Is Science Advice for Policy useful in modern societies?

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Contents

› 1
› 2
› 3

Is Science

Advice for Policy useful in modern societies?

Summary

This document describes the outcome of the series of workshops "Is Science Advice for Policy useful in modern societies?"[1] organised by the Centre for Philosophy of Sciences of the University of Lisbon (CFCUL) in collaboration with the British Embassy Lisbon.

The series of workshops provided an opportunity to bring together policymakers, academics, and science policy practitioners to discuss the interface between science and policy through relevant expertise and direct experience.

The event was organised in three sessions, with each session focusing on a specific subject:

i) science for policy;

ii) science advice to Government;

iii) science advice to Parliament.

This report summarises some of the main issues discussed by examining the views of different speakers[2], covering topics that include: science advice practice, mechanisms of science advice to Government and Parliament, and role of science advice during the Covid-19 crisis.

In covering the issues debated, this report underlines key questions for reflection and debate by the different stakeholders (including science advice practitioners, researchers, experts, and policymakers).

The current challenges at the science and policy interface, fuelled by social and political issues intrinsic to different countries, highlight the need of a better understanding of the factors underpinning the provision of effective scientific advice to, and its uptake by, policymakers.

In doing so it encourages different stakeholders to foster mutual interactions based an open dialogue, co-creation, and trust. ■

[1] https://sciencesadvicepolicy.campus.ciencias.ulisboa.pt/
[2] Recording of the workshops are available in the webpage

1 Introduction

1.1 Background

As societies become more technologically advanced, science is increasingly taking the centre stage in the political debate.

To build a framework aimed at ensuring an effective use of science in policymaking it is essential, however, to consider what fruits science can provide in supporting policymaking, as well its limitations and challenges. By its very nature, science is a dynamic form of knowledge, constantly adapting to new ideas, models and knowledge that it produces.

Many will agree that, although in principle science can provide essential evidence on a broad range of issues, the use of scientific evidence in policy is often in competition with many other factors and drivers shaping policies, including political, social and human aspects. **Climate change, food security, pandemics, and privacy protection, are only some of the many complex issues for which current policies need to be developed and decided upon**. For that, policy makers will need to consider potential economic, environmental and social implications of different policy options and assess their advantages and possible risks taking into account factors that go well beyond those that can be studied systematically with 'hard sciences'. Moreover, policy decisions will also be inherently directed by social goals, values and principles, thus inherently biasing fact-based and, perhaps in a naïve view, value neutral, activities such as science. To have a separation line between scientific evidence, societal values and cultural beliefs is not always simple and it is at the boundaries between these domains that strong tensions often arise. Therefore, to have scientific advisory organisations or processes that can support policymaking by effectively bridging these domains has become increasingly relevant.

Across the world, several approaches and processes have been tested to support effective scientific policy advice, often resulting

in the establishment of dedicated scientific advisory structures. The role and function of these structures depends on how the science advisory ecosystem which they are part of works. Specifically, science advisory ecosystems have been evolving in a complex network of interests, values and actors specific to different countries. As a result, country-specific cultural and historical aspects have been influencing how such structures have formed and evolved.

Science advice typically takes place to support the executive branch (Government) or to the legislative branch (Parliament) of the administration of a country. The nature of science advice provided to them differs substantially. Science advice to Governments aims to advise decision-makers exerting executive power, and it usually operates through scientific advisors or advisory committees and within ministerial hierarchical structures. These sources of science advice can either support or challenge given policy options in a context likely to be shaped by the political agenda of the party in government.

In contrast, science advice to Parliament has the role of supporting parliamentary debate, law-making and scrutiny of government action, making it somehow less strongly tied to context-dependent factors. In the case of Parliaments, one of the more prominent approaches for scientific policy advice has been the use of Technology Assessment (TA) structures, conceived to provide an objective and consistent analysis of relevant scientific and technological issues directly to them. In Europe, several countries have institutionalized TA structures. These structures have evolved in time resulting in the development of different missions and engagement processes. However, some countries in Europe (including Portugal, Czech Republic and Hungary) do not have institutionalized TA structures. Beside the TA mode of science advice, countries may have (or not) other formal and informal legislative scientific advisory structures and processes in place. Despite the different needs of legislators and decision-makers, and of the functions in which they operate, a fundamental question is: **after decades of trial and implementation of science policy advice, how relevant, sought and effective the contribution of these processes to policy making has been across different countries?**

The Covid-2019 pandemic, but before that many other global challenges such as climate change, have highlighted many of the difficulties on the role and relevance of science advice for policy, notwithstanding the inherent uncertainties associated with available knowledge and information. **In particular to face an immediate emergency, the Covid-19 pandemic has forced Governments around the world to make difficult political decisions in the absence of sufficiently mature scientific knowledge and understanding of technical aspects associated with the behaviour of the virus and, possibly, of the societal response to different policy options.** The different views and responses by different individuals and segments in human societies across the world have clearly illustrated the difficult ground on which the interface between science and policy operates and the challenges of communicating information and uncertainty to society, especially in times of crisis. ■

1.2 Aim of the workshop series

The series of workshops “Is Science Advice for Policy useful in modern societies?” aimed at contributing to a broad debate on the role of science in policymaking.

More specifically, it aimed at discussing the role of science advice and the appropriate extent of its contribution to policies and societal developments.

The role of scientific policy advice, both at Parliament and Government level, was discussed focusing on examples of some specific policy-advice mechanisms and their challenges. The generation and uptake of scientific information relatively to the Covid-19 pandemic was used as a focal example, providing an important opportunity to both consider limitations on the handling of the current emergency itself but, more broadly and prospectively, to learn lessons and strengthen the science advice system in preparation for future challenges. ■

1.3

Approach to the production of the summary report

In the following, a general account on some of the key issues discussed during the series of workshops is presented.

The views expressed by different speakers are generally reported without further elaboration. In specific cases, to provide additional context, the discussion was expanded with complementary information by the author of this document.

The views, observations and questions raised by different speakers in each workshop were grouped and discussed together under specific themes. Therefore, this document is a summary of the ideas put forward in the event, rationalised around specific themes to increase communication effectiveness. ■

