Final Report of the Committee for the Review of Proposals to the 2008 Engineering Research and Commercialization Program of the Ohio Third Frontier Program

Committee for the Review of Proposals to the 2008 Engineering Research and Commercialization Program of the Ohio Third Frontier Program

Aeronautics and Space Engineering Board
Division on Engineering and Physical Sciences

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June 16, 2008

Lt. Gov. Lee Fisher
Chair, Third Frontier Commission
Ohio Department of Development
77 S. High Street
Columbus, OH 43215-6130

Dear Lt. Gov. Fisher:

This letter details the work and transmits the final report of the Committee for the Review of Proposals to the 2008 Engineering Research and Commercialization Program of the Ohio Third Frontier Project (TFP). This activity was supported by a contract of the Ohio Department of Development (ODOD) with the National Academy of Sciences and was performed under the auspices of the National Research Council's Aeronautics and Space Engineering Board.

The goal of the Research and Commercialization Program (RCP) is to "make Ohio a national leader in creating new jobs and business opportunities by commercializing technology-based products." Proposals selected for funding under the RCP should lead to "an integrated program of a substantial scale and consistent high quality that will move Ohio toward a position of national leadership in the selected focus area."

Commercialization of new technologies involves multiple phases from imagining new commercial opportunities to market entry and, ultimately, growth and sustainability to generate financial returns. The RCP is focused on two phases of commercialization: the incubating phase (to define the ability to commercialize a new technology) and the demonstration phase (to demonstrate new products and processes in a commercial context). Projects are expected to commercialize new products during the 3 year period when active work funded by the RCP grants will take place. Projects are also expected to demonstrate the potential for on-going commercialization after the grants expire.

Applicants were told that their proposals would be evaluated against multiple criteria, including the following: building on TFP investments, consistency with roadmaps for success, consistency with state and regional priorities, degree of customer readiness, degree of sustainable competitive advantage, demonstrated leadership assets, identified stage of market development, impact on Ohio, importance to key existing and emerging Ohio industry drivers, involvement of anchor companies, involvement of statewide research capacity, level of scientific merit, past performance (if applicable), potential for leverage, potential for products, size of opportunity, and vision for success.

The Request for Proposals (RFP) welcomed proposals in two broad areas: (1) engineering and physical sciences (EPS) and (2) biosciences. This letter assesses proposals in the first area. Another National Research Council committee assessed bioscience proposals, and the results of that assessment are reported separately.

The RCP RFP describes four focus areas relevant to engineering and the physical sciences: advanced materials; information technology; instruments, controls, and electronics; and power and propulsion (including advanced energy). Before submitting a proposal, applicants were required to submit a letter of intent. Based on the letters of intent, each proposal was assigned to either this committee or the bioscience committee for evaluation. A total of 40 proposals were ultimately determined to fall within the scope of the EPS area, including one proposal that was initially assigned to the biosciences area, based on the letter of intent (proposal BIO RCP 08-077). This proposal was reassigned to the EPS area after the proposal was received and examined.

Eight of the 40 EPS RCP proposals were eliminated during an administrative review by ODOD. The other 32 proposals were forwarded to the committee for evaluation. These proposals encompassed all four EPS focus areas.

At the request of ODOD, the National Research Council convened a committee of experts to assess the EPS RCP proposals. The committee of 18 included one member of the National Academy of Engineering. Committee members were chosen to provide necessary expertise based on the subject areas of the 32 EPS RCP proposals to be evaluated by the committee. In addition, the committee included members with expertise and experience in business practices, technology transfer, and economic development. The committee was led by two co-chairs: S. Michael Hudson, vice chairman (retired) of Rolls-Royce North America, and Judy Nagengast, CEO of Continental Design and Engineering, Inc. A committee roster can be found in Appendix C, and biographies of the co-chairs and committee members can be found in Appendix D.

The process used by the committee to review the proposals was as follows: Based on criteria and proposal requirements specified in the RFP, the committee developed an evaluation worksheet (see Appendix B). Each of the 32 proposals was read by a primary and one or two secondary reviewers and assessed using the worksheet. The committee held its first meeting in Washington, D.C., on April 23-24, 2008. At that meeting, primary and secondary reviewers led the rest of the committee in a discussion of the strengths and weaknesses of each of the 32 proposals. Stephen Berger, who served as a volunteer consultant to the committee, provided the committee with additional information on the performance of various applicants on previous TFP-funded projects. The committee selected the 14 best proposals for further examination at the committee's second and final meeting. The committee also developed a list of follow-up questions that addressed areas of concern for each of the 14 proposals. These questions were sent to ODOD, who forwarded them to the applicants prior to the second meeting.

On May 29-30, 2008, 14 members of the committee traveled to Columbus to meet with groups representing the 14 best proposals. Each group was given 30 minutes to address the committee's follow-up questions, followed by 15 minutes of additional discussions led by the committee. On May 30, the committee finalized its recommendations on which proposals were most qualified.

The committee recommends funding five proposals that make a strong case that they would achieve the goals and purpose of the RCP. In terms of the evaluation criteria presented in the RFP, the strengths of these proposals far outweigh whatever weaknesses may be present. A brief description of the subject and strengths of these 5 proposals follow; more detailed reviews of all 32 proposals appear in Appendix A. The committee considers the following 5 proposals as being essentially equivalent in the degree to which they met the standards set forth in the RFP. They are presented here not in rank order but in order by their proposal number:

- **EPS RCP 08-010 Protective Integrated Coatings for Extreme Environments**

The applicant team, led by the University of Dayton, proposes to increase the performance of existing composite materials by developing and applying new coatings without compromising processability. The proposed approach consists of (1) integrating the coating into the manufacturing process by co-curing or integrating coatings comprised of polymers and additives compatible with the base composite structure and (2) making coatings that are hybrid and stratified to make a gradual change from coating property to the substrate property, thus decreasing the possibility of coating/interface failure due to mismatch of material properties. This proposal is well written and is very strong in terms of the

scientific, technical, management, and financial aspects. The applicant team includes companies that span development to commercialization and have succeeded in past TFP projects. The commercial impact will help Ohio move into a leadership position in composite processing and applications with the success of this project. As a consequence, the applicant's commitment to Ohio is strong and clear.

- **EPS RCP 08-017 Adaptive Windows: Path to Zero-Energy Buildings**

The applicant team, led by AlphaMicron, Inc., is developing the world's first auto-adjusting adaptive window technology. The goal is to produced adaptive film that can be attached to new or existing windows to automatically adjust light transmission depending on ambient climate conditions (to allow more light to enter in winter to heat the house and less light to enter in summer). The windows include edge-mounted solar cells, so no external power would be required for the windows to function. The project leverages previous Ohio TFP investments in liquid crystal technologies, flexible electro-optic devices, and photovoltaics. The primary goal is to move adaptive windows technology through the demonstration phase and prepare for market entry. The proposal has a strong technical plan combined with a solid business plan and a strong management team with a clear history of collaboration and commercialization success.

- **EPS RCP 08-054 Ohio Based Manufacturing of Thin-Film Photovoltaics**

The applicant team, led by Xunlight Corporation, seeks to leverage laboratory-demonstrated technology advancements into existing Ohio-based manufacturing lines and bring new products to market. The key technologies relate to roll to roll continuous manufacturing of thin-film material in general and the manufacture of photovoltaic cell solar cells in particular. The proposed project has three primary objectives: develop an improved, advanced thin-film solar-cell fabrication technology; develop an improved, advanced flexible solar module manufacturing process with the necessary equipment; and develop advanced photovoltaic products targeted to markets to leverage the competitive characteristics of their thin-film solar cells. The proposal for this project is well organized and technically sound, with a very clear path to commercialization. The presence and interest of venture capitalists is particularly noteworthy, as is the lead applicant's commitment to Ohio.

- **EPS RCP 08-078 Center for Thermafficient Technology Commercialization: Clean Industrial Waste Heat Power & Energy Solutions for Cost Effective Power Generation**

The applicant team, led by reXorce Thermionics, Inc., will develop technology that can capture waste energy and convert it into usable electricity. The team behind this proposal will take a proven technology, reXorce's Thermafficient™ heat pumps, and improve upon the technology to create cost effective thermal management solutions without the typical negative characteristics currently present in heat pumps, such as high capital costs and undesirable refrigerants. reXorce presented a strong proposal for heat harvesters for industrial and commercial waste heat generation. Their system, in general, promises substantial return to Ohio above the state's initial investment.

- **EPS RCP 08-079 Advanced Materials: Granule-Based Delivery Systems**

The applicant team, led by The Andersons, Inc., will accelerate and commercialize existing and developmental granule technology in various agricultural applications. Advanced granules will improve granular formulation to more effectively contain, transport, and deliver fertilizer and pesticides, or other biologically active ingredients to specific areas. The broad range of targeted applications includes turf, nursery, floriculture, fruits, vegetables, and row crops. The proposal team is led by The Andersons, Inc., with collaboration from several Ohio companies and The Ohio State University. This project has large, near-term commercialization potential as well as the prospect for developing and commercializing additional products over the longer term, and it could improve the competitive position of other Ohio companies.

The RFP specifies that the budget for each RCP proposal should include approximately $2 million to $5 million in state funds. The five proposals, above, ask for a total of $24.3 million in state funds. The committee determined that three additional proposals substantially met the requirements of the RFP and, if funded, they would likely provide value to Ohio. The committee recommends that they also be funded by ODOD, if resources are available. These proposals are summarized below in rank order, starting with the strongest of the three:

1. **EPS RCP 08-003 Nano-Reinforced Polymer Foams for Insulation and Structural Markets**

The applicant team, led by the Ohio State University Research Foundation, will address an innovative approach to resolving several important environmental aspects of the production of polymer foams including the replacement of hydrochlorofluorocarbons and the reuse of recycled polystyrene foam. The proposal also addresses an important energy saving technology by improving the thermal barrier properties of foam materials by incorporating nanocomposite concepts. The resultant foams will theoretically be much more efficient at thermal insulation. The potential for commercialization of the project was a particularly noteworthy strength of the proposal to the committee.

2. **EPS RCP 08-032 Next Generation Nanocomposites: Enabling the Future of Composites through Nanotechnology**

The applicant team, led by Zyvex Performance Materials, LLC, will address the difficulties associated with processing and manipulating promising nanomaterials such as carbon nanotubes (CNTs). This is a major limitation in expanding their applications to large-scale industrial and value-adding structural components. The lead applicant has organized a large team of composite suppliers, end users, academics, and technology transfer organizations in Ohio to pursue the further development of the company's Kentera technology. This technology appears not to damage or compromise the functional attributes of CNTs. The project will develop and commercialize applications to advanced composites, elastomer products, and specialty resin products. An intellectual property (IP) sharing framework is already in place among the team members. The committee is impressed with the potential to impact many different nanocomposite markets. However, the committee is concerned over the team's ability to achieve the necessary reductions in the cost of CNT composites over the duration of the RCP award, and hence, whether these would really translate into projected near term jobs in Ohio, relative to other proposals that satisfy the program's RFP.

3. **EPS RCP 08-031 Development and Commercialization of Nano Graphene Platelets**

The applicant team, led by Angstron Materials, LLC, will develop a new inexpensive method for synthesis and commercialization of Nano-Graphene Platelets (NGPs) to supply the recent high demand for affordable carbon based nanomaterials. The targeted markets focus on three different potential areas: polymer nanocomposites for the automotive industry, lithium-based batteries, and fuel cells supercapacitors. The team convincingly argues that their technology would have a competitive advantage over conventional graphene fabrication methods and could move into the market in a short time. The group benefits from large industry support and the involvement of General Motors is a strong advantage, if GM stays with the project. However, the proposal would be stronger with a better quality system assessment.

All of the remaining 24 proposals scored substantially lower than the proposals listed above, when ranked a*gainst the criteria and requirements specified in the RCP's Request For Proposals*, and they are not recommended for funding under the current RCP. This does not necessarily mean that the proposals lack merit or should not be funded as part of some other program sponsored by the TFP, the state of Ohio, or the federal government. For example, Proposal EPS RCP 08-018, Advanced Offshore Wind Turbine, was very strong in many areas, but the committee determined that the proposed research is so far from commercialization that it is not a good fit for the RCP. However, it may warrant funding

under a program focused on development of technology earlier in the commercialization process. The specific strengths and weaknesses of all the EPS RCP proposals appear in Appendix A.

The committee wishes to thank the state of Ohio for the opportunity to review these proposals and to provide its recommendations as to which of the proposals best meet the requirements set forth in the RCP's RFP.

Sincerely, *Co-chairs,* Committee for the Review of Proposals to the 2008 Engineering Research and Commercialization Program of the Ohio Third Frontier Project,

S. Michael Hudson Judy Nagengast

cc: Marcia Smith

Appendixes

A Individual Summary Evaluations
B Evaluation Worksheet
C Committee Roster
D Biographical Sketches of Committee Members and Staff
E Reviewer Acknowledgment

Appendix A
Individual Summary Evaluations

[1]Based on the letter of intent for this proposal, it was originally categorized as a biosciences proposal, to be evaluated by a separate NRC committee. After the proposal was received, it was reassigned to this committee for evaluation.

EPS RCP 08-003
Nano-Reinforced Polymer Foams for Insulation and Structural Markets
Ohio State University Research Foundation

Proposal Summary:

Proposed Budget		
	State Funds	Cost Share
Operating Funds	$4,097,681	$4,800,000
Capital Funds	$702,319	$0
Subtotal	$4,800,000	$4,800,000
TOTAL	$9,600,000	

This proposal addresses an innovative approach to resolving several important environmental aspects of the production of polymer foams including the replacement of Hydrochlorofluorocarbons (HCFC) and the reuse of recycled polystyrene foam. The proposal also addresses an important energy saving technology by improving the thermal barrier properties of foam materials by incorporating nanocomposite concepts. The resultant foams will theoretically be much more efficient at thermal insulation. The use of recycled expanded polystyrene (EPS) foam as a new material stream for foamed products will cut the manufacturing costs of insulation foam by 30 to 40 percent. The proposed research is based primarily on technology developed at Ohio State University in combination with their spin-off company, Nanomaterials Innovation. Owens-Corning, a leader in insulation materials, is a collaborator on the proposal and will lead the commercialization efforts of the new products.

Detailed Review:

- **Level of Scientific Merit**

The importance of insulation in the building and construction industry is huge, and the potential energy savings from improved products is highly desired. There are several needs in the thermoplastic foam insulation industry that are well-recognized by the technical/commercial community , including increased flame resistance, replacement of HCFC, recycling the large volume of foam entering into landfills, and improved mechanical and thermal properties through incorporation of nanoparticles. This proposal addresses most of these needs for new or improved products desired by the industry. The science behind this proposal is both innovative and feasible.

In addressing the incorporation of nanoparticles, the proposal seeks to generate novel cell morphology/cell density combinations while improving the foam mechanical properties. The nanoparticle incorporation exhibits interest at low density foam for insulation applications and at high density for structural foam applications. The replacement of HCFC with carbon dioxide or water is directly addressed in this proposal. The basic concept is to incorporate a CO_2 sorptive phase to alleviate the CO_2 solubility deficiency. The recycling of expanded polystyrene is also addressed in this proposal and properly notes that landfilling the high volume foam product is particularly undesirable. The potential of nanoparticle incorporation in insulating foam to increase flame resistance and flame spread is a recent development and is addressed in this proposal. An additional product considered for development and commercialization is a structural insulation material where the combination of strength/stiffness and insulation can be combined in a single product for the construction industry.

