European Commission

Trust as a Governance Challenge for Science-for-Policy Ecosystems

Mutual Learning Exercise on Bridging the Gap Between Science and Policy

Fourth thematic report

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Trust as a Governance Challenge for Science-for-Policy Ecosystems. Mutual Learning Exercise on Bridging the Gap Between Science and Policy

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Trust as a Governance Challenge for Science-for-Policy Ecosystems

Mutual Learning Exercise on Bridging the Gap Between Science and Policy

Fourth thematic report

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1. Introduction

This is the fourth thematic report produced as part of the Mutual Learning Exercise on *Bridging the Gap Between Science and Policy*. It is framed by a discussion paper on *Trust as a Governance Challenge for Science-for-Policy Ecosystems* and incorporates insights from three leading experts in the field of science policy. These experts, who are actively involved in major European Commission-funded research projects, have contributed on key issues such as determining *what information to trust* in the face of scientific dissent and uncertainty, and *who to trust* given the strategic use of scientific knowledge and the spread of misleading information in political and policy arenas (see Sections 3.1 to 3.8).

In addition, the report reflects discussions held in Warsaw on 10-11 February 2025, where representatives from 14 European Member and Associated States explored the role of knowledge brokers and the need for a more anticipatory governance approach. These topics are addressed in the outlook section (Section 5).

Drawing from experiences gained during four country visits within the Mutual Learning Exercise, this report identifies two distinct perspectives on science's role in policymaking. The first follows the classical *decisionist* model, where science and politics have a hierarchical relationship – policy decisions are shaped by values, interests, and legal constraints, while science serves primarily as a provider of information. The second is a *pragmatic* model, in which science and policy interact collaboratively in addressing societal challenges (Habermas, 1976). These models are further explored in the outlook section.

This report follows up on the third thematic report, *Assessing the Effectiveness and Implementation of Science-for-Policy Systems* (Oliver, 2025, which examined, among other aspects, the concept of good practices. That analysis highlighted that good practices can only be identified in relation to the normative goals of science-for-policy ecosystems. While Europe exhibits considerable diversity in the design of such ecosystems, some country representatives expressed concerns that their national systems lack comprehensiveness, particularly in terms of distinct advisory bodies fulfilling specific functions.

Despite this diversity, Oliver's assertion remains relevant: trust and trustworthiness may serve as indicators of an effective science-for-policy system. However, empirical research on this topic remains scarce. Most existing studies focus on *public trust in science* rather than *trust in science-for-policy* – the central theme of this report.

This thematic report explores the issue of trust in a conceptual manner: trust as a governance challenge for Science-for-Policy Ecosystems. Pedersen (2023) highlighted that the five foundational principles of 'healthy' and well-functioning science-for-policy ecosystems are: independence, transparency, responsibility, accountability, and respect for diversity. All these foundational principles are well-known and described in detail (European Commission, 2002). These principles provided also a background for developing an evaluation framework for institutional capacity of science-for-policy ecosystems in EU Member States (Pedersen, 2023 and Oliver, 2025).

This report also touches upon these five principles as one can reasonably assume that trust in science-for-policy goes hand in hand with a 'healthy and well-functioning system'. Firstly, it analyses the functional relationship between science and policy, emphasising that modern societies cannot sidestep science while making legitimate public policy. It highlights three factors which foster trustworthiness in science-for-policy ecosystems: *credibility* (resonating with the foundational principle of independence of experts), *responsiveness* (resonating with the foundational principles of transparency and accountability), and *anticipatory capacity* (resonating with the principle of responsibility). Subsequently, the thematic report traces two interrelated historical developments in fostering trust in science-for-policy since the end of the 1980s. Firstly, the call for public scrutiny of science-informed decisions which refer to the legitimacy of the decision-making process, and secondly, the call for quality assurance in the decision-making process as well as the assessment of scientific information and expertise. Finally, the discussion makes the case that trust in science-for-policy ecosystems relates ever less to trust in public policy *decisions* but ever more to a public policy *process* in which many stakeholders are involved. In order to facilitate capacity for anticipatory governance, public policy needs to engage actively with societal-missions-oriented research and participatory foresight.

2. Locating the objects of trust in science-for-policy ecosystems

2.1. The relational and functional relationship between science and policy

This section analyses the relational and functional relationship between science and policy. Before entering into that analysis, it is important to clarify that the reliance on science in policymaking – as well as the acquisition of scientific knowledge to support specific policies – involves distinct and varying objects of trust. These can be categorised into the following, increasingly complex, forms:

- Trust in scientific information
- Trust in scientific expertise
- Trust in scientific advisory bodies
- Trust in science-informed decision-making

2.1.1. Trust in scientific information

In modern societies, it is impossible to sidestep the use of scientific information and knowledge in the policymaking process. One cannot make decisions without an appeal to science. Policymakers must trust the reliability of scientific information, which is delivered through institutional frameworks. For example, while dealing with risks on human health and the environment, one has to rely on the capacity of science to detect and monitor such risks. Today's challenges posed by climate change or environmental pollution are related to complex interactions between natural and socio-technical systems. Science provides the means to reduce the complexity of these challenges to comprehensible problems that can be addressed by policy. The verification of scientific information, however, always lies within the domain of the scientific community itself and is not part of the policymaking process. The primary criterion for trustworthiness, therefore, is the credibility of the source, established through internal scientific processes of verification. For science to be credible as a source, it needs to govern the scientific integrity of its internal process. The assumption here is that scientists who respect the norms of *good scientific conduct* and who are respected by their colleagues of the scientific community, are also more likely to be respected beyond the sphere of science. Conversely, those who violate the norms of scientific integrity can hardly count on the trust of citizens or policymakers.

2.1.2. Trust in scientific expertise

Trust in scientific expertise extends beyond the information itself to include confidence in specific experts' ability to evaluate the quality and relevance of scientific knowledge within particular contexts. This also involves these experts' familiarity with – or ability to acquire – context-specific knowledge on which there is no specific scientific information available. The distinction between trust in scientific information and trust in scientific expertise can be illustrated with the following example:

Jaap van Dissel, the director of infectious diseases at the Dutch National Institute for Public Health and the Environment (RIVM), directly advised the Dutch government during the Covid-19 pandemic. Despite widespread use of masks in other countries, public pressure, and even a direct appeal from Anthony Fauci, his American counterpart, Van Dissel maintained his position that masks had “extraordinarily little effect” on limiting the virus’ spread.[1] He argued that the Dutch government’s decision to recommend mask use in indoor environments was a “political decision, not one based on medical knowledge” (NOS News, 2/10/2020). Van Dissel trusted established scientific information indicating that viruses are so small they can pass through mask barriers, and he feared that mask use might create a false sense of security, prioritising physical distancing instead. This information was not incorrect. However, emerging scientific expertise during the pandemic provided evidence that the virus was primarily transmitted via airborne aerosols rather than droplets.

The scientific expertise in this case relied on two components: advances in aerosol measurement techniques and their application to indoor contexts. The new insights from scientific expertise explained differences in infection rates between indoor and outdoor environments – an aspect not accounted for by Van Dissels’s conventional virological knowledge. In terms of state-of-the-art scientific knowledge, the discrepancy between indoor and outdoor environments provided an anomaly. Van Dissel simply relied on conventional wisdom without acknowledging the evolving insights from scientific expertise concerning the role of aerosols. Fauci, in contrast, trusted this evolving scientific expertise, while Van Dissel adhered to his own virological understanding. Where Van Dissel emphasised the credibility of his source of scientific information, Fauci swiftly relied on the credibility of the evolving scientific expertise. A comprehensive scientific assessment ultimately supported mask use as a means to limit the virus’ spread and protect individuals.

This example illustrates that the scientific advisory system has to become proactive in the event that there is a knowledge gap (in this case, how to explain the differences in infection rates between indoor and outdoor environments). One needs to procure scientific expertise to address the knowledge gap. This presupposes a trust in the capacity of particular experts.

2.1.3. Trust in scientific advisory bodies and science-informed decision-making

Trust in scientific advisory bodies extends beyond confidence in credible scientific sources. It includes trust in policy-embedded scientists to navigate the complexities of the policymaking process. Scientific advice often involves normative judgments, such as defining acceptable risks or determining socially viable measures.

For instance, the recommendation to wear masks is based not only on the level of protection they provide (a normative consideration) but also on the perceived social acceptability of the measure. It relates to the normative issue of social acceptance of wearing masks in particular communities or under certain circumstances and may also relate to broader social, economic and environmental concerns. Over time, as the pandemic progressed, public acceptance of mask-wearing became increasingly contested. The normative baselines for judging the acceptability of risks and the measures to address them have to be made explicit. This will make broader public deliberations possible and contribute to their legitimacy. This might reinforce trust in public policy.