> 2

Issues under discussion

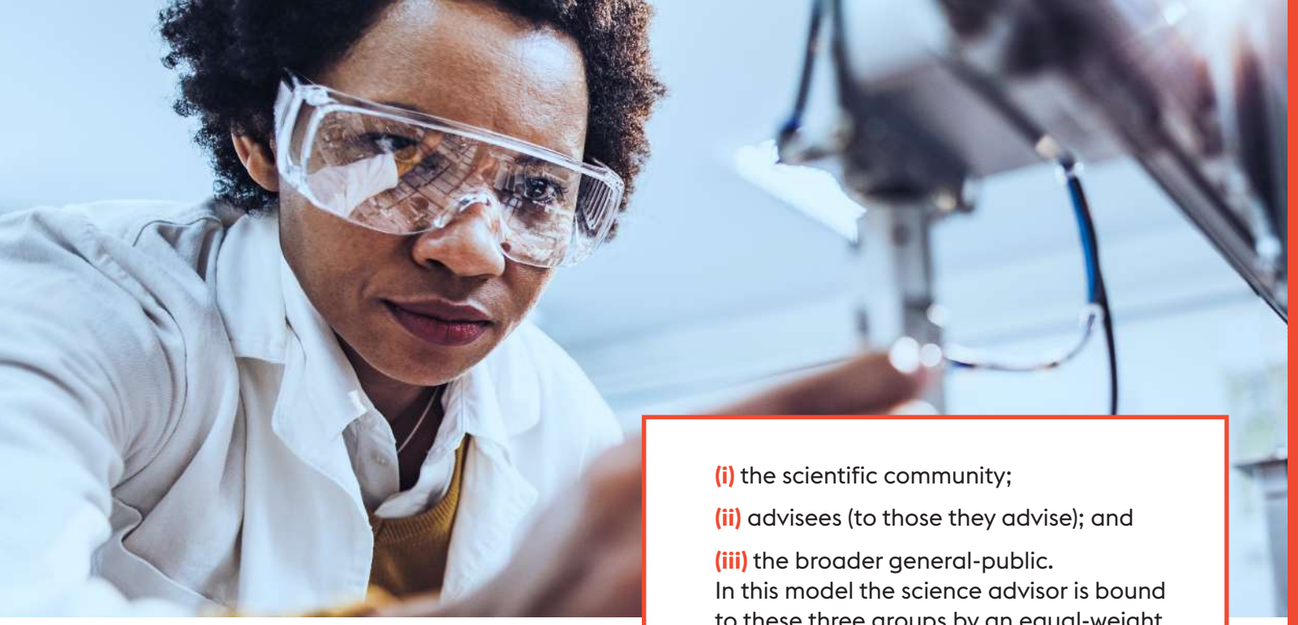
2.1 Models of scientific advice

To assess how scientific evidence can be used to better support policymaking, the science endeavour in its most intrinsic aspects needs to be examined first. More specifically science for policy:

(i) **cannot be built on the false expectation of a direct transfer of truths and facts to policy.** Science provides the ability to produce reliable empirical knowledge at any specific time, but it is not always able to produce permanent facts or truths;

(ii) **should not result in the ability of specific groups or individuals to affirm authority and/or superiority over other groups or individuals, as science should not be another form of power in politics.** However, science should be held in sufficient respect and esteem to provide a key source of valuable information for policymakers;

(iii) **cannot be described as a "movement of value-free information to value-laden decision-makers"**. Specifically, science is not intrinsically value-free, since value-based judgments are often naturally included in scientific practices (e.g. the setting of a research agenda; choice of theoretical/modelling assumptions, deciding on evidence sufficiency). Although aimed at being an epistemic endeavour, science is not only affected by specific biases but, as a culture- and socially embedded practice, is intrinsically not value-free.



The ideal of science providing objective truths (in contrast with the political power holding societal values) has had a strong impact on the shaping of our current understanding of the effectiveness of science advice.

One of the ideals for scientific advice assumes that a science advisor (and more broadly mechanisms of science advice) is independent from outside societal values and political power. This model has been best illustrated by the idea of a spectrum of truth to power where scientists are on the truth end of the spectrum and politicians on the power end of the spectrum – their interactions mediated by professionals and administrators[3].

This model assumes that scientists are only concerned with the pursue of truth and are not influenced by values and politics influencing the politicians. This ideal, however, is too naïve and its bare acceptance is likely to result in a distorted view of the science-policy interface.

A better model for scientific advice may be based on 'constraint' rather than 'independence'. In this model the science advisor will have ongoing obligations, and lines of responsibilities and accountabilities, to three crucial groups:

(i) the scientific community;

(ii) advisees (to those they advise); and

(iii) the broader general-public.

In this model the science advisor is bound to these three groups by an equal-weight bond, i.e. no ranking orders or hierarchies constrain and shape its work, making it very challenging but also less biased. Rather than naively assuming its fully independence, this model recognises potential sources of bias and tries to keep them in check by making the scientific advisor visibly and organically accountable to stakeholders with different agendas. **When considering more specifically the obligations to the:**

(i) scientific community, it was argued that science advisors are never fully independent from such community. Most of the times the science advisors are members of the scientific community, and it is from the interaction with this community that they continuously develop and update their expertise, access constructive critique and differences of opinion, and access niche expertise not in their immediate possession. On the other hand, the scientific community can also be critical of the advice, for example, if the advice is considered not portraying in an accurate way the existent scientific information. Moreover, the debate by the scientific community can also help eliciting the scientific basis of the advice, the level of confidence in it, and any value judgments shaping or unduly biasing it.

(ii) advisees (which can include a member of parliament, minister, head of government agency), science advisors should ensure advice is relevant to the concerns of who they are advising, and it is also clear and, more broadly, useful and implementable. **The obligations should include clarity and transparency on the value judgments**, clear identification of the scientific basis underpinning the advice, limitations of the available knowledge/expertise, identification and impact of crucial uncertainties and, where possible, feasibility/practicability of implementation (at least with respect to the scientific/technical approach which the advice might suggest). The advisors should be able to balance excess of simplicity and of detail. Moreover, advisors should uphold scientific accuracy, maintaining their line of obligation to the scientific community for holding advice against political influence. On the other hand, the advisor should not be conditioning advice, **for example by simplifying or editing it to induce the advisee to consider a specific way of action.**

(iii) broader public, the work of the advisor should be made public and clear to society. As in the case of their obligations to advisees, science advisors should make the basis of their advice transparent to the public, and that can include providing relevant empirical information, sharing the values that shaped the advice and its own limits. The public access to scientific advice is important to enable societies to assess the work of politicians, including their response to the scientific advice they were provided with. **In some cases, access to the advice can also directly support the public, particularly when the public itself needs to take direct action** (as it was the case on the Covid-19 pandemic).

Being transparent on the advice can make attempts by politicians to use science authority to support their particular political objectives visible, thus making them more accountable for their action. The main characteristics of good scientific advice include been trustworthy and useful. Discussion of different models of science advice provides an opportunity to better understand the limitations and challenges of providing trustworthy and useful advice (as well as relevant) and consider best ways to manage them.

The old models of expert advice are currently considered as closed, homogeneous, self-assured and arrogant in claiming authority, demanding trust from the public, expecting consensus and systematically aiming to exercise control. On the other hand, models of science advice as the three lines of obligation model, aim to be more open, diverse, humble, and able to build trust. Advice is expected to be plural, conditional and able to share control.

Along the years, there has been a transition from old models towards new models of science advice. However, old models are still, fully or partly, present in science advice practices.

A key question is how to induce a transition towards new models aiming to provide a more inclusive, engaged and open forms of science advice. ■

[3] Price DK. The Scientific Estate. Belknap, NY: Harvard University Press, 1965.

2.2
Science advice practice

Science advice can target different audiences, depending on the context and needs at play.

Audiences can include the executive power (government), the legislature (legislative science advice), specific government or state officials, public servants (e.g. regulators) and the general public. Reflecting the needs of different potential audiences, science advice can have different roles and purposes, including supporting the routine operations of public institutions, the management of crises, as well supporting regulatory advice. When considering the role of science advice in "normative policymaking", science advice needs to support policymakers in a range of aspects, for example:

i) help them understand the issues in question;

ii) help them identify available courses of action (i.e. strategic options);

iii) help them evaluate such options.

For a better uptake of science advice in public institutions, it seems desirable for policymakers and politicians to experience in their work good quality science advice, and its added value.

One of the underlying issues of science advice is trust. For the advice to be systematically sought and valued, trust must be present between the advisory mechanisms and advisees, but also between the advisory processes and the public, media, and scientific community.

