Supporting Federal Decision Making through Participatory Technology Assessment

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Summary

The incoming administration faces complex issues at the intersections of science, technology, and society. As such, the next administration should establish a special unit within the Science and Technology Policy Institute (STPI)—an existing federally funded research and development center (FFRDC)—to provide capacity for Participatory Technology Assessment (pTA) to the White House Office of Science and Technology Policy and across executive branch agencies.

Robust public engagement can support decision making where neither science nor existing policy provide clear guidance. pTA is an established and evidence-based way to assess public values on contested and complex science and society issues.[1,2] By tapping into a broader community of expertise and experiences, pTA can identify plausible alternatives and solutions that may be overlooked by experts and advocates.

pTA provides critical and informed public input that is currently missing in conventional policy- and decision-making processes. Policies and decisions will have greater legitimacy, transparency, and accountability as a result. When systematically integrated into research and development (R&D) processes, pTA can be used for anticipatory governance—that is, to direct decisions, policies, and investments toward desired outcomes and away from undesired outcomes.

A pTA unit within STPI would provide pTA as a service for the executive branch regarding emerging scientific and technological issues and questions. By integrating public voices alongside expert assessments, the next administration can ensure that federal science and technology decisions provide the greatest benefit to society.

Challenge and Opportunity

Science and technology (S&T) policy problems always involve issues of public values—such as concerns for safety, prosperity, and justice—alongside issues of fact. However, few systematic and institutional processes meaningfully integrate values from informed public engagement alongside expert consultation. Existing public-engagement mechanisms such as public-comment periods, opinion surveys, and town halls have devolved into little more than "checkbox" exercises.[3,4] Such mechanisms are sometimes even actively abused through fraud, as happened when the names of deceased individuals appeared in public comments submitted

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[1] OECD (2020). Innovative Citizen Participation and New Democratic Institutions: Catching the Deliberative Wave. https://www.oecd-ilibrary.org/governance/innovative-citizen-participation-and-new-democratic-institutions_339306da-en.

[2] The Danish Board of Technology Foundation (2020). The Landscape of Science, Ethics and Public Engagement & Its Potential for the Future. https://tekno.dk/wp-content/uploads/2020/11/Kavli_Landscape_Report_Dec1.pdf.

[3] Fiorino, D. J. (1990). Citizen Participation and Environmental Risk: A Survey of Institutional Mechanisms. Science, Technology & Human Values, 15(2), 226–243. https://journals.sagepub.com/doi/10.1177/016224399001500204.

[4] Stirling, A. (2008). "Opening Up" and "Closing Down": Power, Participation, and Pluralism in the Social Appraisal of Technology. Science, Technology & Human Values, 33(2), 262–294. https://doi.org/10.1177/0162243907311265.

on net neutrality.[5] Moreover, existing engagement mechanisms tend to be dominated by a small number of experts and organized interest groups: people and institutions who generally have established pathways to influence policy anyway.

Existing engagement mechanisms leave out the voices of people who may lack the time, awareness, and/or resources to voice their opinions in response to the Federal Register, such as the roofer, the hair stylist, or the bus driver. This means that important public values—widely held ideas about the rights and benefits that ought to guide policy making in a democratic system—go overlooked. For S&T policy, a failure to integrate public values may result in R&D investments that produce market successes with limited public value, such as treatments for cancer that most patients cannot afford.[6,7] Failure to integrate public values may also mean that little to no attention gets paid to key areas of societal need, such as developing low-cost tools and approaches for mitigating lead and other contaminants in water supplies.[8,9]

Institutionalizing pTA within the Federal Government would provide federal agencies access to the tools and resources they need to apply pTA to existing and emerging complex S&T challenges, enabling experts, publics, and decision makers to tackle wicked problems together.[10] pTA can be applied toward resolving long-standing issues, as well as to anticipate and address questions around emerging or novel S&T issues.