Thus, scientific advice is not a passive input but an active component of policymaking. It requires trust in advisory bodies to integrate scientific knowledge with societal norms and practical constraints. Scientific advisory bodies are objects of trust, located not within the realm of science but within the policy domain. Notably in the case of Covid-19, governmental policy had to legitimise the extraordinary case of temporarily restricting fundamental freedom rights, and balancing the requirements for public safety with the infringement of those freedom rights.

[1] NOS news, 2 October 2020: https://nos.nl/artikel/2350709-van-dissel-blijft-erbij-gewone-mondkapjes-hebben-weinig-effect

This underscores how scientific advice is interwoven with broader societal and policy considerations. The institutional provision of scientific advice through advisory bodies or councils does not lead to a science-determined decision-making process. Authorities based in ministries retain the autonomy to deviate from scientific advice. Moreover, these authorities must integrate diverse scientific and other inputs (such as legal, budgetary and political considerations) into a comprehensive framework of various public policy objectives and ensure their coherence.

Using the example of mask-wearing, authorities must consider whether such decisions should be mandatory, under what conditions, and how they align with other measures, such as regular ventilation. In this process, authorities may diverge from the normative protection levels that scientific advisory committees used as the basis for their recommendations. The decision-making process is therefore science-informed but not dictated by science alone since the employment of normative baselines is necessary.

One can now delineate the functional relationships in modern societies concerning objects of trust. Two key functions emerge: the appeal to science from the perspective of policymaking and the provision of scientific insight to public policy from the perspective of science.

The appeal to science by public policy – Public policy appeals to science to address complex problems by rendering them perceivable and manageable. Science reduces the complexity of the issue and can tailor issues for policy considerations and policy options.

Provision of scientific insight to public policy by science – Science provides authorised, consensual data and knowledge, forming a foundational basis for socio-political discourse. This enables science to relieve political and policy debates of dissent over factual matters, functioning as a source of authority. Reliance on this authority implies the institutional assignment of trust, with scientific information and expertise serving as primary objects of trust for policymaking (Table 1 captures the Science-Policy and Public Sphere-Public Policy Relationships).

Communication among the systems of science and policy is more complex than communication among individuals. Whereas the latter can assume a simultaneous presence and interaction among a 'sender' and a 'receiver' this does not apply to the former situation. Science communication may find its way indirectly through the media or reach recipients asynchronously. This situation is regularly echoed by frustrations of either scientists who complain that their insights don't reach policymakers or policymakers who complain that scientists don't deliver or respond to questions asked. A classic example was the climate scientist Stephan Schneider addressed the challenge scientists faced in trying to communicate complex, important issues as follows: "We need to get some broad-based support to capture the public's imagination. That, of course, entails getting loads of media coverage. So, we have to offer up scary scenarios, make simplified, dramatic statements, and make little mention of any doubts we might have."[2]

The relationship between the public and policymaking spheres is not fully analogous to the science-policy relationship, even though similar functional relationships can be distinguished here. The public sphere indirectly (through elected parliaments) and directly empowers decision-making in public policy (provision of power)), while the policymaking sphere integrates diverse and often interrelated policies and interventions in a coherent response to legislative actions and broader public demands (appeal to policy in order to address issues of public concern). Accountability is in democratic states institutionalised, with parliament and the public holding the executive branch and its policymakers accountable for their entrusted powers. Mechanisms such as parliamentary votes of no confidence (expression of 'distrust') can compel governments to step down. This contrasts with the science-policy relationship, as there is no distinct mechanism for making science accountable to society or policymakers for providing incorrect information. As an institution, science has also no formal obligation to inform policymaking. However, the case will be made further below that some kind of institutionalisation of responsibility is necessary when *science goes wrong*.

[2] Quoted in Discover Magazine, pp. 45-48, Oct. 1989

Public trust in decision-making is essential for representative democracies. In a well-functioning democracy, citizens entrust politicians to act on their behalf. In this context, trust in science-informed decision-making gains particular relevance, relying on mechanisms for scientific advice. However, there is no distinct accountability structure for the science-policy ecosystem beyond its integration into the broader public policy system. Consequently, public distrust in policymaking can spill over into the science-policy domain and vice versa. This overlap complicates the distinction between distrust arising from specific science-informed decisions and broader dissatisfaction with the policymaking process.

Another aspect is the public trust in science. Modern societies do not necessarily require high levels of trust in science among the general public. There is no functional necessity as there is for the science-policy relationship. Instead, a baseline of scientific literacy may be sufficient for citizens to participate meaningfully in society, underscoring the importance of science education. For analysing interinstitutional relationships, public trust in science is relevant only as far as it affects trust in science-informed policymaking and decision-making. Following Luhmann's understanding of the functional relationships of science and policy one can distinguish between *functions of appeal* and *provision functions* among societal systems and subsystems, which Luhmann describes in terms of "ecological communication". The use of terminology in relation to science-for-policy ecosystems could possibly be seen as an extension of his analysis (Luhmann, 1989).

Functional Relationship	Function of Appeal	Provision Function	Object of Trust
Science-Policy	Understanding of the state of affairs	Scientific Consensus; consensus on data	Scientific Information; Scientific Expertise
Public Sphere-Public Policy	Integration of Public Policies, with science-informed overarching criteria (sustainability, etc).	Empowerment for legitimate decision-making	Scientific Advisory Committees; Assigned Authorities for decision-making (e.g. ministries)

Table 1: The Functional Relationships of Science-Policy and Public Sphere-Public Policy

The function of the democratic institutions to provide, entrust and empower public policy with legitimate decision-making mechanisms can encounter its challenges, notably for science-informed mid- to long-term policies. Politicians who are elected for relatively short terms of office, are, for example, sometimes unable or unwilling to pursue long-term science-informed sustainability objectives. The authority of the executive power is also challenged as such. In a number of Western countries, the membership[3] of environmental groups far exceeds the total membership of all the political parties together in the country. For decades, citizens have trusted information that has been provided by experts from environmental organisations more than the expert-mediated information they receive from the government (European Commission, Eurobarometer 35.1, 1991). This may lead to a legitimacy crisis as the absence of decision-making

[3] In the Netherlands the membership of the major political parties are in the range of 25,000 to 40,000 (https://www.parlement.com/id/vlqglxuktxtx/nieuws/ledental_politieke_partijen_nam_in_2021), whereas Greenpeace Netherlands had in 2022 547000 members. Other big NGOs have similar membership (https://www.greenpeace.org/nl/algemeen/63234/jaarverslag-greenpeace-nederland-2023).

mechanisms for long-term planning contrasts with the necessity to implement long-term science-informed sustainability objectives. The rise of the role of social media has further complicated this issue, as further described below.

The appeal to policy by the public sphere aims at integrating a diverse set of policy objectives in a consistent manner, with overarching science-informed normative requirements, such as those of sustainability (or normative levels of protection for human health and the environment, etc.). This 'function of appeal' is encountering challenges in terms of trust as well. A disintegration rather than an integration of public policies awaits public administrations confronted with the pressure of a wide range of interest groups. Public interest groups may turn against all available possibilities (for example, the use of nuclear energy *and* coal *and* coal gasification *and* hydropower plants, etc.). Trust in science-informed decision-making may fade as contradictions in governmental policies become apparent. For example, when policy appeals to the public to embrace sustainable forms of consumption and behaviour while at the same time it incentivises production methods allowing or even fostering actors to continue with unsustainable production of goods, and reaping economic benefits from it.

2.2. What fosters trustworthiness in the science-for-policy ecosystem?

In the case of the science-policy relationship, policymaking can neither side-step science nor replace it. In daily life, we might ignore science. The institution of public policy, however, cannot simply side-step the institution of science. It would also be irrational to redo in policy what is completed in science. Science has institutionalised competences which cannot be found elsewhere. For example, if we want to know whether particular levels of radiation represent a hazard for human health, we have to turn to science, even if the answers to our questions are preliminary, uncertain, or to some extent unknown.