For this, trust needs to be built in the work provided by these mechanisms. For that these mechanisms need to understand their role, limits and how it fits in the policy process. Furthermore, having impact and assuring good timing of the advice are often critical characteristics of effective science advice mechanisms.

Besides, they need to be clear about the fact that scientific evidence is one of the many inputs that need to be considered by policymakers and politicians (e.g. public opinion, fiscal priorities, diplomatic impact, etc.) when making decisions.

Trust in science advice is also promoted when the advice and its basis and limitations are made publicly available. One of the challenges of science advice is to avert claims that the advice has been biased to support specific political decisions. One of the common reasons for science advice disputes is the belief that decisions are based on the advice given by science advisory mechanisms when in fact is a political decision which has considered other issues beside science.

Besides considering technical and social aspects, science advice should also include consideration of the consequences of the advice to society. For example, an analysis of the ethical issues raised by advice is often an important element of good science advice.

To consider science advice as a technocratic issue alone limits the ability of science advice to support policymaking effectively. **One of the roles of science advice is to make policymakers aware of interpretations, or even facts, that might be controversial.**

Very often science advice will have to deal with issues for which the evidence available is incomplete in what has been describe as a time of 'post-normal' science. This means that there will be uncertainties and limitations to the knowledge acquired up to that time. Approaches able to deal effectively with these aspects are of critical importance.

The use of multi-and inter-disciplinarity in providing science advice is considered very important from this point of view. Therefore, many issues are considered important to provide solid science advice, including the need for a deep and sound knowledge, multi-disciplinarity, freedom of opinion, independence and reasonable underlying scientific consensus.

Science advice could be said to include two fundamental components:

i) evidence synthesis; and

ii) brokerage.

The first component focuses on considering scientific evidence from a range of different angles and synthesising it appropriately. National academies can have an important role in this type of work, for which broad and/or niche technical skills might be needed.

The second aims to provide policymakers with a better understanding of what is known (and its associated uncertainties) and to align the policymakers' needs with what the scientific community can provide to support them. Science advisors are most typically in this role.

The two components require actors with different skills and different degrees of involvement with the policy processes. It could be said that science advisors are closer to the policy processes than other actors (i.e. they operate 'inside the system').

Other actors such as national academies, committees, scientific bodies, and universities typically have a more distant position from the policy process (i.e. they operate 'outside the system'). The actors outside and inside of the policy processes act in different ways and with different weights. The impact of outside actors on the policy processes is limited and can be seen, more clearly independent from the political process. In contrast, the actors inside the political system are likely to be involved more directly and systematically in the policy cycle, but mostly have a brokerage role which may constraint their independence. Science advice can be said to be a function of an ecosystem of structures composed of commissions, committees, academies, and/or science advisors providing advice or supporting policymakers. Not only effective science advice ecosystems are composed of actors with different roles they also use different mechanisms to drive and regulate the functioning of the advice process. ■

2.3 Science Advisory Mechanisms to Government

Chief Scientific Advisors and Scientific Advisory Group for Emergencies in the UK

In the UK, science advisory processes have been evolving along the years, and are considered to be deeply embedded in public institutions and extend to both the scientific and industrial community.

In the case of government, the scientific advice occurs through a well-established mechanism of Chief Scientific Advisors (CSA). In general, the CSAs are scientists seconded from academia working as civil servants. CSAs are expected to bring the technical expertise of their own field and apply it more broadly across other research areas. Moreover, they will make use of their networks to engage with researchers and innovators across society.

To enhance communication between them and thus strengthen the network of science advice, the CSAs present in each government's department meet on a weekly basis.

The CSAs within their department work closer with their policy teams to advice their respective Minister and Secretary of State, as well as to work with the emergency advice mechanism. Beside each department's CSA, there is also the Government CSA, who provides science advice directly to the Prime Minister.

His/her role includes providing strategic advice during normal administration and in the context of emergencies. Furthermore, the system also encompasses the Scientific Advisory Group for Emergencies (SAGE)[4]. **SAGE is a mechanism that can be activated to advise the UK government's response to emergencies, as in the case of Covid-19 pandemic.**

Through SAGE, the Government CSA can assemble a group of experts at a given time to deal with the emergency that he/she is to advice the Prime Minister on. SAGE relies on external science advice coming from specific groups of experts, depending on the emergency to be dealt with at the time. The role of these expert groups is to consider the existent scientific evidence, discuss among them the available research and associated uncertainties, and produce consensus papers (publicly available).

These papers will include views on the current limits of knowledge and levels of confidence in the consensus reached by the group, which will be then presented to the main body of SAGE. SAGE typically further analyses and scrutinizes these papers before producing a consensus statement. The statement is sent to the policy teams in government that will consider the advice, as well other inputs, and provide policy evidence to ministers.

Science advice can also play a relevant role in building multilateral and stakeholders' relations. In this context, it's important for UK Ambassadors to be fully skilled in bringing the best scientific evidence to the diplomatic relations within the countries in which they are embedded. For this purpose, the work done by the UK Science and Innovation Network (SIN)[5] is considered important and is often described as a unique example of science diplomacy.

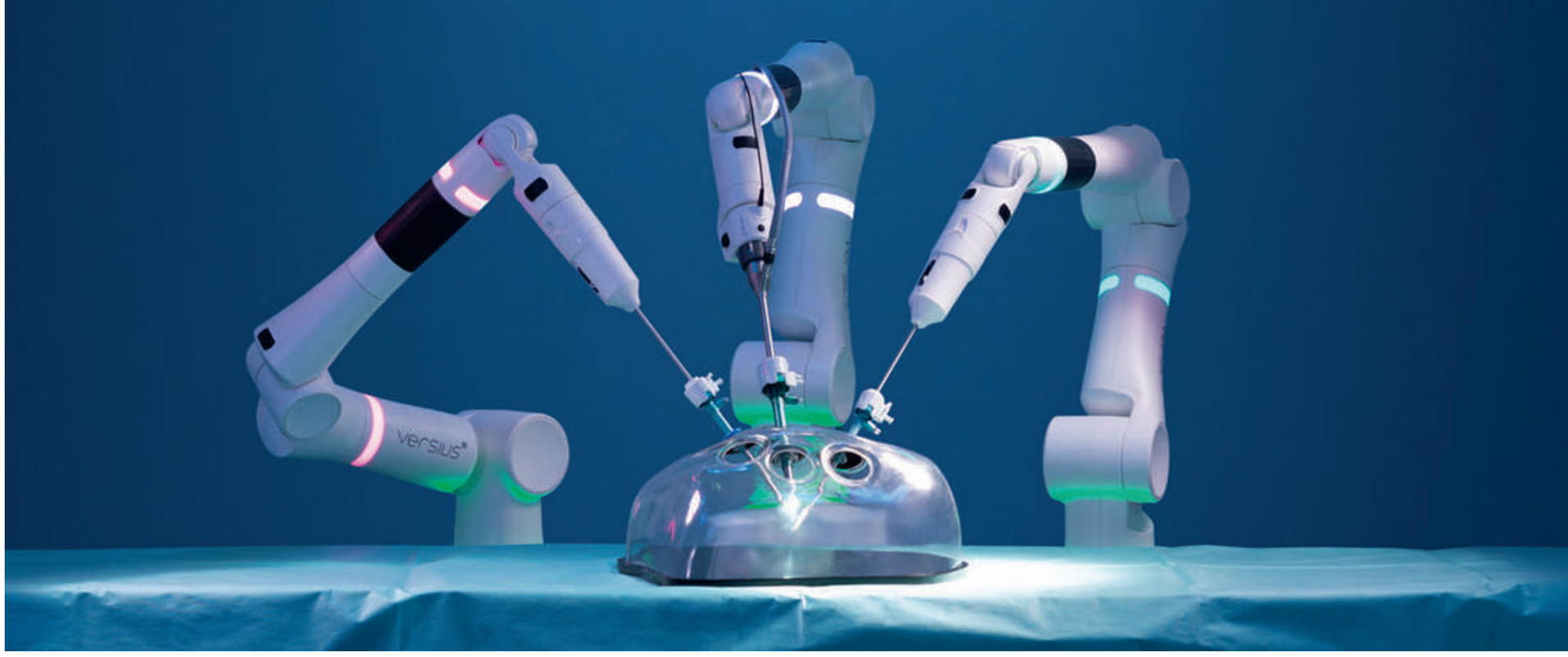
The network includes more than 100 science and innovation attachés embedded to the UK embassies around the world. The attachés can assist ambassadors in the use of science advice to build stakeholder relationships and foster the development of stronger relationships with the UK.

