Hearing of the House Small Business Committee

"Fostering American Innovation: Insights into SBIR and STTR Programs"

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Testimony of

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Good morning Chairman Williams, Ranking Member Velázquez, and Members of the House Small Business Committee. Thank you for the opportunity to speak today. It is an honor to testify on behalf of Physical Sciences Inc. (PSI), a small business headquartered in Andover, Massachusetts, which I am proud to lead. As Congress and this Committee begin the process of reauthorizing the Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) programs, which are set to expire at the end of September, I am pleased to share some insights based on PSI's firsthand experience with these programs that provide enormous benefits to U.S. small businesses and the federal government.

By way of quick biographical background about myself: I hold an Sc.B. Degree in Chemistry from Brown University (1977) and a Ph.D. Degree in Physical Chemistry from the University of California, Berkeley (1981). I joined PSI in 1983 after completing a postdoctoral position at Cornell University where I worked on chemical laser technology relevant to missile defense.

At PSI, the primary focus of my research was the development of sensor technology to remotely detect the battlefield use of chemical and biological weapons. Working with the Army Edgewood Chemical Biological Center and the Joint Program Executive Office for Chemical and Biological Defense, we tested these technologies at facilities throughout the US, as well as in Canada and the United Kingdom, over nearly a 20 year period. One technology was also employed to measure foreign missile plume signatures in the early 2000's and subsequently evaluated to detect trace explosives during U.S. operations in Iraq. These activities were supported by both SBIR and non-SBIR funds.

My career at PSI advanced through levels of increasing responsibility, including establishing methods that aligned our SBIR-funded technology development with the DoD 5000 acquisition paradigm. In 2018 I was appointed Chief Operating Officer, subsequently President, and in 2022 Chief Executive Officer as well as elected to our Board of Directors.

Overview of Physical Sciences Inc.

Physical Sciences Inc. was founded in 1973 with a continuing mission to invent, demonstrate, and translate technical solutions for national priorities in defense, security, energy, environmental, healthcare, and industrial markets. Since 2011 the company has been 100% owned by an Employee Stock Ownership Trust as a retirement benefit for its employees, with no foreign ownership interest. We exclusively employ US Persons and have a rigorous internal program to define technology subject to

International Traffic in Arms Regulations and Export Administration Regulations (ITAR/EAR) controls in order to eliminate technology transfer to foreign entities.

At the inception of the SBIR program in 1982 the company had around 30 employees and $2.5 million in revenues. The company embraced the founding, statutory intent of the SBIR legislation to:

1. "stimulate technological innovation",
2. "use small business to meet Federal research and development needs",
3. "increase private sector commercialization of innovations derived from Federal research and development", and
4. "foster and encourage the participation of socially and economically disadvantaged small business concerns and women-owned small business concerns in technological innovation."

Our company's strong focus from the outset on our nation's defense and security led us down the primary path of applying SBIR funding to meet those Federal Research and Development (R&D) needs while continuously identifying complementary commercial applications for those highly specialized technologies.

Our company has seen enormous growth due in large measure to our participation in the SBIR program, but also through other successful commercial activity. We currently have around 275 employees with almost $100 million in annual revenues.

We are not a single-technology company on a linear venture-capital driven trajectory. PSI focuses on innovating technologies that federal agencies, like the U.S. Department of Defense (DoD) and the service branches, need to meet critical mission objectives, for which no other stakeholders are positioned to deliver.

Our company acts to mature multiple, and often complementary, technology platforms across diverse fields including medical diagnostics, optical sensing and device technology, advanced materials and structures, propulsion and energetics, and industrial and pharmaceutical process development and controls.

PSI possesses an excellent commercialization track record, exceeding performance benchmarks that Congress has periodically implemented through the years, including in the last reauthorization. I am proud of the fact that we have achieved this success, even though, in many cases, no viable longstanding commercial market exists in the public or private sector for the technology we have developed. However, our work has helped the federal agencies ensure that the U.S. defense apparatus and the Warfighter has remained ahead of the rest of the world in technology adoption. That's a key consideration I am hoping to leave with the Committee today – that there are many, many potential pathways for commercial success for small businesses – and the U.S. government should be open to innovation from all small business sources and not arbitrarily cap or limit participation. Doing so would undermine the ability of the federal government to secure the very best technology for its agency priorities.