When policymakers appeal to science, we have to list criteria or good reasons for the trustworthiness of the source. Firstly, the science to which policymakers appeal must be *credible*. The creation of knowledge in science underlies distinct and universal codes for 'good' research conduct, enabling a global research practice that is virtually independent of cultural and national constraints. As a previous director of the US National Science Foundation, Subra Suresh, put it: "Good science anywhere is good for science everywhere." Norms of 'good' scientific conduct have been codified. For a long time, academies of science and funding organisations primarily phrased these norms in negative terms, focusing on what constitutes misconduct in science. For example, the US Office of Research Integrity (ORI) defines research misconduct as "fabrication, falsification, or plagiarism in proposing, performing, or reviewing research, or in reporting research results". The All-European Academies adopted a set of codified principles of research integrity and incorporated them into the European Code of Conduct for Research Integrity (ALLEA Code, 2023). That code builds on and extends the principles and responsibilities set out in the 2010 Singapore Statement on Research Integrity, which represented the first international effort to encourage the development of unified policies, guidelines and codes of conduct worldwide. Since 2017, the European Commission has recognised the ALLEA Code as the reference document for research integrity in all EU-funded projects and as a model for organisations and researchers. The scope of codification is limited to matters of scientific integrity, even though these norms or principles have been described as fundamental to 'good' research practices. The code stipulates that the scientific community has an overarching duty to "promote, manage, and monitor a research culture based on the scientific integrity of its members". The implementation of scientific integrity is managed through *self-regulation by the scientific community.* This may guarantee the trustworthiness of scientific practice and the mutual reliance of scientists upon each other to some extent.

When we appeal to the credibility of an individual expert rather than to a credible scientific practice, the principle of *independence* comes into play. Independence is not about presenting objective or definitive advice to policymakers but "about securing the procedures and autonomy under which evidence is produced and communicated" (Pedersen, 2023). Hence the scientific integrity of the autonomous scientific practice and procedures for knowledge production (thus free from political intervention) should guarantee that the knowledge and evidence generated is a trustworthy source for independent experts to communicate scientific knowledge to policymakers.

However, the science-for-policy ecosystem does not immediately become credible itself by appealing to a credible source or to credible independent experts per se. It is a necessary but not a sufficient condition. It must also be *responsive* to public demands, as the example of scientific advisory bodies has shown: it should appeal to socially acceptable norms which can be used as normative baselines for scientific advice. Public trust in the science-for-policy ecosystem is dependent on the extent to which the scientific advice is based on socially accepted norms and practices. Thus, *responsiveness* constitutes a second criterion. Furthermore, public trust will depend on how effectively the scientific advice is implemented in policy, aligned with a broad set of issues which the electorate has entrusted the government to address. Responsiveness is part and parcel of the accountability and transparency of governmental policy, according to Pedersen(2023): “Governments should be able to explain how scientific evidence is considered when drafting policies and legislation.” In the words of the European Commission (2002), individual advisers should be prepared to “justify their advice by explaining the evidence and reasoning upon which it is based”.

Lastly, the most demanding criterion for trust is the *anticipatory capacity* of the science-for-policy ecosystem. Is the system prepared for future challenges? Trust in science-for-policy ecosystems suffered a serious blow during the Covid-19 pandemic. In fact, public authorities worldwide were in denial whether the coronavirus could become a pandemic until it actually became one (Engström et.al, 2021; footnote 2). They were also in denial that Covid-19 constituted a serious threat to human health until it became an undeniable fact.[4]

Scholars (Guston, 2013; Von Schomberg, Pereira and Funtowicz, 2005; Von Schomberg, 2019) have called for anticipatory governance frameworks that integrate foresight, responsible innovation, and continuous learning to address complex emerging challenges pro-actively and shape the future. OECD members have recently welcomed (OECD press release, April 2024)[5] a framework for anticipatory governance[6] to foster transformative research and responsible innovation. Such a framework is said to *enhance public trust.* “ By being more agile and adaptive, anticipatory governance fosters public trust and strengthens the social contract”. (see footnote 3, OECD). Anticipatory governance resonates with the foundational principle of responsibility (Pedersen, 2023) for science-for-policy ecosystems and with responsible research and innovation (Owen et al., 2013, Von Schomberg, 2013 and 2019). The Dutch government has established a Societal Impact Team whose recent advice (July 2024) recommends how pandemic preparedness on a societal level in the Netherlands can be ensured and improved.[7] This is a rare and novel example of scientific inquiry comprising an *anticipatory capacity* in assessing the societal impacts of emerging pandemics. The Societal Impact Team has also invested in developing an assessment

[4] On 18 January 2020, a spokesperson for the Dutch RIVM said there was only a “small chance” that the coronavirus will even show up in Europe at all, adding “there are no direct flights from Wuhan to the Netherlands.” A few days later, the spokesperson said the institute is preparing for a potential outbreak, but the “chance of the virus entering the Netherlands is small.” About a week later, acknowledging that there was a chance the virus may spread to the Netherlands, Van Dissel said “it will probably be limited to just a handful of cases”. And a spokesperson at the RIVM went so far as to proclaim on 28 January 2020 that the virus is “not very contagious and not easily transmitted between people”. In the USA, as late as 28 January 2020 Robert Redfield (former Director of the Centre for Disease Control and Prevention) declared that the “novel coronavirus is not a threat to the average American citizen”. Alex Azar (former Secretary of Health and Human Services) followed up by saying that “Americans should not worry for their own safety”.
Most of the quotes have been retroactively eliminated from the official websites of the institutes, but you can still trace them in the press and in scientific literature. Quotes are here from:
https://www.forbes.com/sites/joshuacohen/2021/03/11/metamorphosis-of-a-dutch-top-public-health-official-jaap-van-dissel-in-the-face-of-the-covid-19-pandemic/
The identical quotes from the Dutch RIVM are also to be found together with a comprehensive timeline, https://www.containmentnu.nl/articles/timeline?lang=en

[5] OECD legal instruments

[6] Anticipatory governance, OECD

[7] https://www.government.nl/documents/publications/2024/07/31/societal-impact-team

framework that can be used to identify the effectiveness and societal impact of measures together with the key dilemmas and underlying values. The framework illustrates how to be prepared for another pandemic, and to obtain advice informing well-considered decisions during a specific pandemic context and within a particular timeframe.

3. Trust within science-for-policy ecosystems: who and what to trust?

3.1. Science as a functional authority?

The relationship between science and government policy rests on the concept of *functional authority*. When policymakers rely on scientific research, they inherently express trust in the scientific system that produced the information. This trust is not placed in the infallibility of individual researchers but in the overall competence and integrity of the scientific system (Luhmann, 1979 and 1989). Such trust arises from necessity: the complexity of certain problems is so great that science has to reduce its complexity to make it relevant for policy.

The scientific system fulfils a crucial societal function as a trusted provider of reliable information. Appeals to scientific authority reflect this role. When individuals or institutions lack the means or expertise to verify particular claims independently, they defer to scientific authority. This trust allows social actions to proceed without continual debate, enabling timely decision-making in critical situations. Trust in science facilitates action by assuming the validity of its statements and orienting decisions around them. Such trust is foundational for societal progress, particularly in fields of knowledge where complexity necessitates reliance on scientific information and expertise.

In many cases, reliance on scientific authority is unproblematic. Policymakers typically do not question the expertise of scientists when dealing with non-controversial scientific information. In such situations, there is clarity about what constitutes relevant data, and the results of scientific inquiry are predictable and readily available. Non-controversial research often has a pronounced problem-solving character, where theories and methods are not in dispute, and the issues are regarded as solvable in principle. This type of research focuses on resolving specific problems, with scientists acting as problem-solvers within established frameworks.

3.2. Scientific uncertainty and scientific dissent

Many complex issues – such as climate change, the long-term effects of pesticide exposure, the impact of microplastics, and radiation risks – are accompanied by significant scientific uncertainty and dissent. For example, climatologist Stephen Schneider published a book in 1976 warning of a potential ice age, reflecting a consensus among certain scientists. Less than a decade later, Schneider's subsequent book, *Global Warming* (1989), argued that the real threat was the greenhouse effect, a hypothesis first proposed by Arrhenius in 1896 but ignored until then. This shift exemplifies how scientific consensus can evolve, highlighting the inherent uncertainty and the limits of our knowledge. Even today, despite considerable progress, we cannot predict with absolute certainty the extent or consequences of the greenhouse effect, underscoring the incomplete nature of scientific understanding in complex systems.

At the root of scientific dissent often lies fundamental disagreements among scientific authorities – experts who have advanced knowledge within their disciplines. These disagreements arise when disciplines rely on distinct *foundational assumptions and methodologies*. For instance, in assessing the risks of genetically modified organisms (GMOs), molecular biologists prioritise genetic composition as the critical factor, while ecologists focus on ecological analogies, such as the introduction of exotic species into new environments. These divergent perspectives lead to mutual scepticism among specific scientific disciplines about the adequacy and *relevance* of each other's knowledge base for risk assessment.