- **Commercial Potential**

The impact of successful commercialization of the improved foam products noted in this proposal have several important environmental aspects: (1) replacement of HCFC blowing agents, (2) large energy

saving resulting in lower fuel costs and lower CO_2 emissions, and (3) the reduction of landfill volume through using EPS, a somewhat significant contributor of volume at landfills. The products of this proposal have a high potential for large scale commercial utility. It should be noted that a large number of industrial companies are also looking at HCFC replacement with CO_2.

The involvement of Owens-Corning in the proposal is particularly noteworthy, as the company is in a unique position to demonstrate and commercialize products based on a stream of recycled EPS. However, the committee was not convinced of Owens-Corning's commitment to the new technology, given that the company will not pursue the project absent funding assistance from Ohio. This causes some concern as technology development and commercialization success depends upon the commitment of the team participants.

- **Leadership and Management Quality**

The quality of the leadership and management of this proposal is sufficient for successful implementation of the proposal's goals. The proposal indicates that the stage-gate process will be used for product scale-up. This process is particularly well suited for incremental technology developments but has problems in the scale-up of breakthrough technology where innovative management is more relevant than a prescribed process. Owens-Corning's experience with commercialization of similar technology is noteworthy.

- **Impact on Ohio**

The improved products are projected to yield enough new jobs (300) and new sales and investments in the state of Ohio to be worthy of consideration of the funding requested. The estimate of over $90 million in annual sales within 8 years clearly satisfies the RFP's requirements in this area. Owens-Corning has a long term successful track record in the field of insulation materials and has provided a significant impact to the state of Ohio for a number of years.

- **Budget and Cost Share**

The proposal's budget consists of an equal amount of cash and in-kind funds and appears to be sufficient for the proposed research and development.

Review Summary:

The proposal meets the basic criteria requirements for the RFP. The potential for commercialization of the project was a particularly noteworthy strength of the proposal to the committee. However, the committee found other projects to be more meritorious, and thus it should only receive funding if there are sufficient funds left over after the recommended five projects are funded.

EPS RCP 08-010
Protective Integrated Coatings for Extreme Environments
University of Dayton

Proposal Summary:

Proposed Budget		
	State Funds	Cost Share
Operating Funds	$4,445,000	$4,845,000
Capital Funds	$555,000	$155,000
Subtotal	$5,000,000	$5,000,000
TOTAL	$10,000,000	

This project proposes to increase the performance of existing composite materials by developing and applying new coatings without compromising processability. The proposed approach consists of (1) integrating the coating into the manufacturing process by co-curing or integrating coatings comprised of polymers and additives compatible with the base composite structure and (2) making coatings that are hybrid and stratified to make a gradual change from coating property to the substrate property, thus decreasing the possibility of coating/interface failure due to mismatch of material properties. The applications of immediate interest are identified as thermo-oxidative protection, abrasion protection, electromagnetic radiation protection, and vibrational damping. Technical challenges include the integration of the manufacturing process with the desired stratified coatings in addition to developing the stratified coatings that will be required for each application.

The team consists of University of Dayton (UD) leading a consortium of Ohio-based industrial, government, and academic entities and builds on the previous collaboration with CMPND (Center for Multifunctional Polymer Nanocomposites and Devices) to resolve the technical challenges. The collaborators include North Coast Composites, Renegade Materials Corporation, the University of Akron, Vector Composites, GE Aviation, the Goodrich Corporation, and U.S. Air Force Research Laboratory. The consortium will develop and commercialize integrated protective coatings for composites by taking advantage of the Ohio-based supply-chain of technology providers and end-users that are all members of the consortium. The proposal asks for $5 million in state funds and proposes an equal amount in cost share, with $3.4 million in cash and $1.6 million of in-kind contribution.

Detailed Review:

- **Level of Scientific Merit**

The scientific merit is good. There is ongoing research and development regarding the general chemistry and functionality that will make particular properties scientifically and technologically feasible. The innovative part of the program will be to create the stratification during the processing of the materials and the combination of these properties and processes for the specific composite materials used in the applications. New discoveries and advances beyond previous studies are expected through implementing processes that control and design functionality and chemistry of the coatings and its stratification.

- **Commercial Potential**

The commercial potential of this project is significant because the successful development of a coating technique will allow the use of current composites in more advanced applications throughout several industries. In addition, the companies in the consortium that are mentioned in the proposal include parts suppliers and end users that can expect to increase their share of the market with the success of this project.

- **Leadership and Management Quality**

Leadership and management of the project are well detailed and is the same structure that has been proven to be successful by UD and the collaborators in the past. UD has demonstrated successful performance on prior Third Frontier Project grants. A detailed plan for commercialization is given for each collaborator. The existing demand and future potential in the marketplace is explained well. The commercialization strategy for aerospace products is anchored by GE Aviation and a detailed explanation given for different markets.

- **Impact on Ohio**

The successful completion of the project will lead to significant job and revenue generation. The proposal notes a total of 935 new jobs over the eight year project life and $1 billion in revenue generation, assuming the anchor company GE Aviation uses this technology as do other OEMS such as BAE/Goodrich or Honda. According to the proposal, the only limitation to its potential economic impact is Ohio's workforce and infrastructure. Even though this assessment might seem to be optimistic, the potential of being able to use composites in more advanced capacities through application of this coating technology in many industries makes this assessment reasonable.

- **Budget and Cost Share**

The budget is listed in detail and seems reasonable to the committee. The proposal asks for $5 million and is proposing a cost share of $5 million with $3.4 million cash and $1.6 million in-kind. The cost share is reasonable and the amount of money seems to be adequate.

Review Summary:

This proposal is well written and is very strong in terms of the scientific, technical, management, and financial aspects. The purpose of the proposal is to increase the performance of existing composite materials by developing and applying new coatings without compromising processability. The approach consists of making stratified functional coatings and integrating it into the manufacturing process with the base composite structure. The UD led consortium includes companies located in Ohio and span development to commercialization and has shown its potential for success in the past projects. Technical challenges include the integration of the manufacturing process with the desired stratified coatings in addition to developing the stratified coatings that will address the needs for each application. The commercial impact in terms of revenue and job generation is significant and will help Ohio move into a leadership position in composite processing and applications with the success of this project. As a consequence, the applicant's commitment to Ohio is strong and clear.

The committee recommends that this proposal be funded based on the scientific merit, strong management plan, and the commercialization approach that provides for rapid transition to product and creation of Ohio jobs.

EPS RCP 08-012
Knowledge-Based System Approach to Optimize and Control Grinding Processes
TechSolve, Inc.

Proposal Summary:

Proposed Budget		
	State Funds	Cost Share
Operating Funds	$2,096,103	$2,572,695
Capital Funds	$412,000	$0
Subtotal	$2,508,103	$2,572,695
TOTAL	$5,080,798	

The proper and accurate selection of optimum grinding conditions and parameters is a challenge, impeding the ability of machine shops and the finishing industry to achieve higher productivity and efficiency. The proposed project seeks to develop a knowledge-based grinding advisory system (KBGAS) to address the needs of a diverse end-user group of industries in Ohio. Proposers led by TechSolve seek to integrate sensors and process monitoring with soft-computing and artificial intelligence (AI) techniques to help improve the technology for selection of grinding conditions in manufacturing plants, and plan to establish a joint venture for-profit entity among the collaborating institutions to help further commercialize the KBGAS—a process planning software product for use in Ohio's machine shops.

Detailed Review:

Level of Scientific Merit

The proposal addresses a machining technology that is widely used across all material removal and metal-finishing industries, and early application of the envisioned product is for high-value aerospace, automotive and bearing production using creep-feed grinding. However, the committee felt that there was insufficient scientific experience in the team to address the technical challenges of developing and validating a high-reliability grinding process planning package.

Grinding is a broad metal removal process with many different variants and strategies as well as many variables, the impact of which is not all fully understood—a design of experiment matrix focused on GE's (and Delphi/Timken's) materials of interest would have helped show the team's understanding of critical variables to be investigated for automation.

The committee also felt the proposal lacked a proper metallurgical and material science foundation (for verification and convincing early adopters about the accuracy of the envisioned KBGAS) since grinding and surface integrity are major issues in production of high-performance surfaces in the aerospace industry. The committee saw no innovation in how process and material information is acquired. Thus, the relationship and value of adding fuzzy logic and AI techniques linking surface quality to the optimum process was not apparent.

Commercial Potential

None of the collaborating organizations has experience or a track record in spinning off new commercial entities. Including a machine-tool controller manufacturer or grinding machine-tool supplier would have strengthened the team with guidance in real-world production issues with selection of process conditions.

The committee found that the applicants provided a credible assessment of work done by other modelers in the field, but the specific IP in grinding process modeling and sensing that TechSolve owns (or might have access to) was not listed in any level of detail to instill higher confidence. It would have helped to

discuss remaining gaps in key R&D that the team would pursue as a priority in developing and validating the prototype KBGAS system. It appears the Lead Applicant is unclear as to what specific leverage of existing IP is planned without reinventing the wheel, since limited solutions in grinding exist elsewhere.

Leadership and Management Quality

TechSolve is a capable organization with a long history of innovation in metal removal and mechanics of machining, derived from its preceding organizations/affiliations. It is well-qualified for undertaking the development and integration of these challenging modules and capabilities in grinding. However, insufficient knowledge of grinding mechanics was demonstrated in the proposal.

The committee concluded that the proposal was deficient in establishing sufficient intellectual merit (effort has been attempted before by others in the industry with marginal results at best). The committee also felt this team of academic collaborators is relatively less qualified than others and is not well-known in the machining industry.

While an impressive list of references was shown, the faculty partners have not demonstrated similar technology components/modules successes in related machining processes. The committee thought a more detailed knowledge of grinding technology and mechanics was needed by the associated academic PIs—the problem is not trivial to solve.

Impact on Ohio

The committee agreed that Ohio remains a hotbed of machine tool developers and end users for first application of the prototype KBGAS technology. While the proposal states that a Ph.D. tool engineer is not needed to operate the envisioned KBGAS system, and the team will focus on associate degree holders for training with the system, a more specific plan to reach out to community colleges and vocational training organizations was not discussed.

The applicants' projection of 10 new jobs (primarily from a sales and marketing effort) will do little to add to the long term sustainability of the commercialization plan. More thought and planning is needed in this area..

Budget and Cost Share

The proposal brings poor leverage of additional resources (barely 1:1) compared to other higher ranked proposals. This could have been improved with commitment letters from Delphi and Timken who were frequently mentioned in the proposal, but strong commitment letters were not provided.

Review Summary:

The committee felt the proposal lacked the scientific depth and clarity to pursue development of an elusive goal such as fully automated grinding. The specific business model of the partners' joint venture company, and anticipated revenues with realistic assumptions were barely touched upon. The team has no prior record of working together, which adds high risk. Additional technologically conversant entities are needed if a future effort is contemplated. The committee does not recommend that this proposal be funded.

EPS RCP 08-016
Commercialization of Interpenetrating Phase Composite Refractory Systems
Fireline TCON, Inc.

Proposal Summary:

Proposed Budget		
	State Funds	Cost Share
Operating Funds	$3,378,347	$3,291,964
Capital Funds	$0	$90,000
Subtotal	$3,378,347	$3,381,964
TOTAL	$6,760,311	

This proposal would take technology for the molten metals processing industry that was developed at Ohio State University and licensed to Exera Materials Group, a company that went out of business in early 2007, and transfer it for use in developing refractory systems for aluminum foundries. The applicant, Fireline TCON Inc. (FTi), a wholly owned subsidiary of Fireline, Inc., believes these refractories can be used for other materials processing as well, such as magnesium, copper and zinc and possibly ferrous metals. FTi is teamed with Case Western Reserve University, Youngstown State University, Oak Ridge National Lab, Energy Industries of Ohio, and Allied Mineral Products for this proposal.

Detailed Review:

- **Level of Scientific Merit**

The proposal had a low level of innovation and most of the technology was to be derived from various entities. The committee concluded that since significant new IP was not being created by FTi, the advantage for Ohio to maintain a technologically sustainable lead would be minimal and unclear from the way the proposal was presented. While FTi has developed the manufacturing process for these refractories and has done some initial testing, there does not seem to be much risk in executing this work as proposed technically.

- **Commercial Potential**

The proposal has significant commercial potential since there are many foundries around the world and within the United States. The uniqueness and stability of the TCON product resulting from its manufacturing method (by reaction with molten metal) is a plus. However, it is very unclear how FTi plans to carve out the various markets around the world and the mechanisms to do so as they are a relatively small company. Clearer identification of a few specific products and their worldwide potential and the mechanisms the company would use to capture these markets would have been very helpful. Most of the information mentioned in this proposal was very sketchy and subject to interpretation. Long term benefits to compete globally are minimal given the market situation and technological risks and the lack of a secure IP within the company. The proposal relied too heavily on a single individual for information on market potential; Additional letters from GM Foundry could have benefited the proposal regarding potential early big-name users of TCON.

- **Leadership and Management Quality**

The proposed technology builds from research expertise developed at Ohio State University and the team has demonstrated good project management skills over the years. Since FTi will be a subsidiary of Fireline and is currently a small company with two employees and one intern, it is hard to judge its overall quality. However, based on the CV's of the two employees they should have a reasonable capability of moving things forward. The committee felt that significant new hiring of talented people

would be required if the opportunity were to expand as indicated and possibly some of these could be deputed from Fireline in the short term.

- **Impact on Ohio**

While this refractory metal product would generally support the current infrastructure of Ohio and neighboring states that have foundries, such as Wisconsin and Illinois, the sales growth projected over 3 years to $1.4 million is minimal. For a $2.5 million investment, if the return is not above three times the input of funding then the ability to create jobs and provide economic returns to the state will at best be very minimal. While the annual revenues 5 years after the completion of the project are projected to be $15 million, this still is not a significant return after such a protracted period especially when compared to many other dynamic technologies that can provide much better quality high tech jobs and also improved wage structures. Since this growth is also projected based on the availability of the $7 million to enhance the infrastructure, the return is even less attractive after all that investment. Although 65 jobs are projected 5 years after completion of the project, most of these jobs are low paying and are unattractive to the overall economic development in the Ohio

- **Budget and Cost Share**

The numbers provided appear to be reasonable and the cost share provided by each partner was reasonable. No significant discrepancies were noted

Review Summary:

The committee felt that the proposal had good technical merit and the market for these products was reasonable and in the interest of the current infrastructure in Ohio. However, there was no major (new) intellectual property that was expected to be created from this effort. It was also not clear if the IP originally held by Ohio State Univ., and licensed to Exera was exclusive or non exclusive. This could impact the ability of other competitors to enter these markets at a later date. Information related to this and details related to this agreement are vital in assessing the benefits to Ohio. Fireline has also identified that $7 million would be needed in external funding to go forward in their process of commercialization, but it was not clear to the committee what mechanism would be used to raise that funding.

Since FTi is a relatively new company, it was not clear how it would eventually plan to take a share of the large markets that it has identified. Would it be through licenses or through other mechanisms such as joint ventures or its own production entities in different countries or regions within the United States?. Some expression of interest or testing of its refractories with some of the other foundries would have been valuable in facilitating a more favorable decision.

