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INTRODUCTION

Post-normal crises and technology assessment

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Abstract • Reflections on the challenges for science in crises have become an integral part of public policy and technology assessment (TA). The urgency and uncertainty of the COVID-19 pandemic brought up the question of how scientific disciplines and individual scientists can provide appropriate advice to decision makers and the public while maintaining transparency and independence. Because of the speed with which solutions had to be found, the range of questions narrowed and some topics were given priority over others. In many countries, decisions were made without broader public participation and without involving the wide variety of stakeholders. In the light of the waning COVID-19 pandemic and the surging climate crisis, it is time to consider how TA, its organizations, and networks can reasonably position themselves to achieve their goals under these conditions. This introduction presents the Special topic of this TATuP issue, in which four research articles explore the role of TA in crises from different perspectives.

Postnormale Krisen und Technikfolgenabschätzung

Zusammenfassung • *Überlegungen zu den Herausforderungen für die Wissenschaft in Krisensituationen sind zu einem festen Bestandteil der öffentlichen Politik und der Technikfolgenabschätzung (TA) geworden. Die Dringlichkeit und Ungewissheit der COVID-19-Pandemie haben die Frage aufgeworfen, wie wissenschaftliche Disziplinen und einzelne Wissenschaftler*innen Entscheidungsträger*innen und die Öffentlichkeit angemessen beraten und dabei Transparenz und Unabhängigkeit wahren können. Aufgrund der Schnelligkeit, mit der Lösungen gefunden werden mussten, verengte sich das Spektrum der Fragen und Themen mussten priorisiert werden. In vielen Ländern wurden die breite Öffentlichkeit und die zahlreichen unterschiedlichen Interessengruppen kaum in die Entscheidungsfindung einbezogen. Angesichts der zurückgehenden COVID-19-Pandemie und der weiter zunehmenden Klimakrise ist es an der Zeit, darüber nachzudenken, wie sich TA, ihre Organisationen und Netzwerke sinnvoll positionieren können, um ihre Ziele unter diesen Bedingungen zu erreichen. Diese Einleitung stellt das Special topic dieser TATuP-Ausgabe vor, in welchem vier Forschungsartikel aus verschiedenen Perspektiven die Rolle der TA in Krisen untersuchen.*

Keywords • *technology assessment, crises, science advice, science communication, public engagement*

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Introduction

The role and function of science and science advice in public policy has long been a 'hot topic' in academic literature (Jasanoff 1990; Funtowicz and Ravetz 1993; Hilgartner 2000; Pielke Jr. 2007) and has been an essential theme for technology assessment (TA) since its inception. Questions about regulatory processes and decision-making, and expertise within them, have been addressed (Jasanoff 1990) as well as the role of science advisors and the different approaches that they can take in different situations (Pielke Jr. 2007). The question of how individual fields and communities of scholars can meaningfully and effectively act in acute global crises, is a more recent concern especially with regards to the meanwhile exemplary COVID-19 crisis as a policy context in which scientific evidence played an important role (Cairney 2020). In this rapidly growing literature the questions focus on, for instance, structures and processes of science advice and their strengths and weaknesses in terms of transparency and communication (Sasse et al. 2020) or the inclusion and exclusion of specific disciplines and social groups (McKee et al. 2022). Others discuss the proximity to government (Smallman 2020), lessons for policy-making processes (Boin

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et al. 2020) or the relationship between the public, trust, and science (Cairney and Wellstead 2021).

The history of this debate on the relationship between science and politics is, of course, at least over a century old. Weber argued that the role of science is to provide objective facts and value-neutral analysis, and that on this premise science and politics need to remain separate (Weber 1919). However, Jasanoff and the field of Science and Technology Studies (STS) have shown over decades how inherently political features of science, and its institutionalization both within the scientific enterprise and in formal and informal regulatory agencies 'outside' of universities and research institutes, are deeply intertwined with political aspects. The latter (although often hidden) are powerful in shaping the positioning of science and innovation in society and in influencing the decisions made about them (Jasanoff 1990). These interdependencies can be identified in many cases, for instance during the 1996 BSE crisis in the UK, with highly publicly visible use and misuse of science in political decision-making and public communication (Jasanoff 1997). We see that transparency, the use of scientific evidence for political legitimation, centralized structures for science advise and aspects of independence are put under pressure in crises characterized by post-normal problems (Funtowicz and Ravetz 1993), especially with regard to the uncertainty that defines these situations.

