STATE OF MICHIGAN
DEPARTMENT OF LICENSING AND REGULATORY AFFAIRS
LANSING

RICK SNYDER
GOVERNOR

STEVEN HILFINGER
DIRECTOR

Bureau of Energy Systems

SBIR/STTR: Catalyst for Alternative Energy-related Breakthrough Technology Innovations by Michigan Entrepreneurs

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Introduction

Green Technologies, such as Energy Efficiency (EE) and Alternative Energy (Renewable) Technologies (AET), are driving a host of rapidly growing global markets that have great potential for Michigan's combined community and economic reinvention. EE/AET encompasses six (6) broad market segments and more than twenty-five (25) market sub-segments, including:

- Clean Energy (Energy Efficiency, Renewable Energy (e.g., Wind), Energy Infrastructure, Energy Storage);
- Clean Water (Water Purification, Water Treatment, Water Conservation);
- Sustainable Transportation (Electric/Hybrid-electric Vehicles, Biofuels, Mass Transportation);
- Green Manufacturing (Green Chemistry, Advanced Eco-Materials);
- Pollution Control (Pollution Prevention, Lean Manufacturing, Green Production, Pollution Monitoring, Remediation); Resource Recovery (Recycling, Composting, Waste-to-Energy); and,
- Sustainable Living (Green Construction, Green Products, Sustainable Agriculture/Aquaculture, Organic Food).

EE/AET-related technology advancement and innovation will require significant and highly targeted investments in research and development in areas where Michigan has exceptional technical expertise. Moist importantly, opportunities for innovation – and hence business growth and prosperity - abound in the EE/AET markets.

Michigan's Small Business Entrepreneurs, Intrapreneurs and Social Entre/Intrapreneurs & EE/AET Innovation

Michigan's entrepreneurs (i.e., Small Business Entrepreneurs, Intrapreneurs and Social Entre/Intrapreneurs*)* have a critically important role to play in EE and AET. Research shows that small business entrepreneurs generate the lion's share of innovation, wealth and prosperity in the U.S. and, as such, are vitally important to the research, development and – most importantly – *commercialization* of EE/ATE-related breakthrough technologies, products and processes. Furthermore, the federal government has Departments, Agencies and programs that regularly provide grants for ***Commercially Viable*** R&D grant topics to small businesses (500 employees or less).

One such program – ***Small Business Innovation Research (SBIR)/Small Business Technology Transfer (STTR)*** – provides R&D grants to small businesses in the range of $100,000 (Phase I) to $1,000,000 (Phase II).[1] The National Science Foundation SBIR/STTR, Commercialization Assistance Program, provides an excellent example of how entrepreneurs can use government-sponsored R&D grants to development and, most importantly, commercialize breakthrough technology innovations, products and processes. Dr. George Vermont, NSF SBIR, has led an effort to catalog and track the

[1] Some of Michigan's most prominent cutting-edge commercial businesses – such as A123 Systems (formerly T/J Technologies) and Energy Conversion Devices, Inc. – used SBIR/STTR funding to drive the research, development and commercialization of their breakthrough proprietary technology innovations and related portfolio and to leverage their continued market leadership.

commercialization of NSF SBIR/STTR funded projects. With data in 3, 6, 9 and 12 year increments, the following are the highlights of the Assessment:

NSF SBIR/STTR Commercialization Success Rate:

- 41% of SBIR Phase II awards were Fully or Imminently successful;
- 64% of Phase IIB's were commercially successful even though the IIB award rate was 35%. (Phase IIB Projects have Commercial MERIT). Phase IIB's supported by industry have an even higher success rate (83%);
- 38% were still in the research or early-stage commercialization process; and,
- 21% were terminated as unsuccessful.