The committee appreciated the summary of alternatives under development (page 33-34), but a summary table would have been better for clearer comparisons.

Overall this proposal had merit as a need for Ohio and its current infrastructure. However, the proposal did not make a compelling case for either the creation of high quality jobs that exceeded 25$ per hour or a 5-8 fold return in sales to the state within a 3 year time frame. The lack of a clear definition of the ownership of the IP, the exclusivity issues, the fees to be paid to the entities that currently hold the IP were all factors that affected the overall economic valuation. In addition the need for $7 million worth of capital infrastructure coupled with other additional funding needs would make this an extremely unattractive business case where the sales after 5 years of completion of this project reach $15 million.

The committee therefore felt that under these technical and economic scenarios this proposal did not merit any further consideration for TFP funding. If the anticipated benefits of TCON are so compelling and intriguing to the various listed potential end users (casters, heat treaters, furnace-makers), then please consider leveraging small investments from each corporation for achieving key technical development/demonstration milestones. The committee does not recommend that this proposal be funded.

EPS RCP 08-017
Adaptive Windows: Path to Zero-Energy Buildings
AlphaMicron, Inc.

Proposal Summary:

Proposed Budget		
	State Funds	Cost Share
Operating Funds	$4,015,000	$3,125,313
Capital Funds	$985,000	$1,874,687
Subtotal	$5,000,000	$5,000,000
TOTAL	$10,000,000	

The proposed project leverages previous Ohio TFP investments in liquid crystal technologies, flexible electro-optic devices, and photovoltaics. The primary goal of the grant is to move the Adaptive Windows technology from demonstration to the market entry phase of technology commercialization. The specific project is to create a window that has a self-regulating and powered electronically controllable tint.

The lead applicant is AlphaMicron, Inc., in collaboration with the Photovoltaic and Power Technologies Branch of NASA Glen Research Center, the Liquid Crystal Institute at Kent State University, and Sekisui Chemical Company. In order to accomplish the proposal's goals, the applicants must meet several technical objectives.

Detailed Review:

- **Level of Scientific Merit**

The science behind the proposal is based on sound analysis, with a well defined project plan to address the integration and transition of technologies developed by consortium partners from demonstration into a new product. The proposal's objectives are innovative and appear feasible. The project team needs to address a number of durability, maintainability, and life expectancy concerns in order to succeed in their target markets. They must also deal with the technical challenge of refining the technology to waveguide adequate light to the edge mounted solar concentrators and photovoltaic cells. These challenges are well understood by the project team.

- **Commercial Potential**

If the technical goals are achieved, the suite of resultant products has a very large market potential. The proposal clearly identifies an array of markets in which the Adaptive Window might see strong potential demand. It also adequately addresses the different technical requirements and preferences that might emerge in each of these markets, as well as some of the differing supply chain and procurement practices. The project will rely heavily on a large Japanese partner for both manufacturing scale-up and market guidance. The project team would benefit from bringing end users to the table and shift market and customer development to earlier in the project's timeline to help define requirements and guide R&D and product development. The team would particularly benefit from the development of customer-specific value propositions in target markets that can be refined as the technology and specific products evolves.

- **Leadership and Management Quality**

AlphaMicron has assembled a strong team, both inside the company and among their collaborators. Roles and responsibilities are well defined as is the management plan. AlphaMicron's past success in developing and commercializing products in this field, specifically eyewear products and autodimming

automobile mirrors, was particularly noteworthy to the committee. AlphaMicron has received both statewide and national recognition for its products. The AlphaMicron team provided a good discussion about how they plan to manage the challenges facing a small company negotiating with and managing a partnership with a large foreign company.

- **Impact on Ohio**

The project team has a clear understanding of the local technology and job creation potential of the proposal. The potential for new investment in the state is quite high. The commercial opportunity is very large, and Ohio has the potential to capture significant economic benefit.

- **Budget and Cost Share**

The proposal's budget and cost share appear reasonable. A large part of the cost share is in-kind support and overhead offset from the partners with a package of in-kind support and services provided by Sekesui. However, the proposal makes a strong point that although State funding will support the transition to market entry, it may well need more for full development and definitely will need additional funding to develop a suitable manufacturing infrastructure. Not only did the AlphaMicron team provide a clear vision of their funding strategy, they closed on a large series B financing round since submitting the original proposal.

Review Summary:

The proposal has a strong technical plan combined with a solid business plan. Moreover, they have assembled a strong management team with a clear history of collaboration and commercialization success. The proposal fully satisfies the program's RFP, and the committee recommends that this proposal be funded.

EPS RCP 08-018
Advanced Offshore Wind Turbine
University of Toledo

Proposal Summary:

Proposed Budget		
	State Funds	Cost Share
Operating Funds	$4,500,000	$4,685,957
Capital Funds	$500,000	$457,000
Subtotal	$5,000,000	$5,142,957
TOTAL	$10,142,957	

This project proposes to develop advanced floating offshore wind turbines that are anchored to the ocean floor, rather than being placed on a fixed platform. Such a turbine could be placed far offshore for substantially lower costs than today's offshore designs. Just as important, these turbines would not obstruct the view from the shoreline or interfere with the paths of most migratory birds—issues that have challenged and hindered previous offshore wind initiatives.

A world class, Ohio-based team in R & D and manufacturing proposes to demonstrate a prototype in Lake Erie as well as develop a preliminary design of a multi-Megawatt commercial wind turbine. Successful completion will provide proof to create a compelling business case for capital acquisition and entry into the emerging offshore wind market, projected to be $5 billion by 2011. This project is very collaborative, involving both commercial companies and educational institutions.

Detailed Review:

- **Level of Scientific Merit**

This project builds on a teetered hub technology for very large wind turbines developed by NASA's Wind Energy program, which is being provided to UT at no cost (technology transfer document is included with proposal). A detailed engineering analysis, research and development plan, and prototype fabrication and testing plan are included. The R & D plan appears to be well developed and feasible. The proposal indicates a fairly neutral effect on the avian migration paths and addressed mitigating the impact on marine life. The proposal addresses dealing with the harsh ocean environments utilizing their proprietary tower and mooring technology. Overall, the level of scientific merit is quite high with potential for new discoveries and advances beyond previous studies. However there are still a number of hurdles to be overcome before this technology can be put into production and the sheer size of the device make commercialization and production even more challenging.

- **Commercial Potential**

If this technology is developed and validated during the prototype phase, the commercial potential is quite large. Wind is the most commercially successful renewable energy. By 2011 the world market for offshore wind has been conservatively estimated to annually exceed $5 billion with a projected growth rate of 20% per annum. Currently there are no commercial wind turbine systems presently available for deep water installations, although there are three companies in the world wide market who have begun efforts to develop floating wind turbines for deep water. Siemens of Germany has stated they will have the world's first large scale floating turbine by 2009. The proposal's competitive analysis indicates limitations of the alternative configurations that would not be a problem if this project receives funding.

The committee recognizes the large commercial opportunity represented by the development of this technology; however, a large capital infusion will be needed to bring this product to market once the

prototype is proven. The plan to commercialize is conceptualized, but not adequately developed. The committee did not see that any commercialization partners have been contacted or developed.

- **Leadership and Management Quality**

This proposal presents a very collaborative effort between several universities, led by the University of Toledo, the Center for Multifunctional Polymer Nanomaterials and Devices, along with a number of Ohio based manufacturers. The project will be managed by UT. UT has significant resources and experience in providing assistance for technology commercialization and business start-ups. The principal co-investigators Dr. Afjeh, PhD, PE from UT and Dr. Viterna, PhD, PE from Nautica WindPower LLC both bring a great deal of knowledge and experience to this project. The committee is confident in the leadership and management team for this project and was impressed with the high level of collaboration across several diverse entities.

- **Impact on Ohio**

This proposal satisfies the program purpose of being an integrated program of a substantial scale and consistent high quality that it will move Ohio toward a position of national leadership in the focus area. The lead applicant clearly meets the goals and objectives of the program to build on existing strengths and form collaborations that are sufficiently large to bring national recognition to Ohio. The proposal indicates it will create 60 jobs and cumulative product revenue of $100 million. However, Table 5 in the proposal indicates a potential of almost 9000 jobs in manufacturing wind turbines components. This discrepancy was not adequately explained by the project team.

- **Budget and Cost Share**

This proposal is requesting $5 million of state funds with a cost share of $5.1 million. The cost share comes from The University of Toledo, Teledyne, Ironhead Marine, Toledo-Lucas county Port Authority, IPS, Midwest Terminals of Toledo, Bowling Green State University, Cuyahoga County Board of Commissioners, PT-Tech, Gramling Brothers Real Estate and Development, Center for Multifunctional Polymer Nanomaterials and Devices, Minster and Nautica Windpower. In addition, NASA is allowing UT to utilize technology they developed at no cost. Most of the contribution is “in-kind”, but UT will contribute $100,000 in cash and the Toledo-Lucas County Port Authority will contribute $250,000 in unrestricted cash from their Economic Development fund.

Review Summary:

The committee notes that this was an extremely well written proposal which clearly defined the project, scientific background, and the other criteria of the program. This technology shows a great deal of promise, but the path to commercialization was unclear and in the distant future. This is not in line with the requirements of the RFP, and the committee does not recommend that this proposal be funded.

EPS RCP 08-019
Distributed Energy UPS System
Edison Materials Technology Center

Proposal Summary:

Proposed Budget		
	State Funds	Cost Share
Operating Funds	$4,835,000	$4,835,000
Capital Funds	$0	$0
Subtotal	$4,835,000	$4,835,000
TOTAL	$9,670,000	

The project is focused on the development of technologies for increasing the penetration of distributed generation into the utility grid while maintaining or improving the power quality and reliability of the utility grid. These technologies relate to the development of an uninterruptible power supply (UPS) exceeding a capacity of 2 MVA with the increased capacity resulting from novel cooling techniques. The UPS consists of a rectifier, an energy source, an inverter, and a bypass switch. The rectifier is intended to be higher in power than conventional rectifiers with improved energy efficiency and improved line current harmonics. The inverter provides enhanced capability in that it is to be configured to work with photovoltaics and feature communications to make it dispatchable. The proposers suggest that the inverter provides connectivity with the utility grid through an AC bypass switch thereby reducing the cost of grid connected photovoltaic systems. Key markets for this product include industrial UPS and green energy applications. Edison Materials Technology Center (EMTEC) will collaborate with the Leibert Corp., Ohio State University, and Hull and Associates on this project.

Detailed Review:

- **Level of Scientific Merit**

This proposal addresses an important need in developing technologies that support the development of a UPS system having the capability of delivering up to 2 KVA. Concept models, including accompanying mathematics, as well as schedules showing the distribution and roll-out of all technical activities are detailed and well-defined in the proposal. A description of engineering efforts related to the development pathway leading to the construction prototype systems lacked necessary detail. Specifically there was little or no description related to the manner in which the developments leading to key product platform discriminators such as improved efficiency, larger capacity and smaller footprint would be achieved.

- **Commercial Potential**

The technologies being developed as part of this project address a large and growing market for UPS systems. The proposers have assembled a solid team that has a successful track record in developing and commercializing similar systems with well-defined channels to market. The proposal demonstrates a solid understanding of the commercialization process and the resource requirements for commercialization. The proposal provides detail on products in this market sector by referencing product offerings from competitors. The proposal provides very little information justifying the market need for the 2 KVA UPS system, however, as opposed to utilizing multiple smaller systems to address a given application.

- **Leadership and Management Quality**

The proposal demonstrates the commitment of the lead applicant and collaborators with leadership demonstrated through all of the critical phases of the program. The proposal defines a clear line of

responsibility for the program participants with well-qualified individuals playing key roles in program execution.

- **Impact on Ohio**

The proposal demonstrates key impacts to Ohio in terms of job creation (29 jobs in 2012, and 550 jobs by 2017), and new sales ($22 M - $24 M in 2012—two separate numbers quoted in the proposal—for UPS systems and switch gear, $363 M in 2017). Participation of key Ohio industry partners is significant and critical to the success of the project. The proposal builds upon prior successful Ohio programs executed by EMTEC, and in particular a prior TFP investment in the Center for Photovoltaics Innovation and Commercialization program. Since the proposal suggests that Liebert Corp. is executing much of the product development activity, the chances seem to be high for internal funding of follow-on product development activity. But the possibility of leverage of federal or other dollars is unclear.

- **Budget and Cost Share**

The substantial financial commitment, particularly in cash, on the part of the partners to execute this project is recognized and significant. The budget appears to be justified and adequate to meet the goals of this proposal. Cost share letters are provided and are sufficiently detailed.

Review Summary:

The committee felt that the proposal was organized and well-written, addressing an important product sector. The committee also recognized the significant commitment of key industrial partners in addressing the development of a potential product that is very germane to their business. The proposal falls short in describing how some of the developments that lead to key market discriminators will be achieved. The proposal also does not clearly make a case for implementation of a larger capacity UPS system. The committee suggests that the proposing team continue the development activity and re-propose at the next opportunity with the aforementioned deficiencies addressed. The committee does not recommend that this proposal be funded.

EPS RCP 08-023
NanoStructured Metals Commercialization
Powdermet, Inc.

Proposal Summary:

Proposed Budget		
	State Funds	Cost Share
Operating Funds	$3,086,858	$3,906,957
Capital Funds	$147,000	$0
Subtotal	$3,233,858	$3,906,957
TOTAL	$7,140,815	

The proposed work relates to research and commercialization efforts related to composite powder technology. The three primary impact areas in the proposal pertain to development of aerospace coatings as a replacement for chromium in landing brakes, development of armor and antiarmor composites and development of coatings for heavy equipment. The proposed work will build from the prior research efforts done by the company over many years. The primary objective of this effort would be scale the facility to producing 500 lbs/day or 100,000 lbs/year. The applicant, Powdermet, Inc., made its proposal in collaboration with the Ohio Aerospace Institute, Case Western Reserve University, University of Dayton Research Institute, and Oak Ridge National Lab (ORNL).

Detailed Review:

- **Level of Scientific Merit**

The level of scientific merit of the proposal is intermediate from the perspective of the RFP's expectations. Incremental improvements are anticipated to emerge from the large amount of investment that is requested. Since this looked like three different SBIR proposals that were assembled together with no specific focus, the committee felt it was difficult to assess the priorities and the benefits that would be derived from this effort. The use of the ORNL white light facility is a detriment as it is not a mobile facility and until a mobile unit is available the question of commercializing this approach is questionable at best, especially within the time frame of this program. ORNL has been using this facility for over 8 years and has still not developed a mobile facility that can handle these parts on site. Two areas that have not been addressed with sufficient care are the lack of a powder feeder to spray nanocomposites and the inability to consolidate nanomaterials and maintain the nanostructure.

- **Commercial Potential**

The industrial collaboration assembled for the proposed work will cover all of the product areas identified. However, most of the letters provided with this proposal were based on hypotheticals and were not deemed as firm commitments especially by the Government agencies. Several of these areas have been researched by various Government programs over the past 15 years and have not seen any commercial applications. Therefore it is highly unlikely that this funding from Ohio will lead to any significant commercializable product base that would thereby create jobs. While the team is impressive, there are three defined targets and the committee felt that a better focus was needed to make a more realistic assessment of the metrics for success. There are also many competing technologies that are also being proposed in the same areas as identified by this proposal and many of them are economical or have better adaptability due to the already entrenched infrastructure.