In the areas of defense and homeland security we are viewed as the "system innovators" for the large system integrators – e.g., large business, prime contractors. We develop advanced component technologies critical to the performance of larger system platforms and the Defense Industrial Base as well as specialty products in the commercial marketplace. Examples of this paradigm include:

Advanced Li-ion battery technology to support Navy unmanned systems where their operational environment demands a much higher degree of safety, pressure tolerant capability for deep-ocean operations, and specialized construction to handle specific load profiles. The required capability significantly exceeds commercial standard; meaning that there isn't a broader commercialization market due to the enhanced capability. Component technology funded by SBIR awards from multiple agencies is employed to meet these needs. We build these systems for prime contractors under two Navy programs of record from a purpose-built US-based manufacturing facility using domestically-sourced materials to provide a secure supply chain. We are currently seeking to expand this facility to meet additional demand from similar programs.

Rare Earth extraction from coal ash was identified by our company as a potential technology to provide a secure domestic supply of these critical elements. Using internal PSI, and subsequently SBIR funding, we developed and patented process technology for the isolation of these elements from existing ash stockpiles. Technology development proceeded through non-SBIR funded programs supported by the U.S. Department of Energy (DoE) and the DoD, including building a demonstration facility in Pennsylvania. Funding for a $30 million pilot scale plant has been awarded to Winner Water Systems (Sharon, PA) in conjunction with Southern Power (AL), with PSI providing a modest level of technical support as the technology transitions to companies best suited to bring it to market. PSI will derive licensing revenue from future commercial use of the technology.

Radiation detection technology to secure our borders against the trafficking in this threat and protect critical infrastructure from attack was developed initially as an extension of our work on remote detection of chemical and biological threats. Our algorithms and related hardware technology radically reshaped the how these threats were detected, requiring over a decade of evaluation by the U.S. Department of Homeland Security Countering Weapons of Mass Destruction Office (DHS CWMD), the DoE laboratories, and U.S. Customs and Border Protection (USCBP) to achieve acceptance and become the new gold standard. As is often the case, this technology development was initiated with internal PSI funding and subsequently supported by the Defense Advanced Research Projects Agency (DARPA) and DHS CWMD. SBIR funding was employed by both organizations to insert and evaluate new capabilities into the core technology. We manufacture and sell this technology directly to US government agencies. It provides both primary and secondary screening technology to several ports of entry along the southern border as well as mobile and modular detection capability to federal, state, and local law enforcement agencies in the US, in the UK, and in select overseas locations through US organizations responsible for nuclear security.

Remote natural gas leak detection technology, based on optical sensing, was developed as a safer alternative to existing technology that required an operator to enter the region of a suspected leak. Originally an EPA SBIR-funded technology to improve the performance of commercial and military internal combustion and turbine engines, it was adapted to this commercial use under SBIR support in conjunction with the natural gas utility industry. Over 7,400 of Remote Methane Leak Detector systems have been sold by Heath Consultants under a license from PSI with total sales of $112M.

Ophthalmic stabilization technology developed by PSI is an enabling component in a generation of instrumentation that is used by the leading manufacturers of ophthalmic medical devices. Over 24,000 systems have been sold by our partners generating over $1 billion in revenue over the last decade and benefiting the eye health of tens of millions of Americans.

These examples demonstrate the range of approaches we use to bring SBIR-funded technology to market, employing the best approach to reach commercial and government customers. In many instances, numerous SBIR awards, across multiple agencies, were needed to develop a technology. Technology development remains an uncertain process that involves risk-taking; success is accomplished in years, not months.

Furthermore, none of these technologies, by themselves, scale to a large commercial enterprise. In each case SBIR funding was used to initially develop and then de-risk the technology to a level of maturity suitable for commercial adoption or insertion into a much larger and higher value military or homeland security platform. In the 2024 National Academy of Sciences report on metrics for the DoD SBIR program Dr. Devanand Shenoy, Principal Director for Microelectronics in the Office of the Under Secretary of Defense for Research and Engineering, pointed out, "that higher-risk projects typically take longer to mature, which is another reason that SBIR programs tend to focus on smaller components within larger systems." [1]

Our company is considered an "Experienced Firm", or Multiple Award Winner (MAW), under the FY 2022 reauthorization of the SBIR/STTR program. As mentioned above, we are subject to the enhanced metrics for MAWs established in that reauthorization. Those metrics require a Phase I to Phase II transition rate – the "conversion" benchmark – be greater than 50%. The SBA has certified our transition rate to be 71%. Our conversion rate for the agencies of the DoD, our primary customer, was 79%. The increased 2022 metrics also require a company to average at least $450,000 in aggregate sales and investments per Phase II award received during the designated period – the "commercialization" benchmark. PSI received $1,024,386 per in aggregate sales and investments per award.