Such debates extend beyond disagreements over data or methods; they reflect deeper epistemic differences about how knowledge is acquired and made relevant for a particular subject matter. While these debates are essential for advancing individual disciplines, they do not lend themselves to a unified scientific consensus. This lack of consensus undermines the functional authority of science in policy contexts. In these cases, trust in science becomes fragmented, reduced to trust in specific branches or paradigms – what we can call *epistemic trust*. While such trust supports the progression of scientific disciplines, it cannot serve as a singular, authoritative source for policymaking. A debate within science about the relevance of their field for the disputed subject matter is an *epistemic debate on the acquisition of knowledge*. It contrasts with scientific exploration on the procurement of *available* knowledge and the production of scientific information based on *consensual methods* and their relevance to the subject in question. In the context of the epistemic debate in science, we cannot *reasonably* expect scientists to produce an overall consensus. An appeal to scientific authority by public policy would thus fail.

3.3. The issue of epistemic trust

Epistemic debates in science often spill over into public discourse long before scientific closure is achieved, creating challenges for policymaking who face the tricky question: which group of scientists should they trust and endorse? Epistemic approaches to knowledge are closely tied to problem definitions that, in turn, implicitly shape policy approaches. Unrecognised or unresolved epistemic debates can lead to imbalanced policies. For instance, the 'wait-and-see' stance on climate change, once common among nation states, or the premature enthusiasm for emerging technologies, reflect policymaking that takes sides in scientific debates that are still unfolding. Prematurely translating an epistemic debate into the policy realm can result in flawed interpretations of scientific claims. Plausibility becomes conflated with 'truth', projections with 'predictions', and potential dangers with quantifiable 'risks'. (Evers & Nowotny, 1987, Beck, 1986; Von Schomberg, 1992). Such distortions erode both public trust in science-for-policy and trust in scientific expertise and information in public policy. The interplay of scientific uncertainty, dissent, and epistemic trust presents a significant challenge for policymakers. Effective public policy requires a nuanced understanding of scientific debates, careful navigation of epistemic disagreements, and recognition of the limits of scientific authority. By acknowledging the provisional nature of scientific knowledge and fostering transparent dialogue between scientific and policy communities, policymakers can, in principle, better balance the complexities of science and the needs of society.

At the Mutual Learning Exercise meeting in Warsaw, Ralf Lindner introduced the EU-funded IANUS project (https://trustinscience.eu) and provided feedback on the issue of epistemic trust. The project takes a different view on trust, seeing it as not inherently beneficial or problematic, but rather as *warranted* or *unwarranted,* depending on the situation.

Lindner discussed the relationship between science and policy/democracy, often described as two worlds driven by different rationales and logics. The political-administrative system is oriented towards *interest-consideration* and *consensus-building*, while the scientific system is driven by the *logic of knowledge* and the *search for truth*. He cited the issue of paradigm selection bias, arguing that public scepticism about science often stems not from concerns over research integrity but rather from disagreement with the focus and direction of scientific inquiry.

Three models of science-policy interaction were presented, with a focus on the *pragmatic* or *recursive* model which assumes interdependence between political value orientations and scientific knowledge, emphasising the need for reciprocal communication and mutual understanding.

A general challenge for trust in science is that it is easier to debunk scientific findings than to defend them. This is often exploited by interest groups to spread doubts about scientific findings contrary to their interests, as seen in the tobacco industry's tactics.

Lindner emphasised the importance of institutional reforms that facilitate better science-policy interactions. He advocated for creating formal structures that encourage continuous dialogue and mutual learning between scientists and policymakers. He also called for capacity-building efforts, such as training programmes for early-career scientists and government officials, to enhance their ability to work together. Lindner noted the need for concrete implementation and institutionalisation of practices such as openness, transparency, accountability, and public engagement, which have been frequently proposed but not sufficiently practiced.

Science-for-policy ecosystems need to ensure diversity of perspectives, he said, adding that policymaking must build more absorptive capacity to meaningfully connect with science, sharing responsibility with the scientific community for improving performance.

The importance of capacity-building for both early-career scientists and early-career government employees was stressed, suggesting the establishment of training formats to improve mutual understanding between these groups.

Lindner concluded with a quote emphasising the importance of critical engagement with research evidence, shared deliberation about its meaning, and effective integration of evidence within practice as aspirational goals for designing science-policy ecosystems.

Box 1: Response of Dr. Ralf Linder (Head of Competence Center Policy and Society, Fraunhofer Institute for Systems and Innovation Research, Germany) to the issue of epistemic trust.

3.4. Science as a strategic resource in decision-making: who to trust?

In situations of scientific dissent or persistent uncertainty, science's traditional role of reducing complexity and laying the groundwork for public policy can be inverted. Instead of fostering clarity and consensus, science often becomes a *strategic resource* for political action. Interest groups participating in public discourse selectively endorse experts who align with their political objectives, while policymakers may prioritise experts whose views align with vested interests. Consequently, scientific data is weaponised in the battle over information and expertise. Rather than resolving disputes, science can exacerbate them by introducing further dissent and fuelling conflicts in both political and public arenas.

Access to scientific resources thus becomes a critical component of political strategy, in the presence of significant scientific disagreement. Access to scientific knowledge and data becomes itself a strategic objective. Interest groups may want to block the generation of data if they anticipate that it can be used to make decisions that may prove to be undesirable to their cause. Some groups may also prefer non-closure of substantial findings or controversial science if they anticipate that an ongoing debate will result in the absence of decision-making in policy. Oreskes and Conway (2010) write in their book *Merchants of Doubt* that "keeping the controversy alive" by spreading doubt and confusion after a preliminary scientific consensus had been reached was the basic strategy of those opposing action. The tobacco industry successfully applied these tactics to delay public health measures.

3.5. The issue of interest-based knowledge production

The production of scientific knowledge is not confined to traditional academic institutions. An appeal to *science* does not always mean appealing to independent academic research. Industry and civil society organisations now actively engage in both scientific research and policymaking debates. The rise of "mandated science", as described by Salter (1988), highlights this ongoing trend. When stakeholders have vested interests in particular outcomes, they often shape research agendas and innovations to align with their preferred objectives.

The presence of multiple, interest-driven knowledge producers necessitates honest engagement from formal policymaking systems. As Nowotny (1992) emphasised, some form of public scrutiny is essential. Public policy must avoid appearing to align exclusively with particular interest-based knowledge producers and instead safeguard the broader common good. Over the past 30 years, this challenge has driven the emergence of *knowledge brokers*, such as science and technology assessment offices. These organisations independently mediate among various knowledge producers, providing balanced advice to policymakers and parliaments on science and technology issues. Examples include the Rathenau Institute in the Netherlands, the Technology Assessment Bureau at the German Parliament, and at the European level, the Scientific and Technological Options Assessment Office (STOA).

3.6. The need for participatory processes: who and what to trust?

Two key responses to these challenges are critical for reinforcing trust in decision-making under conditions of scientific uncertainty and disagreement:

1. *Implications for public policy* – Addressing how a broad set of interests are integrated with science-informed policy.
2. *Assessing the quality of scientific information and claims* – Ensuring the robustness and reliability of knowledge claims.

Helga Nowotny observed in 1987 that “the public has intruded in public policy and is, so it seems, here to stay, even though it is not always easy to say who the public is”. This insight paved the way for calls to subject science-for-public-policy to *participatory scrutiny*, akin to other political inputs (Nowotny, 1992).

Funtowicz and Ravetz (1992) expanded on this with the concept of *post-normal science,* which marks a shift from traditional scientific norms to a framework addressing issues where “facts are uncertain, values are in dispute, stakes are high, and decisions are urgent”. This approach requires extended peer reviews that transcend academia, forming the foundation for calls for “quality assurance”. It also challenges the conventional notion of evidence-based policy by questioning what qualifies as evidence. While evidence may serve as epistemic support for scientific theories, it does not directly translate into actionable proof in policymaking contexts. Attempts to impose scientific concepts of *proof* and *evidence* on policy processes often leads to irrational debates about what constitutes facts and evidence.

The rationale behind regular calls for evidence-based policy is to enhance the quality of policymaking. It draws on *authoritative appeal* to science described earlier with more emphasis on seeking *authoritative evidence* (functioning as ‘trump’ card) that does not or may never exist. Applying this rationale rigidly to the policymaking process does not relieve the policy process from scientific controversy, but instead leads to contentious debates about what qualifies as facts or evidence. Government decision-making should avoid siding with a particular group of experts and particular – often unarticulated – normative baselines for judging risks, but rather look for broader forms of deliberation.

