**EFFECTIVE SCIENCE AND TECHNOLOGY ADVICE FOR CONGRESS:
COMPARING OPTIONS**

Statement of

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Madam Chair and Ranking Member Lucas,

Thank you for the invitation to participate today. Today's subject is of longstanding interest to me. My perspective is shaped not only by my current post at the National Academies but also by my earlier roles at the former Office of Technology Assessment and at Sigma Xi, the scientific research society. So, the views I express today are my own, based on that perspective and not necessarily those of the Academies or an Academies report, since we haven't addressed this topic recently in an Academies study, although that may be something for you to keep in mind.

The prospect of reinvesting in an effective technology assessment (TA) capacity for Congress has come before you from time to time in recent years, but it should be clear at this point that a renewed investment in Congress's capacity to be better informed about science and technology (S&T) is long overdue. It is essential that you, our elected representatives, can make fully-informed decisions, and S&T issues increasingly complicate many of the decisions you face across the full agenda of Congress and the jurisdictions of your committees. Also, more prominent than ever today are the sweeping implications of the rapid pace of technology change. Artificial intelligence, blockchain technology, the internet of things, quantum computing, autonomous vehicles, data encryption, big data mining, hypersonic weapons, hydraulic fracturing, deep fakes, and gene editing technology are but a few recent examples. Finally, Congress faces many more issues for which the S&T dimension, while often not the dominant concern, is often still a very significant one that, if misunderstood, could lead to poor legislative decisions and oversight, some touching the very heart of our democracy such as elections or information security and privacy. Still others involve massive government investments in S&T related facilities, regulations, and infrastructure, such as preparing for 5G cellular network deployment, securing the nation's food supply, research and development security, and scores of others.

The salient question then is how best to improve Congress's capacity for acquiring S&T information and advice that is authoritative, independent, objective, relevant, timely and tuned specifically to Congress's current needs. Moreover, the needs are compelling enough that investment in expanding Congress's S&T capacity need not be either/or among options being considered. Rather, the objective could be more effective overall to deploy each organization building on its design strengths rather than attempting to reinvent the wheel in any or only one of them and realizing additional economies from effective collaboration among all of them.

Congress draws on many sources of S&T advice though its committee and personal staffs, often supplemented with expertise from universities, professional societies, industry or executive agencies, constituents, and many other interests, all with strengths and weaknesses with respect to serving the needs of Congress. S&T advice delivered to Congress must be both *credible* and *suitable* to congressional needs, more specific measures of which I will address later. In facing this challenge previously, Congress created four traditional options that stand out as having been used most frequently overall in providing advice matching its needs. In chronological order of their assumption of roles in providing S&T advice to Congress, they are:

- First, the **National Research Council** (NRC), the principal operating arm of the National Academies of Sciences Engineering and Medicine, is a private, independent, non-government organization operating under the 1863 congressional charter creating the National Academy of Sciences to "investigate, examine, experiment, and report upon any subject of science whenever called upon to do so by any department of the government." (*NAS Act*, 1863)

- Second, the **Congressional Research Service** (CRS), created in 1914 by Congress to operate within the Library of Congress, which includes S&T as one component of its broad portfolio, "to serve

Congress and, in particular, individual members of Congress, throughout the legislative process by providing broad-ranging legislative research and analysis." (*Legislative Reorganization Act of 1970*)

- Third, the former **Office of Technology Assessment** (OTA), created in 1972 as an agency of Congress (operating though 1995) to provide Congress with independent, objective and authoritative analysis of the complex scientific and technical issues. The intent was for Congress to "equip itself with new and effective means for securing competent, unbiased information concerning the physical, biological, economic, social, and political effects of such [technology] applications." (*OTA Act*, P.L. 92-484, 1972)

- Fourth, the **Government Accountability Office** (GAO), created by Congress in 1921 as an independent auditing agency for Congress to "investigate … matters relating to the receipt, disbursement, and application of public funds, and shall make to the President … and to Congress … reports [and] recommendations looking to greater economy or efficiency in public expenditures" (*Budget and Accounting Act*, 1921), began in 2002, in the wake of OTA's closure, to develop an approach to technology assessment within its portfolio.

I can submit for the record soon an as-yet-unpublished working paper, *Effective Science Advice for Congress: Comparing Options*, which evaluates the strengths and weaknesses of these options in detail in today's circumstances, a few highlights of which I include in my testimony today.