pTA for Long-Standing S&T Issues

Storage and siting of disposal sites for nuclear waste is an example of the type of ongoing, intractable problems for which pTA is ideally suited. Billions of dollars have been invested to develop a government-managed site for storing nuclear waste in the United States, yet essentially no progress has been made.[11] Entangled political and environmental concerns, such as the risks of leaving nuclear waste in a potentially unsafe state for the long term, have stalled progress. There is also genuine uncertainty and expert disagreement surrounding safety and efficacy of various storage alternatives.[12] Our nation's inability to address the issue of nuclear

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[5] Weller, N. (2018). The Online Comment Period Is a Fraudulent Cesspool. Slate Future Tense, February 23. https://slate.com/technology/2018/02/online-comments-are-a-terrible-way-to-involve-the-public-in-policymaking.html.

[6] Bozeman, B. (2020). Public Value Science. Issues in Science and Technology, 36(4). https://issues.org/public-value-science-innovation-equity-bozeman/.

[7] Bozeman, B.; Sarewitz, D. (2011). Public Value Mapping and Science Policy Evaluation. Minerva, 49(1): 1–23. https://doi.org/10.1007/s11024-011-9161-7.

[8] Foley, R.W.; Wiek, A.; Kay, B.; Rushforth, R. (2017). Ideal and Reality of Multi-Stakeholder Collaboration on Sustainability Problems: A Case Study on a Large-Scale Industrial Contamination in Phoenix, Arizona. Sustainability Science, 12(1): 123–36. https://link.springer.com/article/10.1007%2Fs11625-016-0393-1.

[9] Panko, B. (2017). Scientists Now Know Exactly How Lead Got Into Flint's Water. Smithsonian Magazine, February 3. https://www.smithsonianmag.com/science-nature/chemical-study-ground-zero-house-flint-water-crisis-180962030/.

[10] Rittel, H.W.; Webber, M.M. (1973). Dilemmas in a General Theory of Planning. Policy Sciences, 4: 155–69.

[11] Wade, W. (2019). Americans Are Paying More than Ever to Store Deadly Nuclear Waste. The Los Angeles Times, June 14. https://www.latimes.com/business/la-fi-radioactive-nuclear-waste-storage-20190614-story.html.

[12] Metlay, D. (2000). From Tin Roof to Torn Wet Blanket: Predicting and Observing Groundwater Movement at a Proposed Nuclear Waste Site. In: Sarewitz, D.; Pielke Jr., R.A.; Byerly Jr.; R. [Eds]. (2000). Prediction: Science, Decision Making, and the Future of Nature. Island Press.

waste has long impacted development of new and alternative nuclear power plants and thus has contributed to the slow transition away from fossil fuels.

There are rarely unencumbered or obvious optimal solutions to long-standing S&T issues like nuclear-waste disposal. But a nuanced and informed dialogue among a diverse public, experts, and decision makers—precisely the type of dialogue enabled through pTA—can help break chronic stalemates and address misaligned or nonexistent incentives. By bringing people together to discuss options and to learn about the benefits and risks of different possible solutions, pTA enables stakeholders to better understand each other's perspectives. Deliberative engagements like pTA often generate empathy, encouraging participants to collaborate and develop recommendations based on shared exploration of values.[13,14] pTA is designed to facilitate timely, adequate, and pragmatic choices in the context of uncertainty, conflicting goals, and various real-world constraints. This builds transparency and trust across diverse stakeholders while helping move past gridlock.