Over the time our company has participated in the program we have reported almost $677 million in Phase III economic activity to the SBA, almost $187M of which are direct and indirect sales to the US government. Only $5.8M of those funds are formally listed as Phase III awards. The remaining $491M comprise direct and licensed sales of technology to commercial entities and allied foreign governments. This data illustrates the erroneous and misleading conclusions that can be drawn by recent studies that purport to capture total economic activity in their analysis of the effectiveness of MAWs participating in the SBIR program.

We also work closely with research universities and government laboratories to transition early stage technology, hiring students into the workforce as well as advancing technology through subcontracts to these institutions. Under the STTR program we have provided over $23M in funding to 61 research institutions in 32 different states. Many of those awards are to the former research advisors of our employees to enhance that transition.

The Role of SBIR in "Crossing the Valley of Death"

SBIR technology development occurs largely in the realm of "technology push." In this realm government technology managers identify and fund technology development activities based on their understanding of US mission agency needs as well as likely commercial potential. Within the mission agencies, technology is accepted through "acquisition pull." The "Valley of Death" is that gap in technology development before it acquires "acquisition pull." Acquisition pull in the DoD manifests through budgeting in the 5-year Future Years Defense Plan (FYDP), a carefully risk-managed technology development portfolio with very specific requirements, an often pre-defined solution, and little tolerance for high-risk disruptive technology insertion.

Small Businesses seeking to meet these needs or insert their technology to meet problems of significance need to address a broad range of issues:

- Navigate the transition from Technology Development to Product Engineering to Manufacturing,
- Address the skills and priorities of multiple organizations including universities, other small businesses, Science and Technology (S&T) funding organizations, prime contractors, and/or government and commercial end users.
- Develop the certified manufacturing processes, quality systems, information technology, and classified program capabilities necessary to be viewed as a reliable component technology supplier to higher value platforms.
- Invest in a broad range of special facilities, equipment, certifications, and training to address multiple low volume markets that reach full market potential over a decade or longer.

SBIR funding was originally intended to develop technology through a prototype to spark additional acquisition organization or commercial support. However, SBIR has become the de facto method for funding technology development and maturation through engineering and manufacturing development and all the way to low rate production. Put another way, there are no other realistic pathways for small businesses to pursue when it comes to federal funding for technology innovation; agencies will invariably steer small businesses to the SBIR program. Multiple SBIR awards have become the equivalent of private sector venture Series A or DoD 6.3 Advanced Development funding that leads to technology transition. Arbitrarily excluding companies from receiving those awards would be inefficient and would negate the specialized capability developed by those firms to meet specific federal agency needs.

In our experience this process has often been derailed due to factors such as 1) a decision to discontinue development of the platform onto which the technology was to be inserted, 2) delays in the requirements development process; 3) funding delays resulting from the federal budget process, and 4) cost overruns on other program elements that result in the redirection of funding away from new technology insertion. Any of these issues can be fatal to a small business pursuing an early stage single technology track to commercial viability. During the period from 2009 to 2012 many small businesses seeking SBIR program development funds failed or walked away from the program during the series of 14 short-term extensions via continuing resolutions.

Our technology-platform based development approach, coupled with the diversity of fields and applications we address, the broad skills of our staff, and the scale at which we operate, allow us to survive through the inevitable occurrence of those disruptions.

Operations and Investment

Our role as a diverse and often component level supplier requires that we have capability from early - stage development to full production capability across multiple technology verticals with differing expectations and processes. A key factor in our ability to work across these verticals was the extension of the program to provide second Phase II, Phase II enhancements, Direct to Phase II, and similarly intended awards that enabled the further maturation and targeting of prototypes developed under initial Phase II awards. This program expansion enabled us to make significant investments to create that capability. Examples include:

Energy and Hypersonic Technology – In 2018 we opened a 30,000 sq. ft. advanced development and production facility for the specialty battery production discussed earlier, as well as a development and production capability for high-temperature ceramic matrix composites important in hypersonic missile technology. PSI invested over $3 million in facility improvements and capital equipment. Those operations were taken through ISO-9001 certification to meet the quality needs of our prime contractor customers.

Radiation Detection System Production – In 2022 we transitioned our radiation detection system production operations to a 15,000 sq. ft. facility, expanding it to 25,000 sq. ft. in 2024. This facility produces stanchion and gantry-based detection systems for fixed site operations as well as receives and modifies vehicles for law enforcement operations, and then equips them with advanced mobile radiation detection capability. In addition to ISO-9001 quality certification, this facility possesses special radiation material handling capability with associated trained personnel and licensing.