Proponents of rigid evidence-based policy often attempt to strip normative elements from scientific advice, yet broader normative questions cannot be ignored. Public policy must explicitly address and justify these normative foundations underlying any ‘evidence’ communicated through scientific advice.

An example, which illustrates this point, comes from German Minister of Public Health Karl Lauterbach,[8] who was accused of disregarding evidence-based policy during the Covid-19 pandemic. German newspapers questioned whether "Corona-facts" were undesirable. Early in 2022, as the latest wave of infections was receding, Lauterbach refused to lower the virus' risk category despite recommendations from the independent Robert Koch Institute. He argued that, although the wave was subsiding, the potential for significant casualties and uncertainties surrounding the virulence of new variants of Covid-19 justified maintaining higher risk precautions. In an interview,[9] Lauterbach emphasised that as a minister, he was responsible for making value judgments about the social acceptability of risks – an inherently political decision that cannot be delegated solely to scientific advisory bodies. The distinction between risk-assessment and risk-management may in practical terms not always be clear, but the formal responsibility of risk-management is with assigned authorities. This is also reflected in the European Commission's advisory structures. The Commission may indeed deviate in particular circumstances from the advice they receive from regulatory advisory bodies, such as the European Food Safety Authority.

Despite progress, mechanisms for simultaneously ensuring quality assurance, identifying knowledge gaps, and providing foresight remain underdeveloped in the science-for-policy domain (Von Schomberg, Pereira and Funtowicz, 2005; Funtowicz and Ravetz, 2015). One notable exception is the Intergovernmental Panel on Climate Change (IPCC), which has, since 1988, produced authoritative reports on climate change science. By reviewing the "balance of evidence" (IPCC, 2001) and assessing the strength of scientific consensus, the IPCC has fostered *both* scientific and intergovernmental agreement on issues such as human-induced climate change. Its integrative approach – balancing science, addressing criticism, and policy considerations – has established the IPCC as a leading knowledge broker and earned it the Nobel Prize in 2007.

In conclusion, the evolving landscape of knowledge production and its entanglement with political processes highlight the need for effective mechanisms that ensure transparency, accountability, and the alignment of science with public interests. It is a prerequisite for reinforcing trust in science-for-policy.

During the Mutual Learning Exercise meeting in Warsaw, Agata Gurzawska presented findings from the Verity project (https://verityproject.eu). The project analyses trust in science through a systems-thinking approach. It examines the ecosystem of trust in science, including interconnected *stewards of trust* and *stakeholders*.

Gurzawska highlighted four challenges to trust in science: 1) The inherently complex and uncertain nature of science, 2) Changing research environments, 3) Interdependence of science with politics and economics, and 4) The changing ecosystem of trust.

The transition from an *information age* to a *reputation age* was discussed, emphasising the importance of who presents a message rather than its content. This shift is fuelled by social media and has led to a paradigm shift from *institutional trust* to a new form of *distributed trust*.

The Verity project identified various roles that stewards of trust play in the ecosystem of trust in science, including science production, education, communication, science policy, funding, advocacy, implementation, oversight, protection, and science-society facilitation.

Gurzawska proposed a framework for strengthening trust in science, emphasising that trust must be built through a combination of transparency, ethical governance, inclusivity, and active engagement with the public. She stressed the need for clearer accountability mechanisms in scientific research, ensuring that findings are communicated responsibly and that funding

[8] Interview with Minister Lauterbach, Bild Zeitung, 30 November https://m.bild.de/politik/inland/lauterbach-im-talk-waren-corona-fakten-politisch-nicht-gewuenscht-6749977671377d52b91d4cde?t_ref=https%3A%2F%2Fwww.google.com%2F

[9] Interview with Minister Lauterbach, Bild Zeitung, 30 November https://m.bild.de/politik/inland/lauterbach-im-talk-waren-corona-fakten-politisch-nicht-gewuenscht-6749977671377d52b91d4cde?t_ref=https%3A%2F%2Fwww.google.com%2F

sources are transparent. She also advocated for improving science communication efforts, particularly in ways that are accessible and engaging for non-expert audiences. Another key recommendation was fostering collaboration between different stewards of trust to create a more cohesive and resilient science ecosystem. She concluded by highlighting the necessity of aligning scientific research with societal needs and values, arguing that science should be seen as a shared resource that serves the public good rather than as a tool for narrow political or commercial interests.

Box 2: Response of Dr Agata Gurzawska, Cluster Lead – Ethics, Human Rights and New Technologies, Trilateral Research, UK, to the issue of strategic use of scientific knowledge

Misleading information: what sources to trust?

In tandem with the rise of multiple knowledge producers entering the public and policy domains, science communication is increasingly practiced by a diverse array of actors, including governments, public relations experts, universities, research institutions, science journalists, and bloggers. As a result, particular interests often shape science communication. Weingart (2016) aptly observed: "If the communication of scientific knowledge is tainted by interests, if it is conflated with persuasive communication, if one constantly has to be suspicious of bias, this may not only create problems for making the decisions at hand but adversely affect the institution of science as a whole." In this context, the credibility of science is intricately tied to the credibility of science communication.

The proliferation of social media, employed by a wide range of actors to disseminate scientific information, has further exacerbated this issue. Trust in science communication depends on both the medium and the source. For the average citizen or policymaker, it can be challenging to disentangle scientific content from other elements of communication, as well as to assess the extent to which the information has been transformed or contextualised for policymaking purposes.

Two major factors critical to reinforcing trust in science for policy, public scrutiny and quality assurance are described above. While public scrutiny can be driven by various science communicators and media, it often fails to foster meaningful *participatory scrutiny* in public policy or to ensure adequate *quality assurance*. In fact, the proliferation of the channels and methods of science communication can sometimes intensify polarisation and erode trust, particularly if governments themselves function as science communicators and align with specific perspectives without reasoned justification – or worse, out of ignorance.

According to Maria Baghramian and Shane Bergin, on the basis of their experience with the PERITIA project[10] on trust in scientific expertise, "A climate of trust depends not on just science-based expertise, but also on complete openness, transparency, and accountability from those in decision making positions. The media also has a crucial role in constructing a climate of trust."[11] The climate of trust refers to the interaction and relationships among scientists, policymakers, the media, and the public.

The governance challenge of trust becomes particularly acute when governments themselves are compromised, leaving few authoritative sources to rely upon. While this text will not address the deliberate spread of misinformation – a serious issue that undermines democratic functions, as evidenced by Russian interference in US and Romanian elections – it is important to recognise a related phenomenon; the state's active role in shaping what counts as relevant scientific information and using it as a strategic asset, much like other interest-driven entities.

During the first and second Trump presidency, for instance, the US administration sought to undermine the independent public function of the Environmental Protection Agency (EPA) by removing scientific information on topics such as climate change and renewable energy from public websites, including the EPA's own website. In response, scientists are downloading and

[10] https://peritia-trust.eu

[11] Maria Baghramian and Shane Bergin, 'Recreating climate of trust in experts essential for beating' Covid-19 – The Irish Times, 4 November 2020.

safeguarding this data, forwarding it to non-governmental organisations like the Environmental Data and Governance Initiative (EDGI). These efforts aim to preserve scientific information and research amid fears of data erasure following shifts in government priorities.[12] This situation sets a troubling precedent for further political interference in science-for-policy efforts, transforming scientific knowledge from a public good into a strategic resource, vulnerable to the whims of changing administrations.

3.7. The crisis of reproducibility and scientific integrity

The institution of science itself is also compromised to a considerable extent. The increasing reliance on career-driven quantitative metrics – such as publication counts and citation numbers – as proxies for research excellence and impact has transformed the scientific enterprise into a *publication factory*. Ioannidis et al. (2018) found that thousands of scientists publish a paper every five days.

The rise of gold open-access publishing – a business model in which authors (or their institutions) pay to publish – has exacerbated these trends. This model creates a perverse incentive for journals to maximise publications, often at the expense of quality. The emergence of so-called 'mega-journals' illustrates this shift. John Ioannidis, a leading meta-research expert, reported that in 2015, just a dozen biomedical journals accounted for 6% of total publications in the field. Today, that number has skyrocketed to 55 mega-journals, which collectively publish nearly a quarter of all specialised literature. Some of these journals release tens of thousands of articles per year, raising concerns about quality control. Universities are paying millions to journal publications which neither advance science, nor make science relevant for policy or socially desirable objectives.