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One such post-normal problem was the global pandemic spread of the COVID-19 virus. High stakes, urgent decisions, and uncertain evidence in this 'classic' post-normal crisis, with a massive scale of effects and prolonged duration added to the mix. This in turn, has placed previous and established science and advisory mechanisms, as well as public communication channels and the individuals involved, in unprecedented and often overwhelming situations.

While pandemic crises are not a novel socially transformative or disruptive phenomenon, and societies have endured other deadly viruses, such as for example the Spanish Flu in 1918–1920 (Spinney 2017), COVID-19 has shown several outstanding features. First, it is the first pandemic crisis in today's highly digitalized age. It is also the first time that strict measures such as lockdowns, mask mandates, school closures, and travel restrictions were implemented internationally and protracted over several years. The high degree of centralization of government intervention in the design and implementation of these decisions and policies is unparalleled for the post-World War II era, at least for OECD countries. It is also the first pandemic during such a high level of globalization (Krastev 2020). Also, these digitalized and globalized conditions have transformed the environments in which scientific and advisory roles and functions, such as those of TA, are carried out.

The diversity of topics and questions which have been addressed in the growing social science literature on COVID-19, although not directly associated with a singular field, offer specifics to what can be referred to as 'changing conditions'. These include, for example, the management of uncertainty (Rutter et al. 2020), broader health implications of measures (Douglas et al. 2020; Kontoangelos et al. 2020), economic effects of the pandemic (Baldwin and Weder di Mauro 2020; Mena et al. 2022), medical innovation (Sampat and Shadlen 2021), the diversity of government responses (Calvert and Arbuthnott 2021; Farrar and Ahuja 2021; Jasanoff et al. 2021), public trust in science (Plohl and Musil 2021) and the role and staging of science during the pandemic (Hilgartner et al. 2021). Developing TA with these and other changing features presents both opportunities and substantial challenges.

Technology assessment and critical questioning during challenging times

Focusing on scientific and publicly accessible knowledge on the (unintended) social, economic and environmental consequences of technological change and functioning as a so-called 'watchdog' (Smits et al. 2010) for potential risks and uncertainties regarding products and services, TA has historically taken a critical and precautionary stance towards technological progress in times of crisis. While not always critical, TA has sought to provide a balanced view of technological change by bringing together knowledge and information from diverse disciplines. Grand challenges have continuously been at the heart of TA activities. For instance, the climate change crisis and technological changes have been addressed through the lens of sustainable development (Sotoudeh 2005; Grunwald 2017), energy innovation (Ornetzeder and Rohracher 2013), mobility (Truffer et al. 2017), or a critique of eco-modernism (Grunwald 2018). These and related works have also raised concerns over social acceptance (Ornetzeder et al. 2016), and ethical tractability (Grunwald 2016) of climate change solutions and approaches. Organ-

izational TA units such as the Office of Technology Assessment at the German Bundestag (TAB), the Dutch Rathenau Instituut and the Austrian Institute of Technology Assessment have accompanied climate crisis discourses by advising and engaging with national governments (TAB 2022), the public (de Vries et al. 2015), national energy providers, and the European Commission (Ornetzeder et al. 2018).

Every crisis also serves as a catalyst for innovation and the COVID-19 pandemic was no exception (Brem et al. 2021). Since its outbreak in early 2020, innovation has accelerated in a number of areas such as mRNA-based vaccines, therapies, and PCR testing (Tan et al. 2021). The collection and analysis of personal medical and location data has been sped up (Wu et al. 2020) and barriers to sharing have been reduced. Requirements for physical distancing increased the demand for digital infrastructures and connectivity. Social mitigation measures transferred activities to the home, and digital infrastructures made working, schooling, shopping as well as remote healthcare increasingly feasible from the home. As with almost all innovations in times of crisis, implementation had a steep learning curve, in which less critical attitudes prevailed than in 'normal' times. The intensified search for 'quick fixes' and fast-tracking of certain types of innovations over others, came at the expense of narrowing the range of critical questions (for example, masks or no masks), and lowering the diversity of disciplines and the representation of different social groups (Sasse et al. 2020) included in decision-making.