Unmanned and Deployable Systems – Also in 2018 we opened a 35,000 sq. ft. facility for the development, production and testing of small, unmanned quadcopters for solder use, ultimately supplying over 2,500 systems for troops deployed in areas of operation that included Iraq and Afghanistan. The facility included an FAA approved site for flight operations as well as ISO-9001 and FAA Part 105 certifications for its operations and personnel. Recent capital investments in that facility, exceeding $1 million, include a 3-D printing capability to develop high performance aerospace heat exchangers and a special thermal processing to produce advanced components used in spacecraft thermal control.

Energetics and Propulsion - In 2015 we opened a special facility for the production and testing of energetic systems (propellants, explosives, rocket engines, and rocket motors). Its opening was the initial step in the transition of early SBIR-funded laboratory stage production of energetic materials to the larger quantities of material and special test facilities necessary to demonstrate performance of these advanced systems at scales acceptable to the acquisition community. Elements of the facility require recertification by the Defense Contract Management Agency with each new contract award as well as licensing by other federal, state, and local authorities. The facility requires special capabilities for the production, storage, handling, and disposal of these materials. Site and capital investments of approximately $1 million have been made in the facility, which must operate over a large land footprint for safety reasons.

In total our company occupies approximately 175,000 sq. ft. of RDT&E and production space in three states as well as a 13-acre energetics facility. We recently announced a planned $5.6 million expansion of our chemistry facilities to scale up the production of non-energetic components and a

complementary $3.0 million expansion of our energetics facility to increase the quantities and scale at which these systems can be produced and evaluated. We have invested over $40 million in facilities and capability enhancements over the last decade.

These capabilities are unique, address problems that do not scale to commercial markets, and therefore require a level of funding stability consistent with making investments in facilities over a 10 year period and capital equipment over a 5 year period. Reauthorization of the SBIR and STTR programs over these time scales, without restrictions on merit-based awards available to the "system innovator" companies making these investments, is needed to insure as a nation we continue to develop these advanced capabilities.

SBIR as Venture Capital

There have been suggestions that the SBIR and STTR programs should behave as pure venture capital funds, supporting companies on a single-technology linear path to a commercially successful outcome with time-limited funding and a mandate to "graduate" from the program. We strongly disagree. Despite acquiring the slogan "America's Seed Fund," that singular intent of the program was not enshrined in its 1982 creation or subsequent execution. It would not serve the needs of the mission agencies of the US government that provide the largest segment of funding for the program.

It is important to understand the different objectives of venture capital and mission agency technology investment. Venture capital invests to obtain the largest possible monetary return, at the highest possible margin, in the shortest time frame. Mission agencies invest to obtain a capability return not available commercially, at the lowest possible margin, on timescales consistent with platforms that take over a decade to develop, and often at market sizes that are not attractive for commercial investment.

This contrast, and its consequence, was identified in the 2019 Council on Foreign Relations – Independent Task Force 77 report entitled "Innovation and National Security: Keeping Our Edge." [2] That task force was co-chaired by Admiral William McRaven, the retired commander of the US Special Forces Command and former Chancellor of the University of Texas system. The report identified a shift in venture capital investment in software vs hardware from a 55%/45% split in 2006 to a 92%/8% split in 2017.

The report offered the following explanations for this disinvestment in hardware: "Companies built around hardware face high risk in terms of technology development and high costs associated with building research facilities, attracting scientific expertise, and manufacturing." Furthermore: "Given the smaller risks of investing in software, VC firms funnel the vast majority of their investments to software, resulting in a funding gap for hardware." It noted that "Weapons platforms that involve large numbers of warfighters in the loop, such as airplanes, submarines, and ships, will always demand longer development times, exceptional performance, and steady oversight" and "not everything, of course, can fail fast."

To improve their economic outcomes, the venture-only advocates have stated that SBIR funding should only go to technologies that can "scale" to commercial as well as mission agency applications. This approach would severely limit the ability of the program to invest in those specialized capabilities that do not meet this scaling criteria. Furthermore, this approach tends to "commoditize" our capabilities to a level of commercial performance that is easily copied and hence readily available to our adversaries. The suspicion that the Chinese Large Language Model *DeepSeek* is built on Open AI's *ChatGPT* is only the latest example of this form of technology transfer.