- **Leadership and Management Quality**

The leadership team for the specific technical tasks and the overall management is reasonable and can meet the requirements of the program.

- **Impact on Ohio**

The impact on the economy of Ohio appears to be overstated and it is highly unlikely given the very diversified base of products that are proposed. Furthermore the number of jobs projected—over 200—are highly unlikely and will at best be low paying jobs.

- **Budget and Cost Share**

The budget from the development and management tasks seem generally reasonable. Relative to the requested funds in the budget and the technological hurdles, the return on investment is expected to be low and unpredictable.

Review Summary:

The proposed technology builds from research expertise developed over many years at Ultramet and licensed by Powdermet and the team has demonstrated good project management skills over the years. However, long term benefits to compete globally are minimal given the market situation and technological risks and the competing technologies in the marketplace that are also pursuing the same goals. The lack of a single product focus is also a significant detriment to assess the metrics for success for this investment. The committee does not recommend that this proposal be funded.

EPS RCP 08-025
Advanced Lightweight Monolithic Carbons for Solar, Battery, and Aerospace Applications
GrafTech International Holdings Inc.

Proposal Summary:

Proposed Budget		
	State Funds	Cost Share
Operating Funds	$3,541,166	$3,567,153
Capital Funds	$231,000	$231,000
Subtotal	$3,772,166	$3,798,153
TOTAL	$7,570,319	

This proposal describes an attempt to develop Lightweight Monolithic Carbons (LMCs) targeting three different potential market areas: new electrodes, lightweight aircraft composites, and thermal insulating layer for silicon (Si) manufacturing. The market space for this proposal is centered in the construction of an advanced LMC technology platform starting from raw materials where the demand for a certain purity, thermal stability, chemical stability, strength, toughness, and permeability of this material can be achieved and designed according to the market needs. The partners in this endeavor are: the National Composite Center, Maverick Corporation, Renegade Materials Corporation, Smithers-Oasis Company, and the University of Dayton Research Institute. The proposal requests a total of just under $3.8 million matched by slightly more in cost share, largely in the form of in-kind support.

Detailed Review:

- **Level of Scientific Merit**

The scientific merit of this proposal is good but did not strike for originality, neither in the approaches followed in the production nor in the level of innovation brought to Ohio. The development of LMCs as viable alternatives to currently used materials in different engineering applications is intrinsically connected to the fundamental understanding of side components as seals, surfactants, and insulation and to the synthesis and response of sandwich structures and their high temperature response. However, the conceptual framework merely fits in the production line of the lead company allowing for products development. The conceptual framework and overall methods proposed are very well described and adequately explained.

- **Commercial Potential**

The committee recognizes the excellent commercial potential of this proposal. The proposal accurately addresses market needs and has very realistic assumptions about the market share that could be captured. The credibility of the leading company and the large market share that it holds in the field provides a valuable edge on the sustainable competitive advantage expected. The strength of GrafTech in the market and the competitive advantages worldwide are recognized. GrafTech has a long term standing history of excellent commercialization strategies. The current commercialization plan includes targeting three very different areas of the market (new electrodes, light weight composites, and silicon manufacturing). The proposal would have benefited from greater clarification of how the integration among the different commercial target areas will be achieved.

- **Leadership and Management Quality**

The proposal presents a very good leadership and management team. GrafTech has assembled a well complemented group of partners in which all the players and collaborators appear to have a good

coordination plan and viable work distribution. A more substantial description of the financial strategy planned by this team for the effective additional cash fund raising, in the absence of the RCP funding would have been a valuable addition to the plan.

- **Impact on Ohio**

The impact on Ohio appears significant and realistically measured. Interest from the potential customers' side is encouraging and the recent growth of the company now in "Acquisition mode" demonstrates the past impact in Ohio and large future potential. The project leverages on existing resources in Ohio and fits well within the scope Ohio's economy. The proposal also presents and underlines links with existing relevant research capabilities.

- **Budget and Cost Share**

The budget presented appears reasonable and well thought out. The financing requested reflects the needs for the technology to move from the incubating to the demonstrating phase in most of the area and to project the products in the market. Overall, the project appears to be mostly an internal technology focus at GrafTech for the development of new or better products to address direct costumers needs and requests. As such, in-kind support from the partners appears sufficient to the effort.

Review Summary:

GrafTech presents a strong proposal coupled with a well recognized commercialization history and successful track record of the company. The lack of major technologically innovating elements is recognized as the major shortcoming of the proposal with respect to the RCP goals. In short, the proposed goals appear broad and the research direction and innovation proposed not very well defined. The proposal does not fully satisfy the RFP, and the committee does not recommend that this proposal be funded.

EPS RCP 08-031
Development and Commercialization of Nano Graphene Platelets:
A New Class of Carbon Nano Materials
Angstron Materials, LLC

Proposal Summary:

Proposed Budget		
	State Funds	Cost Share
Operating Funds	$3,599,809	$3,686,812
Capital Funds	$530,802	$994,500
Subtotal	$4,130,611	$4,681,312
TOTAL	$8,811,923	

Angstron Materials, LLC leads this proposal that seeks to develop a new inexpensive method for synthesis and commercialization of Nano-Graphene Platelets (NGPs) to supply the recent high demand for affordable carbon based nanomaterials. The targeted markets focus on three different potential areas: polymer nanocomposites for the automotive industry, lithium based batteries, and fuel cells supercapacitors. The listed partners in this endeavor are: Nanotek Instruments, Inc., Applied Sciences, Inc., Pyrograf Products, Inc, HST Auto, and K2. The project team will also involve academic and research partners including the National Composite Center, Wright State University, and Ohio University. Other contributors/partners include the Honda Americas, Delphi and Nanosperse LLC. The proposal requests a total of ~$4.1 million matched by ~$4.7 million in cost share, largely in the form of cash support.

Detailed Review:

- **Level of Scientific Merit**

The committee recognizes a high degree of scientific merit in this proposal. The development of extremely cheap manufacturing processes for graphene sheets, a nanostructure now residing at the cutting edge of the nanomaterials research and development, will not only inject the market with a highly requested resource but will also prompt fundamental discoveries. The specific targets proposed for the marketing of the technology include important analysis for the processed material covering a broad and interdisciplinary range of research. The main focus will include mechanical, thermal, and electronic characterization of the synthesized new materials. Fundamental advances in the chemical functionalization for improved dispersion and matrix adhesion is expected to derive from this work and will prompt advances in both fundamental research areas as well as applied manufacturing. The scientific objectives are original and a high potential for new discoveries exists.

The committee recognizes the technical advantages provided by the patents in place for Angstron's technologies that allow having and sustaining competitiveness and commercial advantages. A technology that allows for exfoliating graphene plates without the need for oxidation or other chemical means allows for a very controllable and largely scalable production. Having a physical peel off method is a clear advantage to address several areas of application. At the same time, more details could have been provided clarifying the existing technologies and competitors and the main differences. It was not clear to the committee the reason for the lack of explanation on the technique and the reservation against descriptions if IP rights have already been secured and several patents are currently claimed to be in place for the technology.

- **Commercial Potential**

This proposal represents both high risk and the potential for high returns. The current high demand for carbon based nanostructures at an extremely low cost is matched by an unstable market perspective. The

commercial potential is quite high: beyond the applications/potential markets described in the proposal, the committee recognized an even larger potential via expansion to the ITO market and by considering a business model alternative to directly license the production technology. The possible involvement of Owens Corning on the thermal management application is an added advantage. The strong interest from VCs to add financing commitments and GM's involvement adds credibility to the project. The time-to-market competitiveness is well addressed.

- **Leadership and Management Quality**

The committee recognizes the management quality of this proposal as fair and sufficient. The team assembled is diverse and based on a large collaborative effort to branch out in the different applications proposed. The committee recognizes the good quality of the collaborators although points out the minimal involvement of Ohio academia and universities in the team. The proposal seems to be very market oriented and the management team reflects this goal. Details provided on the proposed Joint Venture have been clear and sufficient to clarify the agreements in place.

- **Impact on Ohio**

The project does not have a strong foundation on previous TFP investments, but has the potential to push the State of Ohio to the forefront of research and technology development in carbon based nanomaterials. The ambitious plan includes a very optimistic projection on income and job creation in Ohio. The commitment of K2 of moving a facility in Ohio is a further plus.

- **Budget and Cost Share**

The proposal's budget and cost share are very good although the proposal would be stronger if more substantiated information on the solidity of the matching funding offered by HST Automotive were provided, quantifying the effective level of commitment on the matter. The additional presence of GM as a primary active partner in the effort is recognized as a plus, although no letter of commitment was provided, which raises questions about the level of GM's commitment.

Review Summary:

The committee recognizes the high technological level of the proposal, its potential impact on diverse applications, and its ability to introduce a novel and emerging industry in Ohio. The team convincingly argues for their competitive advantage over conventional graphene fabrication methods and on their ability to move into market in a short time. The group benefits from large industry support and the possible presence of GM as a partner is a strong advantage, if GM stays with the project. However the proposal would be stronger with a better quality system assessment. Although the level of technological innovation brought to Ohio would be very significant, the scientific risks appear high and the proposal would have benefited in an improved assessment plan. The proposal satisfies most elements of the RFP, and would do well if funded, however, the committee found other projects to be more meritorious, and thus it should only receive funding if there are sufficient funds left over after the recommended five projects are funded.

EPS RCP 08-032
Next Generation Nanocomposites:
Enabling the Future of Composites through Nanotechnology
Zyvex Performance Materials, LLC

Proposal Summary:

Proposed Budget		
	State Funds	Cost Share
Operating Funds	$4,021,949	$6,118,857
Capital Funds	$978,000	$872,000
Subtotal	$4,999,949	$6,990,857
TOTAL	$11,990,806	

The lack of processibility and manipulation of promising nanomaterials such as carbon nanotubes (CNTs) is a major limitation in expanding its applications to large-scale industrial and value-adding structural components. Zyvex Performance Materials (ZPM) has organized a large collaboration team of composite suppliers, end users, academics, and tech transfer organizations in Ohio to pursue the further development of the company's Kentera technology. This technology appears not to damage or compromise the functional attributes of CNTs. Through three thrusts, ZPM proposes to develop and commercialize applications to advanced composites, elastomer products, and specialty resin products. There is an IP sharing framework in place with the diverse organizations and participants.

Detailed Review:

- **Level of Scientific Merit**

The proposed project will enhance ZPM's existing Kentera platform technology; enabling entry into markets where advanced composites and structures are critical, including the marine, sporting goods, aerospace, and high-end automotive industries. The technology is an innovative platform and could have significant impact, if the project is successful. The proposal lists a higher number of Level C attributes (Table 1A), which indicates that several significant technology risks have been addressed. Additionally, the proposal provides a comprehensive discussion of A, B, C level metrics with credible partners.

It appears that there is significant process- & product-oriented research needed to reach milestones of more credible composite applications with CNTs, and also many cost-reduction opportunities.

- **Commercial Potential**

The applicant team proposes to engage and expand new applications of CNT composites from early sporting goods and high performance uses to wider defense, aerospace, automotive, marine, energy, and industrial markets—this is an excellent fit for Ohio's economy. The proposal has the right balance of technology push and market pull efforts in place with its commercialization strategy for new products in thermoset nano-composites, new adhesives, and thermoplastics.

It should be noted that ZPM could be spread too thin in its resources and personnel in pursuing three separate product lines. However, since this three-pronged approach is also a potential advantage for accelerating the industry and Kentera technology appears to have many tailorable applications, the focus on three products did not particularly hurt the committee's view of the proposal.

- **Leadership and Management Quality**

The project team and its track record are very strong, and appreciated the presence and endorsement of Lockheed-Martin as a "technology pull" end-user. ZPM has a strong prior track record as an innovator in nanomaterials and tools for nanotechnology, and is well-suited to manage this project. The industrialization team is also well-composed with a good balance of suppliers and academic support.

- **Impact on Ohio**

The diverse commercialization team and supply chains proposed for undertaking the research and development across three product applications has the potential to help accelerate nano-applications of CNTs and broaden product lines—this is likely to yield high-value future jobs in Ohio. The Committee welcomes Arkema's intention to set up a plant for CNTs in Ohio, but also felt that there are some critical technology and manufacturing scale-up hurdles to be overcome in the near-term before further large-scale investments would be needed in Ohio. The market needs must be nurtured first.

- **Budget and Cost Share**

The proposal's budget and cost share include significant industry matches and the project leverages particularly well on previous Ohio investments. Stronger in-kind commitments from potential end users such as Lockheed Martin would further benefit the team, as a key challenge will be achieving timely qualification of parts and facilities before large-scale production can proceed to generate the bulk of the proposal's new jobs.

Review Summary:

The committee is impressed with the potential for ZPM's team to impact many different nanocomposite markets. However, the committee expresses concern over the project team's ability to achieve the necessary reductions in the cost of CNT composites over the duration of the ERCP award, and hence, whether these would really translate into projected near term jobs in Ohio, relative to other proposals that satisfy the program's RFP. This proposal is meritorious, however, the committee found other projects to be more meritorious, and thus it should only receive funding if there are sufficient funds left over after the recommended five projects are funded..

EPS RCP 08-034
Development and Commercialization of Membrane-based Purification Systems for Bio-Fuels and Chemicals
Promerus, LLC

Proposal Summary:

Proposed Budget		
	State Funds	Cost Share
Operating Funds	$4,995,723	$5,144,781
Capital Funds	$0	$10,000
Subtotal	$4,995,723	$5,154,781
TOTAL	$10,150,504	

Promerus requests funds to develop, commercialize, and manufacture in Ohio unique norbornene polymer membrane systems that will further reduce the cost of bio-butanol processes. The company believes that butanol is a promising alternative to ethanol as a biofuel. Promerus' collaborators and subcontractors are: Ohio State University, University of Akron, Butylfuel, USEPA, Chemstress, Centennial Associates, Rescentris, Nexant, and Mid-Atlantic Commercial Research.

Promerus proposes to develop, design and fabricate polymeric norbornene membranes and modules which will be demonstrated in a bio-butanol purification process at Butyfuel's 100 gallon per week demonstration unit. Butylfuel has a patented process to produce bio-butanol with no unwanted byproducts, "but the material coming out of the fermentor is a very dilute aqueous solution of butanol." Promerus believes it can "develop and enable the manufacture of a new class of separation membranes, ideally suited to the initial recovery of butanol from these dilute mixtures…"

Promerus states that its parent company, Sumitomo Bakelite, "is ready to invest in the next phase(s) of commercialization: fabrication of alpha/beta commercial skids and an Ohio-based membrane/module manufacturing facility if the business plan completed under this project meets or exceeds their typical financial targets."

Detailed Review:

- **Level of Scientific Merit**

The bio-butanol discussion was quite strong, however, this is a membrane based proposal predicated on the premise that bio-butanol will be commercialized and will require a new membrane for success. First pervaporation technology and membranes exist for ethanol/water separation and would probably work quite well for butanol/water. While pervaporation could yield energy savings in ethanol/water separation phase change separation processes (distillation) and dehydration are presently utilized due to the high capital cost of the membrane system. It does not appear that polynorbornene is really unique; the applicants have not clearly defined this or convincingly compared existing commercial pervaporation systems to this specific separation. As this is indeed a membrane program, commercialization either as a spiral wound or hollow fiber system would require a knowledgeable membrane fabrication company. Production of commercially viable membrane separation modules is not a trivial task.