These examples, which can no longer be dismissed as isolated incidents, do not yet reflect the systemic issues plaguing 'authoritative' journals and policy-relevant scientific knowledge production. The hyper-competitive nature of modern science – often driven by industrial mandates – has led to a troubling reality: science frequently "goes wrong." In a 2013 lead article, *The Economist* observed: "Too many of the findings that fill the academic ether are the result of shoddy experiments or poor analysis. A rule of thumb among biotechnology venture capitalists is that half of published research cannot be replicated. Even that may be optimistic."

Supporting this claim, researchers of the company Amgen found they could reproduce only six of 53 "landmark" cancer studies, while a research group of the company Bayer managed to replicate just 25% of 67 influential papers. A prominent computer scientist expressed concerns that up to 75% of research in his subfield lacks validity. Furthermore, between 2000 and 2010, an estimated 80,000 patients participated in clinical trials based on research later retracted due to errors or misconduct.

A *reproducibility crisis* further compounds the problem. In a 2016 *Nature* survey of 1,576 scientists, over 70% admitted they had failed to reproduce another group's experiments. While this crisis stems partly from methodological flaws – such as publication bias toward statistically significant results or context-dependent sample usage – it also intersects with the competitive nature of science. Rigorous verification through replication, often requiring rigorous repetition of research, is devalued in an environment where time, funding, and data-sharing are scarce.

In the last decade, major academic publishers like Elsevier and Springer have shifted their business focus from publishing to data-analytics services. These research information systems allow scientists to identify relevant publications and data sources, but they also raise significant concerns:

1. *Steering research objectives* – Universities increasingly rely on these systems, which can "steer" research agendas. Metrics-driven rankings compel researchers to publish in journals hosted by the same providers, thereby perpetuating a self-serving cycle. Consequently,

[12] CNN, 19 November 2024: https://www.cnn.com/2024/11/19/science/video/internet-archives-research-science-data-fears-trump-contd-digvid

scientific trends may be artificially hyped rather than emerging from genuine intellectual inquiry.

2. *Profiling researchers* – Publishers collect data on researchers' behaviour, such as search histories and preferred topics. Combining multiple data sources enables highly accurate personal profiling. This practice raises ethical questions, including potential violations of data protection laws and grey areas surrounding privacy. Publishers often outsource data collection to third-party companies, which may sell the information for commercial purposes, sometimes without clear user consent.
3. *Erosion of the knowledge commons* – Publicly accessible knowledge is increasingly at risk. Budget constraints may force universities and public institutions to limit licensing agreements with publishers, leading researchers to favour specific platforms. This further concentrates control in the hands of a few dominant publishers, undermining the development of a "knowledge commons". Karen Maex, former rector of the University of Amsterdam, has called for a European *Digital University Act* to address these issues, complementing existing regulations like the Digital Services Act.[13] Similarly, the German Research Foundation (DFG) has warned that "scientific freedom" is at stake.[14]

The current trajectory of quantitative-metrics-driven science undermines *scientific integrity* and the credibility of knowledge production. Simultaneously, closed, competitive research environments erode the *reliability* of scientific findings and limit the *accessibility* of knowledge essential for the public good.

Together, these challenges threaten science-policy ecosystems' ability to identify *credible, reliable,* and *relevant* knowledge necessary to support socially desirable public policy objectives. Addressing these systemic issues requires urgent reforms to restore integrity, reproducibility, and openness to modern scientific research.

During the Mutual Learning Exercise meeting in Warsaw, Martin Bauer presented findings from the POIESIS project (https://poiesis-project.eu). The project focuses on trust measures, public engagement events, and discussions with mediators and stakeholders at universities supporting researchers in communication and research integrity.

Bauer challenged the presumption that a lack of research integrity is a cause of potential mistrust in science. He identified a misalignment between research assessment, pursuit of integrity, and public engagement efforts. He argued that research integrity efforts, public engagement initiatives, and research assessment metrics are often in conflict with one another, creating tensions for scientists and institutions. For example, scientists are increasingly pressured to demonstrate impact through engagement activities, but these activities are often assessed using metrics that prioritise visibility over genuine public dialogue. Similarly, institutional efforts to promote research integrity may be perceived as bureaucratic hurdles rather than meaningful ethical commitments.

Contrary to concerns on public trust in science, Bauer presented data showing that trust in science has continuously increased since the 1990s in the UK, with only minor fluctuations. However, the data did not touch upon trust in science-for-policy.

Bauer highlighted a tension in public engagement between dialogue-driven approaches and reputation management. Bauer also noted an 'arms race' for attention among universities, with communication efforts strengthening in more competitive environments.

Box 3: Response of Martin Bauer, Professor of Social Psychology and Research Methodology, LSE, London to the issue of misleading information and lack of scientific integrity/failed self-governance of science

[13] Karen Maex, Time Higher Education, 30 August 2021,
internet, https://www.timeshighereducation.com/author/karen-maex
[14] https://www.dfg.de/download/pdf/foerderung/programme/lis/datentracking_papier_en.pdf

4. Trust in science-for-policy as a theme with recurring calls for openness and transparency

Nowotny and Ravetz's early calls for participatory scrutiny in science-for-policy ecosystems and for quality assurance of scientific information and claims have contributed to a gradual process of learning aimed at improving science-for-policy ecosystems. This process has been especially relevant considering emerging technological, ecological, and human health risks, as well as the need to implement overarching sustainability requirements. The governance of and response to subsequent emerging technologies has progressively become more comprehensive. In Europe, regulations and directives were developed ahead of the introduction of GMOs and for food products involving nanotechnology. The learning process in defining and managing risks has also taken into account the ever-evolving public debate, particularly during responses to crises.

In Europe, crises such as Bovine Spongiform Encephalopathy (BSE) and other food safety issues prompted in the late 1990s and early 2000s a major overhaul of risk governance and management mechanisms, leading to changes in scientific advisory procedures across Europe. These included:

- How scientific advice was formulated
- Composition of scientific advisory bodies
- Transparency of the decision-making process
- Independence of advisory bodies (separation of risk assessment and risk management)
- Adoption of the precautionary principle in policymaking as part of broader European Governance (Commission of the European Communities, 2001)

At that time, the European Commission diagnosed: "The advent of biotechnologies highlights the unprecedented moral and ethical issues posed by technology. This underlines the need for a wide range of disciplines and experiences beyond the purely scientific. Recent food crises have emphasised the importance of informing people and policymakers about what is known and where uncertainty remains. However, they have also eroded public confidence in expert-based policymaking. Public perceptions are further undermined by the opacity of the Union's expert committees and the lack of transparency regarding their functioning. It is often unclear who is making decisions—experts or political authorities. Meanwhile, a better-informed public is increasingly questioning the content and independence of the expert advice provided." (Commission of the European Communities, White Paper on Governance, 2001, p. 18)

The initial calls for quality assurance led to the regular appointment of experts from multiple scientific disciplines, along with transparent reporting and open access to the meeting reports of scientific advisory bodies. Calls for 'participatory public scrutiny' evolved into efforts to democratise the science-informed decision-making process. EU Member States began facilitating public hearings on proposed public policy objectives and other forms of public involvement. In 2002, the European Commission launched its first *Science and Society Programme*, which promoted public understanding of science and encouraged public engagement with science. This initiative also supported the further development of international networks, such as the "science shops", which have since expanded to include more recent citizen-science-based initiatives.[15]

The implementation of the precautionary principle has been a transformative development. This principle, enshrined in the European Treaty (1992) establishes a rationale for action (Von Schomberg, 2006), lowering the threshold for government intervention. It represents a significant departure from previous practices, where political actors could exploit persistent scientific dissent as an excuse to delay action. This was particularly evident in the cases of ozone layer protection and climate change, where political inaction persisted for extended periods. Considerable progress has been made in addressing scientific uncertainty by integrating all relevant scientific disciplines

[15] https://livingknowledge.org

when seeking expert advice. The European Commission published guidelines on democratising expertise as early as 2002.