Critical TA perspectives before the pandemic have been characterized by the articulation of a collective responsibility to preserve and maintain human rights, such as privacy and data protection (Strauss 2019), or social achievements such as social security (Allhutter et al. 2022). Their erosion, or loss, is often experienced as slow, quiet and gradual, but it is often irreversible (Frischmann and Sellinger 2018) especially for vulnerable individuals, social groups, and regions. This turns TA advice and research into an even more critical issue in times of fast-paced innovation under pressures of urgency in times of crisis.

Positioning advice in institutions during crises: technology assessment institutes, organizations and their networks

Scientific advice for policy-makers during the COVID-19 pandemic has recently become one of the most analyzed and discussed topics in disciplines such as political science, sociology, health and public policy (Morgan 2020; Greenhalgh 2020; Hilgartner et al. 2021). The centrality of biomedical issues, combined with the urgency of decision-making, increased governmental reliance on inputs from (certain) experts and national advisory systems. The complex, evolving and protracted nature of the crisis changed the way science and policy interacted, resulting in the emergence of new advisory units such as the (meanwhile dissolved) Gesamtstaatliche COVID-Krisenkoordination (GECKO) in Austria and corresponding constellations in other countries. The complexity and uncertainty in the science relevant to the pandemic and the widespread dissatisfaction with national governments begs further questions of intermediary functions and processes for managing conflicts and tensions between disciplines, social groups, sectors, regions and countries. TA as a long-standing advisory practice holds practical as well as theoretical expertise on such issues and is well suited to contribute to these debates. Further, TA continues to be highly prominent in its policy advice on advisory systems and their processes (Bogner et al. in print) at least in countries with established TA structures.

Throughout the COVID-19 pandemic, public and broader stakeholder participation in decision-making was weak in most countries. While public needs for, opinions on and compliance with governmental measures were regularly monitored throughout the pandemic, they were not always listened to and acted upon (Scally et al. 2020). In the UK, for instance, the government failed to respond to urgent requests from local healthcare workers to stockpile personal protective equipment ahead of the pandemic, resulting in higher infection rates and death toll (Morgan 2020). Studies confirm that expert advice on human behavior and social acceptability was insufficiently considered in political decision-making on the type and timing of measures (Drury et al. 2020). Inclusion of publics in decision making has been a long-standing and central topic in TA studies. For instance, a study by the Rathenau Instituut showed that public trust in science was higher than in the judiciary, the media, the government and large companies throughout the pandemic, but that clear communication and a comprehensive strategy are crucial accompanying factors for maintaining public trust (van den Broek-Honingh et al. 2021).

The COVID-19 pandemic has challenged scientists, governments and the public with problems of massive scale and complexity. Many disciplines and organizations were not prepared to produce 'quick' evidence or make rapid decisions based on relatively scarce data. In the past, both 'Real-Time' as well as 'Constructive TA' approaches have been advanced to meet the need to provide helpful contributions by embedding TA in specific technology development or scientific research processes. However, there is still scope for elaborating on and testing TA's role and modus operandi in expanding crises (Hahn et al. 2020). In most national contexts, TA engaged rather late in COVID-19 crisis management. TA-based advice is traditionally grounded in the integration of existing evidence from a wide range of sources. With the sudden occurrence of unforeseen events, the adoption of different approaches may be required, such as the formalization of rapid response mechanisms (e.g., building on the expertise of the UK Parliamentary Office of Science and Technology (POST)). It remains to be seen which role TA institutes need to opt for (Bauer and Kastenhofer 2019) in urgent and unfolding situations such as the sudden COVID-19 crisis, as well as for other urgent and pervasive crises such as climate change. The global nature of COVID-19 and climate change calls for reflections on the role of TA as transnational broker, supporting cooperation, coordination and exchange (for example, through Global TA).