pTA for Emerging and Novel Issues

pTA is also useful for anticipating controversies and governing emerging S&T challenges, such as the ethical dimensions of gene editing or artificial intelligence. pTA helps grow institutional knowledge and expertise about complex topics as well as about public attitudes and concerns salient to those topics. For example, challenges associated with COVID-19 vaccines present several opportunities to deploy pTA. Public trust of the government's pandemic response is uneven at best. Many Americans report specific concerns about receiving a COVID-19 vaccine.[15] Public opinion polls have delivered mixed messages regarding willingness to receive a COVID-19 vaccine,[16,17] but polls can overlook other concerns and developments in rapidly changing environments. Demands for expediency in vaccine development complicate the situation. A vaccine developed and made widely available sooner could save more lives, but apparent pressure to deliver a vaccine as soon as possible may raise public concern that vaccine safety is not being adequately vetted. Logistical and ethical questions about vaccine rollout also abound: who should get vaccinated first, at what cost, and alongside what other public health measures? The nation needs a portfolio of differentiated and locally robust strategies for vaccine deployment. pTA would help officials anticipate equity challenges related to vaccine use and inform messaging, helping inform rollout strategies for different communities across the country.[18]

[13] Selin, C.; et al. (2017). Experiments in engagement: Designing public engagement with science and technology for capacity building. Public Understanding of Science, 26(6): 634–649. https://journals.sagepub.com/doi/10.1177/0963662515620970.

[14] Reflections from pTA participants include references to learning about and valuing other people's perspectives. See for example, https://youtu.be/6yImAjIws9A.

[15] Mathews, A.W.; Toy, S. (2020). Nursing Homes Grapple With Staff Hesitant to Get the Covid-19 Vaccine. The Wall Street Journal, December 20.

[16] Silverman, E. (2020). STAT-Harris Poll: Most Americans Won't Get a Covid-19 Vaccine Unless It Cuts Risk by Half. STATNews, November 10. https://www.statnews.com/pharmalot/2020/11/10/harris-poll-covid19-vaccine-masks-distancing/.

[17] Hopkins, J.S. (2020). Ahead of Covid-19 Vaccine, Half of Americans Indicate Reluctance, WSJ/NBC Poll Finds. The Wall Street Journal, October 15.

[18] Gayle, H.; Foege, W.; Brown, L.; Kahn, B. [Eds]. (2020). Framework For Equitable Allocation Of Covid-19 Vaccine. Washington: The National Academies Press. https://www.nap.edu/catalog/25917/framework-for-equitable-allocation-of-covid-19-vaccine.

pTA is an Established Practice

pTA has a history of use in the European Union and more recently in the United States. Inspired partly by the former U.S. Office of Technology Assessment (OTA), many European nations and the European Parliament operate their own technology assessment (TA) agencies. European TA took a distinctive turn from the OTA in further democratizing science and technology decision-making by developing and implementing a variety of effective and economical practices involving citizen participation (or pTA).[19] Recent European Parliamentary Technology Assessment reports have taken on issues of assistive technologies, future of work, future of mobility, and climate-change innovation.[20]

In the United States, a group of researchers, educators, and policy practitioners established the Expert and Citizen Assessment of Science and Technology (ECAST)[21] network in 2010 to develop a distinctive 21st-century model of TA. Over the course of a decade, ECAST developed an innovative and reflexive participatory technology assessment (pTA) method to support democratic decision-making in different technical, social, and political contexts.[22] After a demonstration project providing citizen input to the United Nations Convention on Biological Diversity in collaboration with the Danish Board of Technology, ECAST piloted its first independent pTA project, working with the National Aeronautics and Space Administration on the agency's Asteroid Initiative.[23,24] **NASA-sponsored pTA activities about asteroid missions revealed important concerns about mitigating asteroid impact alongside decision support for specific NASA missions.[25–28] Public audiences prioritized a U.S. role in planetary defense from asteroid impacts. These results were communicated to NASA administrators and informed the development of NASA's Planetary Defense Coordination Office, demonstrating how pTA can identify novel public concerns to inform decision making.[29]**

[19] Sclove, R. (2010). Reinventing technology assessment for the 21st century. Woodrow Wilson International Center for Scholars (WWICS), Science + Technology Innovation Program.

[20] See European Parliamentary Technology Assessment (EPTA): https://eptanetwork.org/.

[21] See Expert and Citizen Assessment of Science and Technology (ECAST): https://ecastnetwork.org/.

[22] See ECAST pTA Method: https://cspo.org/areas-of-focus/pta/.

