Office of Technology Assessment at the German Bundestag (TAB), which was founded in 1990, is an interesting case in this regard. TAB represents an expert-based form of PTA that establishes a close collaboration between the spheres of parliament on the one

hand and science on the other [4], while emphasizing their distinctiveness. It is operated by an independent research organization (since 1990, this has been the Institute for Technology Assessment and Systems Analysis (ITAS) of the Karlsruhe Institute for Technology (KIT)) and controlled by a parliamentary steering committee with equal representation from each parliamentary group to safeguard political impartiality. TAB's work is mainly based on gathering expert scientific opinions. Its task is to integrate relevant knowledge in a comprehensive manner, to weigh up the available information, to disclose different positions and their normative premises, and to identify new options for (political) action in order to support the democratic decision-making processes [8].

In the last 30 years, TAB's institutional design has remained rather stable. The political and scientific world around TAB, however, has changed significantly during this time. The growing awareness of planetary boundaries and the associated challenge of a global transformation towards sustainability have increased the demand for anticipatory and reflexive knowledge to support decision making around issues of high uncertainty [9]. Science, especially in the field of sustainability, is confronted with the new role of not only researching societal transformation, but actively supporting and driving it forward [10–12]. It has been long known that this has led to a growing scientization of politics and politicization of science [1,13]. As a result, science rests more and more on close interactions with societal actors and is actively promoting normative goals and societal values. The distinction between the roles of scientific experts on the one hand and stakeholders as well as policymakers on the other is becoming increasingly blurry [14,15] (p. 89).

This affects not only the relationship between science and politics but subsequently raises various challenges for policy advice in general and for approaches that resort to experts in particular. In the face of wicked issues [16], diverging interests, and contested values, the authority of scientific experts is fundamentally called into question [17]. New forms of scientific policy advice in the fields of sustainability research (SR) and innovation policy (such as responsible research and innovation, RRI) have emerged in response. The new actors introduce novel ways to respond to the challenges of scientific policy advice (cf. [18]): ensuring neutrality in the light of conflicting norms and values in problem-oriented research (challenge of normativity), integrating a wide variety of knowledge sources, including scientific and non-expert knowledge (challenge of integration), and involving societal stakeholders, i.e., those affected by the issues at stake (challenge of participation). As recent research shows, the roles that policy advisors take on have diversified significantly, going far beyond traditional knowledge brokering [12,19–21]. As a result, the role of established actors in the field of scientific policy advice, such as PTA institutions, is increasingly scrutinized and discussed (e.g., [21–23]).

In this paper we seek to shed light on how the growing expectations towards scientific policy advice to support the transformation towards sustainability have affected TAB's mode of operation. By concentrating on TAB as a rather technocratic institution that "involves, in addition to the politicians, a layer of permanent experts working for the Parliament and supporting the decision-making process with a prominent role" [5] (p. 437), we aim to gain insights into how the three challenges imply a need for institutional and/or procedural innovations in expert-based PTA, identify blind spots in the debate about new forms of policy advice, and draw conclusions for future analyses of the roles and interrelations of scientific policy advice in the face of societal transformation.

We do so by first elaborating on the specific modes in which SR and RRI deal with issues of normativity, integration, and participation (Section 2). Second, we analyze the reports produced by TAB in studies on various aspects of digitalization, a topic area that has become increasingly important since the 1990s (Sections 3 and 4). Finally, we compare TAB's mode of work, as documented in its reports, with the ways SR institutions position themselves. We discuss what the results of our analysis reveal about the role of scientific policy advice institutions in a changing socio-political environment, which is characterized today not only by the transformation towards sustainability, but also by growing uncertainty about normative orientations, growing expectations regarding the

participation of societal actors, and blurring boundaries between scientific experts on the one hand and stakeholders as well as policymakers on the other (Section 5 and concluding Section 6).

## 2. SR and RRI: Modes of Policy Advice and Three Challenging Issues

The systemic character of environmental problems and the need for transdisciplinary research to apprehend them were increasingly recognized in the SR community after the Rio Conference on Sustainable Development in 1992 and were highlighted by the German Advisory Council on Global Change (WBGU) in 1996 [24]. The WBGU is an independent advisory body founded in 1992 by the German government to make recommendations on how to prevent detrimental global environmental developments. It strengthened its message in 2011 and began advocating not only for research about transformation processes but also for the production of knowledge “that actively advances the transformation” towards sustainability by developing specific technological and/or social innovations in relevant sectors [25] (p. 22), which includes knowledge on how to shape the transformation [26]. This call for action further spurred the SR community to contribute to the mission of societal transformation.