Specific elements are considered important to support and drive science advice in the UK.

These elements include: **being closely connected with the national academy of sciences, such as the Royal Society, working with the university sector, and having a robust funding system, a well-established scientific community, an internationally world-renowned science ecosystem, and strong international scientific collaborations.** For effective science advice to take place, it is essential for the science advice mechanism to be supported by good science.

Furthermore, the public engagement ecosystem existent in the UK is also relevant in supporting trust in science and science advice. Specifically, public engagement on science issues can contribute to keep the public involved in relevant discussions and decisions, thus engaging the overall society more effectively. ■

[4] https://www.gov.uk/government/organisations/scientific-advisory-group-for-emergencies
[5] https://www.gov.uk/world/organisations/uk-science-and-innovation-network



Research Institutes in Portugal

In Portugal, the research organisations are considered one of the organisational mechanisms for scientific advice.

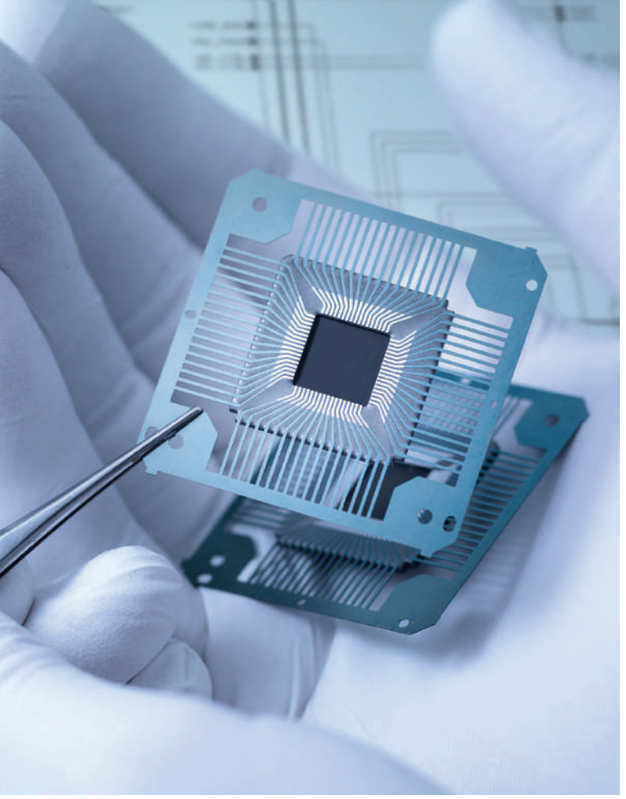
However, it has been observed that "an interconnected set of scientific advice relationships, with specific cross-cutting coordination mechanisms, is lacking in Portugal". This is one of the main findings regarding science for policy in Portugal in the recently published report by the JRC [6].
In Portugal, the Government can ask research institutions to provide support in different areas (e.g. environment and public health).

One of these institutions is the Institute for Systems and Computer Engineering, Technology and Science (INESC TEC)[7], a research and technology organization with experience in providing public policy advice. In the text below the impact of this institute is analysed in some detail to illustrate the role that some of the research institutes have in supporting the Government. **The INESC TEC is one of the largest engineering, Research and Development (R&D) and technology transfer institutes in the country.** It works in several technical domains, including computer science and network intelligent systems.

The INESC TEC focuses on knowledge transfer to generate science-based innovation in contexts in which science can have a direct impact in generating economic value.

For that, the INESC TEC has created platforms to address real world challenges, contributing

[6] https://publications.jrc.ec.europa.eu/repository/handle/JRC128856
[7] https://www.inesctec.pt/en



with innovative technological processes to the modernization of the Portuguese industry.

Examples of technological impact include the textile industry (particularly footwear) and the agro-industry. In addition to this, INESC TEC has supported the Portuguese government in emergencies situations.
For example, in the large fires in 2017, INESC TEC advised the Portuguese government on questions regarding the emergency communication systems that collapsed during the fires. In general, they also provide regular consultancy to the Minister of Science, Minister of Economy and regional bodies and ultimately, contribute to several legislative regulation and by-laws.

The Portuguese government, as many other governments, is facing complex challenges that include, for example deciding on:

i) the use of hydrogen in the energy system, especially when considering the high level of initial investment needed in the technology;

ii) the regulation of complex smart grids;

iii) fiscal policies for electric cars;

iv) licensing for underwater mining;

v) and dealing with public health issues raised by the Covid-19 pandemic.

One of the questions that could be raised is who is best suited to provide scientific policy advice to governments in these and many other relevant matters.

In 2021 the Portuguese government established a National Council of Science, Technology and Innovation (CNCTI) to provide advice to the government in matters of science, technology and innovation. More specifically, the CNCTI will work with the Government in the areas of economy, science and technology.

CNCTI's remit includes a broad range of activities that go beyond providing scientific advice. Specifically, the CNCTI will be involved in the development and support of the national scientific and technological system, in the internationalization of the Portuguese science, and in promoting the transversal and inter-ministerial articulation of science and technology policies. **The CNCTI is formed by individuals coming from research, business as well as other fields.**

However, the mechanism through which the CNCTI will be advising the government is currently unclear. In any case, the council is expected to have autonomy and independence to advise the government on the issues on which advice will be requested, although the council may take the initiative to advise government on other issues. ■

2.4 Science Advice in the European Commission

Scientific Advice Mechanism

Besides the work carried out by the European Commission's (EC) Joint Research Centre (JRC)[8] on science for policy, as part of the Research and Innovation department the EC has a unit working on science policy, science advice and ethics.

The unit delivers science advice by supporting an independent body of advisors called the Group of the Chief Scientific Advisors.

The selection process of the chief scientific advisors is run by an independent committee that selects and proposes names for these appointments.

The appointment is subsequently made by the EC. The key features of the Group of the Chief Scientific Advisors should include independence, competence and transparency. They typically provide advice upon request by the EC high-level political community. However, the chair of the Group of the Chief Scientific Advisors can also propose to offer opinions to the EC and European institutions by their own initiative.