- **Commercial Potential**

The committee is not convinced that there is great chance for successful commercialization within the proposed time period.

- **Leadership and Management Quality**

The CVs of those involved and letters of support would affirm commitment to the proposed project. However, given the lead applicant's lack of experience in this particular market, the committee is not convinced the product will be successfully commercialized.

- **Impact on Ohio**

The committee was not convinced that there would be sufficient impact on job creation and/or profit to Ohio.

- **Budget and Cost Share**

The committee found the proposed budget and cost shares to be relatively reasonable and in line with the requirements of the RFP.

Summary:

The committee does not recommend that this proposal be funded, primarily because it does not appear that polynorbornene is really unique. The applicants did not clearly define what is unique about it or convincingly compare existing commercial pervaporation systems to this specific separation. The committee also does not believe that there is a significant chance of success of commercialization within the proposed time period.

EPS RCP 08-035
Next Generation High Pressure Aerospace Fuel Systems
Eaton Corporation

Proposal Summary:

Proposed Budget		
	State Funds	Cost Share
Operating Funds	$4,002,152	$4,002,152
Capital Funds	$997,000	$997,000
Subtotal	$4,999,152	$4,999,152
TOTAL	$9,998,304	

Advanced propulsion concepts are demanding higher pressure fuel systems. These systems will require pressures that current technology pumps cannot provide. The primary technical objective of this proposal is to design and test a new pump concept that will meet these new requirements. In addition, there are two secondary issues that this new pump design will address. Through the use of new materials a weight reduction is achievable. In addition, the new pump will not require a bypass flow that dumps heated fuel back into the fuel tank. As a result, the heat sink capability of the fuel in the fuel tank will be preserved for cooling aircraft systems (coming from the 'more electric airplane'). Eaton Corporation is teamed with Ohio Aluminum and the Air force Research Lab for this proposal.

Detailed Review:

- **Level of Scientific Merit**

The technologies needed to achieve success have been under development for 12 years and "it is receiving market acceptance from all three major aircraft engine manufacturers." Very little technology development remains, at least as part of this proposal. The dual stage gear pump challenges all have design options as their solution—or advanced materials. The variable displacement ring pump has similar technical solutions to its issues. The proposal team is relying on others to provide those new materials.

- **Commercial Potential**

Eaton holds a substantial share of the current fuel pump market. This penetration is across military, business jet and large commercial jet transport markets. Lockheed Martin and the F-35 Joint Strike Fighter program is a potential early adopter of the variable displacement ring pump, but this pump does not meet the even-higher pressure requirements that are emerging. The commercial aircraft industry has undergone unprecedented sales during the 2005-2007 period (over 6000 airplanes). As a result, the market for fuel pumps is assured for the next 6-8 years. Given that the VDRP has over 20,000 hours of demonstration testing the market potential seems guaranteed.

- **Leadership and Management Quality**

Eaton holds a leadership position in the market. This is not an accident. It is the result of a focused, committed and capable management team. Their team is not totally 'home grown'—they have come from GE Aircraft Engines, Crane Aerospace, Westinghouse Electric, United Technologies, etc. This provides a broad perspective for managing technology and product development programs. And with 75% market share, they MUST be doing something right.

- **Impact on Ohio**

The impact on the economy of Ohio appears to be limited to maintaining the current workforce. In addition, it appears that the impact is exclusive to Eaton. There is little collaboration, and hence, little impact either favorable or unfavorable, on the rest of Ohio. There was no mention of a plan to bring suppliers to Ohio. As a result, this proposal was viewed as maintaining employment in Ohio and not a growth opportunity.

- **Budget and Cost Share**

The budget to complete the project seems reasonable, given the 20,000 hours of already accomplished demonstration testing for the VDRP. Cost share is a different story and it couples with the impact statement. Ohio State, AFRL and Rolls Royce all express support, but no dollar commitment. Ohio Aluminum was the only cost-sharing partner with $121,000 committed. The proposers are encouraged to broaden their sphere of collaborators.

Review Summary:

Strengths:
The technology that was proposed is already in the demonstration phase. The management team has demonstrated good business acumen (75% market share). The market for advanced fuel pumps seems assured given the current environment for military, business and commercial jet production for the foreseeable future.

Weaknesses:
The benefit is to one company—Eaton; there was very little collaboration with very little cost share or other external funding sources. The economic impact to the state of Ohio seems minimal and more along the line of sustaining jobs rather than growing jobs. In addition, Eaton has been doing this work for 12 years, it is hard to imagine that they would stop development at this stage regardless of whether or not they received a TFP grant.

Recommendation:
The committee does not recommend that this proposal be funded.

EPS RCP 08-037
Superconducting Fault Current Limiter
Hyper Tech Research, Inc.

Proposal Summary:

Proposed Budget		
	State Funds	Cost Share
Operating Funds	$2,664,287	$3,134,443
Capital Funds	$335,713	$0
Subtotal	$3,000,000	$3,134,443
TOTAL	$6,134,443	

This proposal is built on a collaboration between Hyper Tech, Inc. and Ohio State University for utilizing magnesium diboride ($MgB_{2)}$ wires produced by Hyper Tech in Superconducting Fault Current Limiters (SFCLs, also produced by Hyper Tech) for Rolls Royce (RR). The intended markets for this product are marine and power generation applications. Until now, RR has constructed two prototypes with the MgB_2 wire and a third is scheduled to be completed in 2009 (11 kV, 200 A, 3 phase). Here, it is proposed to commercialize units with 13.8 kV, 1000-1500 A, 3 phase capabilities manufactured by Hyper Tech (not RR). The current technology of using circuit breakers would be far improved with SFCLs, and the proposal indicates systems using MgB_2 would be potentially cheaper than competitive technologies in addition to having good performance.

Detailed Review:

- **Level of Scientific Merit**

In general the proposed level of scientific merit in this proposal is average. The majority of the work comes across as incremental improvements on existing RR designs. On numerous occasions in the narrative it is stated that results from RR's testing and development will be implemented in the design of Hyper Tech's SFCL. However, the fact that RR is not included as a collaborator is of great concern. While a letter of support (as a potential customer) is included from RR, it does not satisfy the substantial commitment that is implied in the proposal. In addition, no preliminary data from either of the first two RR prototypes are presented which makes it extremely difficult to assess the potential for success.

As the lead institution undoubtedly realizes, the design and implementation of a SFCL is incredibly intricate, with many sources of potential failure. That said, aside from Task 4 (to which only 6 months is allotted), there is not nearly enough detail presented to convince a reader that the intended tasks can be completed as described (especially in terms of the cryogenic system and electrical component design). Add to this the significant reliance on data obtained from other entities not listed as collaborators (RR, Scientific Magnetics, University of Manchester) and the potential for success is severely questioned.

- **Commercial Potential**

The level of commercial potential for this proposal is average to good. The proposers have clearly identified one major customer (RR) for their marine and power generation applications and they obviously have experience in the commercialization arena. Their plan is reasonably well thought out, it addresses the need of one end user, but without data on the first two prototypes it is not clear that a proof-of-principle has been demonstrated. In addition, it is not clear that they have adequately assessed the level of competing technologies. The cost and performance of BSCCO and YBCO (specifically) based superconducting wire is improving on a rapid basis, and with two companies in the U.S. currently marketing products based on this technology it is not clear that MgB_2 based systems will maintain a degree of sustainable competitive advantage for very long (if there is even one now).

- **Leadership and Management Quality**

The leadership and management quality of the proposers is good. It would have been strongly enhanced by a commitment of collaboration from RR on this project. There is no doubt that Hyper Tech is committed to this, however it just is not clear that it can be completed without a stronger commitment from RR. The past performance of Hyper Tech with Third Frontier grants seems to be very positive.

- **Impact on Ohio**

If successful, the impact of this work on Ohio would be very good. After 3 years, 26 jobs are predicted and after 6 years, about 300 jobs are predicted. The major customer (RR) is an Ohio-based company and the project does build on previous Third Frontier investments.

- **Budget and Cost Share**

The budget seems to be satisfactory.

Review Summary:

As the proposers must know, the Department of Energy (DoE) has been supporting development of SFCL's for at least 8 years through what is currently called the Office of Electricity Delivery and Energy Reliability. There are currently at least two projects underway to design, construct, implement, and commercialize this technology based on 2nd generation superconducting wire ($YBa_2Cu_3O_7$-based). First, the time and manpower spent on these projects is an indication of the significant level of detail that must be put into the design of all components (which was missing in the narrative of this proposal). Second, the DoE has specifically stated that research on SFCL's using MgB_2 wire will not be supported through that office as the technology based on 2nd generation wire will result in more widely useful products in the near and long term. It is the committee's opinion that if an entity such as this delivers this type of message, it is difficult to ignore. However, to be clear, this is not the only reason for rejection of this proposal; the lack of a real commitment of collaboration from RR is of great concern. This, combined with the very heavy reliance on results from RR's first three prototypes (with no preliminary data given and a lack of detail on specific critical tasks) leaves a large hole to be filled in the proposed work. The committee does not recommend that this proposal be funded.

EPS RCP 08-040
Unducted Low Noise Fans for Extremely Fuel Efficient Engines
Ohio Center for Advance Power and Propulsion/ OSU Research Foundation

Proposal Summary:

Proposed Budget		
	State Funds	Cost Share
Operating Funds	$4,990,000	$3,000,000
Capital Funds	$10,000	$2,000,000
Subtotal	$5,000,000	$5,000,000
TOTAL	$10,000,000	

This proposal was submitted by the Ohio State University (OSU) as the lead university for the Ohio Center for Advanced Propulsion and Power, a consortium of Ohio universities. The research proposed by this team consisting of OSU and NASA's Glenn Research Center, in collaboration with GE Aviation, is directed at improving the understanding of noise generation and methods for reducing it to future levels needed for the next generation of commercial transports utilizing a propulsion concept that offers significant fuel efficiency.

Detailed Review:

- **Level of Scientific Merit**

The proposed program is based on a balanced technical approach consisting of both analytical and empirical activities to provide both detailed understanding of the parameters impacting noise and operating efficiencies of unducted fans and generate tools for future propulsion systems designs. The proposal contains original and innovative approaches to the design of high speed rotating aerodynamic components and methods development and validation. The proposed work will generate a more detailed understanding of the noise generation phenomenon and the interaction with propulsion efficiency. The proposal points out that the technology development process will most probably generate the need for additional technology generation by other members of the Ohio aero propulsion community such as advanced composite materials. The work is capable of being performed by the proposed team and facilities.

- **Commercial Potential**

The proposal provides a detailed assessment of the market potential and the assumptions are based on the General Electric Company's strong position in this field. It does not describe the requirements for the associated aircraft development nor the schedule or timing for the development and entry into service for the vehicle. It is noted that the primary commercial application that is targeted is the medium size narrow body transport and it was mentioned that the technology has military application. The committee was concerned that the commercialization and the creation of jobs associated with production is a significant time away.

The issues of airframe, airline and traveling public customers' reception of unducted fan equipped vehicles are not discussed. There have been concerns about the perception that the appearance of "propeller" equipped aircraft will not be readily accepted by the public. A curve of the process of commercialization is provided along with a targeted 2012 date when the next new commercial aircraft will be introduced, but no details are provided concerning the requirements for both technical and marketing coordination with the airline and airframe customers.

The proposal notes General Electric's dominant position in the targeted market and discusses the importance of the proposed technology in sustaining this competitive position. It also notes that others are

actively pursuing competing technologies and expresses a degree of urgency in implementing the program. Also, the goals identify reductions in noise, fuel usage, and NOX and CO2 emissions, however the impact of these on competitive position in the market place are not noted or quantified.

- **Leadership and Management Quality**

The proposal notes the significant strength of the aerospace power and propulsion community in Ohio and the leadership provided by the proposal lead, OSU, the competitive position of the General Electric Company, and the strengths of the NASA Glenn Research Center. The Ohio Center for Advanced Propulsion and Power (OCAPP) is comprised of seven universities throughout Ohio led by OSU; University of Cincinnati, University of Dayton, Case Western Reserve University, the Air Force Institute of Technology, the University of Akron, and the University of Toledo. OCAPP addresses critical technology needs for Ohio's propulsion and power industry. This consortium represents one of the best balanced research organizations in the field of propulsion and is strength for sustained development of the proposed technology. The proposed program involves only three of these members.

The proposal mentions Timken, Argo-Tech and Parker-Hannifin as Ohio component manufacturers that will benefit form the success of this technology development at some point in the future. In addition, composite component suppliers are mentioned as beneficiaries of the program, but how these companies and technologists will be involved in the program and what the timing will be is not addressed. The potential for garnering additional funding from other sources is also not addressed in the proposal although military applications are mentioned.

The performance of the principal organizations on prior state of Ohio grants appears to be very good and the discussion on the process of transitioning of technology to product indicates a good understanding of the requirements and of the involvement of team mates in the activities.

- **Impact on Ohio**

The proposal represents the effort as providing technology that will sustain a portion of Ohio's 60,000 jobs in the aerospace sector based on a projection that GE will maintain or grow their strong market share position. It does not attempt to quantify the exact numbers of jobs resulting from this proposal nor does it definitize the time frame these jobs will be produced. It notes that engineering education programs may be increased by five to ten percent as a result of this investment in technology in the state which was considered a strength of the proposal by the committee.

- **Budget and Cost Share**

The proposal provided for in-kind cost share by the participants and meets the requirements of the RFP. The budget appears sufficient to cover the initial phase of the project.

Review Summary:

The strength of the proposal is based on the inherent strengths of the three groups proposing to conduct the work. The General Electric Company brings their extensive experience in aircraft engine technology and commercialization. The Ohio State University brings their strong position as a research institute in the area of power and propulsion. NASA's Glenn Research Center is recognized as a leader in propulsion research and technology demonstration. The committee does not recommend that this proposal be funded. The applicant team should consider reapplying for future funding rounds as the market requirements and airframe opportunities become clearer.

EPS RCP 08-046
Integration of Advanced Fuel Cell¾
Energy Storage Systems into the Distribution Grid of the Future
The Ohio State University Research Foundation

Proposal Summary:

Proposed Budget		
	State Funds	Cost Share
Operating Funds	$3,681,773	$3,688,122
Capital Funds	$6,000	$0
Subtotal	$3,687,773	$3,688,122
TOTAL	$7,375,895	

The focus of this project is to develop software controls and power electronics to integrate fuel cells, and potentially other distributed generation sources, with the electric grid. The Ohio State University is proposed as the project lead with Rolls Royce and American Electric Power (AEP) as industrial collaborators. Key project activities include the integration of a 1 MW Rolls Royce solid oxide fuel cell (SOFC) system into AEP's distribution system, establishment of an operations center to provide for collection of real-time data, optimization of power electronics, modeling of the effects of cables and conductors on turbo-generator performance, lifetime prediction and diagnostics, recommendations on ancillary control strategies, evaluation of environmental noise, development and fabrication of a 250 kW inverter and associated controls, evaluation of fuel cell materials and contaminants to achieve a 40,000 hour lifetime. This product addresses markets for stationary power, distributed generation and central station power.