A main conclusion of the paper is, as I indicated at the outset, that the time for reinvesting in an effective TA advice capability for Congress is at this point long overdue, but, also as noted earlier, in order to be effective, the advice delivered must be both widely recognized as both credible and tailored to the needs, context, and language of Congress. The paper elaborates on measures of *credibility* of advice from the perspective of those who will use the advice, which in sum are that it must be (1) **authoritative**, (2) **objective**, and (3) **independent**. As measures of *suitability*, it must be (4) **relevant**,

(5) **useful**, and (6) **timely**. The table attached summarizes and compares the four options noted earlier against these six criteria.

Filling the Gap Left with OTA's Closure

Congress created each of the four most-often-used options just noted for a specific purpose, although all evolved significantly since their creation. Regarding S&T advice specifically, the NRC, CRS, and GAO each assumed some of the former OTA's function in the wake of the OTA's closure in 1995, but that assumption has occurred only to a modest degree so far, even after nearly a quarter of a century. The following are three illustrations of this:

- First, following OTA's closure, congressional requests for National Academies or NRC studies doubled but then the next year fell back to the historical trend, at least in part because most NRC studies currently are carried out at a different level of policy context than the kinds of efforts that Congress traditionally commissioned to the former OTA.

- A second observation is that CRS's delivery of timely "off the shelf" S&T information remains an excellent resource for the Congress for that purpose and has improved with new technology and experience, including becoming publicly accessible, but it hasn't filled and never really aspired to fill the analysis gap left by OTA's closure.

- And, finally, in 2002, GAO began to develop a TA capacity, but progress has been very slow towards adopting key features for providing effective TA for Congress, at least to the standard set by the former OTA.

To elaborate on the last illustration, I highlight three features reflective of the OTA experience. Over OTA's 23-year history the office delivered hundreds of technology assessments that (1) drew extensively and broadly on the nation's authoritative S&T expertise through its advisory panels, as

contractors, as consultants, and though participation in information gathering workshops and in rigorous peer review of its products; (2) relied on experienced and highly qualified staff expertise recruited specifically for the technical and policy needs of each assessment undertaken; and (3) focused on topics matched to clearly articulated needs of congressional committees of jurisdiction as judged by the agency's statutory Technology Assessment Board of House and Senate Members and informed by the Technology Assessment Advisory Council of external experts, also a statutory group.

By comparison, for these 3 illustrative features, during the 17 years that the GAO TA function has been active (2002-2019), GAO issued 15 efforts listed as TAs issued, but so far developing a TA model including features commensurate with the OTA experience has progressed very slowly. As three examples to illustrate: (1) early GAO TA efforts (2002-2010) rarely involved in any formal way the nation's broad reservoir of S&T expertise and, even in more recent efforts (2011-2019), one-time Academies-organized expert meetings have provided the only prominent degree of formal access to external expertise; (2) over the same period, GAO TA internal agency mechanisms dominated review of draft reports; only recently has there been incremental movement toward comprehensive external review by inviting review comments on draft reports from some Academies technical expert meeting participants; and (3) GAO has yet to initiate a TA with bipartisan requests from the relevant committees of jurisdiction in both congressional chambers and most efforts to date carried no formal request expressed by the committees of jurisdiction over the TA topics undertaken.

Modernizing Options

Going forward, the developing design of GAO's Science, Technology Assessment and Analytics Team promises features tuned to today's context and in the direction of the OTA standard, although GAO has much to do to rise to that standard, as illustrated above, as well as with other examples. Also, going forward, the NRC is undergoing an internal transformation process that may yield new ways of

providing S&T advice to Congress. For any of the four options, developments to adapt capabilities to today's congressional needs are certainly possible and I elaborate on those possibilities in detail in the working paper.

However, even with prospective changes to the NRC, GAO, and the former OTA, some structural limitations with each of them may limit the degree to which substantial change is possible. The following are three examples related to: (1) access to authoritative expertise, (2) quality assurance with external review, and (3) decision-making about selection of assessments tuned to congressional needs.

