STATEMENT OF
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BEFORE THE
COMMITTEE ON SMALL BUSINESS
U.S. HOUSE OF REPRESENTATIVES

APRIL 22, 2009

Madam Chairwoman and Members of the Committee: Thank you for inviting me to speak today about the Small Business Innovation Research (SBIR) program at the Department of Energy (DOE).

The Office of Science manages the SBIR program for the Department and has done so since the SBIR program was formed in 1982. In addition to the Office of Science (SC), six other DOE programs participate in the SBIR program: Defense Nuclear Nonproliferation, Electricity Delivery and Energy Reliability, Energy Efficiency and Renewable Energy, Environmental Management, Fossil Energy, and Nuclear Energy. Some areas of the Department are exempt by law and do not contribute to SBIR, including Naval Reactors and other national security programs.

The statutory SBIR program has several purposes: to stimulate technological innovation; to use small businesses to meet Federal research and development (R&D) needs; to foster and encourage participation by socially and economically disadvantaged small businesses; and to increase private sector commercialization of innovations derived from Federal research and development.

The Department's SBIR goals include: funding high quality projects with relevance to the Department's mission needs; increasing private sector commercialization of technology developed through DOE SBIR-supported R&D; stimulating technological innovation in the private sector; and improving the return on investment from federally-funded research for economic and social benefits to the nation.

In accordance with the U.S. Small Business Administration's (SBA) SBIR Policy Directive, the SBIR program is administered in three phases. Phase I is to evaluate the scientific or technical merit and feasibility of ideas that appear to have commercial potential. Phase II builds on Phase I work and encompasses the core of the research and development effort. Phase III refers to work that derives from, extends, or logically concludes efforts performed under SBIR funding agreements, but is not itself funded by the SBIR program. Phase III work funded by the respective program office is typically oriented towards commercialization of the SBIR research or technology. That is, the SBIR funding pays for research or R&D meeting DOE objectives identified by the DOE

(Phases I and II); non-SBIR investment provides follow-on developmental funding to meet commercial objectives (Phase III).

The Office of Science also manages the Small Business Technology Transfer (STTR) program, which was established in 1992. The major difference between the SBIR and STTR programs is that STTR grants must involve substantial cooperative research collaboration between the small business and a research institution. At least 40 percent of the research or analytical effort must be allocated to the small business, and at least 30 percent of the effort must be allocated to a single research institution. The budget for DOE STTR program is also much smaller than SBIR. In Fiscal Year (FY) 2008, the STTR program was funded at $15 million, while the SBIR program was funded at $124 million. FY 2009 funding levels and awards are still being determined.

A portion of DOE's funds appropriated under the American Recovery and Reinvestment Act of 2009 are eligible for the SBIR set-aside. The Department plans to award these funds in accordance with current allocation procedures discussed later in this Statement.

SBIR PARTICIPATION

Over the 26 years of its existence, the SBIR program has matured and evolved significantly. We have issued 26 Phase I solicitations, reviewed approximately 34,600 proposals, and funded over 4,900 Phase I projects and 2,000 Phase II projects. Each year we have issued the solicitation on schedule, met the deadline for the selection of both Phase I and Phase II awards, and published abstracts of our Phase I and Phase II projects.

In FY 2008, the Department received 1,494 Phase I grant applications from 756 companies of which 1,246 were sent out for external peer review. We selected 318 applications for Phase I awards resulting in grants to 191 small businesses in 33 states. Sixty of the 318 grantees were first time winners with DOE. Eleven of the applicants selected for funding were from socially and economically disadvantaged small businesses and 15 were from small businesses located in a HUBZone (historically underutilized business zone).

Below are additional statistics:

Year	**2005**	**2006**	**2007**	**2008**
Number of Applications Submitted	1558	1387	1318	1494
Number of Applications Peer Reviewed	1100	1062	1075	1246
Number of Awards Made	389	289	318	318
Number of Individual Companies that Submitted	823	700	672	756
Number of Companies with Funded Projects	179	173	189	191
Number of First-time Awardees	80	62	74	60

Year	2005	2006	2007	2008
Number of Small & Economically Disadvantaged Small Business Awardees	31	33	22	12
Number of Woman-owned Small Business Awardees	33	29	32	31
Number of HUBZone Awardees	9	14	23	15