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Contributions in this Special topic

Within this growing field of 'reflexive pandemic research', this TATuP Special topic on 'Potentials of technology assessment in sudden and enduring crises' presents four papers from the perspectives of researchers in sociology, TA, STS, and philosophy of science. Our call for papers invited contributions on the social impacts of technological processes that were catalyzed during the pandemic, on roles and functions of science advice and public engagement throughout, and their lessons for the field of TA within crises. Are socio-technical analyses of technological innovations made redundant during a pandemic, and hence which role for TA is required in such situations? How have national and international experiences in science-based policy advising during the COVID-19 pandemic changed the roles and functions of science for public policy? What are the experiences of public participation and engagement throughout the crisis? These remain pertinent questions as crises present particular challenges and opportunities for the objectives and activities of TA.

First, as mentioned above, COVID-19 sped up innovation in products and processes which were implemented very quickly given the urgency of saving people's lives. Under these conditions, critical views of these innovations were put on hold, especially those viewed through the lens of TA with regards to their implications for human rights, shared social norms such as privacy, security, safety, autonomy, and dignity, or societal imperatives such as sustainability. Second, the importance of scientific evidence for policy, particularly from the natural sciences, was reported on and much discussed throughout (Morgan 2020; Greenhalgh 2020; Hilgartner et al. 2021). TA as a long-standing advisory institution holds practical as well as theoretical expertise on such issues and is well suited to contribute to these discussions. Third, public response in an acute crisis is fundamental: People need to know what to do to protect themselves. Inclusion of publics in decision making is another central topic in TA studies. Fourth, many universities, research institutes and national research infrastructures were not prepared for the urgency in which evidence needed to be produced. All four contributions to this Special topic explore options to adapt TA practices to crisis conditions.

In their paper '(Re-)connecting academia during a sudden, global crisis' Karen Kastenhofer, Hannah Rosa Friesacher, Alexander Reich, and Leo Capari analyze responses to an expert survey addressing the side-effects, opportunities and preparedness of the international academic community during the pandemic. The authors ask: Can TA contribute to sudden and urgent crises by serving as an integrating hub? What are the potential benefits, the downsides and the obstacles to such an endeavor? Based on 81 responses from academics in 11 countries, the authors show the key issues, opportunities and lessons for TA unveiled throughout.

Michaela Evers-Wölk. André Uhl, and Siegfried Behrendt discuss in their paper 'Frühwarnung in Zeiten von COVID-19' how early warning systems worked during the pandemic and how they can be improved to meet the specific challenges of global crises. Based on a description of the chain of reporting between organizations in the monitoring system for infectious diseases in Germany, the authors present learnings from its performance during the pandemic crisis. Examples are provided from successful international experiences and EU initiatives, innovative approaches based on AI tools, and suggestions for a responsible forward-looking systems approach to early warning are made.

Gabriel Bartl in his contribution 'Governance between ignorance and evidence: TA in the context of pandemic crisis management' reflects on the interrelationships between predictive and anticipatory tools and models and ambiguity in crisis management during the pandemic, and diffusion of political accountability. Based on this description of the situation, Bartl makes suggestions for TA in the areas of technologies in use during crises, participation, and evidence from the social sciences.

Marius Albiez, Lisa Schmieder, Nora Weinberger, Markus Winkelmann, Johanna Krischke, and Oliver Parodi present in their empirical article 'Erwartungen an Wissenschaft in Krisenzeiten: Impulse für die Technikfolgenabschätzung aus zwei Beteiligungsformaten' the results from two online surveys and a citizens' dialogue altogether focusing on changes in trust and expectations during the pandemic. Their study asks the following questions: How is trust in science assessed the TA-related community and by citizens? What expectations of science can be derived from this? Based on a thematic presentation of responses the contribution discusses the implications for TA in terms of reflection, participation and transparency.

How have national and international experiences in science-based policy advising during the COVID-19 pandemic changed the roles and functions of science for public policy?

We offer this Special topic as a starting point for reflection on the immediate and emerging challenges for TA in this world increasingly characterized by sudden and enduring crises. For us, as for many in the TA community, our approaches and practices are an important element to provide knowledge for political, societal, and scientific action. As the contributions in this TATuP Special topic show, TA has a role to play here, based on

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its expertise and experience in the interactions between science, policy and the public. Yet, it also becomes clear that TA needs to adapt to the rapid changes coming and potentially find new functions and approaches in order to meet its objectives under novel conditions.