1. **Access to Expertise**. The NRC typically provides authoritative analysis and advice from widely recognized experts serving as pro bono volunteers on an appointed NRC study committee that provides specific evidence-based recommendations on a course of action. It is a widely valued resource, but the topics addressed most often are subjects tailored to executive agency needs, which comprise the bulk of the NRC's work portfolio. For policy analysis, the NRC's consensus study process limits the range of perspectives participating in the committee deliberation, both due to the necessity of excluding conflicts of interest as well as limiting the degree to which deep ideological differences can be reconciled in achieving a consensus view. Such challenges are not at all insurmountable, however, and finding new ways to address value-laden policy issues is a task for the ongoing internal NRC transformation. By contrast, OTA's objective was solely to inform the policy debate, including consideration of the broader social, economic, and political context and proffering alternative policy options and analyzing their consequences but not providing specific recommendations. As noted earlier, OTA assessments were carried out by professional staff whose expertise was carefully tuned to the topic of the assessment. Assessments were also informed and guided by an advisory panel of external experts like that of an NRC committee but including a broad range of experts and stakeholder interests relevant to the topic. The main point, however, is that both

the NRC and OTA models draw extensively and broadly on the nation's S&T expertise. GAO's STAA has a similar advisory objective to OTA's but to date has developed relatively weak mechanisms for acquiring the best external expertise possible or tuning available staff expertise to the needs of current assessments. *Going forward, it is certainly possible for the NRC to build the staff capabilities to fully support an "OTA-like" approach, i.e., that focuses on articulating the broad implications of policy options tuned to congressional needs, and such features could well be an outcome of the NRC's ongoing internal transformation. Similarly, it may be a stretch for GAO to build strong mechanisms to access extensive authoritative external and staff technical expertise tuned to the needs of current assessments, but it is essential to include such a feature as the STAA's approach develops.*

2. **Quality Assurance through External Review**. As another example, both the NRC and OTA have/had strong and highly structured external review mechanisms for draft reports. This helps ensure quality and accountability to standards of evidence as judged by experts. The review processes differed in that the NRC stresses the independence of the external review through a formal appointment process for reviewers and a very structured response-to-review process accountable to an independently appointed report monitor who judges the adequacy of the study committee's response to reviewer comments. The OTA process sought to involve all stakeholder interests in its external review process, which often expanded the review to include many more individuals (sometimes involving a hundred reviewers) with the adequacy of the response-to-review judged by the office of OTA's Director. That is, both the NRC and OTA models involve extensive and accountable external review mechanisms. GAO's process traditionally has been dominated by the agency's internal review process, but more recently has involved some degree of external review, at least of the technical features of the assessment, by inviting comments from some participants from a

group of technical experts recruited for a one-time "meeting of experts" by the Academies to help

inform the assessment, inclusion of which has become more common in recent GAO TA activities.

Generally, though, GAO would benefit from strengthening its external review process, adopting

more extensive accountable review procedures like those of the NRC or OTA.

3. **Setting Priorities**. As a final example, the mechanisms for ensuring that assessments undertaken are

tuned to high priority needs of the Congress vary considerably by option. Congressionally mandated

studies commissioned to the Academies typically require passage of legislation, which, by

definition, denotes a high congressional priority since the legislation requires passage by both

chambers and the signature of the President. Further, the resources to carry out the work are

committed in appropriations language or by agreement of executive agencies. The drawback is that

this is a lengthy process and may preclude many worthy efforts since it takes so long to commission

a study. Reconciling congressional intent with the terms of reference defined by federal agencies

sponsoring the study can add delay. Both OTA and GAO were/are allocated an annual appropriation

from which the resources to carry out an assessment were/are committed. In OTA's case, the

Technology Assessment Board (noted earlier), which convened monthly, weighed the relative

priority of prospective assessments against congressional needs judged by the nature of the requests

from committees of jurisdiction (with a strong preference for endorsement of both majority and

minority committee leadership) and the legislative agenda before authorizing an assessment to

proceed. GAO relies on the internal "congressional protocol" developed for its performance audits to

process requests, the current version of which does not mention TA. This protocol has not resulted in

TAs to date commissioned in response to a bipartisan request from the relevant committees of

jurisdiction in both congressional chambers. *Developing new mechanisms for commissioning NRC*

studies more quickly is certainly possible and GAO could significantly strengthen its procedure for

determining the priority of requested assessments relative to directly expressed congressional needs and the jurisdiction of committees requesting the assessment.

Comparing Options

Since progress towards replicating the key features of OTA has been so slow over nearly a quarter of a century, reconstructing an OTA with many of the original agency's features beckons as one viable option, although it could take years for a new entity to mature and involves start-up costs relative to trying to build and strengthen TA capacity in existing agencies of Congress. It may be worthwhile, however, and there is nothing to preclude a longer-range risk-adjusted strategy of pursuing multiple options simultaneously. In addition, circumstances are changing rapidly and developing any or all the options to include more OTA-like features, even restoring an OTA-like organization, would need to include new features as well to match today's needs. Such features include: (1) a broader portfolio of activities and products including, some related to shorter term needs of individual Members as opposed to exclusively those of congressional committees, (2) closer connections with other organizations to more efficiently gather the most recent and comprehensive information, (3) enhanced communications capacity for considerably expanded and timely information gathering and delivery of information to the Congress and the public; and (4) collaboration across congressional support agencies where topical areas overlap and strengths are complementary.