Institutional innovations have also occurred. Regulation EC 178/2002, which established the European Food Safety Authority (EFSA), includes specific procedures for handling cases where scientific opinions diverge. This regulation mandates cooperation with relevant bodies when disagreements arise – particularly with community bodies – to clarify the issue and publish joint findings in publicly accessible documents. It also requires EFSA to actively engage with non-community bodies holding divergent views to share information. These requirements represent some of the most innovative approaches to managing scientific dissent and uncertainty, going far beyond the typical calls for transparency and openness in decision-making.[16]

Since the launch of the European Commission 2001 White Paper on Governance, calls for openness, transparency, accountability, and public engagement with science-informed decision-making have been regularly repeated.[17]

Most recently, the 2024 report of the British Academy on Public Trust in Science-for-Policymaking[18] offers several recommendations or key messages: "Policymakers should not underestimate the public's desire for nuance and transparency", they should "be open where there are uncertainties, while indicating how knowledge gaps will be addressed", and "avoid a simple 'follow the science' approach, instead acknowledging the diversity of considerations and evidence." The Academy report adds that "policymakers, researchers and knowledge brokers should deepen their engagement with different publics to build trust in science".

The 2023 Council Conclusions, now considering the recent Covid-19 crisis, call again for "transparent and responsible communication about scientific processes and the dissemination of scientific evidence" and encourage "societal engagement and participatory processes in R&I, in line with democratic values". These calls do not extend what was already called for in the context of the European Commission's White Paper on Governance in 2001.

[16] The author is not able to verify here to what extent EFSA currently actively practices these requirements. It may lead to *more* precaution. For example, EFSA lowered the threshold for human consumption of Bisphenol A with a factor of 20,000 in 2023, to 0.2 nanograms per kilo body weight. In contrast, the German Institute for Risk Assessment advises consumers to accept a level of 200 nanograms. The institutes disagree by a factor of 1,000.
[17] All recent and ongoing Commission-funded research projects on the issue of trust equally underline these https://trustinscience.eu; https://poiesis-project.eu; https://peritia-trust.eu; Verity
[18] https://www.thebritishacademy.ac.uk/documents/5185/Science-Trust-and-Policy-report.pdf

5. Outlook and conclusions

5.1. Evolving challenges for science-for-policy ecosystems

The circumstances under which science-for-policy ecosystems operate have changed significantly. By 2024, *identifying credible, relevant, and reliable knowledge* for policymaking has become increasingly difficult, largely due to the erosion of the institution of science in fulfilling its role. The self-governance of science shows shortcomings in several key areas:

- *Scientific integrity* – Self-regulatory codes of conduct are insufficient for managing scientific integrity. Perverse incentives, particularly those driven by the pressure to publish, undermine these codes, putting the credibility of the scientific knowledge base at risk.
- *Science communication* – The dissemination of scientific information has been co-opted by various actors seeking to influence public policy. Scientific communication, rather than serving the public interest, has become a strategic tool for socio-political purposes, often as a result undermining the credibility of the source.
- *Commodification of knowledge* – Competitive, closed science and the commodification of research have led to knowledge production that is ill-suited to addressing societal challenges. Metrics-driven definitions of academic 'excellence' further exacerbate this issue, reducing science's capacity to meet public needs. The responsiveness of the scientific system is negatively affected.
- *Erosion of collaboration*: Tackling complex societal challenges requires collaboration, yet competition is prioritised over cooperation. This undermines the scientific community's ability to engage effectively in collective problem-solving.

Public participatory scrutiny of science-for-policy processes has reached its limits. While regulatory science can still address specific issues through transparent procedures and accountability mechanisms (such as EFSA's), addressing mid- to long-term societal challenges is fundamentally different. *Knowledge acquisition* amid scientific disputes and uncertainties to address such societal challenges is a *multiple actor process*. Addressing this issue requires governance that integrates public policy and science, rather than treating them as separate domains.

This approach demands more than transparency or openness; it calls for institutional reforms that fundamentally reshape both public policy and science. It is about governance of science *and* science-for-policy within the broader public policy domain. Trust in science-for-policy relates less and less to trust in *particular decisions* (except in regulatory science) and ever more to a *process* in which many stakeholders are involved and provides a productive context of social collaboration. Social cooperation based on mutual responsiveness among all stakeholders with a shared responsibility and commitment to mid- to long-term objectives constitutes this process-based trust.

5.2. Implications for the governance of science

To address these challenges, science must shift from *incentivising competition* to *fostering social collaboration*. This involves encouraging mutual responsiveness among scientists, and enabling coordinated research based on shared understanding. Interdisciplinary and transdisciplinary research missions can emerge from such collaboration, producing knowledge that transcends disciplinary boundaries.

Foster social collaboration through mission-oriented research

Social collaboration can also occur at the institutional level, particularly at the interface between science and society. Here, societal and scientific actors share responsibility for steering science and innovation. Research councils and funding organisations, for example, are well-positioned to facilitate this shift. The European Union's Horizon Europe programme (2021-2027) exemplifies this approach, emphasising mission-oriented research that addresses societal challenges. Beneficiaries of this funding must co-design and co-create research agendas with stakeholders, including academia, industry, civil society, and public authorities (Mazzucato et al., 2020). Such collaboration, underpinned by norms of openness and mutual responsiveness, fosters anticipatory governance and aligns scientific efforts with socially desirable outcomes (Robinson et al., 2021, Von Schomberg, 2024). This approach will undergo a litmus test of process-generated trust: the participants will observe whether the results of these missions will factually translate in corresponding public policy.

Another example of co-creation of research agendas and innovation trajectories has been demonstrated by the emergence of *Living Labs,* which provide spaces for organisational learning and experimentation. The European Network of Living Labs (ENOLL) was founded in November 2006 under the Finnish Presidency of the Council of the European Union. Since that time, the number of European benchmarked Living Labs has grown to 480+ (ENOLL, 2024). Living Labs have progressively taken up principles of 'Responsible Research and Innovation' in their practice. ENOLL now defines Living Labs as ''real-life test and experimentation environments that foster co-creation and open innovation among the main actors of the Quadruple Helix Model, namely: citizens, governmental organisations, industrial organisations and academia'' (see https://enoll.org/about-us).

This definition embraces fundamental elements of open and responsible research and innovation (Von Schomberg, 2019), namely, to make stakeholders co-responsible and mutually responsive to each other by engaging them in an open co-creation process. This may include co-enquiry by the stakeholders including by citizens either by practising *citizen science* or by cooperating with other stakeholders.

Expanding on the role of knowledge brokers in trust-building

An increasingly important mechanism for strengthening trust in science-for-policy ecosystems is the role of knowledge brokers. These intermediaries translate complex scientific data into actionable insights while maintaining neutrality and transparency. Research suggests that institutions such as science-policy interfaces, advisory councils, and open-access knowledge platforms contribute to trustworthiness by enhancing clarity and reducing perceived bias in decision-making processes (Gluckman et al., 2021). The effectiveness of knowledge brokers depends on their ability to foster collaboration between scientists, policymakers, and the public while ensuring adherence to established principles of scientific integrity and accountability. To enhance public trust, governments should institutionalise knowledge brokers who facilitate communication across different stakeholders, ensuring that policy decisions are informed by the most reliable and consensual scientific knowledge.

The crisis of reproducibility and its impact on trust

The reproducibility crisis has eroded public and policymaker confidence in scientific research, particularly in areas where policy decisions rely heavily on contested or uncertain scientific findings. Ioannidis et al. (2014) found that up to 50% of published research in biomedicine fails reproducibility tests, raising concerns about the reliability of scientific evidence in regulatory and policy settings. A framework for systematic replication studies, including open peer review and funding for replication efforts, is necessary to reinforce the credibility of research that underpins policy decisions. Greater transparency in data-sharing practices and the adoption of open science principles can mitigate these concerns, ensuring that science-informed policymaking is based on robust, validated research (Munafò et al., 2017).

Trust in relation to different components of the science-for-policy ecosystem

During this Mutual Learning Exercise, we identified the need to distinguish between the various types of science-informed decision-making. The particular component of 'regulatory science', for example, scientific advice for the authorisation of products or scientific advice on food safety issues, operates in the EU under conditions of institutional distrust (e.g. companies have to inform competent authorities with risk assessments of their products, providing evidence for safety, rather than competent authorities having to demonstrate that the products might be harmful, which amounts to a reversal of the burden of proof).

Whereas 'regulatory science' is institutionalised under conditions of functional distrust, the employment of scientific information for mid- to long-term sustainability issues, such as the European Green Deal, is embedded in the form of networked/distributed trust among stakeholders, fostered by a collaborative mode of operation. In the context of stakeholder engagement in societal challenge-based and mission-oriented research, the production of evidence is co-created and the process is dependent on the social commitment of stakeholders to achieve a common objective, thereby aligning potential conflicting interests.