RRI, on the other hand, is not a distinct field of research, but rather marks a fundamental shift in the governance of scientific innovation. Promoted especially in the European Union from 2010, RRI is based on a notion of governance as open, transparent, and participative ([27] (pp. 36–37); [28]). The main aim is to make innovation socially sustainable, desirable, and acceptable, and “to better align both the process and its outcomes, with the values, needs and expectations of European society” [29] (p. 3). This is done by taking up ideas and approaches from TA, as well as methods such as Living Labs or citizen dialogues that bring together innovation actors and societal stakeholders along with scientists and policymakers.

In the German R&I context, beyond sustainability or TA, the term RRI has not reached broader attention outside of EU-funded projects [30]. However, it is widely recognized that there is significant overlap between these notions, with the normative idea of responsibility providing a conceptual anchor point [31]. TA and SR as well as RRI are all forms of problem-oriented research striving to raise the reflexivity of policymaking under the conditions of societal transformation. In order to do so, they have to deal with the three challenges mentioned above in specific ways:

- *Normativity:* Sustainable development (SD) is about “change in social institutions in the direction of more equity within and between generations in opportunities to meet needs” and therefore an intrinsically normative idea [32] (p. 122). Since SR is providing the knowledge base for SD, it has to be issue-oriented and take an active stance with regard to normative questions [33] (p. 188). The same is true for RRI, which has been defined as “a transparent, interactive process by which societal actors and innovators become mutually responsive to each other with a view on the (ethical) acceptability, sustainability and societal desirability of the innovation process” [34] (p. 50). This is obviously in stark contrast to viewing R&I as isolated from societal values. Instead, innovation should be put forward in accordance with the basic values expressed, e.g., in the European Treaties (such as fundamental rights, sustainable development, social justice, human health, etc.), which Schomberg [34] (p. 42) describes as “normative anchor points” for assessing the “right” impacts of research. TA institutions, however, are usually committed to non-partisan and independent advice [35] and refrain from advocating certain value standpoints [22]. Although this view of TA has recently been scrutinized [36,37], a neutral stance is still a central aspect of TA’s role as an “honest broker” [38,39].
- *Integration:* In SR, integration is seen as necessary to better understand the causes and implications of complex social transformation processes. It refers to integrating knowledge from various disciplines through interdisciplinary or transdisciplinary research [40], considering interlinkages and systemic dependencies between various

sectors of the economy and policy fields [18], in particular across the three pillars of sustainability (economic, environmental, and social) [41] (p. 184) and across spatial and temporal scales [42]. Jahn et al. [43] (p. 7) define integration along three levels: on the epistemic level, integration is about demarcating and interlinking different bodies of knowledge; on the social-organizational level, it is about explicating and connecting different interests and activities of participating researchers; and on the communicative level, it is about establishing a common language to advance mutual understanding and agreement. RRI also relies heavily on an integrative understanding of innovation. It requires the interdisciplinary collaboration of actors from the natural sciences, the social sciences, and the humanities [44] and includes considerations of gender equality, science education, and ethics [29]. TA, finally, is also by definition an interdisciplinary field of research, considering technologies and their impacts from various angles.

- *Participation*: SR is expected to provide transformation knowledge to practitioners and decision makers, which is considered to be best achieved by working directly with them [45] (p. 49), [46] (p. 420). The aim is therefore to produce more “socially robust” knowledge [15] (p. 240), which also has a long tradition in TA (especially in participatory TA, [47]). This can be achieved either by using participative methods of knowledge acquisition, that is by involving societal stakeholders in the inquiry phase, and/or by giving stakeholders a truly active role in the particular innovation process (e.g., by using methods of participative design), which is close to the rationale of RRI [48,49]. This is also underlined by the reference to the procedural aspects of RRI as a transparent, interactive, and responsive process.

Today, making norms and values transparent, integrating different perspectives and disciplines, and involving relevant stakeholders and the public are seen as essential prerequisites in research contexts dealing with societal challenges and transformative issues. The debate about these issues at the time of TAB’s foundation reflected a different state of play; in the following section, we analyze TAB’s digitalization-related reports over the last 30 years to look more closely into how TAB has dealt with these issues in its core working practices. We chose digitalization as it represents not only a technological issue, but a fundamental societal transformation characterized by a complex interplay of technological and social/cultural/political aspects. Digitalization has gained increasing attention in SR over the last few years [50] and was a subject of RRI considerations [51], making the field particularly suitable for comparison. Yet, while many SR institutes have increased their activities in the field of digitalization, projects labelled RRI are virtually nonexistent in Germany, which is why we solely focus on the former.

### 3. Materials and Methods

#### 3.1. Case study of TAB’s Work on Digitalization

We focused our analysis of TAB’s work on the topic area of digitalization, that is, the implementation of digital technologies (often referred to as information and communication technologies, ICTs) in various fields of society. At the initiative of various committees of the German Parliament, digitalization issues have been tackled by TAB in more than 40 projects, ranging from analyses of specific technologies (e.g., biometrics, additive manufacturing) to that of cross-sectional societal challenges in areas such as culture or work. In that time, ICTs have developed an increasingly transformative impact, not only with regard to the economy, but also society more broadly. The political and public discourse in Germany has closely followed this development, starting with the Bundestag’s Study Commission on ICTs in the early 1980s through to the current debates on data privacy, the consequences of Artificial Intelligence (AI), and the ecological impacts of digitalization.