[23] Tomblin, D.; et al. (2015). Informing NASA's Asteroid Initiative: A Citizens' Forum. Expert and Citizen Assessment of Science and Technology (ECAST). https://www.nasa.gov/sites/default/files/atoms/files/ecast-informing-nasa-asteroid-initiative_tagged.pdf.

[24] Worthington, R.; et al. (2012). Technology Assessment and Public Participation: From TA to PTA. Expert and Citizen Assessment of Science and Technology. https://cspo.org/legacy/library/1301301001F12269256VO_lib_ECASTReportTAtop.pdf.

[25] Tomblin, D.; et al. (2015). Informing NASA's Asteroid Initiative.

[26] Bertrand, P.; Pirtle, Z.; Tomblin, D. (2017). Participatory technology assessment for Mars planning: Public values and rationales. Space Policy, 42: 41–53.

[27] Pirtle, Z.; Tomblin, D. (2017). Well Ordered Engineering: Participatory Technology Assessment at NASA. In: Pitt, J.; Shew, A. [Eds]. Spaces for the Future: A Companion to the Philosophy of Technology. New York: Routledge.

[28] Tomblin, D.; et al. (2017). Integrating Public Deliberation into Engineering Systems: Participatory Technology Assessment of NASA's Asteroid Initiative. Astropolitics, 15(2): 141–166.

[29] Lindley Johnson of NASA's Planetary Defense Coordination Office stated: "In 2014 when we had the ECAST study, there were still a lot of people in NASA that had the opinion, 'No, NASA shouldn't be doing this.'…It would be overhyped to say [the ECAST pTA study] was the deciding factor but it certainly was a factor in helping us to realize that we did need to set up an office specifically focused on coordinating the efforts across the agency…and internationally. It's led to the establishment of the Planetary Defense Coordination Office a little over two years ago." From: School for the Future of Innovation in Society. (2018). Discussion of Office of Planetary Defense Creation. Arizona State University. https://vimeo.com/423275286.

This NASA pTA paved the way for pTA projects with the Department of Energy on nuclear-waste disposal and with the National Oceanic and Atmospheric Administration on community resilience.[30,31] ECAST's portfolio also includes projects on climate intervention research,[32] the future of automated vehicles[33], and gene editing.[34] These and other projects have been supported by more than three million dollars of public and philanthropic funding over the past five years. Strong funding support in recent years highlights a growing demand for public engagement in science and technology decision-making.

However, the current scale of investment in pTA projects is vastly outstripped by the number of agencies and policy decisions that stand to benefit from pTA. ECAST's capacity and ability to partner with federal agencies is limited. Any external entity like ECAST will encounter difficulties in building institutional memory and in developing cooperative-agreement mechanisms across agencies with different missions. Integrating public engagement as a standard component of decision making will require aligning the interests of sponsoring agencies, publics, and pTA practitioners within the context of broad and shifting political environments[35-37]. An FFRDC office dedicated to pTA would provide the embedded infrastructure, staffing, and processes necessary to achieve these challenging tasks. A dedicated home for pTA within the executive branch would also enable systematic research, evaluation, and training related to pTA methods and practices, as well as better integration of these tools into decision making.

Plan of Action

The next administration should support and conduct pTA across the Federal Government by expanding the scope of the Science and Technology Policy Institute (STPI) to include a special unit with a separate operating budget dedicated specifically to pTA. STPI is an existing federally funded research and development center (FFRDC) that already conducts research on emerging technological challenges for the Federal Government. STPI is strategically associated with the

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[30] See the Climate Hazard Resilience Forums project: https://www.mos.org/pes-forum-archive/noaa-forum.

[31] Sittenfeld, D.; et al. (In review). Citizen Science, Civics, and Resilient Communities: Informing Community Resilience Policies Through Local Knowledge, Community Values, and Citizen-Created Data. Citizen Science: Theory and Practice.