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References

Allhutter, Doris et al. (2022): Sichere Stromversorgung und Blackout-Vorsorge in Österreich. Entwicklungen, Risiken und mögliche Schutzmaßnahmen. Wien: ITA. Available online at https://epub.oeaw.ac.at/ita/ita-projektberichte/ITA-AIT-17.pdf, last accessed on 16. 05. 2023.

Baldwin, Richard; Weder di Mauro, Beatrice (2020): Mitigating the COVID economic crisis. Act fast and do whatever it takes. London: CEPR Press. Available online at https://cepr.org/system/files/publication-files/60118-mitigating_the_covid_economic_crisis_act_fast_and_do_whatever_it_takes.pdf, last accessed on 16. 05. 2023.

Bauer, Anja; Kastenhofer, Karen (2019): Policy advice in technology assessment. Shifting roles, principles and boundaries. In: Technological Forecasting and Social Change 139, pp. 32–41. https://doi.org/10.1016/j.techfore.2018.06.023

Bogner, Alexander; Buntfuß, Paul; Fuchs, Daniela; Sinozic-Martinez, Tanja (in print): Wissenschaftliche Politikberatung in Krisenzeiten. Eine vergleichende Analyse ihrer Prozesse, Praktiken und Probleme mit Blick auf Österreich, Deutschland und Großbritannien. Wien: ITA.

Boin, Arjen; Lodge, Martin; Luesink, Marte (2020): Learning from the COVID-19 crisis. An initial analysis of national responses. In: Policy Design and Practice 3 (3), pp. 189–204. https://doi.org/10.1080/25741292.2020.1823670

Brem, Alexander; Viardot, Eric; Nylund, Petra (2021): Implications of the coronavirus (COVID-19) outbreak for innovation. Which technologies will improve our lives? In: Technological Forecasting and Social Change 163, p. 120 451. https://doi.org/10.1016/j.techfore.2020.120451

Cairney, Paul (2020): The UK government's COVID-19 policy. Assessing evidence-informed policy analysis in real time. In: British Politics 16, pp. 90–116. https://doi.org/10.1057/s41293-020-00150-8

Cairney, Paul; Wellstead, Adam (2021): COVID-19. Effective policymaking depends on trust in experts, politicians, and the public. In: Policy Design and Practice 4 (1), pp. 1–14. https://doi.org/10.1080/25741292.2020.1837466

Calvert, Jonathan; Arbuthnott, George (2021): Failures of state. The inside story of Britain's battle with Coronavirus. New York: HarperCollins.

de Vries, Annick; van Waes, Arnoud; van Est, Rinie; van der Meulen, Barend; Brom, Frans (2015): Enabling participation. A vision on public participation in decision-making about long term radioactive waste management. The Hague: Rathenau Instituut. Available online at https://www.rathenau.nl/sites/default/files/2018-04/Enabling%20participation%20-%20Rathenau%20Instituut.pdf, last accessed on 16. 05. 2023.

Douglas, Margaret; Katikireddi, Srinivasa Vittal; Taulbut, Martin; McKee, Martin; McCartney, Gerry (2020): Mitigating the wider health effects of covid-19 pandemic response. In: BMJ 369, p. m1557. https://doi.org/10.1136/bmj.m1557

Drury, John; Reicher, Stephen; Stott, Clifford (2020): COVID-19 in context. Why do people die in emergencies? It's probably not because of collective psychology. In: British Journal of Social Psychology 59 (3), pp. 686–693. https://doi.org/10.1111/bjso.12393

Farrar, Jeremy; Ahuja, Anjana (2021): Spike. The virus vs. the people – the inside story. London: Profile Books.

Frischmann, Brett; Selinger, Evan (2018): Re-engineering humanity. Cambridge, UK: Cambridge University Press. https://doi.org/10.1017/9781316544846

Funtowicz, Silvio; Ravetz, Jerome (1993): Science for the post-normal age. In: Futures 25 (7), pp. 739–755. https://doi.org/10.1016/0016-3287(93)90022-L

Greenhalgh, Trisha (2020): Will COVID-19 be evidence-based medicine's nemesis? In: PLoS Med 17 (6), p. e1003266. https://doi.org/10.1371/journal.pmed.1003266

Grunwald, Armin (2016): Nachhaltigkeit verstehen. Arbeiten an der Bedeutung nachhaltiger Entwicklung. München: oekom verlag.