The US won World War II in part based on its superior industrial strength and population advantage. Since that era, the US has relied on the doctrine of "overmatch," in which superior capability rather than superior number is used to deter and defeat our adversaries. In the 1991 war to liberate Kuwait, within a week, Iraq went from having the 4th largest army in the world to having the 2nd largest army in Iraq as a result of overmatch. And at the pivotal World War II battle of Midway it was Japan's four aircraft carriers that "failed fast" as a result of our superior code breaking capability. Arbitrarily limiting the ability of capable small businesses to contribute to future overmatch, based on a misconceived technology funding doctrine, portends a commodity-equipped US military going up against an industrial peer with four times our population.

SBIR Reauthorization

A common theme in the discussions surrounding the reauthorization of the SBIR/STTR programs is the difficulty small technology firms experience in bringing new technology to the needs of the US government. That difficulty is present whether the firm is an experienced business like ours or a new entrant into the program. The challenge of the programs' reauthorization is to reduce barriers to entry and broaden, not restrict, participation in the program. The reauthorization should reinforce several principles:

Merit-based Awards - Congress should maintain the competitive, merit-based fundamentals of the program to insure the best technology is developed. The congressionally-mandated Government Accounting Office (GAO) review of the program showed that Multi-award Winners were effective in meeting their 4.5X increase in performance metrics and that there were no "SBIR Mills" crowding out other small businesses by any accepted measure of market concentration.[3] There should be no arbitrary award caps, highly restrictive submission limits, or forced graduation from programs. The ability of most multi-award winners to meet the enhanced participation metrics included in the 2022 legislation that reauthorized SBIR/STTR programs indicates the intent of the program is being met.

Agency Discretion - Agencies should have discretion to shape the program and define merit consistent with their missions. The GAO found that multi-award winners are regularly selected to research and develop technologies that meet specific agency or warfighter needs without wider applications. Multi-award winners should not be penalized for those agencies' lower rate of adoption and commercialization potential. The ability of a small business to submit proposals should not be unreasonably restricted so as to effectively limit competition or to inhibit the federal government's ability to secure the very best technology it wants/needs.

Improved Communication – Agencies should be required to improve the communication of their needs and opportunities to small businesses across all topic types. Open topics provide a way to make topic managers aware of potential technology solutions, but their lack of specificity can deprive companies of the ability to tailor their proposals to meet specific needs that might improve their potential for award and ultimate technology transition.

Application Simplification – Perhaps the largest barrier to participation in the program for new entrants is the increased administrative burden and complexity of proposal submission. Safeguards to address foreign influence and technology transfer, however necessary, have further increased that barrier. A myriad of proposal formats and solicitations, changes in how proposed program staffing is reported, and now mid-program changes in the allowability of administrative and facility costs have made it difficult for even the most sophisticated organizations to participate in the program. Data has shown that per capita proposal submission rates from underserved regions of the country are some of the lowest in the program, reflecting those barriers.

Permanent Authorization – Companies make investments based on an assessment of their ability to grow and recover that investment. The GAO report identified investments in dedicated testing, training, contracting, IT, and business processes as key to receiving awards from the DoD. Commercialization of technologies requires investment in capital equipment and facilities, with long depreciation times, to be viewed as reliable suppliers. Program permanency reduces the concern that those investments will be stranded at the next reauthorization without limiting the ability of Congress to make further adjustments to the program.

Organizations across the political spectrum that have reviewed the SBIR program have remarked that it is "disproportionately effective," "invests more in America's heartland than venture capital invests," and "overcome the tendency of federal contracting officers to deal only with large firms that are familiar to them and have the expertise and lobbying clout to navigate the federal procurement process." At a time when the Defense Industrial Base is shrinking, companies funded through the SBIR/STTR program are strengthening it across multiple domains.

Thank you again for the opportunity to participate in this hearing. I look forward to answering your questions.

Citations

[1] National Academies of Sciences, Engineering, and Medicine. 2024. Data and Metrics for the DOD SBIR and STTR Programs: Proceedings of a Workshop. Washington, DC: The National Academies Press. https://doi.org/10.17226/27984.

[2] James Manyika and William H. McRaven, Chairs, Adam Segal, Project Director, "Innovation and National Security: Keeping Our Edge," Report of the Council of Foreign Relations Independent Task Force 77, September 2019 (https://www.cfr.org/report/keeping-our-edge/)

[3] Government Accounting Office Report, "Small Business Research Programs: Increased Performance Standards Likely Affect Few Businesses Receiving Multiple Awards," GAO-24-106398, March 2024.