To illustrate this last feature, as an example, even with a restored OTA, the developing GAO STAA team approach, building on their traditional approach to performance audits, would likely be better suited than an OTA TA in many cases to evaluating the management performance of agency programs engaged in the nation's now massive federal S&T enterprise. The current example of NRC-organized expert meetings to support a GAO TA is another example. That is, as I noted at the outset, investment in expanding Congress's S&T capacity need not be either/or among options. Rather, the

objective could be more effective to deploy each organization building on its design strengths rather than attempting to reinvent the wheel in any or only one of them and realizing additional economies from collaboration among all of them.

Let me end where I started. The time for reinvesting in new effective approaches S&T advice to support Congress is now long overdue. I very much urge you to get on with it, including restoring and modernizing an OTA-like agency as well as fashioning ways to make sure that the existing entities, such as the NRC, CRS, and GAO, can move much more effectively to both fill the rapidly accelerating gap left in the wake of OTA's closure now nearly a quarter of a century ago and Congress's growing needs. Developing a more collaborative environment to draw on all their collective strengths would yield important benefits. Thank you for your attention.

Table 1. Strengths & Weaknesses of Selected Sources of S&T Assessment Advice for Congress

Dimensions of Effectiveness		CONGRESSIONAL AGENCY--DIRECTLY ACCOUNTABLE TO CONGRESS						OUTSIDE GOVERNMENT
		Former OTA		GAO		CRS*		NASEM
QUALITY	**Authoritative**	4	Expert advisory panels; dedicated staff;rotational staff	1	Assigned staff--may have relevant expertise	2	Dedicated issue area staff	5 Expert, often world-class committees; dedicated staff; consultants
	Informed	5	Panel review of perspectives included; focused workshops; staff research; consultants	1	Staff research; expert meetings	1	Independent staff research	4 Committee meetings; workshops; staff research; consultants; scope controlled by contract
	Independent	5	Scope approved by board; COI procedures for staff; all perspectives included and verified by advisory panel; articulate options; extensive external review	2	No governance group oversight; no expert committee or advisory panel; limited external review	3	Institutional procedures and policies	5 Elaborate COI procedures for committee and staff; rigorous external review
	All perspectives	5	Advisory panel & workshops; research by dedicated staff, contractors and consultants	2	Expert meetings to inform staff	2	Literature and individual research by experienced staff	3 Elaborate appointment of consensus committee; workshops; staff research
	Peer Review	4	Extensive external review	1	Institutional review; some external review	1	Institutional review	5 Independent external review
CONGRESSIONAL CONTEXT	**Relevant**	5	Requests from committees of jurisdiction and priorties set by Technology Assessment Board	1	Agency selection based on requests	5	All requests by design	5 Legislation and contract
	Presentation	5	Written to be tuned to congressional context	5	Written to be tuned to congressional context	5	Written to be tuned to congressional context	3 Usually tuned better to executive agency needs
	Useful	5	Requests from committees of jurisdiction and priorities set by Technology Assessment Board	3	Sometimes commissioned by committees of jurisdiction	5	For "off the shelf" analysis	5 Comissioned by law and contract
	Report/follow-up	5	Staff and panel members briefings and hearings	3	Staff briefings, hearings	4	Staff briefings, occasionally hearings	5 Committee members and staff
	Shared Staff	5	Project director and staff called upon for follow-up and analysis	0	Assessment staff available for limited follow-up	4	Expert staff available for follow-up	0 Very limited follow-up beyond initial briefings
	Timely	3	Detailed, evidence-based, peer reviewed reports with no recommendations	4	Detailed reports with supporting evidence; limited peer review	5	Summary reports	3 Detailed, evidence-based, peer reviewed reports with recommendations; contract required
	Other products		--background papers		--forum highlights		--now publicly available	--workshop reports
			--interim reports		--updates			--interim reports
			--issue papers		--podcasts			--letter reports
			--shared staff follow-up					--phased reports
								--release workshops

*CRS seldom produces major reports.

Strong<---------------->Weak

| 5 | 4 | 3 | 2 | 1 | 0 |