Grunwald, Armin (2017): Technology assessment and policy advice in the field of sustainable development. In: Lech Zacher (ed.): Technology, society and sustainability. Cham: Springer, pp. 203–221. https://doi.org/10.1007/978-3-319-47164-8_14

Grunwald, Armin (2018): Diverging pathways to overcoming the environmental crisis. A critique of eco-modernism from a technology assessment perspective. In: Journal of Cleaner Production 197 (2), pp. 1854–1862. https://doi.org/10.1016/j.jclepro.2016.07.212

Hahn, Julia et al. (2020): Technology assessment for a changing world. In: TATuP – Journal for Technology Assessment in Theory and Practice 29 (3), pp. 74–75. https://doi.org/10.14512/tatup.29.3.74

Hilgartner, Stephen (2000): Science on stage. Expert advice as public drama. Stanford: Stanford University Press. https://doi.org/10.1515/9781503618220

Hilgartner, Stephen; Hurlbut, Benjamin; Jasanoff, Sheila (2021): Was "science" on the ballot? Labelling dissent as "anti-science" is bad social science and bad politics. In: Science 371 (6532), pp. 893–894. https://doi.org/10.1126/science.abf8762

Jasanoff, Sheila (1990): The fifth branch. Science advisers as policymakers. Cambridge, MA: Harvard University Press.

Jasanoff, Sheila (1997): Civilization and madness. The great BSE scare of 1996. In: Public Understanding of Science 6 (3), pp. 221–232. https://doi.org/10.1088/0963-6625/6/3/002

Jasanoff, Sheila; Hilgartner, Stephen; Hurlbut, Benjamin; Özgöde, Onur; Rayzberg, Margarita (2021): Comparative Covid response. Crisis, knowledge, politics. Interim report. Cambridge, MA: Harvard Kennedy School. Available online at https://www.hks.harvard.edu/publications/comparative-covid-response-crisis-knowledge-politics#citation, last accessed on 16. 05. 2023.

Kontoangelos, Konstantinos; Economou, Marina; Papageorgiou, Charalambos (2020): Mental health effects of COVID-19 Pandemia. A Review of clinical and psychological traits. In: Psychiatry Investigation 17 (6), pp. 491–505. https://doi.org/10.30773/pi.2020.0161

Krastev, Ivan (2020): Is it tomorrow, yet? Paradoxes of the pandemic. London: Penguin Books.

McKee, Martin et al. (2022): Open science communication. The first year of the UK's independent scientific advisory group for emergencies. In: Health Policy 126 (3), pp. 234–244. https://doi.org/10.1016/j.healthpol.2022.01.006

Mena, Carlos; Karatzas, Antonios; Hansen, Carsten (2022): International trade resilience and the Covid-19 pandemic. In: Journal of Business Research 138, pp. 77–91. https://doi.org/10.1016/j.jbusres.2021.08.064

Morgan, Marcus (2020): Why meaning-making matters. The case of the UK Government's COVID-19 response. In: American Journal of Cultural Sociology 8, pp. 270–323. https://doi.org/10.1057/s41290-020-00121-y

Ornetzeder, Michael; Rohracher, Harald (2013): Of solar collectors, wind power, and car sharing. Comparing and understanding successful cases of grassroots innovations. In Global Environmental Change 23 (5), pp. 856–867. https://doi.org/10.1016/j.gloenvcha.2012.12.007

Ornetzeder, Michael; Wicher, Magdalena; Suschek-Berger, Jürgen (2016): User satisfaction and well-being in energy efficient office buildings. Evidence from cutting-edge projects in Austria. In: Energy and Buildings 118, pp. 18–26. https://doi.org/10.1016/j.enbuild.2016.02.036

Ornetzeder, Michael et al. (2018): Determining factors for integrated smart grid solutions. Deliverable 3.1. Alborg: Alborg University. Available online at https://vbn.aau.dk/en/publications/determining-factors-for-integrated-smart-energy-solutions-deliver, last accessed on 16. 05. 2023.