PROGRAM EFFECTIVENESS

Awards from the SBIR program help small businesses attract investment by affirming that the companies have excellent technical capability, thus reducing some of the uncertainty involved in early-stage investment. Several comprehensive reviews of the SBIR program by the Government Accountability Office (GAO) have found it to be successful in enhancing the role of small businesses in Federal R&D, stimulating commercialization of research results, and supporting the participation of small businesses (Testimony before the Subcommittee on Environment, Technology, and Standards, Committee on Science, House of Representatives, *Federal Research: Observations on the Small Business Innovation Research Program*, June, 28 2005, GAO-05-861T, and references therein). Furthermore, a recently completed National Research Council (NRC) of the National Academies study entitled *An Assessment of the SBIR Program at the Department of Energy* concludes that the DOE SBIR program "is making significant progress in achieving the congressional goals for the program. The SBIR program is sound in concept and effective in practice…" DOE's SBIR program has supported excellent research, resulting in spin-off companies and technologies, and is a model with respect to the commercialization assistance program. According to the SBA, DOE was the first agency to offer commercialization assistance to awardees beginning in 1990.

PROGRAM MANAGEMENT OVERVIEW

The SBIR program complements the Department's other R&D funding mechanisms. SBIR is regarded within the Department like any other R&D program, namely, as a vehicle by which the Department accomplishes its R&D objectives. SC's long history of using merit-based review of grant applications and its thorough understanding of scientific and technical research are key elements in our successful management of the SBIR program. As with other SC programs, the scientific/technical evaluations of SBIR grant applications are performed by external researchers expert in the subject area. SC's relationship with the scientific community, from which the peer reviewers are drawn, is extensive.

Cooperation throughout the Department in administering the SBIR program is achieved through a balance of centralized and decentralized management. The SBIR program is centralized in the setting of schedules, procedures, scoring guidance, final award selections, and all logistics relating to the processing of proposals. It is decentralized in that the SC and DOE technology program offices are responsible for developing specific

research topics that support their mission goals, identifying peer reviewers, and providing a priority ranking of grant applications to be considered for funding.

Some current technical topic titles include: technology to support Basic Energy Sciences user facilities; technologies related to energy storage for hybrid and plug-in hybrid electric vehicles; advanced water power technology development; climate control technology for fossil energy applications; high-speed electronic instrumentation for data acquisition and processing; carbon cycle measurements of the atmosphere and the biosphere; nuclear physics instrumentation, detection systems, and techniques; scalable system software for petascale computer systems; advanced technologies and materials for fusion energy systems; simulation and software tools for nonproliferation R&D; advanced technologies for electricity systems; improved characterization of waste in tanks and ancillary piping; advanced technologies for nuclear energy.

Within the SBIR office, an oversight review of the scoring of SBIR grant applications is conducted to assure that any proposal recommended for funding is supported by the set of peer reviews for that grant application. We believe that SC's management practices, with emphasis on quality science and technology, are critical to maintaining the integrity of this process.

METHODOLOGY FOR DETERMINING GRANT RECIPIENTS

The Department issues an annual combined solicitation for the SBIR and STTR programs. The solicitation typically contains approximately 50 research topics, and small businesses with strong research capabilities in science or engineering are encouraged to apply. The solicitation is advertised on Grants.gov, the Federal Government's Web Portal for all federal grant applications and also the Department's E-Center (http://e-center.doe.gov) for all DOE Business and Financial Assistance opportunities available.

Additionally, we use the internet, regional and national conferences, and trade journals to ensure the applicant community is well informed about SBIR and to encourage a high number of grant applications. The SBIR electronic mailing list consists of over 12,000 small businesses.

Phase I grant applications are judged on a competitive basis against other applicants within the same technical program area (e.g., Fossil Energy, Energy Efficiency and Renewable Energy) in several stages. First, all are screened initially by DOE technical managers to ensure that they meet stated funding opportunity notice requirements; are responsive to the topic and subtopic category; contain sufficient information for a meaningful technical review; are for research or for research and development; and do not duplicate other previous or current work. Grant applications which fail to pass the initial screening are declined.

Second, grant applications that meet the conditions above are further evaluated by outside independent scientific and engineering experts who are selected by DOE technical program managers. About 1800 experts completed over 3,900 merit reviews of the

approximately 1,200 Phase I applications that made it through the first step. Similarly, about 670 individuals also completed over 890 merit reviews of 280 Phase II applications. The external reviewers evaluate each proposal in terms of three criteria:

- **Strength of the Scientific/Technical Approach,** as evidenced by the innovativeness of the idea and the approach; the significance of the scientific or technical challenge; and the thoroughness of the presentation.