[8] https://ec.europa.eu/jrc/en

The Group of the Chief Scientific Advisors works with the Scientific Advice for Policy by European Academies (SAPEA)[9] consortium, which gathers expertise of a larger number of academies and societies across Europe. The advisors and the SAPEA, together with the unit secretariat, are known as the Scientific Advice Mechanism (SAM)[10].

The SAM considers societal challenges or/and policy priorities for which advice has been requested. It is noteworthy that the advice delivered by the Group of Chief Scientific Advisors does not, however, include policy for science, which is delivered by other existing mechanisms in the EC. Following an initial request, as part of the advice process the policymaking team discusses the issues at interest with the Group of Chief Scientific Advisors, so as to formulate together the questions of interest, thus avoiding technicism or too generic questions.

The interface between the scientific advisors and policymaking team is mediated by the unit secretariat, which promotes effective discussion before the advice is delivered.

Following these initial steps, a first document is published ('scoping paper'), framing the problem when considering the available scientific evidence. Subsequently, SAPEA performs a review of the scientific evidence available on the area of interest, producing an Evidence Review Report. The report is delivered to the Group of Chief Scientific Advisors and made publicly available.

The Group of Chief Scientific Advisors considers the Evidence Review Report, as well the inputs from other experts and/or stakeholders (typically obtained through ad hoc meetings), to elaborate their scientific advice and produce a Scientific Opinion document. This document is delivered to policymakers with the aim of informing proposals for policy or legislation following the European Union (EU) policymaking process.

In some cases, the Group of Chief Scientific Advisors can be asked to deliver advice in a short period of time, as it has been the case during the Covid-19 crisis.

In the case of the Covid-19 pandemic, due to the need to respond to pressing issues over a short period of time, they delivered a statement without a complete review of the scientific evidence produced by SAPEA.

Scientific advice can be central to support the EU Better Regulation Agenda[11], an agenda defined as a way to develop better policies and laws, which "ensures evidence-based and transparent EU law-making based on the views of those that may be affected"[12].

The objectives of the Agenda are to make simpler and better laws, allowing citizens, businesses, and stakeholders to be involved in decision-making processes, thus allowing decision-making to be more open and transparent. The Better Regulation Agenda for policy and laws aims to be inclusive, transparent and impactful. In this context science advice can have an important role in providing a solid evidence base for policymaking in Europe. ■

2.5 Science Advisory Units in European legislatures

Parliamentary Office of Science and Technology in the UK

The (UK) Parliamentary Office of Science and Technology (POST)[13] is a bicameral body that makes scientific research accessible to the UK Parliament.

POST was set up in 1989 as a charity by a group of Members of Parliament (MPs), building initially on the United States (US) former Congressional Office of Technology Assessment (OTA) model. The OTA is considered the international pioneer institution in Technology Assessment (TA)[14]. POST was initially funded by Parliament on a trial basis. In 2001 it become a permanent body within the Parliament itself, having now 13 staff members. 'POSTnotes' are one of the outputs produced by POST. Currently POST releases about 25-30 notes per year – their production involving interviewing around 30 stakeholders from across government, civil service, and civil society. The document will go through an internal and external review process before a final publication is generated. The information gathered is synthesized into a four-page briefing to enhance communication effectiveness.

[9] https://www.sapea.info/
[10] https://ec.europa.eu/info/research-and-innovation/strategy/support-policy-making/scientific-support-eu-policies/group-chief-scientific-advisors_en
[11] https://ec.europa.eu/info/law/law-making-process/planning-and-proposing-law/better-regulation-why-and-how_en
[12] Better Regulation Agenda

[13] https://www.parliament.uk/
[14] TA is a particular mode of science advice that focuses on analysing the impacts of scientific and technologic developments from a legal, ethical and policy view

The remit of the work of POST includes the analysis of scientific and grey literature as well as of knowledge being developed and that has not yet been captured in written form. A variety of POSTnotes are published on issues ranging from social sciences to biology, health and physical sciences. The notes try to capture the range of evidence-based views, including conflicting views, that may exist in respect to a given issues thus communicating both well-established knowledge and existing uncertainties.

POST is also involved in retroactive knowledge consolidation work (or research synthesis) by analysing and summarising existent research in topics of interest to parliamentary select committees. During the Covid-19 crisis the work of POST was extended to enable a rapid response mechanism.

In general, POST has a proactive work approach to support policymaking, achieved through a horizon scanning process used to identify future trends and developments of likely interest to society. This process includes analysing research papers and reports on issues that will impact Parliamentary work within the UK in the next five years. In the last horizon scanning, POST identified 60 'areas of change', which were subsequently grouped into 30 priority areas.

From these 30 high level overviews on changes that may happen, a shortlist of specific topics was developed. This list was shared with the select committees and staff from the two parliament libraries to identify the best topics to support their work and any upcoming select committees' inquiries. **The final horizon scan is used to inform the shortlist that is shared with the Board[15] of POST, which will make a decision on the topics for future POSTnotes, setting their agenda.**

Following a research report (2017) looking at the role of research in the UK parliament, it was found that the links between research producers and policymakers were limited. Specifically, the report found that research producers were not called to present evidence to select committees and select committees had an insufficiently clear understanding of what the evidence indicated.

To increase the impact of research on policy from all disciplines, a strategy ("POST at 30 strategy")[16] was launched. **To help deliver it, in 2018, POST established the Knowledge Exchange Unit (KEU)[17].**

The KEU aims to be an outward face of Parliament aimed at the academic community, conceived to facilitate and strengthen the exchange of knowledge between researchers and the UK Parliament through more effective mutual engagement. **To achieve its aims, KEU has been growing a network of 'knowledge mobilizers' that includes university staff members, impact officers, policy managers, and academic librarians.**

The network can identify academic experts that can support POST, select committees and the Libraries in their work (e.g. a bill going through parliament). Furthermore, the KEU also provides training to academic researchers on how to engage with policy makers (to become "policy-wise researchers").

Training schemes on how best to use research evidence have also been developed for parliamentary staff as well as MPs and their staff. The training sessions on how academics can engage with Parliament are available online[18].

The Covid-19 crisis had an impact in the work of POST, pushing its work to become more reactive.

Their work during the pandemic included scrutinizing the scientific advice given to government and analysing if the advice given was adequate.

In this context, POST produced rapid responses to issues that ranged from the management of the pandemic in schools, to the use of apps in helping to control the spread of the virus, to social distancing through to the management of the food supply chain.

POST has also supported the inquiry work of many of the select committees on the diverse issues related to the Covid-19 crisis. Additionally, POST launched a call to academia to establish a 'COVID-19 Outbreak Expert Database' that gathered around 5000 academics.

This database enabled researchers to provide expert insights relating to Covid-19. Based on expert opinion, POST also identified 20 Areas of Research Interests (ARIs) on Covid-19 in which Parliament needs more evidence to enable sufficiently informed decisions to be made (e.g. lessons learned from the Covid-19 outbreak; national and international preparedness for future pandemics; and economic recovery and growth). ■

[15] The Board is composed of 10 members of the House of Commons, 4 members of the House of Lords and 4 representatives of the scientific community.
[16] https://www.parliament.uk/globalassets/documents/post/postat30-brochure.pdf
[17] https://www.parliament.uk/get-involved/research-impact-at-the-uk-parliament/knowledge-exchange-at-uk-parliament/

[18] https://www.parliament.uk/academic-webinars/

Rathenau Institute in the Netherlands

The Rathenau Institute (RI)[19], part of the National Academy, is similar to POST and was modelled after the US OTA, 35 years ago.