Detailed Review:

- **Level of Scientific Merit**

This proposal addresses several important engineering activities necessary to achieve integration of a 1 MW SOFC with the electric grid. Key technical challenges include integration of the first 1 MW SOFC into the AEP distribution system, power electronics optimization and cost reduction, and a durability investigation. While the committee recognized that these activities are important to the overall integration process, the proposal failed to identify specific, enabling pieces of science or technology to be developed as part of this project that would lead to an important competitive advantage or provide a new product introduction. Instead, the proposal linked many important but somewhat unrelated elements that represented incremental advancements of the technology.

- **Commercial Potential**

The technologies being developed as part of this project address a large and growing market for distributed energy resources; particularly for fuel cells. The proposers have assembled a solid team that has a successful track record in developing and commercializing similar systems with defined channels to market. The proposal demonstrates a solid understanding of the commercialization process and the resource requirements for commercialization.

- **Leadership and Management Quality**

The proposal demonstrates the commitment of the lead applicant and collaborators with leadership demonstrated through all of the critical phases of the program. The proposal defines a clear line of responsibility for program participants with well-qualified individuals playing key roles in program execution.

- **Impact on Ohio**

The proposal demonstrates key impacts to Ohio in terms of job creation (260 jobs in 2014), and new product and service revenues ($260 M and $66 M in 2014, respectively). Participation of key Ohio industry partners is significant and critical to the success of the project. The proposal builds upon prior successful Ohio programs executed by Rolls Royce and prior partners. The team has had a strong track record of attracting development funds to support its fuel cell program activity, and the chances of continuing to do so in the future appear to be solid.

- **Budget and Cost Share**

The substantial financial commitment, particularly in cash, on the part of the partners to execute this project is recognized and significant. The budget appears to be justified but may not be fully adequate to meet the goals of this proposal given the anticipated challenges associated with commissioning such a large scale system. Cost share letters are provided, however the Rolls Royce letter does not call out the significant contribution to project cost share that is enumerated in the proposal budget forms. The overall financial commitment of Rolls Royce to the execution of this project is therefore in question.

Review Summary:

The proposal was organized and well-written, addressing critical elements in an important product sector. The committee recognized the significant commitment of key industrial partners in addressing the development of a potential product that is very germane to their business, although the specific financial commitment by Rolls Royce, an important partner, was not defined in the letter of support. The proposal does not make a convincing scientific case for this project as it does not highlight or emphasize key, enabling technological developments that would lead to an important technical advantage for this product. The proposal also fails to link technical developments to important market discriminators for the anticipated fuel cell platform. The committee suggests that the proposing team continue the development activity and re-propose at the next opportunity with the deficiencies outlined in this review addressed. The committee does not recommend that this proposal be funded.

EPS RCP 08-047
Brushless Starter Generator Systems for Turbine Engines
GE Aviation Systems, Electrical Power - Dayton

Proposal Summary:

Proposed Budget		
	State Funds	Cost Share
Operating Funds	$4,947,099	$5,040,088
Capital Funds	$50,000	$0
Subtotal	$4,997,099	$5,040,088
TOTAL	$10,037,187	

Within the aircraft industry there is a move toward the "more electric airplane." The F-35 and 787 are clear examples of this trend. These airplanes require more AC and DC power. In addition, weight and reliability requirements continue to be more stringent. The proposed brushless starter generator (BSG) concept addresses all of these issues. GE Aviation Systems, Electrical Power-Dayton is teamed with the Ohio Aerospace Institute (OAI), PC Krause and Associates, the Ohio State University, and the Air Force Research Lab on this proposal.

Detailed Review:

- **Level of Scientific Merit**

The technology for the brushless starter generator has been tested in breadboard form. Additional work is desired in the area of materials to improve the performance-to-weight ratio. Design of a prototype is also required, but this is not a technology issue.

- **Commercial Potential**

GE Aviation Systems, Electric Power is a $240M business based in Vandalia, Ohio. The commercialization process will require 36 months. This represents the accelerated schedule enabled by Third Frontier funding. In addition, funding is available from the U. S. Government via congressional earmarks. Private funding from venture capitalists and potential customers like Boeing, Lockheed Martin, Airbus, Cessna and Bombardier is also envisioned. One source of confusion is the fact that the proposal tends to focus on military and commercial transports as reasons for developing the BSG, yet the initial sales estimates show the business jet market as being the kickoff customer (page 32).

- **Leadership and Management Quality**

GE Aviation clearly has a strong management team. The plan shows a reasonable scheme for managing the collaboration partners. OAI in particular has demonstrated the ability to manage diverse teams. Roles and responsibilities for all partners are clearly defined.

- **Impact on Ohio**

The impact on the economy of Ohio appears to be limited to maintaining the current workforce with some potential for limited employment growth. This employment growth affects only one company—GE Aviation Systems, Electric Power. There was no mention of a plan to bring suppliers to Ohio.

- **Budget and Cost Share**

The budget to complete the project does not seem reasonable. With 129,000 hours in labor, $4.8 million does not seem sufficient to cover this expense. It is acknowledged that GE does say that the project is expected to cost more than $10 million, yet it doesn't commit funds above the $10 million level. The definition of the deliverables is very vague.

The cost share commitment from the partners is reasonable.

Review Summary:

The technology being proposed addresses several issues faced by the aerospace industry: more electric platforms requiring more power, lower maintenance costs, and lighter weight. However, the proposal does not include any other Ohio companies. The cost estimate does not appear to include sufficient funds to cover the labor estimate. It is not clear how the demonstration phase can be concluded by September, 2008, as stated on page 21.

The committee does not recommend that this proposal be funded.

EPS RCP 08-049
Nano and Bio Based Materials for Next Generation Composite Systems
National Composite Center

Proposal Summary:

Proposed Budget		
	State Funds	Cost Share
Operating Funds	$4,244,297	$3,243,948
Capital Funds	$750,000	$2,500,000
Subtotal	$4,994,297	$5,743,948
TOTAL	$10,738,245	

Sheet Molding Compound (SMC) and Bulk Molding Compound (BMC) molders and material suppliers are major employers in Ohio with the automotive industry being the major customer base. This proposal is led by the National Composites Center (NCC) with a large number of collaborating companies. SMC and BMC materials have several key concerns today that are restricting market penetration, including: relatively high specific gravity, styrene emissions, thermoset recycling difficulties, surface and paint defects, and high labor cost associated with trim and finishing.

This proposal intends to reduce the weight, make the material "greener," and lower its cost by using nano and bio materials and streamlining the processing. The objective is to expand SMC/BMC market penetration and increase industry employment by overcoming the perceived barriers to future use of SMC and BMC, particularly in the automotive sector.

Detailed Review:

- **Level of Scientific Merit**

The NCC capabilities and substantial collaboration on the proposal are commendable, particularly in the attempt to streamline the SMC maturation and manufacturing processes. The approach of using bio-based fillers to replace some or all of the high-density calcium carbonate is attractive, although there is little evidence presented that the specific bio-fillers proposed will permit significant substitution for calcium carbonate, particularly at an affordable cost. The proposal does not seem to address the styrene emissions, recycling, and surface quality concerns. Furthermore, because of the fragmented nature of the SMC/BMC industry and its orientation toward proprietary formulations, it seems unlikely that centrally-developed technologies would be readily implemented. Overall, the committee believes that the many issues associated with use of SMC and BMC are daunting and will continue to grow. This proposal does not provide a likely path for meeting all the requirements simultaneously, as will be required for maintaining, let alone growing, market penetration, particularly in automotive applications.

- **Commercial Potential**

The goals of this proposal are to increase market penetration for SMC and BMC. If these goals were met it would have a very substantial economic and jobs impact on Ohio, readily justifying the Ohio investment. But because the technical approach seems to be inadequate for meeting the goals, the commercial potential is likewise inadequate. Further, although there are "customer" participants including Deere and a commuter vehicle manufacturer, there appears to be little commitment or support from the auto industry—a major "customer" with stringent requirements—which will be necessary for success.

- **Leadership and Management Quality**

This area is truly a key strength of the proposal. The NCC, with its equipment, personnel, and well-coordinated supplier participation, has demonstrated success in developing and commercializing composite technologies. The proposal does an excellent job of utilizing the previous Ohio technology investments.

- **Impact on Ohio**

As stated earlier, the SMC/BMC industry is very important to Ohio and has a major impact on jobs. It seems clear that key industry participants have demonstrated a level of commitment to the proposal. However, as written, the proposal does not demonstrate an ability to have a significant positive impact on the viability of the industry.

- **Budget and Cost Share**

Although the budget and cost-share letters seem appropriate for the work planned, the commercial goals of the proposal are unlikely to be met.

Review Summary:

In summary, this proposal is aimed at improving SMC and BMC technologies to overcome a rapid loss in usage of these materials. The key weakness of this proposal is that the proposed technical approach is unlikely to overcome the many reasons for market losses in SMC and BMC, and thus in comparison to other proposals, is unlikely to result in significant growth opportunities for Ohio. The committee does not recommend that this proposal be funded.

EPS RCP 08-050
Hydraulic Hybrid Commercialization
Impact Engineering, Inc.

Proposal Summary:

Proposed Budget		
	State Funds	Cost Share
Operating Funds	$3,600,000	$8,494,000
Capital Funds	$600,000	$0
Subtotal	$4,200,000	$8,494,000
TOTAL	$12,694,000	

This proposal examines a systems engineering and development project to demonstrate the benefits of a split-power hydraulic hybrid drivetrain for medium and special duty trucks, including military vehicles. The hydraulic hybrid provides substantial fuel savings in high-power applications involving wide range of speed/load conditions (duty cycle involving stop/starts and frequent high and low load changes). Such high-power applications are difficult and very expensive for electric hybrid technology. The goal is to package a unique hydro-mechanical transmission (HMT) in the same envelope as the current truck transmission. This will allow easier and lower cost implementation of hydraulic hybrid function into existing and new vehicles, while potentially permitting implementation of the HMT transmission, without hybridization, into a wide range of trucks. The inherent infinitely variable transmission (IVT) benefit of the HMT may provide up to 20% fuel economy benefit without hybridization. Ohio is proposed as the site for the design, testing and building of HMT transmissions and demonstration vehicles.

Detailed Review:

- **Level of Scientific Merit**

Despite the relatively low level of collaboration and research and development in this proposal, the committee perceives the scientific merit as very high. This is because of the very large fuel economy benefits possible from the potentially cost-effective hybridization of class two through six trucks and possibly a wider range of vehicles that have a suitable duty cycle to benefit from hybridization, and the smaller, but significant, fuel efficiency benefit from IVT transmissions in an even wider range of vehicles.

- **Commercial Potential**

Commercial potential is also perceived as very high. This approach to the hydraulic hybrid is commercially superior to the other known approaches. As described above, the proposed concept, if successfully developed, is particularly well-oriented for commercial implementation, particularly considering the normally very high cost of implementing new vehicle drive lines. If successful in packaging the HMT into the envelope of the current transmission, it can be implemented with relatively few vehicle changes. Furthermore, if the high-volume cost of such a transmission is close to that of the transmission being replaced and meets the performance requirements, it may replace most or all transmissions because of the potential fuel economy and drivability benefits of HMT even without hybridization. The market potential probably exceeds 100,000 hybrids per year, and possibly 500,000 more HMT transmissions.

- **Leadership and Management Quality**

This area is of concern to the committee because of the uncertain availability of the technical and management resources required to implement such a major development effort. IEI seems to be a nascent

organization with relatively few current committed employees and with limited engineering and development facilities.

- **Impact on Ohio**

The proposal's impact on Ohio is very high in the short term because DOD is expected to provide cost sharing of almost two times the Ohio-requested funds, which would result in engineering and development personnel in Ohio. In the longer term a multi-billion dollar annual business of manufacturing components, assembling transmissions and assembling vehicles is possible. There is some concern however that manufacturing and assembly may not be permanent in Ohio.

- **Budget and Cost Share**

The committee has concerns over the proposal's budget and cost share. The committee recognizes that the tasks and goals of this project require large resource commitments, well beyond the funds available from Ohio. IEI and its planned collaborators are unlikely to be able to obtain the necessary additional funds without large support from other sources such as DOD and DOE. The proposed $7.2 million cost share by DOD is considered essential to the success of this program.
If DOD cost sharing is realized as planned, the program may be adequately funded for the first few years, but substantially more funding will be required in the future to reach commercialization. Assuming successful development of demonstration vehicles, such funding should be forthcoming because of the large fuel economy benefits, particularly to DOD.

Review Summary:

Although this proposal has considerable scientific and commercial merit, the committee does not recommend that this proposal be funded at this time because the cost share requirement for the program is not committed at this point. The proposal would be decidedly stronger if the DOD funds were obligated to the project. It is suggested that the proposal be resubmitted for future award programs when the cost share requirement is met.

EPS RCP 08-051
Advanced Materials for the 21st Century
Maverick Corporation

Proposal Summary:

Proposed Budget		
	State Funds	Cost Share
Operating Funds	$4,512,500	$4,570,000
Capital Funds	$487,500	$430,000
Subtotal	$5,000,000	$5,000,000
TOTAL	$10,000,000	

This proposal seeks to develop and commercialize advanced composite materials for use in military aircraft, missiles, the aviation industry, as well as a variety of other markets. During the three years of RCP funding, the project team will develop advanced prepregs, adhesives, films, and molding compounds that will offer Ohio businesses a strong competitive advantage in aerospace and marine markets.

There are a large number of collaborating entities with this project, including Renegade Materials Corporation; Zyvex Performance Materials; A & P Technology; Akron Polymer Systems; CMPND; Hartzell Propeller, Inc.; American Technical Coatings, Inc.; University of Dayton Research Institute; and EMTEC.

Detailed Review:

- **Level of Scientific Merit**

It is not clear to the committee that the science behind this proposal is sufficiently innovative for this grant program. For the most part, the proposal will take concepts from a previous collaboration and apply them for product entry into markets. In effect, the team aims to take a material that is producible and apply it to products, with only minimal alterations to the material. The composites field is significant for Ohio's economy, but this proposal does not satisfy the RFP's requirement for innovative science. Additionally, the science behind the proposal is not particularly detailed or well explained. The proposal would benefit greatly from improvements in this area, as greater detail may have conveyed the level of innovation associated with the proposed research.

- **Commercial Potential**

There is a strong commercial potential for this proposal. There are numerous Ohio-based companies that can benefit from the commercialization of this platform technology. However, the proposal lacks sufficient detail concerning the commercialization strategy for the specific products. While there is significant value in commercializing a platform technology, the proposal would have been much stronger if more details had been provided about commercialization plan, especially with regard to the initial thrusts of the technology.

- **Leadership and Management Quality**

The assembled team is top caliber in this field. Maverick has extensive experience with commercialization of products for military use, and the large number of collaborators only strengthens the likelihood of the team's success in the numerous markets being targeted. The management plan is sufficiently developed and detailed.

- **Impact on Ohio**

The impact on Ohio of this proposal, in terms of creating new jobs, is only fair, especially when compared to other proposals. The number of jobs created (around 300) seems rather low, especially if the projected sales (close to $300 million over 8 years) occur as projected.