- **Ability to Carry out the Project in a Cost Effective Manner,** as evidenced by the qualifications of the principal investigator, other key staff, and consultants, if any, and the level of adequacy of equipment and facilities; the soundness and level of adequacy of the work plan to show progress toward proving the feasibility of the concept; and the degree to which the proposed project budget is justified by the research plan.

- **Impact,** as evidenced by the significance of the technical and/or economic benefits of the proposed work, if successful; the likelihood that the proposed work could lead to a marketable product or process; and the likelihood that the project could attract further development funding after the SBIR project ends.

DOE makes selections for Phase I awards from those grant applications judged to have the highest overall merit within their technical program area, with approximately equal weight given to each of the criteria above. DOE will not fund any grant application for which there is a reservation with respect to any of the three evaluation criteria, as determined by the review process. In addition, because DOE has developed a process intended to support only high quality research and development, grant applications will be considered candidates for funding only if they receive strong endorsements with respect to at least two of the three criteria.

Third, from the candidates for funding following peer review, each of the participating DOE program areas make selections. Final decisions are made by the DOE SBIR/STTR program manager based on the recommendation of the technical managers and consideration of other factors such as budget and program balance. On average, about 1 out of every 5 grant applications is selected for funding.

The Phase II methodology is the same, except that a commercialization plan is also evaluated as part of the Impact criterion. As with Phase I, Phase II grant applications are sent out for external peer review by independent experts. Phase II applicants must be prior DOE Phase I recipients. About half the Phase II grant applications are selected for funding.

The Department's SBIR program does not provide Phase III funding; however, we offer commercialization assistance to Phase I and II awardees, which I will describe later.

DOE SBIR ADVISORY BOARD

Because the SBIR program impacts six DOE organizations in addition to the Office of Science, a Department-wide SBIR Advisory Board, comprised of Deputy Assistant Secretary-level representatives from the twelve DOE program offices (including six program Associate Directors within the Office of Science) participating in SBIR, was established in 1996 to provide policy advice to the Director of the Office of Science on the conduct of the SBIR program.

All major policy decisions affecting the SBIR program must be endorsed by the SBIR Advisory Board before being implemented. Over the years, the SBIR Advisory Board has expressed a high level of satisfaction with the management of the SBIR program within the Office of Science in cooperation with the other DOE program offices.

ALLOCATION OF FUNDING

Within the Department, individual programs separately determine their methodology for taking the 2.5 percent assessment on the extramural R&D budget to fund SBIR projects. Typically, about 25 percent of the funds are spent on Phase I grants and 75 percent are used for Phase II. Each technical program area participating in SBIR is allotted its contribution of the set-aside to spend on projects pertaining to its particular research program, provided a sufficient number of high quality grant applications are available. The SBIR office oversight procedures assure that only high quality grant applications are awarded in each program area. The technical managers from the programs across the Department are very supportive of this funding allocation process.

COMMERCIALIZATION ASSISTANCE

Many of the SBIR awardees have excellent skills in science and engineering research but lack experience in product development, financing business growth, raising venture capital, and marketing. In accordance with a statutory program purpose of increasing private sector commercialization of innovations derived from Federal R&D, the Department provides funding for commercialization assistance. The SBIR law allows each agency to use a portion of the SBIR set-aside funds for discretionary technical assistance like commercialization. Companies participate in DOE's commercialization assistance services at no cost and participating research programs benefit from early introduction of mission-related technology into the marketplace.

These services are delivered through a competitively selected contract that includes the following:

Trailblazer™, initiated early in Phase I to support Phase II application, develops market data and participation required for concurrent engineering-based product or service development. Both literature searches and interviews are conducted. The program runs six weeks and helps businesses identify major market niches for commercialization, determine key requirements and traits for market-viable products or services, develop a value for the technology that gives it a competitive advantage, identify feasible vehicles for commercialization, and map out a path into the market.

Deal Advisories™, initiated mid-Phase II to evaluate the value of the technology to prospective Phase III partners, uses computer-based templates to explore commercialization deals by establishing a sequence of tasks for the completion of R&D, transitioning the technology development into production, and transitioning the technology product into the market. Deal Advisories™ also identifies critical path tasks and milestones for commercialization. The program helps to identify associated costs, required resources, outputs, and metrics for success, duration, and intellectual property concerns for each task, which can be used to track and evaluate post-deal progress. Deal Advisories™ can also be used to identify potential technology, knowledge, and capability gaps in product development and in transitioning into the market and make suggestions for risk reduction. The duration of this program is six weeks.