Pielke Jr., Roger (2007): The honest broker. Making sense of science in policy and politics. Cambridge, UK: Cambridge University Press.

Plohl, Nejc; Musil, Bojan (2021): Modelling compliance with COVID-19 prevention guidelines. The critical role of trust in science. In: Psychology, Health and Medicine 26 (1), pp. 1–12. https://doi.org/10.1080/13548506.2020.1772988

Rutter, Harry; Wolpert, Miranda; Greenhalgh, Trisha (2020): Managing uncertainty in the covid-19 era. In: BMJ 370, p. m3349. https://doi.org/10.1136/bmj.m3349

Sampat, Bhaven; Shadlen, Kenneth (2021): The COVID-19 innovation system. In: Health Affairs 40 (3), pp. 400–409. https://doi.org/10.1377/hlthaff.2020.02097

Sasse, Tom; Haddon, Catherine; Nice, Alex (2020): Science advice in a crisis. London: Institute for Government. Available online at https://www.instituteforgovernment.org.uk/sites/default/files/publications/science-advice-crisis_0.pdf, last accessed on 16. 05. 2023.

Scally, Gabriel; Jacobson, Bobbie; Abbasi, Kamran (2020): The UK's public health response to covid-19. In: BMJ 369, p. m1932. https://doi.org/10.1136/bmj.m1932

Smallman, Melanie (2020): 'Independent Sage' group is an oxymoron. In: Research Professional News, Political science blog, 05. 05. 2020. Available online at https://www.researchprofessionalnews.com/rr-news-political-science-blog-2020-5-independent-sage-group-is-an-oxymoron, last accessed on 16. 05. 2023

Smits, Ruud; van Merkerk, Rutger; Guston, David; Sarewitz, Daniel (2010): The role of technology assessment in systemic innovation policy. In: Ruud Smits, Stefan Kuhlmann and Phillip Shapira (eds.): The theory and practice of innovation policy. Cheltenham: Edward Elgar Publishing. https://doi.org/10.4337/9781849804424.00025

Sotoudeh, Mahshid (2005): Links between sustainability and technology development. In: IEEE Technology and Society Magazine 24 (1), pp. 9–14. https://doi.org/10.1109/MTAS.2005.1407742

Spinney, Laura (2017) Pale rider. The Spanish Flu of 1918 and how it changed the world. New York, NY: PublicAffairs.

Strauss, Stefan (2019): Privacy and identity in a networked society. Refining privacy impact assessment. London: Routledge. https://doi.org/10.4324/9780429451355

TAB – Büro für Technikfolgen-Abschätzung beim Deutschen Bundestag (2022): Energy consumption of ICT infrastructure. Berlin: TAB. https://doi.org/10.5445/IR/1000152733

Tan, Chianru et al. (2021): Applications of digital PCR in COVID-19 pandemic. In: VIEW 2 (2), p. 20 200 082. https://doi.org/10.1002/VIW.20200082

Truffer, Bernhard; Schippl, Jens; Fleischer, Torsten (2017): Decentering technology in technology assessment. Prospects for socio-technical transitions in electric mobility in Germany. In: Technological Forecasting and Social Change 122, pp. 34–48. https://doi.org/10.1016/j.techfore.2017.04.020

van den Broek-Honingh, Nelleke; Glas, Iris; Vennekens, Alexandra (2021): Trust in science in the Netherlands (2021 survey). The Hague: Rathenau Instituut. Available online at https://www.rathenau.nl/sites/default/files/2021-12/REPORT_Trust_in_science_in_the_Netherlands_2021_survey_Rathenau_Instituut.pdf, last accessed on 16. 05. 2023.

Weber, Max (1919): Politik als Beruf. Tübingen: Mohr Siebeck.

Wu, Jun; Wang, Jian; Nicholas, Stephen; Maitland, Elizabeth; Fan, Qiuyan (2020): Application of big data technology for COVID-19 prevention and control in China. Lessons and recommendations. In: Journal of Medical Internet Research 22 (10), p. e21980. https://doi.org/10.2196/21980

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