- **Budget and Cost Share**

The budget for the proposal appears sufficient. The level of cash support in the cost share (approximately 50%) is particularly noteworthy to the committee.

Review Summary:

This proposal is a good fit for Ohio's economy, but fails to make sufficiently make its case, especially with regard to the science behind the project and the specifics of the commercialization plan. The proposal would have been stronger with greater focus and detail. The impact on Ohio is only fair compared to other proposals, and seems a bit low for the projected sales. The committee does not recommend that this proposal be funded.

EPS RCP 08-054
Ohio Based Manufacturing of Thin-Film Photovoltaics
Xunlight Corporation

Proposal Summary:
The proposed project seeks to leverage laboratory-demonstrated technology advancements into existing Ohio-based manufacturing lines and bring new products to market. The lead applicant is Xunlight Corporation which will work in collaboration with the University of Toledo (UT), UT's Wright Center for Photovoltaic Innovation and Commercialization, UT's Wright Center for Photovoltaic Electricity and Hydrogen, Xunlight 26 Solar, LLC, and SCI.

Proposed Budget		
	State Funds	Cost Share
Operating Funds	$4,925,000	$2,375,704
Capital Funds	$50,000	$3,050,000
Subtotal	$4,975,000	$5,425,704
TOTAL	$10,400,704	

The key technologies relate to roll to roll continuous manufacturing of thin-film material in general and the manufacture of photovoltaic cell (PV) solar cells in particular. The proposed project has three primary objectives: develop an improved, advanced thin-film solar-cell fabrication technology; develop an improved, advanced flexible solar module manufacturing process, with the necessary equipment; and develop advanced photovoltaic products targeted to markets to leverage the competitive characteristics of their thin-film solar cells.

Detailed Review:

- **Level of Scientific Merit**

Past collaboration among the team members resulted in the development of foundational manufacturing technologies upon which the current proposal is based. These technologies have been embedded in a pilot production line, and the team has raised institutional funding to build its first production line—scheduled for completion in the third quarter of 2008. The proposal identified several laboratory-scale technologies that show very high potential improvements if integrated into a large-scale manufacturing line. These innovations and the research plan were reviewed by the committee and it was determined that this is a well defined project with a strong probability of success. The applicant team provided substantial detail on the primary technical and commercial risks likely to be faced by the project as well as the team's mitigation plans.

- **Commercial Potential**

Very large commercial potential exists for this proposal. Demand for solar cells is growing at accelerated rates with significant oil price and policy drivers. If production cost and efficiency targets are met, then Xunlight will have a clear opportunity to acquire a portion of this rapidly growing market. The team is very focused on succeeding in their targeted markets, and provided a very clear understanding of competing companies and technologies.

The committee saw the team's success at acquiring substantial institutional funds as a strong validation of both the technology and the business plan.

- **Leadership and Management Quality**

Xunlight has assembled a strong team, both inside the company and among their collaborators. Roles and responsibilities are well defined and the management plan appears sound. Xunlight is young, but has a good track record in moving their technology into pilot scale. The company has received statewide and national recognition. The firm has recruited top level talent to drive the marketing and business development effort. Several key partnerships are in place and others under discussion.

- **Impact on Ohio**

The proposal offered a good assessment of the collaboration-specific economic impact on Ohio, as well as a very credible assessment of the direct impacts of this grant program on their value chain (suppliers and distribution/installation channels). The proposal estimates an expansion of direct jobs from an anticipated base of 884 to 2218 by the year 2012. Developments in the supply chain will create even greater job and income impacts.

- **Budget and Cost Share**

The budget and cost share appear reasonable for the proposed tasks. A large part of the cost share is supported by institutional investor funding, which is a very positive leverage of state funds.

Review Summary:

This is a strong, well organized proposal. It is technically sound with a very clear path to commercialization. The presence and interest of venture capitalists is particularly noteworthy, as is Xunlight's commitment to Ohio. The committee recommends that this proposal be funded.

EPS RCP 08-065
Commercialization of 10 Gigabit Ethernet (10 GigE) "SmartNIC" and "Smart" Software
RNET Technologies, Inc.

Proposal Summary:

Proposed Budget		
	State Funds	Cost Share
Operating Funds	$5,000,000	$5,015,000
Capital Funds	$0	$0
Subtotal	$5,000,000	$5,015,000
TOTAL	$10,015,000	

The proposal outlines a plan to take a prototype 10 Gigabit Ethernet computer network interface card (NIC) to market. RNET Technologies, in collaboration with Ohio State University and Sellex International, proposes to build upon several Department of Energy (DOE) and National Science Foundation (NSF) grants. A $750,000 grant from the DOE Small Business Innovative Research (SBIR) program in FY2006 (to RNET Technologies, then located in Palo Alto, CA) was aimed at building on a prototype NIC with a work plan in which "the required software infrastructure will be developed to off-load the networking software stack to a network interface card, which would serve as a bridge between the ultra-high speed lambda networks and traditional internet protocol networks." A $150,000 NSF Small Business Technology Transfer (STTR) grant in FY2007 is also cited, to investigate "the design of a data-center functionality off-load engine (DCFOE) based on a field-programmable gate array (FPGA)-based accelerator to off load common data center services."

The proposal outlines a plan to engage data center managers to advocate with computer vendors to offer the SmartNIC product, and the expected market entry of the product is July 2010. The proposal notes the 2007 competitive landscape as follows: "Several vendors of 10 GigE products, such as, NetXen, Myricom, Neterion, etc., are offering several network off-loading capabilities in addition to TOE. However, no vendor is offering the extent of "deep" off-loading, i.e., application-related and application-level off-loading." The proposal seems to argue that the shrinking share of the cluster interconnect market among the world's top 500 clusters (the Top 500 list) for vendors such as Myricom is evidence that the market is in need of a better solution. An equally valid interpretation of the data is that commodity solutions are displacing specialized products, which would make it difficult to introduce new specialized systems such as "SmartNIC."

The market entry plan outlined is to have data center managers convince server manufacturers to offer the SmartNIC product. The rationale for this approach is a belief that data center input/output (I/O) performance issues are primarily due to network protocol (software) processing and thus moving this processing to the network interface card will dramatically improve data center I/O performance.

Detailed Review:

- **Level of Scientific Merit**

Offloading network protocols to hardware interfaces has been attempted, with mixed success, for over 20 years. The commercial data center market relies on commodity standard network solutions such as Gigabit Ethernet and Fibre Channel, and operating system vendors have incorporated several decades of improvements to network protocol processing. In cases today where processor power is consumed by network protocol processing, the diagnosis is poor software stack implementation, as illustrated by benchmarks of commodity operating systems such as Microsoft Windows.

RNET's expertise in field programmable gate array (FPGA) is thus being applied in this proposal to an outdated view of data center performance problems.

- **Commercial Potential**

As noted in the proposal, even the leading vendor of specialized "smart" interface cards—Myricom—has dropped from 39% to under 16% in terms of the share of the interconnect market among the world's top 500 (www.top500.org) systems. It is unclear where this interpretation comes from, as the site shows a drop for Myricom from 14% in November 2003 to 3.6% in November 2007. In this same period of time, five specialized network interconnect technologies that collectively represented 47% of this market in November 2003 have all but disappeared in November 2007 (now collectively with less than 3% of the market). During this four-year period, commodity Gigabit Ethernet rose from 22% to 54% and the Infiniband standard rose from 0% to 23%.

Given the data for the high-performance computing market, where I/O performance is paramount, commodity offerings have driven specialized companies out almost entirely, with Myricom surviving as a very small company.

In the general data center environment, commodity is even more important to data center managers for reliability and due to the overall lower total cost of ownership working with standards (for which there are multiple suppliers) versus specialized products (for which there is typically a single supplier). This explains why even leaders in high-performance, such as Myricom, have essentially no footprint in the general data center market.

In terms of customers convincing suppliers to provide SmartNIC, large vendors such as Sun, HP, IBM, and Intel already have significant internal investments in making their commodity network products perform at a level that customers demand. Further, each of these vendors also have high-performance specialized interconnect product offerings or plans for the high-performance market.

Finally, with a market entry planned for fully five years behind the competition, the SmartNIC product will have a difficult time competing due to two additional factors (beyond those noted above). First, competing offerings will have three years of field-experience with respect to hardware and software maturity. Second, and more significant, the market will be looking for 40 and 100 Gigabit per second products by 2010 when RNET is introducing its first 10 Gigabit per second product.

- **Leadership and Management Quality**

Beyond what appears to be a misunderstanding of the market for specialized network interface, the management would need to focus all of its efforts on the SmartNIC product in order to deliver a successful offering. Further, 2 years to introduce a product that builds on 2 years of study and prototype raises the question of execution. Lastly, the most recent NSF STTR grant by the principals at RNET (January 2008) is to apply the FPGA technology to bioinformatics search performance. This, in addition to a previous DOE SBIR grant to apply FPGA to offloading Lattice Quantum ChromoDynamics processing, suggests that RNET is not yet certain what is the right commercial application for their FPGA expertise.

- **Impact on Ohio**

RNET Technologies is listed in web directories and on several NSF grants as a company from Palo Alto, California—thus perhaps recently they have relocated to the current Dayton, Ohio address. The proposal projects 80 high-tech jobs, presumably in Ohio, but does not take into account the shrinking market

opportunities for specialized network interfaces noted above. For example, the current leader of this dwindling market has only a fraction of the staffing that RNET projects.

- **Budget and Cost Share**

Not applicable given above.

Review Summary:

RNET clearly has expertise in FPGA application, but would be more likely to succeed by looking more closely at commercial needs looking into the future—not into the past to disappearing markets such as with 10 Gigabit network interfaces. The committee does not recommend that this proposal be funded.

EPS RCP 08-074
Small Scale Food Waste-to-Energy Systems: A New Ohio Industry
EISC, Inc.

Proposal Summary:

Proposed Budget		
	State Funds	Cost Share
Operating Funds	$4,287,700	$2,401,212
Capital Funds	$712,300	$2,714,673
Subtotal	$5,000,000	$5,115,885
TOTAL	$10,115,885	

This proposal outlines a plan to convert food waste to energy from 1000 grocery stores and over 2000 restaurants and many food processing companies in Ohio to generate substantial revenues within five years. It proposes to use waste for energy and byproducts through feedstock preparations of food waste through anaerobic digestion, gasification, and energy conversion via fuel cell systems to produce electricity. The proposal also proposes to use integrated modeling methods and post audit verification studies to predict economic benefits, environmental sustainability, and other impacts from the technology. The project team includes the Ohio Groceries Association, Ohio Department of Natural Resources Division of Recycling and Litter Prevention, and Ohio Restaurant Association. Those involved appear to be the right team members.

Detailed Review:

- **Level of Scientific Merit**

The establishment of a small-scale integrated waste-to-profit manufacturing system for sustainable economic solutions for conversion of food waste into electricity is relatively innovative and feasible. The science behind this project appears sound. Reusing, recycling, composting, and disposal in combustion facilities and land fills is a great idea. However, the specifics of the process were not detailed well, and the potential of the project is hurt by the need to separate or remove the lignocellulosic matter before the enzymatic digestion phase.

- **Commercial Potential**

The proposal claims revenues of $20 million in the first year and $1 billion in five years. This is rather substantial, although seemingly overoptimistic. Additionally, there is no convincing reason that the partners will profit from this business because of the need to separate/ remove biomass matter before the digestion phase, as mentioned above. On the plus side, developing small facilities to reduce transportation costs is a good method for this project. However, the project will need technology providers, a competent supplier industry, and market adaption through adaption sites. The proposal did not detail these elements particularly well.

- **Leadership and Management Quality**

The leadership of this team is strong. The project team includes collaboration from the groups necessary for a project of this sort to succeed, including the Ohio Groceries Association, Ohio Department of Natural Resources Division of Recycling and Litter Prevention, and Ohio Restaurant Association. The lead applicant and partners are well qualified for the proposed work; the only concern in this area is whether the process would be profitable.

- **Impact on Ohio**

The proposal details an incredibly high number of jobs and new revenues if the project is successful and profitable. However, these gains are not within the near term, and are strongly related to success of the project. If the project is not successful in the large scale envisioned, then the impact on Ohio will be negligible. This is particularly a problem with this proposal, as the committee is not convinced the business model can profitably pan out.

- **Budget and Cost Share**

The budget and cost share comply with the program's RFP.

Review Summary:

This project is a very interesting concept, but should not be funded because of scientific and commercial failings. The exact conversion processes to be utilized were not explained well by the proposal. The idea of converting waste into profitable energy sounds great, but the team is off target with how to accomplish this feat. Secondly, there is no guarantee that the conversion would financially benefit Ohio or even the project team. Even if it is profitable in the long term, the project will not necessarily create a significant number of jobs in Ohio. The committee does not recommend that this proposal be funded.

EPS RCP 08-077
Enabling Technologies for Advanced Natural Fiber Reinforced Composites
Ohio State University Research Foundation

Proposal Summary:

Proposed Budget		
	State Funds	Cost Share
Operating Funds	$4,150,000	$4,850,000
Capital Funds	$850,000	$150,000
Subtotal	$5,000,000	$5,000,000
TOTAL	$10,000,000	

This proposal is focused on increasing the utility of natural fiber reinforcement of conventional polymeric materials. The technology is at least partly based on the fibrillation of naturally occurring fibrous materials (e.g. jute, flax). The proposal is emerging from an existing Wright Center (Ohio BioProducts Innovation Center) and has a large number of small and large Ohio-based companies involved with the commercialization roadmap. Ohio State University Research Foundation is teamed with a large number of companies and organizations in this proposal.

Detailed Review:

- **Level of Scientific Merit**

Natural fiber reinforcement of polymers is, of course, not new as the earliest thermosetting materials employed cotton fibers for improved properties/lower cost. Inorganic fillers and fibers have dominated polymer composites for the past several decades. A recent successful commercial composite is "plastic lumber" capable of replacing wood in more demanding applications. The composites noted in this RCP are considered to be the next generation of similar composites. The primary technology advance noted involves the fibrillation of natural fibers into smaller diameter, more uniform fibers for polymer matrix reinforcement. With success, this will allow commercial introduction into higher value added markets. As the reinforcement capabilities will still be quite inferior to fiberglass and exfoliated clay, the level of market penetration will depend on replacement of non-strength/stiffness critical applications (probably at the expense of $CaCO_3$, talc, wollastonite etc. filled polymers). There will be, of course, a market where the "green" aspects of the product will allow use in consumer products.

The technology aspects of this proposal appear straight-forward and capable of scale-up to commercial use. The success will depend upon the ability to replace conventional materials (often filled polymers). Replacement of fiberglass reinforced composites (such as SMC) is not viewed as technically/economically viable. The market potential is probably best directed at replacement of specialty wood products as compared to existing polymer composites. The proposal does discuss the use of this technology into the more demanding wood based markets in building and construction products as well as replacement of wooden pallets. The natural fibers have serious problems relative to fillers/fibers presently employed in polymeric composites (processing stability, flammability, water sorption, surface roughness, difficulty to incorporate as a fiberglass reinforcement for unsaturated polyester/styrene in their typical composite systems, difficulty in producing blow molded fiber-filled composites). It should be noted that the properties listed in Table 1 (while noted in the text to be good) demonstrate the transformation of unfilled polypropylene into a product with very low impact strength as judged by the unnotched toughness and the low tensile elongation. The area under the stress-strain curve (an estimate of practical toughness) would be well over an order of magnitude lower than for the unfilled polypropylene. A proper comparison would be with 40% talc filled polypropylene which has a modest volume market with which such natural fiber reinforced polymers would need to replace if commercial success were to be envisioned.