[32] Nelson, J.P.; Kaplan, L.; Tomblin, D. (2019). Assessing Solar Geoengineering Research Funding: Insights from Two U.S. Public Deliberations. Anthropocene Review. https://journals.sagepub.com/doi/10.1177/2053019620964845. See also Daniel Sarewitz's presentation about this project to the National Academies of Science: https://vimeo.com/showcase/5998431/video/336892138.

[33] Chen, K.; Tomblin, D. (In review). Social Media as a New Tool to Complement Surveys for Understanding Public Opinions: An Empirical Demonstration of Public Opinions about Autonomous Vehicles. Public Opinion Quarterly (Special Issue on New Data in Social and Behavioral Research). The public report on this project available at https://themobilitydebate.net/results/

[34] Dryzek, J.S.; et al. (2020). Global citizen deliberation on genome editing. Science, 369(6510): 1435–1437. https://doi.org/10.1126/science.abb5931

[35] Stirling, A. (2008). "Opening Up" and "Closing Down": Power, Participation, and Pluralism in the Social Appraisal of Technology." Science, Technology & Human Values, 33(2): 262–294. https://journals.sagepub.com/doi/10.1177/0162243907311265.

[36] Moynihan, D.P.; Roberts, A.S. (2010). The Triumph of Loyalty Over Competence: The Bush Administration and the Exhaustion of the Politicized Presidency. Public Administration Review, 70(4): 572–581. https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1540-6210.2010.02178.

[37] Hoppe, R.; Wesselink, A.; Cairns, R. (2013). Lost in the Problem: Role of Boundary Organizations in the Governance of Climate Change. Wiley Interdisciplinary Reviews: Climate Change, 4(4): 283–300. https://onlinelibrary.wiley.com/doi/abs/10.1002/wcc.225.

White House Office of Science and Technology Policy (OSTP). Integrating pTA across federal agencies aligns with OSTP's mission to "coordinate the scientific and technical work of the Executive Branch...to provide the greatest benefit to society."[38]

A dedicated pTA unit within STPI would (1) provide expertise and resources to conduct pTA for federal agencies and (2) document and archive broader public expertise captured through pTA. Much publicly valuable knowledge generated from one area of S&T is applicable to and usable in other areas. As part of an FFRDC associated with the executive branch, STPI's pTA unit could collaborate with universities to help disseminate best practices across all executive agencies.

We envision that STPI's pTA unit would conduct activities related to the general theory and practice of pTA as well as partner with other federal agencies to integrate pTA into projects large and small. Small-scale projects, such as a series of public focus groups, expert consultations, or general topic research could be conducted directly by the pTA unit's staff. Larger projects, such as a series of in-person or online deliberative engagements, workshops, and subsequent analysis and evaluation, would require additional funding and support from the requesting agencies. The STPI pTA unit could also establish longer-term partnerships with universities and science centers (as in the ECAST network), thereby enabling the federal government to leverage and learn from pTA exercises sponsored by non-federal entities.

The new STPI pTA unit would be funded in part through projects requested by other federal agencies. An agency would fund the pTA unit to design, plan, conduct, assess, and analyze a pTA effort on a project relevant to the agency. This model would enable the unit to distribute costs across the executive branch and would ensure that the unit has access to subject-matter experts (i.e., agency staff) needed to conduct an informed pTA effort. Housing the unit within STPI would contribute to OSTP's larger portfolio of science and technology policy analysis, open innovation and citizen science,[39] and a robust civic infrastructure.[40]

Cost and Capacities
Adding a pTA unit to STPI would increase federal capacity to conduct pTA, utilizing existing pathways and budget lines to support additional staff and infrastructure for pTA capabilities. Establishing a semi-independent office for pTA within STPI would make it possible for the executive branch to share support staff and other costs. We anticipate that $2.5–3 million per year would be needed to supporting the core team of researchers, practitioners, leadership, small-scale projects, and operations within STPI for the pTA unit. This funding would require congressional approval.