#### 3.2. Empirical Analysis of TAB’s Approach to Normativity, Integration and Participation

TAB’s projects on digitalization cover a wide variety of themes and also methodical approaches, including surveys and short studies. For our analysis, we focus on projects

for which a report is already available—even if it has yet to be published—and which are based on expert scientific opinions that were specifically commissioned. This excludes all those projects that entailed only a survey of the literature or short overviews of a topic. A report of a TAB project is a rather standardized object; it documents not only the results and recommendations handed out to parliament, but also the assumptions and methods used in the project. Although it leaves out the informal aspects of the work, we use the re-port as a proxy for what has been done in a project.

The reports of 30 TAB projects (of the total 47 projects, 9 are ongoing or in preparation and 8 did not meet the above criteria) were empirically analyzed by means of content analysis (see Table A1, Appendix A; in the following, reference is made to the TAB reports by indicating the report number given there, e.g., #187 for the report on “Autonomous weapon systems”). We used qualitative content analysis to infer the latent meaning from the manifest texts [52]. The analysis included the following steps (Table 1): First, we formulated analytical categories from the three main challenges identified above: normativity, integration, and participation. Second, we searched in the reports (especially the summary and conclusion sections) for textual instances corresponding to the categories. Based on the results, the categories were refined inductively if new relevant aspects were identified. Finally, all textual instances were analyzed manually regarding how the respective challenge was treated in the corresponding project. Where appropriate, results were quantified to assess their weight. The quantitative analysis served primarily as a means to formulate hypotheses on the practice of TAB and deepen the qualitative interpretation.

**Table 1.** Categories and analytic focus used in the analysis.

	Questions Guiding the Analysis	Categories Applied in the Analysis	Type of Content Analyzed
Normativity	How are values presented/discussed/justified? How are value conflicts dealt with?	Values referred to in the RRI/SR discourse (basic rights, democratic values, values associated with social, economic, and environmental sustainability)	Policy options (concluding section)
Integration	What types of knowledge are picked up from the expert reports? Which disciplinary approach(es) guides the analysis? Which governance scale(s) are considered?	Knowledge area (technological development, types of impacts, and policy options); sustainability dimension (environmental, economic, and social); governance scale (international, European, national, federal states)	References to expert reports, report structure, policy options (methodology and concluding section)
Participation	How are stakeholder opinions taken into account in the project? What forms of engagement are being recommended?	Methods and levels of stakeholder engagement (surveys, workshops, discourse/media analysis, public debate, and secondary/literature analysis)	Methodical approach, policy options (methodology and concluding section)

#### 4. Results: TAB’s Approach to Normativity, Integration, and Participation

TAB’s projects addressing digitalization-related issues are distributed unevenly over time, reflecting the growing political importance of the topic. In the 1990s, only one thematically relevant project was carried out. In the 2000s a total of 14 projects were carried out, and since 2010, there have been 15 (with five of them ongoing). In addition to assessing the challenges and potential associated with the new ICTs, which is part of the core business of a TA institution, two other major and recurring focuses stand out: first, aspects of digital democracy, which TAB has addressed in six projects and which, of course, reflected a core operative interest of the parliament; second, the subject area of new media and education (six projects on e-learning and related topics), the salience of which in TAB’s work is partly attributable to the fact that the Committee for Education, Research and Technology Assessment is TAB’s governing body.

#### 4.1. Normativity

Normative references that can be assigned to all three pillars of sustainable development, to ideals of deliberative democracy, and to fundamental rights can be found in all 30 reports (Table 2). Regarding sustainability, interestingly, social and economic aspects are at the foreground (covered in 18 and 17 of the projects, respectively), with digital participation and access, fair competitive conditions, and good employment conditions as well as the profitable implementation of technologies (considering the interests of SMEs) as main concerns. Basic rights were referred to in 14 projects, with the impact of digital technologies on privacy and data protection emerging as the most prominent concern. In contrast, goals of ecological sustainability (such as environmental protection and resource conservation, mentioned in eight of the projects) and deliberative democracy (seven projects) played a minor role in comparison, with the latter coming into play primarily in the projects on e-government.