Technology Niche Analysis™, initiated mid-Phase II to identify Phase III partners, assesses potential applications for a technology. Both literature searches and interviews are conducted. For each viable application, Technology Niche Analysis™ identifies the needs and concerns of end-users which drive the competitive opening; competing technology and products; the competitive advantage of the technology and market drivers; key standards, regulations, and certifications influencing buyer acceptance; potential customers, licensees, investors, or other commercialization partners (targets specified by participant preferences); and a commercialization strategy, together with tasking and a schedule for implementation of the strategy and design suggestions for the product. Targets are contacted to ensure they are viable leads and to collect important information for follow-up deal-making. Points of contact are included. This program lasts for six weeks.

ADVANCING INNOVATION

The NRC's "Assessment of the SBIR Program at the Department of Energy" noted that the DOE SBIR Program has made significant progress in stimulating technological innovation in three important ways:

1) Generating patents and publications: A significant number of the projects responding to the NRC Phase II survey (43 percent) reported at least one patent application and nearly half of the projects surveyed resulted in at least one peer reviewed article.

2) Stimulating the transfer of technology from universities to the market: About one-third of the projects in the same survey had some alignment with a university, through the use of university faculty as contractors on the project, use of universities as sub-contractors, or employment of graduate students.

3) Indirect paths: Case studies in the NRC study provided anecdotal evidence that projects provide investigators and research staff with knowledge that may later become relevant in a different context (e.g. in another project or as an employee of another company).

Furthermore, the DOE SBIR program conducts its own annual survey of Phase II grantees. The survey requests companies to: (1) list all products and services derived from their DOE SBIR projects; (2) report on both sales and/or Phase III investment related to these products and services; and (3) identify which Phase II projects contributed to the development of the products and services. Approximately 90 percent of Phase II grantees respond to the annual surveys.

Since the inception of the SBIR/STTR programs, the Department has invested $1.6 billion in SBIR and STTR Phase I and Phase II grants. Survey data indicate that in return, approximately 60 percent of Phase II-supported companies have earned a total of more than $1.7 billion in sales and $1.4 billion in additional Phase III development funding – although the precision of those self-reported numbers cannot be verified. Sixty-seven percent of this additional Phase III development has come from non-federal sources, thus further helping the nation capitalize on its substantial R&D investment.

Projects funded by SBIR tend to be high-risk, however, and therefore a relatively small percentage of these companies received a significant portion of the $3 billion in Phase III funding. The survey data indicate that 61 percent of the businesses had received Phase III sales or further development investment. Similar to small start-up companies supported by non-Federal and venture capital funds, a small percentage of the small businesses funded by the DOE SBIR program achieve large commercial successes.

In addition to the potential for commercial success, SBIR funded innovations advance the DOE mission in critical areas. The lithium-ion batteries developed by A123 Systems, for example, have an unprecedented combination of power, safety, and long-life compared to previous lithium-ion batteries. A123 Systems and Chrysler recently announced a strategic partnership whereby A123 Systems will supply the energy storage systems for Chrysler's first-generation ENVI Electric Vehicles. This innovation also has applications to cordless power tools and hybrid-electric vehicles. SBIR funds also allowed Green Wood Resources to begin a poplar hybridization program, which is part of a larger study examining ways to make poplars a better source of renewable fuel. Further examples of SBIR innovations are found in the table below.

Company	**Technology/Process developed**	**Technology's purpose**	**Technology's application and benefit**
A123 Systems	Lithium-ion battery technology based on doped nanophosphate cathode materials	Produce lithium-ion batteries with unprecedented power, safety and life using low-cost, widely available, environmentally-friendly raw materials	Higher powered solutions for the aerospace, electric (including hybrid) vehicle, and defense industries

Company	Technology/Process developed	Technology's purpose	Technology's application and benefit
Advanced Fuel Research	Optical technique for measuring radiative properties	Analysis of gases and surfaces	Better quality products for the semiconductor industry.
Amonix, Inc.	Photovoltaic Power System	Create cost-effective solar generating systems	Generate clean, renewable power at low cost
Atlantia Offshore, Limited	Floating platform	Enable deep water oil and gas drilling	Oil and gas development of new U.S. offshore fields in the Gulf of Mexico
Ceramatec, Inc.	Shock resistant and temperature-tolerant ceramics	Components for diesel engines and diesel filters	Energy efficient engines and turbines
Deep Web Technologies	Web-based search engine with relevance-ranking	Optimize desired search results in multiple database internet searching	Obtain desired information from publicly accessible government R&D databases
Duly Research	Photoelectron linear accelerator	Create a cost effective injector for use in accelerators	Improve future linear colliders, synchrotrons, x-ray sources for research and medical applications
Fuelcell Energy, Inc.	Ceramic fibers	Carbonate- based fuel cells	Increases life and availability of Direct FuelCell that can achieve electric efficiency greater than 70%
Green Wood Resources	Energy feedstock	Analysis to improve caloric value and chemical composition of poplars by selective breeding	Make poplars a better fuel source
MacConnell Research Corp.	Automated blood purifier for molecular biology applications	Smaller, faster, cheaper instrument for DNA purification and analysis	DNA sequencing, genomic research, drug development