The National Science Foundation SBIR/STTR program is also one of the leading SBIR/STTR programs in the nation for funding *commercially-viable* AET-related R&D projects. For example, the following are EE/AET-related R&D grant opportunities (http://www.nsf.gov/eng/iip/sbir/2009_nam.jsp):

Alternative Energy

- Energy Harvesting
- Energy Conversion and Storage
- Sensing Systems and Sensing Tools

Advanced Materials

- **AM1 – Electronic and Magnetic Materials:** Material innovations for new functionalities or improved performance in electronics and magnetics applications. Includes conductors, semiconductors, wide-bandgap materials, insulators, dielectrics, and magnetic materials for applications in CMOS systems, lithography and printing, flexible electronics, data storage etc.
- **AM5 – Structural Materials:** Material innovations to improve the performance of materials in structural applications, including advanced composite materials, structural foams and other lightweight materials, structural alloys, structural ceramics; and new processing techniques for structural materials (including materials related to these processes, such as adhesives, sealants, fillers, additives, and binders).
- **AM6 – Coatings and Surface Modification:** Material and process innovations in surface modifications and coatings. Includes coatings for improved corrosion and wear resistance, surface modifications for specialized applications such as superhydrophobic or biologically/chemically active surfaces, techniques to improve manufacturability, deposition rate, reduce cost etc.
- **AM8 – Materials for Sustainability:** Material innovations designed for improved sustainability, mitigating adverse environmental impacts, and/or improved public health. Includes materials for energy efficiency or energy conservation applications, and new processes and techniques which allow increased use of non-toxic, green, recycled, and/or organic materials.

Manufacturing

- **Manufacturing Processes:** Innovative processes for molding, forging, casting, joining of dissimilar materials, with an emphasis on environmentally benign manufacturing techniques. Projects leading to the development of new processes and control techniques, including new hybrid techniques to achieve net shape products and complex multi-scale, multi-functional products with superior quality and performance.
- **Machines and Equipment:** Innovations in machine and control system design for applications in the manufacturing and construction industry that will produce improved efficiency and/or reduced cost. The application of sensors and sensed data to improve throughput, quality and/or performance is also supported.
- **Modeling and Simulation:** Innovations in modeling and simulation of enterprise operations, manufacturing processes, machines and equipment, including predictive modeling of tooling and machine performance, and discreet event simulation of manufacturing systems.

IT and Software

Energy Efficiency and Alternative Energy-related information technology and software are promising high tech industries that have great potential for Michigan communities. The National Science Foundation's SBIR/STTR Program, for example, conceptualizes Information and Communication Technologies in the form of a five-layer stack, with each layer being built upon the previous layer (At the foundation of the IC stack are devices. Devices are the building blocks for Components that are assembled into Systems built for Applications that are

employed to deliver Services. NSF SBIR/STTR R&D grant opportunities in IT and Software areas[2] for EE/AET are listed below:

Services • Security and privacy • Knowledge discovery, search, data mining, data management and/or visualization • Virtualization	**Applications** • Mobile applications • Tools for facilitating collective intelligence • Collaboration-enabled applications • Component/devices design/test software
Systems • Energy and Power Management Systems o Portable sources for mobile technologies o Energy Scavenging/harvesting o Smart grids, buildings and circuits o Compact energy conversion systems o New storage technologies • Engineering systems and critical infrastructure innovations	**Components** • Micro-Electro-Mechanical Systems (MEMS) • Sensors Packaging and thermal management **Devices** • Ultra low-power semiconductor transistors • Novel device or chip architectures • ICs with novel materials Quantum-effect devices

In addition to the National Science Foundation, EE/AET related SBIR/STTR funding opportunities also exist in several other federal department and agency programs including, but not limited to the following:

U.S. Department of Defense (http://www.dodsbir.net/)
U.S. Department of Energy (http://www.er.doe.gov/sbir/)
Environmental Protection Agency (http://www.epa.gov/ncer/sbir/)

SBIR/STTR: Platform for Robust Collaboration

In the 1970s, the lion's share of the R&D 100 award-winning U.S. innovations came from corporations acting on their own behalf. Over the past two decades most of these award-winning innovations came from partnerships involving business (large, medium and small) and government (including federal labs and federally funded university research). Indeed approximately two-thirds of award-winning U.S. innovations now involve some kind of inter-organizational collaboration.[3]

According to the 2008 report from the Information Technology and Innovation Foundation, there is, in short, "a high degree of consensus that successful technological innovation now requires the assembly and management of multidisciplinary teams that bring together different types of expertise."[4] In his work titled "The Technology Imperative," Gregory Tassey describes this phenomenon as follows:

> "… for better or worse, the U.S. innovation system today is much more collaborative than it was several decades ago and the federal government is playing a much more supportive and important role in innovation. Several factors explain this phenomenon: (1) growing global competition is shrinking technology life cycles; (2) the complexity of emerging technologies is beyond the internal R&D capabilities of even the largest firms; (3) the expansion of R&D capability in more industries is causing R&D investment to spread vertically in high-tech supply chains, which increases the potential for the loss of value added from a single domestic economy; and, (4) a growing number of nations are responding to these trends by implementing new mechanism that increase the efficiency of R&D"

[2] See: http://www.nsf.gov/eng/iip/sbir/2009_ict.jsp
[3] Information Technology and Innovation Foundation, "Where Do Innovations Come From? Transformations in the U.S. National Innovation System, 1070-2006," under a grant from the Ford Foundation and support from the University of California, Washington Center.
[4] Information Technology and Innovation Foundation, "Where Do Innovations Come From? Transformations in the U.S. National Innovation System, 1070-2006," under a grant from the Ford Foundation and support from the University of California Washington Center.

The federal SBIR and STTR programs provide an excellent framework for collaboration centered on the research, development and, most importantly, *commercialization* of breakthrough EE/AET-related technologies, products and processes. For example, the following types of Michigan organizations could benefit from participating in an EE/AET-related SBIR/STTR collaboration:

- ***Small business Entrepreneurs:***
  - **Small Businesses** (500 employees or less) - Senior Technical staff from durable goods-related OEM's, Total System, Sub System, Component and Raw Material Suppliers, *seeking research and develop funding* for proprietary EE and AET-related innovations, products and processes that have *high commercial potential*.
  - **Free Lance PhD's in Hard Science** interested in *partnering* with the SBIR/STTR Applicants (i.e., being written into the SBIR/STTR Grants as the Principal Investigator).

- ***Intrapreneurs:***
  - Large & Medium-Sized **Businesses** and/or Third-Party **Investors** seeking to *partner* with the small SBIR/STTR businesses to commercialize their successful R&D results.

- ***Social Entre/Intrapreneurs:***
  - **University/Institute Faculty and Staff** seeking *consulting opportunities* with the small businesses on their SBIR/STTR grants.
  - **Community and Economic Developers** interested in fostering the creation, retention, expansion and attraction of innovative entrepreneurs as part of a viable *Economic Gardening* and/or *Green Communities* strategy and program.
  - **Non-Profit Organizations** interested in developing ventures that use SBIR/STTR innovations to produce positive social change.

- ***Business Support Service Providers***:
  - **Patent Attorney's** and **Accountants** with expertise in Government Data Rights and Federal Acquisition Regulations.
  - **Marketing and business development specialists** with expertise in cutting-edge venture formation and growth.

Bureau of Energy Systems: Commercially-viable SBIR/STTR Support

The Bureau of Energy Systems houses individuals with nationally recognized expertise in commercially-viable SBIR, STTR and related grants. BES provides Executive Training on Commercially Viable SBIR/STTR procurement directly as BES sponsored events and indirectly through partnerships with organizations interested in fostering commercially-viable SBIR/STTR projects.

BES strongly encourages applicants SBIR/STTR projects that have scientific, technical and, most importantly, *commercial* merit. To successfully compete in SBIR/STTR programs with a commercial orientation, the Bureau recommends applicants review the following NSF findings on successful SBIR/STTR Projects:

NSF has found that successful projects have following characteristics:

- Close collaboration with a market leader;
- Strong focus on a narrow technology and market;
- Strong patent position;
- Long term dedicated technologists;
- Key company officer is long term project champion;
- Commercialization of sound science is used as a smart business strategy; and,
- Grant proposals with strong collaborations and financial backing from industry leaders should receive more credit in the review process.

For more information on Commercially-Viable SBIR/STTR opportunities in EE/AET-related areas please contact: Mark H. Clevey, Manager, Consumer Education and Renewable Energy Programs, Bureau of Energy Systems, cleveym@michgian.gov.