However, there are several differences between the RI and POST, including their localization and funding. The RI is not located in Parliament, and it is funded by the Ministry of Education and Science (in contrast POST is located at Parliament, and it is funded by Parliament).

Although RI can perform work for Parliament when a request is made and can bring issues to the parliamentary agenda, the RI's agenda is not owned by Parliament. Its independence is mainly guaranteed by having:

i) a fixed-amount budget,
ii) an independent board, and
iii) ownership of their work programme.

The RI has currently a team of 60 people. The establishment of the RI was supported by the interest of both business and academic communities in having a TA structure able to support the analysis of societal and political implications of technology.

RI aims to consider the ethical and societal impact of new technological developments and innovations, as well as their sustainability and inclusivity.

The RI could be said to have a boundary function which includes bringing to the debate the available evidence, and identifying lines of responsibility and implications to society. It aims to analyse issues from a societal perspective, i.e. to consider the interests of citizens upon agreed 'public values'. RI works with different communities including Parliament, academia and society, facilitating interactions between different groups and help translating useful and trusted evidence into policymaking.

It's way of working aims at facilitating the direct engagement of key stakeholders in the policy advice process, for example helping identifying researchers to be invited to Parliamentary panels to discuss specific topics. One of the main roles of RI is to support parliamentarians in formulating relevant questions to Ministers, based on relevant information from research.

It also supports them in formulating questions to the scientific community (e.g. Covid-19 passport; etc.) by bring together existent scientific evidence, societal values, rights (constitutional and/or human rights) and/or societal costs and benefits. When is facilitating the debate of technological issues and underlying questions, RI aims to support all parliamentarians independently from their political positions, avoiding as much as possible political biases.

The RI mandate includes serving society, which involves engaging with the public to make them familiar with the issues in debate.

To this effect, their work includes organising public dialogues to assess citizens' questions and views on topics of interest. The use of public dialogues methods is also included in RI process of providing scientific advice to Parliament. For example, the outputs from the organization of a citizen's dialogue on human enhancement supported the deliberations made by Parliament and government on the matter.

The RI can produce short briefs (similar to the POSTnotes), as well as long reports, in which policy options are presented. ■

[19] https://www.rathenau.nl/en nt/

Legislative science advice: Spain

In 2021, the Spanish parliament agreed on establishing a science and technology advisory office with the Spanish Foundation for Science and Technology (FECYT).

Until very recently Spain did not have an institutionalized legislative science advisory mechanism to inform debate and the policymaking process in parliament.

The first reference in the Spanish parliament to a science advisory office is dated to 1986.

At this time similar discussions were happening in other countries (like the UK and the Netherlands), typically considering as a model the work of OTA in the US. However, several attempts in the past to support the establishment of a parliamentary advisory unit in Spain were not successful.

The process started in early 2018 with a group of scientists that quickly evolved into a grassroots movement, the 'Ciencia en el Parlamento' (Science in Parliament). The group 'Ciencia en el Parlamento' used social media to build a network of people interested on better engaging scientists in policymaking processes.

They started by sharing a proposal on ways to promote this interaction, which gathered many contributions from civil society. The initiative was widely supported by citizens and institutions, leading to a meeting with the Spanish parliamentary board. Following the meeting, a 2-day conference took place in the Spanish parliament in November 2018, which counted with the participation of over 200 scientists and almost 100 Deputies of the Spanish Congress.

The first day was organized as a public event, with discussions taking place on several topics.

The second day provided the opportunity for parliamentarians of different political parties to interact directly with experts by asking questions on more specific issues in a closed-door format.

The topics were based on themes that emerged from a public consultation. From the collected themes a shortlist of topics was prepared[20].

The parliamentary groups selected the top 12 topics from the short list (e.g. artificial intelligence; climate change, etc.) to be discussed in the conference, and reports on the topics of interest were produced by selected experts. Later on, the Board of Congress approved unanimously a motion to establish an independent scientific advisory office, but it was only in March 2021 that an agreement to fund an office of science and technology in the Spanish Parliament was announced.

It was argued that one of the reasons for the success of the initiative was that it was driven by civil society and not by a specific scientific institution or political party.

The Spanish parliamentary office is expected to operate inside the Parliament but supported by an external institution, the FECYT (a foundation with experience of communicating science with society). The nature of the advisory body was informed by other models of legislative science advisory mechanisms that exists in Europe, as evidenced in a report produced by the group 'Ciencia en el Parlamento' to the Spanish parliament.

The report emphasises the need of a permanent legislative scientific and technological advice mechanism to support Parliament by gathering evidence on a range of technical and social issues. Additionally, it also highlights the relevance of creating mechanisms to close engagement gaps between scientists and politicians, as well as the need of scientists in communicating their work to policymakers more effectively. ■

Legislative science advice: Portugal

In Portugal, the Parliament does not have a permanent legislative advisory mechanism in place.

A reference on the establishment of a legislative advisory mechanism in the Portuguese parliament dates at least to 2009. Specifically, in 2009, a report entitled "Relatório sobre Ciência" (Report about Science) was produced by the Standing Committee for Education and Science with a reference to the importance of developing an office of Science and Technology in the Portuguese Parliament. The report led to a resolution ("Resolução da Assembleia da República n° 60/2009"[21], approved by Parliament at the time) that determines to:

"(1) Build an institutional platform to promote the interaction of politicians and scientists, with the aim of providing, in a timely and instrumental manner, qualified, current and usable information on all controversies and scientific implications that determine, or are a consequence of, public policies, anticipating or assessing the human, social, economic and environmental impacts of political decisions made in Parliament;

(2) Pursue a feasibility study for the possible establishment of a Parliamentary Office of Science and Technology;

(3) Promote efforts to enable the future membership of the "Assembleia da República" to the European Parliamentary Technology Assessment (EPTA) network; (4) (...)".

The first time the Portuguese Parliament considered the operationalization of the resolution was in 2011, with the appointment of a rapporteur to reflect on the matters of Parliamentary Technology Assessment (PTA) that was approved according to the proposal of the Chairman of the committee for Education, Science and Culture (CECC).

The mandate of the rapporteur was to consider and evaluate the operationalization of the resolution, to gather information regarding the European Parliamentary Technology Assessment (EPTA) network, to provide a map of the different models of PTA in Europe, and to submit a proposal for approval by the committee.

In 2012, the rapporteur presented a report to the CECC proposing a model for an advisory office to be established within the Portuguese Parliament.

To some extent the model proposed was similar to the one to be implemented by the Spanish Parliament, as it was to be based in Parliament and have a permanent scientific team.

Further progress on the matter, however, was halted due to budgetary constraints (noting the financial crisis unfolding at the time) and led to a recommendation by Parliament (2013) that another organizational model making use of existing resources should be considered. The recommendation suggested that, as an interim solution, a member of the CECC would be nominated as a rapporteur for PTA, with the CECC taken responsibility over PTA.

In 2014, hearings held by the CECC with several stakeholders with interest in TA showed strong support in establishing a legislative advisory mechanism. In 2015 a report was presented by the rapporteur for PTA that included a proposal envisaging a different model for the advisory mechanism.