**Table 2.** Value dimensions referred to in TAB reports.

Basic Rights (Privacy, Human Dignity/Autonomy, etc.)	Deliberative Democracy (Political Participation)	Social Sustainability (Equal Opportunities, Social Security, Consumer Protection, etc.)	Economic Sustainability (Profitability, Competitiveness, Employment)	Ecologic Sustainability (Climate, Environmental and Resource Protection, etc.)
#33, #74, #76, #78, #93, #146, #149, #156, #171, #173, #174, #177, #187, #190	#33, #74, #100, #118, #127, #146, #173	#33, #74, #76, #82, #93, #100, #115, #118, #122, #129, #149, #166, #171, #174, #175, #177, #190, #196	#33, #78, #93, #105, #106, #107, #122, #118, #129, #149, #156, #171, #174, #175, #177, #193/194, #199	#78, #82, #106, #156, #175, #193/194, #198, #199

Normativity should come as no surprise when analyzing future technological developments. The norms and values mentioned are widely accepted in society, often even enshrined in law, and are closely linked to the respective political discourse on digitalization. For example, sustainable digital transformation as well as inclusive and equitable digital participation are the official goals of the German government, and there is a clear regulatory framework for data protection. Thus, it seems almost impossible to address a digitalization-related topic in policy advice without relating to such normative issues. The e-government/online participation projects (#127, #146, #173), which would be inconceivable without reference to an implicit democratic value framework (such as deliberation and political participation as part of good democratic processes), are particularly good examples of the pervasiveness of certain norms and values. This way, a certain normative framing is often already specified in the topics (e.g., ecological sustainability goals in the project “Energy consumption of ICT infrastructure”, #198), which, in the case of TAB, are determined by parliament. Overall, TAB assessments seem to be based on a similar value framework as SR and RRI, such as respect for basic rights, values of sustainability and deliberative democracy.

Since strict impartiality has long been regarded as an iron principle, especially in PTA, and is an essential part of TAB’s self-understanding [39], the question arises as to how this identified (new) level of normativity affects the non-partisan character of TAB’s policy advice. In this context, it is striking to observe that wherever TAB emphasizes normative orientations this is mostly done in a descriptive, analytical manner, e.g., by referring to established political aims or the existing legal framework. For example, the report on disability-compensating technologies in the workplace (#129) refers to the goals of disability policy in Germany to justify the importance of the self-determined participation of people with disabilities (p. 5). Interestingly, as the analysis of the policy options sections of the various reports shows (and as was already observed elsewhere, [37]), many policy options are formulated as recommendations (e.g., “should be done”, “has to be done”). This apparently clear normative standpoint seems to conflict with TAB’s institutional orientation on developing different options for action from an impartial point of view [39]. However, an explanation is that TAB’s analyses are usually based on normative grounds, and hence an

evaluation of the effects of technologies can point to clear needs for action. This is the case, for example, when the use of new technologies such as care robots challenges established norms such as privacy protection, which requires legal action (#177, pp. 212–213). In contrast, when it comes to controversial goals or interests, TAB usually avoids taking a specific position and rather describes the state of the scientific, legal, and/or social discourse on the topic (a particularly good example is the project on observation technologies in the field of civil security, #190).

An interesting case for the analysis of TAB's approach to normativity is the question of how conflicting interests and goals are dealt with. Trade-offs and conflicts between different sustainability dimensions, for example, are an unavoidable aspect of sustainability assessments [53]. Indeed, most TAB projects point to more than one of the five normative dimensions identified as relevant (fundamental rights, deliberative democracy, social, environmental, or economic sustainability): A total of 11 projects include 2 of these dimensions, 10 projects include 3, and 1 project ("Multimedia", #33) addresses 4 dimensions (see Table 2). Nevertheless, normative trade-offs and value conflicts are explicitly highlighted and discussed by TAB in only a handful of projects (e.g., robotics and assistive neurotechnologies in the care sector, #177; autonomous weapon systems, #187). Here, too, it can be clearly observed that TAB strives for an impartial analysis, primarily by making the normative presuppositions of the respective conflicts of interest explicit. Instead of advocating a specific normative position, TAB normally restricts itself to procedural solutions, with participatory and deliberative procedures featuring particularly prominently (e.g., proposal of participatory, demand-oriented technology development such as in #177, pp. 203–205; or reference to the need for a public debate, e.g., #93, p. 14).

#### 4.2. Integration

TAB commissions expert reports for three major reasons (Table 3): (1) to empirically survey and evaluate the state of and prospective developments of specific technologies; (2) to shed light on a specific type of impact or on a controversy (such as the ethical acceptability of autonomous weapons, #187, or the epidemiological effects of electromagnetic fields, #196)—this sometimes requires an examination of disciplinary discourses in order to identify the underlying hypotheses and methods that led researchers to contradicting conclusions; and (3) to identify solutions to unleash potential and minimize risks (e.g., data protection requirements for the use of biometric procedures in identity documents, #93).