Company	Technology/Process developed	Technology's purpose	Technology's application and benefit
Precision Combustion	Catalytic combustor	Reduce engine pollution of gas turbines	Cost-efficient retrofits of existing gas turbine engines to meet emission requirements
Wind Tower Systems, LLC	Wind turbine tower	Towers that can support turbines at greater heights with less weight and cost	Develop lighter-weight, modular wind turbine towers
X-Ray Optical Systems, Inc. (XOS)	Polycapillary Optics and Doubly Curved Crystal Optics	Enhance the performance of X-ray and neutron analytical instrumentation	Improved spatial resolution, orders of magnitude increases in intensity, and a significant reduction in background radiation for materials analysis

JOBS CREATION AND RETENTION

Due to low administrative overhead within the SBIR program, the program does not rigorously track job creation and retention data. The estimates presented here are based on our own budget-related data for Phase I, and findings of the 2008 National Research Council study, "An Assessment of the SBIR Program at the Department of Energy," that includes a survey of Phase II awardees.

Our Phase I budget data show that about 90 percent of Phase I awards go to labor costs. We conservatively estimate that these awards employ one person for the six to nine month duration of the award. With over 5000 Phase I awards made so far, we estimate that over 3,000 person-years have been supported through SBIR and STTR Phase I awards since the program began.

The NRC study found that, on average, Phase II awards employ about three people per project (averaging about 1.5 hires and 1.5 retentions.) With over 2,000 Phase II awards granted so far, we estimate that about 12,000 person-years were supported through SBIR and STTR Phase II awards since the program began.

The NRC assessment further finds that nearly one-quarter of all small business SBIR grantees surveyed indicate that their companies were founded entirely or partly because of an SBIR award; and that DOE SBIR support directly resulted in noticeable, though minor, employment growth among DOE respondents.

Potential Areas for Improvement

The DOE SBIR program provides a mechanism for the Department to support high-risk, high-return research through small businesses, resulting in innovative new technologies. The commercial impact of this innovation could be strengthened by increasing the provisions for discretionary technical assistance within the existing set-aside allowed by law under SBIR.

SBA project funding limits in Phase I and Phase II are not adequate to support a strong technical assistance program, including commercialization assistance. Currently up to $4,000 above the awarded amount can be used per Phase I award for commercialization assistance activities and up to $4,000 per year (included within the awarded amount) can be used for each Phase II award for commercialization activities. SBIR Phase II recipients have indicated in qualitative surveys that the commercialization assistance programs and services offered by DOE's SBIR program are valuable to their product development and commercialization efforts.

The SBIR and STTR programs currently do not rigorously track the impact of awards on employment. Measuring this impact is not trivial. Making a small fraction of the existing SBIR set-aside available for agency administrative purposes would provide the resources needed to do rigorous tracking. These administrative funds could also improve the evaluation of the successes of participating small businesses and their impacts on DOE mission goals. More comprehensive, long-term data collection would allow better assessment of the results of the programs and enable the programs to adjust management practices as appropriate

CONCLUSION

The DOE SBIR and STTR programs currently provide about $150 million each year to small businesses to help entrepreneurs take their ideas from conception to reality. The Department has benefited from small business participation through the technologies the small businesses have developed and the new knowledge gained from SBIR funded research that contributes to the Department's R&D activities. Successful collaborations between small businesses and the DOE R&D complex have advanced the Department's missions to improve the Nation's energy, economic, and national security with new insights and innovative technologies, including improved batteries for energy storage, advances in particle accelerator technology, experiments to develop poplar trees as energy sources, and development of improved wind turbine towers.

Small businesses are usually agile, tend to produce quickly with low overhead, and have demonstrated success in developing niche technologies, which often support the Department's larger projects. High-technology small business grantees, many of whom started in business as a result of SBIR awards, have become a valuable resource for solving high risk, high technology problems. Solving these high technology problems will continue to be essential to meeting the Nation's current and future energy challenges.