[20] https://www.rathenau.nl/en nt/

[21] https://dre.pt/dre/detalhe/resolucao-assembleia-republica/60-2009-493036

However, since then, no progress in establishing a science advisory structure seems to have been made. Notwithstanding the absence of a dedicated science advice structure, the Portuguese parliament has structural mechanisms to support parliamentarians in gathering and analysing scientific information.

Such mechanisms include inviting scientists and experts to participate in relevant parliamentary hearings.

Additionally, the "Café de Ciência" (Science Café), an annual meeting that takes place in Parliament, enables an informal dialogue between politicians and scientists by fostering engagement of scientists and policymakers on matters of concern.

The recent reinstalled Nacional Council of Science, Technology and Innovation, an advisory body to the Portuguese government, seems to be able to collaborate, whenever requested by parliament, in parliamentary debates on science and technology.

However, it is still not clear how any collaboration process will take place.

Overall, despite the recognition of the positive role that scientific evidence can play in informing effective policymaking, there have been limited advances in conceiving a permanent and structured legislative advisory mechanism in the Portuguese Parliament. ■

2.6
Science advice in times of Covid-19

The Covid-19 pandemic has been a time of unprecedented pressure on the need of effective engagement between scientists and policymakers.

The management of the pandemic in different countries provides a rather unique opportunity to assess how different scientific advice mechanisms have operated in countries and their effectiveness. Some of the societal challenges underlined by the pandemic are not new but they gained unprecedent force and urgency. During this time many of the challenges and tensions at the science and policy interface became more evident than ever.

Some of the contradictions and tensions that arose pinpointed to several paradoxes:

1) greater demand for scientific advice was accompanied by increased contestation of the advice itself;

2) countries with poor decision-making performances included some of the best informed and prepared countries;

3) proliferation of uncertainty and calls for consensus and control;

4) contrast between the best qualities of scientifically-advanced ecosystems and some of their more negative aspects; and

5) promise of transformation with few changes having (yet) occurred.

These paradoxes are analysed in some more detail below:

1) the paradox of the scientific authority is not a new observation as it has been seen before in others politicised contexts of advisory processes[22]. In the pandemic, however, structures of scientific advice have taken centre stage in unprecedent way, enabling criticism of science advice to become more visible in society. Typically, there was debate and dispute on the nature of the advice itself as well as criticism of the advisory structures in place. On the latter, some of the views expressed contested their level of transparency and diversity of expertise and the broader ability of governments to balance health, economic and wider interests.

2) the poor performance of some countries in dealing with the pandemic (at least in the beginning) is in sharp contrast with their advanced scientific advisory systems and underlying expertise of their scientific community. This paradox was illustrated by countries like the UK and the US, which not only have in place sophisticated and well-developed advisory systems, but also specific strategies in place to deal with pandemics. Their biomedical research systems are advanced, complex and sophisticated and they make large investments in R&D.

Therefore, based on the maturity of their science advice mechanisms and underlying relevant technical expertise, these countries would have been expected to have managed the pandemic more effectively than countries with poorer science advice mechanisms (and especially than those with limited biomedical know-how).

However, their performance in terms of number of deaths, hospitalizations, and case numbers/ pro capita can be considered relatively poor. An extensive discussion and reflection are needed to assess and reach insightful conclusions on the reasons for this observation. In that context, the effectiveness of the relationship between the research system, science advice mechanisms in place, and uptake by public policies needs to be assessed. **However, any assessment to this effect would need to consider other factors as well, for example the response of specific cultures to similar circumstances.**

3) almost everywhere, the increase of uncertainty and chaos in response to the pandemic was opposed at the same time with demands for consensus and control by the much of the society. Over the course of the pandemic, the level of uncertainty and chaos changed. In the beginning there was almost no information on the virus (e.g. on how it behaved and how it spread). Later, as more information was gathered, there was an increased debate within the scientific community, as well as between the scientific community and the broader society. The issues in debate included the validity of the information used to make judgements, how to take into account uncertainties in the available knowledge and data, and the effectiveness of the models, used to make decisions, in making predictions on the behaviour of the virus.

The expectation of some might have been for the scientific community to display strong consensus relative to some of the technical aspects of the problem. However, it is not customary for the scientific community to speak in unison nor, if this was at all feasible, there are mechanisms in place for it do so. At times there have been divergent positions in the scientific community on how best to respond to the pandemic. For example, in the UK, these conflicting views led to the organization of an initiative (indie-SAGE) that shadowed the official SAGE mechanism.

4) the pandemic gave visibility to some of the best qualities of strong science ecosystems, for example the ability to develop effective vaccines in a very short time and the ability of epidemiologists and the researcher's community to support national responses to the pandemic.

However, it also exposed negative issues present in the scientific community. Negative aspects include the production of scientific studies published without sufficient quality assurance or the limited considerations given to issues of diversity and inclusion within the community. This duality was best discussed in article by Ed Yong[23].

On one side there has been the mobilization of best practices for sharing data and conducting experiments in a fast and effective manner, and on the other many weaknesses were uncovered including wasteful practices, overconfidence, inequality and biomedical bias.

It seems important for the scientific community to reflect on how to improve these aspects, and with them the credibility and efficacy of scientific advice mechanisms.

[22] Bijker WE, Bal R and Hendriks R. The Paradox of Scientific Authority: The Role of Scientific Advice in Democracies. Cambridge: MIT Press, 2017.

[23] https://steps-centre.org/blog/modernity-without-its-clothes-the-pandemic-crisis-shines-a-light-on-futilities-of-control/

5) the pandemic has brought several expectations and aspirations for transformation and improvements in societies, and within that to science advisory systems. An article by Andy Stirling[24] highlights this view of approaching the pandemic with all these expectations. However, Stirling argues that, in the end, changes being demanded by people are not different from those demanded before the pandemic ("business as usual"), i.e. people are demanding changes in line with what they were advocating beforehand. Beside economic and social consequences, the pandemic has intensified the degree of risk and threat to our livelihoods.

However, the hype and hope of transformation is not, at present, been accompanied by real changes. Above all examples, most countries do not seem to have introduced more formalized science advisory systems in their response to Covid-19, as suggested by a policy-tracker initiative developed by the International Network for Government Science Advice (INGSA)[25] to follow the action of scientific advisory mechanisms in several countries during the crisis.

During the Covid-19 crisis several pertinent questions on the science advice process were raised, including whether the identity of the experts chosen to be part of the advisory groups, the mix of scientific or disciplinary expertise present in such groups, and the balance of practice-based and theoretical expertise, should be fully known to the general-public. For example, in the UK, there were calls asking for the SAGE advisory group to be more open and transparent, which led to the minutes of the meetings being regularly published, thus enabling the public to develop a better understanding of who was involved in the group.

This crisis also illustrated that, besides the inputs of virologists and epidemiologists, to help analysing the problems at hand in its full breadth there was the need of inputs from other disciplines, including inputs from economists, political scientists, human behaviour scientists, as well ethicists. Additionally, the crisis highlighted some of the limitations of current advisory processes in managing uncertainties in the information been provided to policymakers. Specifically, it was often argued that uncertainties were often not adequately explained, and their implications not sufficiently conveyed to policymakers. Beside the need of managing uncertainties in scientific evidence, there is the need to balance options for different courses of action against the weight given to societal values in different societies. This is best illustrated when decision-making has to balance health outcomes with different values (e.g. as in the case of the anti-vaccination views).