**Table 3.** TAB projects that commissioned at least one expert report on the following issues.

Analysis of Technological Trends	Impact Analysis	Analysis of Barriers, Success Factors, and Policy Options
All reports except #149 and #122	#33, #78, #82, #76, #107, #105, #106, #127, #129, #149, #156, #171, #187, #190, #196, #194	#33, #74, #78, #82, #96, #76, #100, #122, #107, #115, #105, #127, #129, #146, #156, #174, #171, #177, #187

An expert report commissioned by TAB rarely relies on a single disciplinary method but is usually based on mixed-methods analyses and carries out a preliminary knowledge integration across various disciplines. In most cases, the expert teams that are commissioned cover different disciplines and have the skills to present an overview of knowledge on a sub-topic, either because the main contractor(s) cooperate with various institutions or because they stand out for their interdisciplinary competences. (Sub)disciplinary methods are described in detail when contradictory results need to be explained in a literature review (e.g., epidemiology vs. cell studies to assess adverse health effects of electromagnetic fields, #196), or to make transparent how the commissioned experts collected primary data. To make sure that the impacts and options for action are considered from a wide variety of perspectives, TAB also often convenes interdisciplinary workshops.

As far as the integration of knowledge across scales (multi-level governance) is concerned, policy options tend to first and foremost target national policymakers, yet not exclusively. Options for action are formulated not only for German legislators, but also for research funders or decision makers at other governance levels (in 58% of the reports that describe policy options), especially the latter when a change in German regulation requires a change in the European framework or when competencies in the field are distributed across different levels (e.g., education is primarily a competence of the federal states, see #122, pp. 147–148; #115, p. 133; #107, p. 197). It is only when a topic is solely of interest to the parliament (e.g., “Online citizen participation in parliamentary work”, #173) that policy options are addressed exclusively to parliament. The interplay between governance scales is considered in the formulation of policy options but primarily insofar as national regulations are directly related to European, international, or regional frameworks.

TAB’s central task is to comprehensively analyze the opportunities and risks associated with scientific and technological developments. This includes a systematic analysis of dependencies and synergies across sectors, as far as the parliamentary request does not set boundaries to the impact areas to be investigated (such as in #166 on the addictive effects of new electronic media). In addition, an increasing number of projects have been conducted in the last few years that analyze digitalization as a transformation process and encompass a wide range of digital innovations and/or look into impacts across several sectors (e.g., #193/194, #199). While such large projects offer the possibility to adopt a comprehensive approach including the three pillars of sustainable development, the specific interplay between the dimensions tends to be out of the scope of most of the studies. This is particularly the case when it comes to synergies and interdependencies between policy options. Although 19 of the 30 projects commissioned external expert reports on the current regulatory framework to uncover conditions of success and/or identify options for action, TAB reports tend not to focus on the potential consequences of policy options in much depth. The extent to which options allow the achievement of certain goals, the cost they may incur for other policy fields or the side-effects that could unfold are usually considered to be out of scope.

To conclude, TAB’s analyses systematically include knowledge from various disciplines and consider the effects and side-effects of technological development across various areas of life, sectors of the economy, policy fields, and across governance scales. Yet, TAB analyses tend not to provide a fully integrative perspective in a more reflexive sense, as far as the policy options themselves may unfold side-effects.

#### *4.3. Participation*

The inclusion of knowledge from various perspectives is also an important aspect with regard to TAB’s approach to the challenge of participation. We observed a wide range of sources not only from the academic field, but also from societal stakeholders (in almost half of the projects, Table 4), suggesting that the focus on expert authority is less exclusive or dominant than TAB’s original conception suggests. However, that does not imply, in most cases, a participative orientation or methodology for TAB’s work in general (only eight projects go beyond (mostly expert) interviews), although there are indications that this is gradually changing. An example of TAB’s specific approach to the issue of participation is the report on observation technologies (#190): Although the authors point out that there are societal controversies about the use of such technologies, they restrict their analysis to empirical facts and scientific expertise. The opinions of the general public and interest groups play only a minor role, notwithstanding several recognizable public protests against the use of observation technologies in recent years, for example, at train stations. Survey results from the population are cited, but these are provided to assess the impact of observation technologies on citizens’ actual behaviour rather than in regard to their opinions or viewpoints. Furthermore, the value of public surveys is downplayed as methodologically less valid in comparison to the results of “scientific investigations” (#190, p. 141).



**Table 4.** Participatory aspects of TAB reports.

Whose Knowledge Was Included?	Which Forms of Participation Were Used?	Which Forms of Participation Were Recommended?
Scientific/expert knowledge: all reports	Survey/interviews: #74, #76, #78, #106, #115, #118, #127, #146, #156, #166, #173, #174, #175, #198	Broaden societal debate: #33, #82, #93, #118, #166, #177, #187, #194
Societal stakeholders: #33, #74, #76, #82, #118, #146, #149, #156, #166, #173, #174, #177, #187, #194	Workshop/focus group: #100, #118, #146, #166, #174, #175, #198	Consult stakeholders: #33, #76, #82, #100, #127, #146, #173
Media/public discourse: #33, #82, #100, #173	Online panel: #166, #173	Establish commissions: #33, #82, #187
		Conduct participative R&D: #74, #100, #115, #118, #129, #175, #177, #194, #196

The focus on objective, scientifically founded, and non-partisan knowledge is dominant in TAB's work on digitalization in general. The main mode of investigation is to obtain expert reviews, mainly from scientific experts. These in turn draw on publications, again mainly from scientific sources, or conduct original studies based on surveys, statistical analysis, or interviews and expert discussions—held in most cases with scientific experts or experts involved in technology development. The aim of this approach is clear and often explicated in the reports: to establish a consensual evidence base for political assessment by the members of parliament.