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[38] Federal Register. (n.d.). Science and Technology Policy Office.
[39] The Day One Project. (2020). A Federal Strategy for Science Engagement. https://www.dayoneproject.org/post/a-federal-strategy-for-science-engagement.
[40] Rich, M.D.; Kavanagh, J. (2020). Putting America's Civic Infrastructure on the Biden-Harris Agenda. The RAND Blog, November 19. https://www.rand.org/blog/2020/11/putting-americas-civic-infrastructure-on-the-biden.html.

The STPI pTA unit and its staff would be dedicated to housing and maintaining a critical infrastructure for pTA projects, including practical know-how, robust relationships with partner organizations (e.g., science centers or other public venues for hosting deliberative pTA forums), and analytic capabilities. This unit would not wholly be responsible for any given pTA effort. Rather, sponsoring agencies should provide resources and direction to support individual pTA projects.

We expect that the STPI pTA unit would be able to conduct two or three pTA projects per year initially. Capacity and agility of the unit would expand as time went on. In the fifth year of the unit (the typical length of an FFRDC contract), the presidential administration should consider whether there is sufficient agency demand for pTA—and whether the STPI pTA unit has sufficiently demonstrated proof-of-concept—to merit establishment of a new and independent FFRDC or other government entity fully dedicated to pTA.

Operations
The process for initiating, implementing and finalizing a pTA project would resemble the following:
- Agency approaches the pTA unit with interest in conducting pTA for agency assessment and decision making for a particular subject.
- pTA unit assists the agency in developing questions appropriate for pTA. This process involves input from agency decision makers and experts as well as external stakeholders.
- Memorandum of understanding/agreement (MOU/MOA) is created, laying out the scope of the pTA effort.
- pTA unit and agency convene expert and/or public workshops (as appropriate) to inform pTA activities.
- pTA unit and agency create, test, and evaluate prototype pTA activities (see FAQs below for more details on evaluation).
- pTA unit and agency work with a network of pTA host institutions (e.g, science centers, universities, nonprofit organizations, etc.) to coordinate pTA forums.
- pTA unit oversees pTA forums.
- pTA unit collects, assesses, and analyzes pTA forum results with iterative input and analysis from the hosting agency.
- pTA unit works with stakeholders to share and finalize pTA reports on the subject, as well as a dissemination plan for sharing results with stakeholder groups.

Conclusion

Participatory Technology Assessment (pTA) is an established suite of tools and processes for eliciting and documenting informed public values and opinions to contribute to decision making around complex issues at the intersections of science, technology, and society. By creating capacity for pTA within STPI, the incoming administration will bolster its ability to address

longstanding science and technology issues, as well as to anticipate questions and public values around novel and emerging issues. Such capacity and capabilities will be crucial to improving the legitimacy, transparency, and accountability of decisions regarding how we navigate and tackle the most intractable problems facing our society, now and for years to come.

Frequently Asked Questions

Aren't expert panels the best way to address complex S&T issues? Why should S&T assessments focus on involving the public and public values?

Experts can help map potential policy and R&D options and their implications. However, there will always be an element of judgment when it comes to deciding among options. This stage is often more driven by ethical and social concerns than by technical assessments. For instance, leaders may need to figure out a fair and just process to govern hazardous-waste disposal, or weigh the implications of using genetically modified organisms to control diseases. Involving the public in decision-making can help counter challenges associated with expert judgment (for example, "groupthink") while bringing in perspectives, values, and considerations that experts may overlook or discount.

How can you know that members of the public are sufficiently informed to be able to contribute to a decision?

pTA incorporates a variety of measures to inform discussion, such as background materials distributed to participants and multimedia tools to provide relevant information about the issue. The content of background materials is developed by experts and stakeholders prior to a pTA event to give the public the information they need to thoughtfully engage with the topic at hand. Evaluation tools, such as those from the informal science-education community, can be used to assess how effective background materials are at preparing the public for an informed discussion, and to identify ineffective materials that may need revision or supplementation. Evaluations of several past pTA efforts have 1) shown consistent learning among public participants and 2) have documented robust processes for the creation, testing, and refinement of pTA activities that foster informed discussions among pTA participants.[45,46]

Will doing pTA enhance the communications missions of federal agencies?

pTA can result in products and information, such as reports and data on public values, that are relevant and useful for the communication missions of agencies. However, pTA should avoid becoming a tool for strategic communications or a procedural "checkbox" activity for public engagement. Locating the Federal Government's dedicated pTA unit within an FFRDC will ensure that pTA is informed by and accountable to a broader community of pTA experts and stakeholders who are independent of any mission agency.