5.3. Implications for the governance of science for policy

The more individuals and institutions collaborate, the better they understand one another, reducing the need for mutual control and oversight. Ultimately, fostering trust requires co-responsibility among all actors. Organising the latter is a task of public policy. Public policy must engage stakeholders in *defining problems* and developing alternative scenarios on the basis of participatory foresight exercises and clarifying specific epistemic assumptions. The goal of participatory foresight is "to strengthen people's capacity to recognise and embrace uncertainty while collectively shaping a preferable vision of the future" (Rosa et al., 2021).

In this way, epistemic dissent in science can become a productive force in policymaking rather than a barrier to decision-making or a cause of paralysis. Multi-stakeholder *foresight exercises*, for instance, can align stakeholders with shared social and public policy objectives (such as those derived from the European Green Deal). Foresight exercises are not instruments for public participatory scrutiny but rather a tool to commit stakeholders to social objectives for which they have a shared responsibility. Public policy has the task to organise co-responsibility among stakeholders and define their roles and participation rights. Public policy will then likely cease to be a battlefield for lobbyists and the subject of polarised information from science communicators.

Public engagement on science advice has to be elevated to the level of meaningful participation on mid- to long-term research and innovation processes on which they share common responsibilities. Subsequently, stakeholders can translate them into individual tasks within the context of their organisations.

Anticipatory governance as a trust-enhancing mechanism

The concept of anticipatory governance – integrating foresight and proactive decision-making – has emerged as a key trust-building and enhancing mechanism within science-for-policy ecosystems (Guston, 2013). Public scepticism about policy decisions based on uncertain or emerging science can be reduced by incorporating participatory foresight exercises, where diverse stakeholders co-create policy scenarios. This approach has been successfully applied in climate change policy, where organisations such as the IPCC engage in extensive stakeholder dialogue to produce assessments that balance scientific consensus with societal concerns. Establishing anticipatory governance structures within science advisory mechanisms can enhance legitimacy and responsiveness, reducing public distrust in science-based policy recommendations (Rosa et al., 2021)

Trust in science-for-policy relates less and less to trust in *particular decisions* (except in regulatory science) and ever more to a *process* in which many stakeholders are involved – a productive illustration of social collaboration. The emphasis on social cooperation based on mutual responsiveness among all stakeholders with shared responsibility and commitment to mid- to long-term objectives is a demonstration of *process-based trust*. Horizon Europe missions on societal challenges act as litmus test of this process-generated trust concept: participants will observe whether the results of these missions will factually translate in corresponding public policy. The science-for-policy system has to prepare for and become responsive to the outcomes of the missions

The more individuals and institutions collaborate, the better they understand one another, reducing the need for mutual control and oversight. Ultimately, fostering trust means better organising co-responsibility among all actors. The latter is a task of public policy.

Figure 1 illustrates the various components to enable a science-for-policy ecosystem to become credible, responsive, and anticipatory (the basic three factors for fostering trustworthiness of the science-for-policy ecosystem).

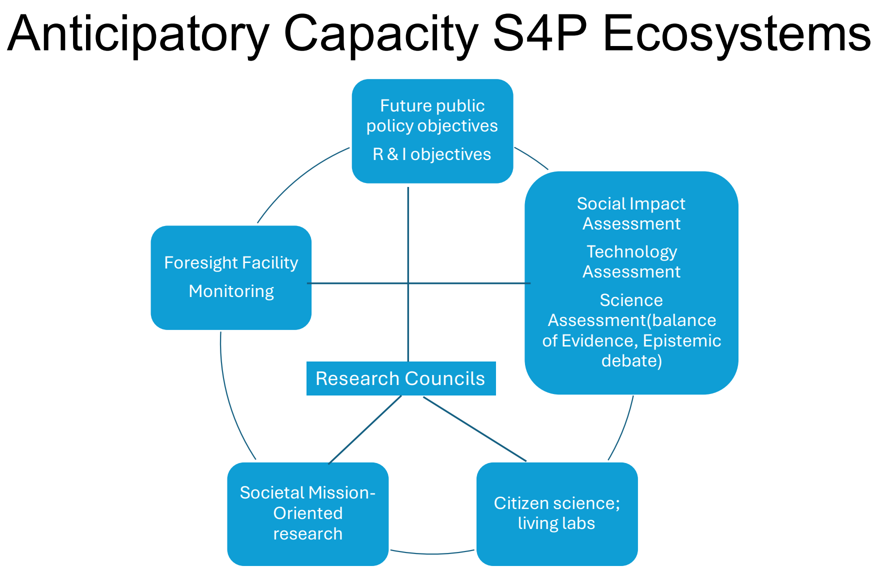

Figure 1: Anticipatory Capacity of Science-for-Policy Ecosystems
Source: authors own creation

The Decisionist vs. Pragmatist Model for Science-for-Policy in Relation to Trust

The *decisionist model* follows a hierarchical structure where politics determines decisions based on values, interests, and legal constraints, while science serves as an authoritative provider of information. In contrast, the *pragmatist model* promotes a collaborative approach where science, policy, and society interact dynamically to address societal challenges (Habermas, 1976).

It remains a open empirical question what the impact of science's privileged access to policy under the decisionist model is on other stakeholders' trust in the science-for-policy system. Some participants advocated for "safe spaces"—venues where scientists and policymakers can engage in dialogue to enhance mutual understanding. Within the decisionist framework, science communication is primarily the responsibility of scientists, and knowledge brokers mainly translate policy needs for scientific audiences. In contrast, the pragmatist model envisions a broader role for both science communication and knowledge brokers as described above (Gluckman, 2021).

The Pragmatist Model and Scientific Literacy

Contributions from Ralf Linder and Agata Gurzawska align with the pragmatist model. Linder argued that distrust in science cannot be seen as inherently negative. Unlike the decisionist model, which counts on public trust in science, the pragmatist approach underscores the importance of scientific literacy among the broader public. This model necessitates active engagement from all stakeholders, including scientists, in the policymaking process. Scientific literacy enables the public to critically assess scientific information and expertise rather than merely trusting it at face value.

Gurzawska highlighted the role of diverse 'stewards of trust', who operate through various communication media and stakeholder networks. In this model, *relational trust*—where trust emerges from shared or aligned interests—gains prominence over *institutional trust*, which relies on scientific independence. Pragmatist governance challenges include aligning stakeholder interests and ensuring public authorities remain committed to the public good. Unlike the decisionist model, which provide privilege for academic science, the pragmatist model embraces knowledge co-production between academia and other societal actors. Here, the legitimacy and quality of decision-making are closely intertwined.

A key example of this approach is *anticipatory governance* by means of societal mission-oriented research which fosters co-creation of knowledge, evidence, and innovation. Some science-for-policy ecosystems prioritise addressing societal challenges, as seen in particular in science-for-policy strategies of the Netherlands and Belgium.

The EU's evolving science-for-policy landscape

The EU has advanced participatory policymaking through the Better Regulation guidelines, which promote stakeholder engagement. A recent JRC policy brief (Rodriguez et al., 2025) underscores the benefits of co-creation: "By involving a range of stakeholders, co-creation enhances the adaptability and responsiveness of policies, allowing them to better address the unique challenges faced by different communities. In the EU context, co-creation is increasingly recognised as an appropriate method for policy innovation because it is able not only to increase the relevance of policies but also to build trust between stakeholders and enhance the legitimacy of policy outcomes."

Co-creation also strengthens vertical coordination between governments and external actors, as well as horizontal coordination among inter-agency collaborations.

The above decisionist and pragmatist models offer distinct governance approaches for integrating science into policy. While the decisionist model emphasises authoritative scientific input and institutional trust, the pragmatist model fosters stakeholder engagement, scientific literacy, and co-created knowledge. The EU's evolving governance frameworks increasingly reflect pragmatist principles, recognising the value of participatory, trust-building processes in shaping effective, science-informed policies. This aligns with more global trends, as articulated by the OECD's endorsement of anticipatory governance. Governments worldwide are seeking ways that not only better respond to present challenges, but also anticipate and shape future possibilities. *Anticipatory innovation governance* is a proactive approach that integrates foresight, innovation, and continuous learning into the heart of public governance.[19]

[19] https://www.oecd.org/en/topics/anticipatory-governance.html

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This thematic report explores the issues of trust in, and governance of Science-for-Policy ecosystems. It makes the case for making Science-for-Policy credible, responsive and with anticipatory capacity. The paper reflects on the questions: what to trust and the issue of persisting scientific dissent and uncertainty, and who to trust amidst misleading science communication and interest-based strategic use of scientific knowledge. It provides an outlook on a more collaborative approach among science, policy and society actors.

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