This assessment comes with some qualifications. In some projects TAB spends considerable effort eliciting the opinions and views of various societal stakeholders. This comprises analyses of media and public discourse, including actors and argumentations (four projects, Table 4); conducting/commissioning representative surveys of the population on topics such as petitioning and postal communication (#146, #156); focus group discussions with stakeholders including lobby organizations and NGOs (three projects: #146, #174, and #118 on “Development through electronic networks“, where local stakeholders from four African countries were involved by help of surveys, expert workshops and online forums) and organizing tests with users of electronic petitions (#146) as well as setting up an online panel (Stakeholder Panel TA) to assess the views and opinions of stakeholders across various studies (#166 on the addictive effects of new electronic media; #173 on citizen participation via the internet). With the inclusion of the IZT–Institute for Futures Studies and Technology Assessment in the TAB consortium in 2013, participative competence and orientation were integrated at an institutional level, resulting in a growing number of projects employing participative methods of knowledge elicitation (such as stakeholder surveys and also future workshops) but also using more dialogic and inclusive formats to present the results.

Once we consider not only the methods of assessment, but also the content of the options formulated, TAB actually appears quite supportive of participatory forms of policymaking (in varying degrees of agency/involvement). In many concluding sections of the 30 reports, we found reference to the importance of societal debate being “wide and open“ (eight projects), although this is mostly not further explicated. In some cases, we found detailed practical advice of how to strengthen the orientation towards citizens by way of consultations (seven projects) or by the establishment of commissions that include stakeholders (three projects). Especially through several projects on e-petitions, TAB has actively accompanied the German Parliament's development of a participative format (#127, #146, #173). All in all, TAB can be seen as advising and aiding the German Parliament to open up policymaking towards more participative forms, while gradually opening up its own practices to non-scientific modes of knowledge generation. Depending on the topic of a given investigation, it adapts its methods flexibly, including moving away from an expert-centered analysis to the point of regularly consulting stakeholders via its own online panel.

## 5. Discussion

TAB's model of scientific policy advice relies on a rigid boundary arrangement between politics and science, for which the authority of scientific experts on the one hand and the primacy of the parliament on the other is fundamental. The latter concerns the choice and definition of the technologies to be scrutinized as well as the political decisions that may result from the knowledge gained during the process. In its projects on digitalization, TAB lends great attention to a systematic and accurate description of technological trends and their intricacies with societal, economic, and environmental dimensions. By engaging relevant experts from the field, it collects knowledge on decisive dynamics of societal and technological change, their conditions, interdependencies, and consequences for the achievement of goals in order to identify possible courses of action.

In that sense, we observed a strong orientation in TAB's work towards objectivity and authority of scientific knowledge, which corresponds to the still very common "modernist logics" of policy advice [19]. Yet, as was found for other similar advisory institutions [17,19–21], a modernist orientation can coexist with more reflexive orientations. In TAB's case, a similar tendency of mixing orientations can be observed. It can be seen not only in the increasing interest in inclusive forms of assessment that let various stakeholders participate in the knowledge acquisition process, but also in an increasing number of TAB projects that have focused on analyzing the interconnections and interdependencies between the sustainable and digital transformations in an integrative manner. The latter coincides with existing demand and efforts to jointly govern the sustainable and digitalization transformations in a coherent manner [54], [55] (pp. 305–338), [56] (p. 20).

In the SR community, the coexistence of modernist and reflexive logics takes different forms depending on the organization. Indeed, while the ideal of transformative research is widely embraced among sustainability researchers, the perspectives and narratives that transformative and solutions-oriented research entails strongly differ [10,12]. Some of the researchers still adhere to the ideal of "speaking truth to power", whereas others see themselves more as "change agents". Accordingly, SR institutes pursue different strategies to gain and maintain their scientific authority (in particular an assessment-oriented mode, a counseling-oriented mode, and a solution-oriented mode), with the solution-oriented approach gaining more and more prominence [20]. This is echoed in the German context, where many of the SR institutes (e.g., the Wuppertal Institut für Klima, Umwelt, Energie, the Öko-Institut, or the Institute for Advanced Sustainability Studies) show on the one hand great flexibility in the manner by which they interpret their expert roles in specific contexts (reflecting the great diversity of project and actor settings they are engaged with), while on the other hand they officially take a clear *normative* stance according to their institutional self-description. They refer to their mission, which is to contribute to the transformation of society towards sustainability with scientific evidence. Some of them even explicitly define themselves as value-oriented research organizations (see, for example, <https://www.oeko.de/en/the-institute> (accessed on 5 October 2021)). Regarding *integration*, these SR institutes emphasize two dimensions of integration across disciplines and between lay and expert knowledge, and they therefore nurture strong relationships with practitioners and organize dialogues with stakeholders (<https://www.ecornet.eu/en/profile.html> (accessed on 5 October 2021)). With regard to the latter, key elements of *participation* such as public dialogue and stakeholder involvement are also being put into practice, with the involvement of SR institutes, to meet the emerging demand and strengthen social and political dialogue and learning (<https://ariadneprojekt.de/ariadne-anspruch/> (accessed on 5 October 2021); <https://www.wpn2030.de/en/dialogue/> (accessed on 5 October 2021)).