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[45] Nelson, J.P.; Kaplan, L.; Tomblin, D. (2019). Assessing Solar Geoengineering Research Funding.

[46] Todd, K.; et al. (2019). Science Center Public Forums: Summative Evaluation Report. Museum of Science, Report 2019-03. https://www.informalscience.org/sites/default/files/FINAL%20Science%20Center%20Public%20Forums%20Summative%20Evaluation%20Report.pdf.

Why does the Federal Government need in-house capacity to conduct pTA?

The work of universities, science centers, and nonpartisan think tanks have greatly expanded the tools and approaches available for using pTA to inform decision-making. Many past pTA efforts have been driven by such nongovernmental institutions, and have proven agile, collaborative, and low cost. These efforts, while successful, have limited or diffuse ties to federal decision making.

Embedding pTA within the Federal Government would help agencies overcome the opportunity and time cost of integrating public input into tight decision-making timelines. ECAST's work with federal agencies has shown the need for a stable bureaucratic infrastructure surrounding pTA at the federal level to build organizational memory, create a federal community of practice, and productively institutionalize pTA into federal decision-making

Importantly, pTA is a nonpartisan method that can help bridge divides. Involving a diversity of perspectives through pTA engagements can help stakeholder move beyond impasse and conflict. pTA engagements emphasize recruiting and involving Americans from all walks of life, including those historically excluded from policymaking.

How would a pTA unit within STPI complement existing technology assessment capacity? How would it differ from that existing capacity?

Currently, the Government Accountability Office's Science, Technology Assessment, and Analytics team (STAA) conducts technology assessment for Congress. Technology Assessment (TA) is designed to enhance understanding of the implications of new technologies or existing S&T issues. The STAA certainly has the capacity to undertake pTA studies on key S&T issues if and when requested by Congress. However, the distinctive form of pTA developed by ECAST and exemplified in ECAST's work with NASA, NOAA, and DOE follows a knowledge co-production model in which agency program managers work with pTA practitioners to co-design, co-develop, and integrate pTA into their decision-making processes. STAA, as a component of the legislative branch, is not well positioned to work alongside executive agencies in this way. The proposed pTA unit within STPI would make the proven ECAST model available to all executive agencies, nicely complementing the analytical TA capacity that STAA offers the federal legislature.

Why should the government establish a pTA unit within an FFRDC instead of using executive orders to conduct pTA or requiring agencies to undertake pTA?

Executive orders could support one-off pTA projects and require agencies to conduct pTA. However, establishing a pTA unit within an FFRDC like STPI would provide additional benefits that would lead to a more robust pTA capacity.

FFRDCs are a special class of research institutions owned by the Federal Government but operated by contractors, including universities, nonprofits, and industrial firms. The primary purpose of FFRDCs is to pursue research and development that cannot be effectively provided by the government or other sectors operating on their own. FFRDCs also enable the government to recruit and retain diverse experts without government hiring and pay constraints, providing the government with a specialized, agile workforce to respond to agency needs and societal challenges.

Creating a pTA unit in an FFRDC would provide an institutional home for general pTA know-how and capacity: a resource that all agencies could tap into. The pTA unit would be staffed by a small but highly-trained staff who are well-versed in the knowledge and practice of pTA. The pTA unit would not preclude individual agencies from undertaking pTA on their own, but would provide a "help center" to help agencies figure out where to start and how to overcome roadblocks. pTA unit staff could also offer workshops and other opportunities to help train personnel in other agencies on ways to incorporate the public perspective into their activities.