It will be useful to assess how well the advisory mechanisms used during covid-19 crisis (e.g. SAGE) worked in different countries, so to form a view on how they can be further strengthened. It would also be useful to assess whether scientific advice mechanisms in place to provide advice during normal administration are also the best model for crises. In the case of SAGE in the UK, this mechanism was established to address crisis and emergencies of various types, which are normally of short duration. However, the Covid-19 crisis has been unprecedented in its duration, scale, complexity, impact and demands from an advisory system not conceived to operate in these circumstances. **It may be important to reflect on the impact of these factors on the nature of crises management systems (and associated science advice mechanisms) that might need to be in place in the future.**

One of the strengths of the SAGE model could be said to be is flexibility, associated with the ability to bring together relevant experts in a short period of time. However, one limitation of this approach is that assembling a group of experts that do not have to follow any of the normal processes of appointment to a public body can generate public concerns on the level of scrutiny of the expertise of the group, as well as concerns associated with government bias. Another limitation is the difficulty of identifying lines of accountability, especially if the identities of the experts involved are not known. ■

[24] https://www.theatlantic.com/magazine/archive/2021/01/science-covid-19-manhattan-project/617262/
[25] https://www.ingsa.org/

3

Conclusions

The effective use of scientific evidence by policymakers is viewed more than ever as an important aspect in supporting better policy decisions, especially in dealing with complex challenges.

The interface between science and policy, is however, complex and the ability to establish and deploy successful science advice mechanisms requires consideration of many challenges, including the identification of better ways to translate scientific evidence into a policymaking context.

Models on the practice of science advice have been evolving with time, gradually promoting new ways to operate at the interface of science and policy. However, according to some, scientific advice still hovers too often between old and new models of expert advice, with old models described as closed, homogeneous, self-assured, and expecting consensus.

One of the proposed changes to the practice of scientific advice to align it to new models is for the advice to be based on a 'constraints' model rather 'independence' model. In the constraint model the science advisor (and more broadly mechanisms of science advice), have ongoing obligations, and lines of responsibilities, towards three crucial groups: the advisee, the scientific community, and the public.

This model is argued to generate a stronger trust in science advisors by key stakeholders in the advisory process (the scientific community and the general-public). B**y maintaining obligations to all three lines, the science advisor work is constrained by checks and balances which are insufficiently strong in conventional models** (in which the advisor is somehow assumed to be independent from the advisee).

These lines of obligation are expected to support the mechanisms of scientific advice by generating more open and trustful communication, and by ultimately enhancing society engagement on the political issues in discussion.

Advisory structures and mechanisms are already in place in many countries. Such structures include commissions, committees, academies, and/or groups of science advisors. These advisory mechanisms present in different contexts can provide advice to different audiences, for example to parliaments or governments. The provision of the advice can take different forms, with a wide variety of science advice mechanisms and ecosystems in place within the same countries and in different countries. The constitution and approach to policymaking of each country may have had an influence on the mechanisms that are currently established. Mechanism of CSA to governments are in place in several, but not all countries (e.g. UK and New Zealand).

Specifically, although a national council and other institutions are often used to advice the Government, in Portugal there is not a purposely established CSA structure. In evaluating suitable or improved models for these structures, key questions include how best to increase their efficiency and efficacy, how to assess/monitor their usefulness and, more broadly how to ensure that their action is underpinned by principles of trust, transparency, and integrity.

A common mandate for the work carried out by these advisory structures is to provide good quality, reliable and well-communicated scientific evidence to inform policies and decisions in countries governed through democratic processes. For this to occur, some essential elements are needed, including a sufficiently skilled and vibrant scientific community (which implies long-term investments) allowing science to be critical and independent from political powers, an ecosystem of effective actors involved in science advice processes, and trust in the mechanism involved by the public.

Besides science evidence, however, public policies need to systematically consider and manage inputs from other disciplines (e.g. economic and ethical inputs), as well as societal values and concerns. As a result, science advise mechanisms will need to be cognizant of that science inputs into policies need to be balanced with other inputs, and often work through across disciplines to achieve their goals.

Science advice has been very much discussed in amidst of the Covid-19 crisis, since it provided an opportunity to understand and evaluate more specifically how some of these structures operate. **Several challenges and questions for science advice mechanisms were raised during the pandemic, including important paradoxes which advanced societies will need to continue to work on.** ■

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In memoriam of Melanie Peters (1965-2021), inspiring and passionate director of the Rathenau Instituut (The Hague, the Netherlands), who had an unrivalled ability to make the impact of science, technology and innovation on society tangible and understandable.

Annex 1
Programme

11th March 2021

Opening:
Chris Sainty, British Ambassador to Portugal

Introduction:
Mara Almeida, Senior Researcher at the Centre for Philosophy of Science of the University of Lisbon (CFCUL)

1st workshop:
Science for policy: what does it mean? (2.30-4.30pm)
The panel members will discuss the nature of science, what does the scientific process entails and its uses in the context of policymaking and politics. In doing so it will consider the range of societal views about the role and usefulness of science. What can science offer now and in the future at the political and societal level?

Speakers:
Heather Douglas, Associate Professor at Philosophy Department, Michigan State University
James Wilsdon, Professor of Research Policy at the University of Sheffield and Director of the Research on Research Institute
Clarissa Rios Rojas, Research Associate at CSER, University of Cambridge

Moderator:
Elizabeth Sukkar, Managing Editor and Global Healthcare Lead, Thought Leadership at The Economist Intelligence Unit (The EIU)

18th March 2021

2nd workshop:
Science Advice to Government - Why is it relevant? (9-11am)
The panel members will reflect on existing processes, mechanisms and structures providing scientific advice to governments in Europe. In doing so it will discuss how to increase the demand and uptake of evidence generated by these structures, and more in general, in political decision-making. What are the challenges and guiding principles of providing scientific advice to policymakers? Are they evolving with time? Are they different in a context of complexity and uncertainty as illustrated by the Covid-19 pandemic?

Speakers:
Renzo Tomellini, Head of Unit, Scientific Advice Mechanism, DG Research and Innovation EC
José Manuel Mendonça, President National Council for Science, Technology and Innovation (CNCTI)
Peter Gluckman, Chair of the International Network for Government Science Advice (INGSA)
Carole Mundell, Foreign, Commonwealth and Development Office FCDO Chief International Science Envoy

Moderator:
David Budtz Pedersen, Professor of Science Communication and Director of the Humanomics Research Institute in Copenhagen

25th March 2021

3rd workshop:
Science Advice to Parliament - Why is it relevant? (2.30-4.30pm)
The panel members will discuss the relevance of legislative science advice in Europe, including existent processes and mechanisms that support the use of evidence in national parliaments. It will also discuss initiatives taking place to institutionalise the provision of scientific evidence in countries in which institutionalised structures do not currently exist. The panel members will reflect on the way in which these structures operate, their impact on the parliamentary work and demand for evidence by parliamentarians. How does legislative science advice take place in a situation of crisis such as the Covid-19 pandemic?

Speakers:
Grant Hill-Cawthorne, Head of POST, UK
Melanie Peters, Director of Rathenau Instituut, NL
Andreu Climent, President of the initiative "Science in Parliament", Spain
Carla Sousa, Vice-President of the Parliamentary Committee on Education, Science, Youth and Sports, Portugal

Moderator:
Wiebe E. Bijker, Professor of Technology & Society, Department of Interdisciplinary Studies of Culture, Norwegian University of Science and Technology


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