What clearly distinguishes TAB from such scientific assessments in the field of SR is the fact that it neither explicitly prioritizes between impacts across the three pillars of sustainable development, nor does it systematically consider normative aspects such as transformation issues or responsible innovation as an entry point for its analyses. In most cases, TAB draws primarily on scientific expertise when deriving options for action

and attempts to integrate multidisciplinary perspectives on the subject matter. With the exception of normatively particularly controversial topics, TAB generally refrains from reflecting or explicitly positioning itself regarding normative issues, and mostly limits its analyses to referring to goals, norms, and values that are largely undisputed in societal and political discourse.

The last point is especially striking when comparing TAB's work to that of expert bodies that conduct assessments in the field of sustainability such as WBGU or the German Advisory Council on the Environment (SRU). WBGU and SRU are independent scientific advisory bodies, giving exclusive scientific policy advice to the government. In that sense, their institutional design resembles TAB in many ways, especially concerning the expert-based approach and the rigid science-policy interface. Nevertheless, they tend to work in a much more mission-oriented way and focus more strongly on the environmental dimension of transformational issues. This focus on policy appraisal is in line with the observed growing demand for response options and policies in global environmental and sustainability assessment [9]. TAB's approach, on the other hand, can be described as problem- rather than solution-oriented, insofar as societal transformation is not approached as an overarching goal. Instead, TAB aims at opening up and describing the space of potential options for action, without prioritizing among societal goals.

The scientific authority of TAB is not mainly based on the authority of the scientists involved, as in the case of WBGU and SRU, but rather results from the special institutional boundary arrangement that gives the legislator a strong role in the advisory process while guaranteeing independence from political interests. This seemingly paradoxical construction—scientific independence while maintaining political control—sets TAB apart from other institutional actors in the German sustainability landscape. Its institutional setup does not allow for a more active role to achieve specific goals, as it has to serve the parliament as a whole, irrespective of individual political orientations. In that sense, its institutional setting sets clear limitations to its ability to stretch the boundaries of what is considered as “appropriate”, as is also the case with other advisory institutions [17].

We interpret the TAB model as one solution to “navigate the authority paradox” [17], according to which large uncertainties and value conflicts make objective scientific advice increasingly necessary, while this type of advice can only be acquired via contested scientific institutions and experts, an issue that most scientific advisory bodies that deal with wicked issues have been struggling with. By concentrating on intensive collaboration with scientific experts to generate value-neutral advice that facilitates policy learning, TAB can help to mitigate this “tension field between scientific objectivity and societal and political relevance” [10] (p. 1). For example, by critically evaluating the results of transformative research, crossing them with research results from other relevant research communities to unravel synergies and trade-offs and fuel debates in the political sphere. That way, the evaluation and weighing of options benefits from the extension of actors and approaches in the field of problem-oriented research. TAB's work in “democratising expertise” [8] and stimulating a democratic technology governance is thus based on a lively scientific discourse encompassing manifold methodological approaches and expert opinions. Its adaptability in addressing issues of technological innovation, as seen in our analysis (e.g., large variety of methods, the use of discourse analyses and participatory elements), reflects this extension of the field. However, it is important to point out that TAB only has the political standing to do so by strictly adhering to an impartial approach, since otherwise it would risk its credibility as an honest broker mediating between the spheres of science and politics. A crucial aspect of TAB's work is the interplay between methodological flexibility in its individual investigations and the institutional safeguards assuring its role as an impartial mediator. One of these safeguards is the consensus principle, along which the steering committee that controls TAB works and which ensures that TAB respects a common normative framework underlying all political orientations represented in parliament.

## 6. Conclusions

Technology Assessment has been described as a bridge-builder between science, society, and policy [57,58]. This idea is especially true for TAB, which has been specifically developed to support the governance of science and technology in Germany, acknowledging the important role that parliaments play in this regard. Currently, facing interdependent grand societal challenges on a broad scale and ever more societal actors striving for an active role in taking them up, a strengthened role for the legislative branch seems more relevant (but also more contested) than ever in order to foster as well as ensure a democratic form of societal transformation.