Other potential homes for a dedicated federal pTA unit include the Government Accountability Office (GAO) or the National Academies of Sciences, Engineering, and Medicine. However, GAO's association with Congress would weaken the unit's connections to agencies. The National Academies historically conduct assessments driven purely by expert consensus, which may compromise the ability of National Academies-hosted pTA to include and/or emphasize broader public values.

How will the government evaluate the performance and outcomes of (1) pTA efforts and (2) a dedicated pTA unit? How has pTA been evaluated previously?

Evaluating a pTA effort means answering four questions:
- First, did the pTA effort engage a diverse public not otherwise engaged in S&T policy formulation? pTA practitioners generally do not seek statistically representative samples of participants (unlike, for instance, practitioners of mass opinion polling). Instead, pTA practitioners focus on including a diverse group of participants, with particular attention paid to groups who are generally not engaged in S&T policy formulation.
- Second, was the pTA process informed and deliberative? This question is generally answered through strategies borrowed from the informal science-learning community, such as "pre- and post-" surveys of self-reported learning. Qualitative analysis of the participant responses and discussions can evaluate if and how background information was used in pTA exercises. Involving decision makers and stakeholders in the evaluation process—for example, through sharing initial evaluation results—helps build the credibility of participant responses, particularly when decision makers or agencies are skeptical of the ability of lay citizens to provide informed opinions.
- Third, did pTA generate useful and actionable outputs for the agency and, if applicable, stakeholders? pTA practitioners use qualitative tools for assessing public opinions and values alongside quantitative tools, such as surveys. A combination of qualitative and

quantitative analysis helps to evaluate not just *what* public participants prefer regarding a given issue but *why* they hold that preference and *how* they justify those preferences. To ensure such information is useful to agencies and decision makers, pTA practitioners involve decision makers at various points in the analysis process (for example, to probe participant responses regarding a particular concern). Interviews with decision makers and other stakeholders can also assess the utility of pTA results.

- Fourth, what impact did pTA have on participants, decisions and decision-making processes, decision makers, and organizational culture? This question can be answered through interviews with decision makers and stakeholders, surveys of pTA participants, and impact assessments.

Evaluation of a pTA unit within an existing FFRDC would likely involve similar questions: questions focused on the impact of the unit on decisions, decision-making processes, and the culture and attitudes of agency staff who worked with the pTA unit.[47] An external evaluator, such as the Government Accountability Office or the National Academies of Sciences, could be tasked with carrying out such an evaluation.

How publicly accessible should the work of a pTA unit be? Should pTA results and processes be made public?

pTA results and processes should typically be made public as long as few risks are posed to pTA participants (in line with federal regulations protecting research participants). Publishing results and processes ensures that stakeholders, other members of government (e.g., Congress), and broader audiences can view and interpret the public values explored during a pTA effort. Further, making results and processes publicly available serves as a form of accountability, ensuring that pTA efforts are high quality.

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[47] See Collaborative Research: Participatory Technology Assessment and Cultures of Expertise:
https://www.nsf.gov/awardsearch/showAward?AWD_ID=1827826

About the Authors

Nicholas Weller is a Postdoctoral Research Associate at Arizona State University. He promotes engagement among scientists, public audiences, policy makers, and cultural organizations in service of creating a just, free, and sustainable future. He studies the use of deliberative public forums to shape science and policy on uncertain, contested, and technical topics. Currently, he works with ASU's Center for Innovation in Informal STEM Learning to help professionals at museums and other cultural organizations develop sustainability-related programs. He also works with ASU's Consortium for Science, Policy and Outcomes to better link science with public values.

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About the Day One Project

The Day One Project is dedicated to democratizing the policymaking process by working with new and expert voices across the science and technology community, helping to develop actionable policies that can improve the lives of all Americans, and readying them for Day One of the next presidential term. For more about the Day One Project, visit **dayoneproject.org**.