The tension between scientifically independent, non-partisan policy advice and the pursuit of political and societal impact naturally affects the conduct of transformative science, but it has also accompanied PTA from the beginning and is a continuous challenge for TAB in its daily work. Although the institutional design of TAB has not changed much since its foundation in 1990, TAB has shown some flexibility in adapting to new challenges by entering into a cooperation with new partners to strengthen its competence in the field of sustainability and by repeatedly trying out new methods to foster a dialogue with stakeholders. Nevertheless, the way TAB deals with the issues of integration, participation, and normativity sets it clearly apart from transformative research as it is conducted in the SR community, insofar as TAB navigates the authority paradox by cautiously integrating interactive and reflexive elements in a traditionally rather modernist practice. By doing so, TAB has maintained its reputation as an integrated assessment specialist and a trustworthy actor.

In this paper, we have argued that this gives TAB a special role in the governance of societal transformation; while many advisory institutions in the fields of TA and SR are flexing their roles and adopting more inclusive and reflexive forms of knowledge transfer [19–21], TAB can act as a mediating actor between parliament and (sustainability) science because it is based on an institutional arrangement that maintains the clear demarcation between science and politics. This enables TAB to bring findings from transformative (sustainability) science into the parliamentary arena after a thorough scientific quality review. In that sense, TAB navigates the authority paradox together with sustainability institutes. What can be learned from the TAB case is that while increasingly blurry boundaries between science and society can help institutions strengthen their influence and become increasingly solution-oriented [22], scientific authority still has a very high value for decisionmakers and is the precondition for finding echo in the political arena. In a diversifying transformation landscape, consisting of different governance actors with their diverging interests, goals and motivations, the ability of advisory institutions to cooperate and flexibly take on tailored roles while maintaining their scientific reputation seems more important than ever.

Yet, in the context of changing science–policy interfaces, normative notions of objectivity and what counts as scientific authority and trustworthy scientific advice are subject to constant change [19]. Whether TAB will be able to fulfill its mediating role in the future depends largely on whether the notions of trustworthiness and objectivity, anchored in its institutional setting, will continue to be shared by the political actors. Currently, we can observe a shift in many democracies towards a so-called post-truth regime, which leads to mistrust in science and an erosion of established democratic values [59], not least due to digital change and its effects on social and political communication. This development threatens the very political and epistemic conditions that PTA institutions such as TAB require for their practice to flourish [36] and makes the old question of how political TA is, or should be, more topical than ever [60].

Against this background, it seems debatable whether TAB's strategy to avoid a clear normative stance, as shown in the empirical analysis, can be maintained in the future. There may be a need for a new, more flexible boundary arrangement based on more open reflection and defence of the values necessary for responsible societal transformation and, not least, its democratic governance. In this regard, TAB may have to strengthen its

activities of fostering public dialogue and lend greater attention to the analysis of policy pathways, e.g., by mapping alternative policy pathways [61] through the problem-solution space [62].

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## Appendix A

**Table A1.** List of TAB projects used for the empirical analysis <sup>1</sup>.

Year of Completion	Title	Report-No.
1995	Multimedia	33
2001	New media and culture	74
2002	Biometric identification systems	76
2002	E-Commerce	78
2002	Health and ecological aspects of mobile telecommunications and transmitters	82
2003	Biometrics and identity documents	93
2005	Internet and democracy	100
2005	eLearning in the area of vocational training and further training	105
2005	Modern agricultural techniques and production methods (Precision Agriculture)	106
2006	eLearning in research, teaching, and further education	107
2007	eLearning for children and elderly people	115
2007	Internet communication in and with developing countries	118
2007	Media use and eLearning in schools	122
2008	Public electronic petitions and civil participation	127
2009	Disability-compensating technologies in the workplace	129
2011	Electronic petitioning and modernization of petitioning systems in Europe	146
2012	Regulations for access to the information society	149
2013	Postal services and modern information and communication technologies	156
2015	New electronic media and addictive behaviour	166
2016	Digital media in education	171
2016	Online citizen participation in parliamentary work	173
2016	Opportunities and threats of mobile and digital communication in the workplace	174
2017	Additive manufacturing (3D printing)	175
2017	Robotics and assistive neurotechnologies in the care sector	177
2019	Autonomous weapon systems	187
2020	Observation technologies in the field of civil security	190
2020	Digitization of agriculture	193/194
2021	Possible health impacts due to different frequency ranges of electromagnetic fields (HF-EMF)	196
2021	Energy consumption of ICT infrastructure	198
2021	Innovative technologies, processes, and products in the construction industry	199

<sup>1</sup> The published reports are available as PDF files on the TAB website: <https://www.tab-beim-bundestag.de/de/untersuchungen/alle-untersuchungen.html> (accessed on 5 October 2021).

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