- **Commercial Potential**

The proposal is well-written and combines a number of partners into a plan that should be capable of assessing the market and commercial potential. The project has already been highly funded by the Ohio. The impact on Ohio is, however, rated as intermediate as proposed. Successful adaptation of the technology to the replacement of wood-like or wood-based products (e.g. furniture), extruded shapes replacing wood, would appear to have a higher impact than replacement of existing polymer composites and presumably the technology appears to already exist to test these markets.

- **Leadership and Management Quality**

The applicant has put together a strong team and a large number of relevant partners.
They would be able to successfully conduct the proposed research and development.

- **Impact on Ohio**

As noted above, the impact on Ohio is modest. The fiber sources discussed are not typically produced in Ohio although some of the polymer industry that could be involved is in the state. The ability to replace well-entrenched products with this technology is not readily apparent as prior attempts to utilize existing similar natural products have been less than successful.

- **Budget and Cost Share**

The budget and cost share elements of the proposal appeared reasonable and acceptable.

Review Summary:

The strong aspects of this proposal involve the number of involved parties and the focus on a specific technology involving fibrillation of natural fibers. The commercial promise and impact on Ohio is not as strong as might be desired, however, and the committee does not recommend that this proposal be funded.

EPS RCP 08-078
Center for Thermafficient™ Technology Commercialization: Clean Industrial Waste Heat Power & Energy Solutions for Cost Effective Power Generation
reXorce Thermionics, Inc.

Proposal Summary:

Proposed Budget		
	State Funds	Cost Share
Operating Funds	$3,700,670	$3,799,060
Capital Funds	$599,330	$500,940
Subtotal	$4,300,000	$4,300,000
TOTAL	$8,600,000	

This proposal aims to develop technology that can capture waste heat and convert it into usable electricity. Most of the world's electrical power, approximately 10 trillion watts, is generated by heat engines that convert heat into mechanical energy, which is then converted into electricity. Approximately 15 trillion watts of energy is not converted, but is instead released into the environment. If even a small fraction of this lost heat is converted to electricity, the impact on the cost and availability of energy would be enormous. Industrial production, whether in chemicals, steel, or any other product, also generates a large excess of heat that is not converted into energy and in fact forces the additional use of energy to power cooling units and air conditioning. The team behind this proposal will take a proven technology, reXorce's Thermafficient™ heat pumps, and improve upon the technology to create cost effective thermal management solutions without the typical negative characteristics currently present in heat pumps, such as high capital costs and undesirable refrigerants. Parker Hannifin, University of Akron and CWRU, Ohio companies and institutions, as well as Carbide Derivative, Advanced Diamond Technologies and South Louisiana Ethanol are collaborating with reXorce on this project.

Detailed Review:

- **Level of Scientific Merit**

The proposal provides a good justification for the area of investigation and commercialization. The scientific studies to be pursued are sophisticated and pertinent. A key factor promoting this prospect is a strong and growing patent position for supercritical carbon dioxide ($ScCO_2$)-based thermal engines and heat exchanger technologies.

- **Commercial Potential**

For the purposes of a focused business plan, reXorce is first concentrating on industrial waste heat recovery and its potential for distributed energy opportunities. Distributed energy is energy that is decentralized and produced at its point of consumption. Retail large industrial and commercial businesses are indicating as representing excellent opportunities for distributed energy because of the abundance of waste heat streams. A key partnership with Parker Hannifin, due to their strong presence in commercial heating, air conditioning and refrigeration (HVAC/R), is forecasted to capture a 1% share in the waste heat recovery effort, creating a revenue stream in excess of $155 million/year within 5 years.

- **Leadership and Management Quality**

reXorce will lead and manage the program, evaluating the best approaches, organizing the component supply chain and select and certify a systems integrator to produce the sellable commercial product from its collaborators. reXorce will provide prototype manufacturing, selection and procurement of components from collaborators, perform the necessary shakedown of the system, test and certify the commercial product, deliver and commercialize the resulting systems through a combination of established partnerships, marketing, and sales channels.

The proposal's key participants at reXorce are qualified for the task. Additionally, the research will include investigators from all of the collaborators.

- **Impact on Ohio**

In 2016, five years after the project concludes, reXorce predicts there will be a combined $155 million in product sales for the collaborators based on a modest market share target for the category as a whole. It is projected that the business would generate a total job growth of approximately 58 new Ohio job positions. Based on an average salary of $78,000 (manufacturing and professional), these new positions would represent more than $4.5 million in personal income per year. reXorce and its collaborators will also be making a significant investment in Ohio during the five-year period following this proposal, in order to produce this product.

- **Budget and Cost Share**

The committee expressed the belief that while the budget appears to be adequate, it is suggested that it be reexamined in light of the change in beta site for the projects.

Review Summary:

reXorce presented a strong proposal for heat harvesters for industrial and commercial waste heat generation. Their system, in general, promises substantial return to Ohio above the State's initial investment. The committee recommends that this proposal be funded, as it is entirely compliant with the RFP.

EPS RCP 08-079
Advanced Materials: Granule-Based Delivery Systems
The Andersons, Inc.

Proposal Summary:

Proposed Budget		
	State Funds	Cost Share
Operating Funds	$4,551,000	$4,720,000
Capital Funds	$449,000	$280,000
Subtotal	$5,000,000	$5,000,000
TOTAL	$10,000,000	

This project proposes to accelerate and commercialize existing and developmental granule technology in various agricultural applications. Advanced granules will improve granular formulation to more effectively contain, transport, and deliver fertilizer and pesticides, or other biologically active ingredients to specific areas. The broad range of targeted applications includes turf, nursery, floriculture, fruits, vegetables, and row crops. The proposal team is led by The Andersons, Inc., with collaboration from several Ohio companies and The Ohio State University.

Detailed Review:

- **Level of Scientific Merit**

The Lead Applicant has successfully developed and commercialized granule technology and several lines of granular products. The proposed project will fund a series of commercial development efforts including:

1. Crop-specific granular delivery systems;
2. Crop-specific bioactive ingredient formulations; and,
3. Innovative new granule dispersion apparatus.

- **Commercial Potential**

Granule technology is a commercially viable and seems to have tremendous growth potential. The applicant's comprehensive development and commercialization plan comprises a team of established collaborators that projects $28 million in new annual revenues in the next 3 years and $89 million by 2015. This seems credible, especially given the potential for the applicants to successfully to market their products to other Ohio companies, such as the Scotts Company, LLC, and thereby improve their economic success.

- **Leadership and Management Quality**

The leadership and management quality of the Andersons Inc. is very good. The company has a clear, successful history of product development and commercialization, and it is well qualified to accomplish the goals of the proposal.

- **Impact on Ohio**

Successful development and commercialization of granular technology will enhance Ohio's leading position in granule-based delivery systems and related technology. The applicant's projection of new jobs (28 new jobs over the 3 years of state funding and 101 jobs by 2015) seems credible.

- **Budget and Cost Share**

The proposal requests $5 million in funding which will be matched with another $5 million from the project team—including $2.7 Million from The Andersons, Inc. and $0.6 million in in-kind support from The Ohio State University.

Review Summary:

The committee recommends that this proposal be funded. It has large, near-term commercialization potential as well as the prospect for developing and commercializing additional products over the longer term, and it could improve the competitive position of other Ohio companies.

EPS RCP 08-082
Agile Manufacturing of High Value Sheet Metal Components
Edison Materials Technology Center (EMTEC)

Proposal Summary:

Proposed Budget		
	State Funds	Cost Share
Operating Funds	$4,261,269	$4,280,344
Capital Funds	$0	$0
Subtotal	$4,261,269	$4,280,344
TOTAL	$8,541,613	

The proposed work relates to research and commercialization efforts related to electromagnetic metal forming technology. The three primary impact areas in the proposal pertain to supply chain development, process and equipment improvements for automation, and product and process simulation packages. The proposed work will build from the research of the Daehn group at Ohio State University (OSU) over the last two decades and benefit the sheet metal working industry by addressing the market needs of agile manufacturing and mass customization. The Edison Materials Technology Center (EMTEC) is teamed with OSU and a large number of academic and industrial partners in this proposal.

Detailed Review:

- **Level of Scientific Merit**

The level of scientific merit of the proposal is intermediate from the perspective of the RFP's expectations. Incremental improvements are anticipated to emerge from the large amount of investment that is requested.

- **Commercial Potential**

The industrial collaboration assembled for the proposed work will cover project management, instrumentation development, prototype fabrication, and technology demonstration design packages. While the team is impressive, there are no clearly defined targets for new equipment fabrication. The potential impact on the sheet metal working industry is questionable since the impact of capital cost barriers and workforce safety issues related to operating high voltage equipment are not adequately addressed. Further, design packages can provide critical cost savings in principle but the time-lines and cost for developing and validating the package can limit widespread use in an industry struggling with near-term survival.

- **Leadership and Management Quality**

The leadership team for the specific technical tasks and the overall management is very strong.

- **Impact on Ohio**

The impact on the economy of Ohio appears to be limited to trying to maintain the current workforce. The industry is currently struggling to compete with cheaper overseas manufacturing. The arguments for agile manufacturing and mass customization notwithstanding, the potential for successfully transforming the Ohio manufacturing landscape to compete globally is low. As a result, this proposal was viewed as maintaining employment in Ohio and not a growth opportunity.

- **Budget and Cost Share**

The budget from the development and management tasks seem generally reasonable. The supplies requested is low (< $200,000 including cost share) relative to the targeted cost of a new machine ($600,000 estimated in the proposal). Therefore it is not clear if even prototype equipment based on the new advances could emerge based on the allocated resources. As discussed earlier, relative to the requested funds in the budget, the return on investment is expected to be low.

Review Summary:

The proposed technology builds from research expertise developed at OSU over two decades; and the team has demonstrated good project management skills over the years. However, long term benefits to compete globally are minimal given the market situation and technological risks. The committee does not recommend that this proposal be funded.

EPS RCP 08-086
SensorPlex II: Data Processing, Management & Analytics for Medical, Environmental & Defense Applications
Qbase, Inc.

Proposal Summary:

Proposed Budget		
	State Funds	Cost Share
Operating Funds	$4,850,000	$24,759,250
Capital Funds	$150,000	$1,117,500
Subtotal	$5,000,000	$25,876,750
TOTAL	$30,876,750	

The proposal is for a new data processing capability, "SensorPlex II" that builds on an extant system, "SensorPlex," to "address the need for extraction of usable information and intelligence from bewildering amounts of data." SensorPlex II is proposed with new capabilities summarized in the proposal as being "enormously faster, and, in some cases, near real-time" for sensor data processing, providing "leading-edge search and retrieval of data in user-friendly formats," and with "sophisticated end-user tools for change detection and object recognition." The proposal also states that "SensorPlex II" will be designed so that it can be customized to interact with nearly any sensor type, making it a multipurpose solution." Qbase, Inc. is teamed with the Air Force Research Lab, Central State University, Woolpert, LLC, University of Dayton Research Institute, Greater Dayton Area Hospital Association, and Kettering Health Network on this proposal.

Detailed Review:

- **Level of Scientific Merit**

The proposal does not at any point detail the successes or design of SensorPlex, the planned design of SensorPlex II, nor any of the algorithms or even high level approaches that will be used to design SensorPlex II. The proposal does not outline a strategy, approach, or any detail related to the new capabilities for any of the market areas.

No performance data or projections are provided to suggest whether or not the proposers can achieve speed increases to "near real time."

No overview or details are provided regarding the approach that the group will take, nor what is meant by, "leading-edge search and retrieval" or "user-friendly formats."

There is no discussion about what "sophisticated end-user tools" are envisioned for "change detection and object recognition."

The proposal text lacks any implementation details and no description of the base capabilities of SensorPlex. Without these details there is no scientific component to the proposal.

- **Commercial Potential**

The proposal outlines a strong set of market areas, but does not provide any evidence that the team can solve the problems of these market areas. The proposers must move beyond demonstrating an understanding of the needs, and must substantiate their ability to meet the needs, in order to enable a judgment about commercial potential.

The areas outlined—including data mining, synthesis of knowledge from various (real-time and historical) data sources, and incorporation of sensor data into decision-support—each have tremendous competition from established groups. The most successful companies are highly focused on a single area that exploits their expertise, or alternatively are companies or consortia with a set of complementary tools, capabilities, and experts.

The personnel and organization information in this proposal suggests that a very strong set of expertise exists, and indeed the quality of the team is generally more important than the details of the technical plan. However, without any information about approach, tools, or capabilities (extant or planned) there is not sufficient data to determine commercial potential.

- **Leadership and Management Quality**

The leadership team clearly has excellent background in the area of working with large databases and they demonstrate a good understanding of the needs of various market segments. They do not detail how they would lead or manage the delivery of solutions to these markets. From a technical standpoint, the team is extremely strong in most of the areas necessary. With a strong plan this team has great promise.

- **Impact on Ohio**

The team is impressive in scope and could in principle have a significant impact on the State of Ohio. They must, however, go beyond outlining market needs in order to achieve impact- they must address market needs with specific services, none of which are included in this proposal.

- **Budget and Cost Share**

The cost sharing shows significant commitment from all of the partners, and the management plan shows a good understanding of the costs of managing a consortium.

Review Summary:

The proposal details a number of important market sectors, each of which require these types of capabilities, and ranging from medical to military to environment to emergency responders. The impressive team of collaborators is led by a team from QBase with extensive experience in providing data services. However, there are no details in the proposal regarding implementation or approach to achieving the objectives.

This proposal would have been stronger had a plan been included as to how the team would address the market needs they describe, or achieve the goals that they lay out. But the goals are very qualitative and broad—"enormously faster," "leading-edge," and "user-friendly." It appears that the partners did an excellent job of building a team, which is clearly the highest priority and the first step to a successful project. But the team has not articulated a plan in sufficient detail that it can be funded. It would be unfortunate if this team did not continue to push forward together, concentrating on a specific set of deliverables and tasks, along with plans to execute those plans.

If, in the next cycle, this team were to provide such plans along with details regarding the successes to date it would be a very powerful proposal. Without such plans, the committee does not recommend that this proposal be funded.

EPS RCP 08-087
New Roll Technologies to Commercialize High Quality, Low-Cost Steel
ArcelorMittal Cleveland

Proposal Summary:

Proposed Budget		
	State Funds	Cost Share
Operating Funds	$5,000,000	$4,791,000
Capital Funds	$0	$209,000
Subtotal	$5,000,000	$5,000,000
TOTAL	$10,000,000	

The ArcelorMittal (AM) Steel Corp. leads a team of three academic institutions (WSU, OSU, and the Dayton Area Graduate Studies Institute) and one small technology business (Deformation Control Technology, Inc.) that seeks to (1) develop a validated suite of software tools and methods and (2) apply them for commercializing higher surface quality, lower-cost sheet steel produced by AM's hot strip rolling mill in Cleveland. The particular focus is on development, validation, and acquisition of critical rolling equipment such as High Speed Steel (HSS) and Continuously Poured Clad (CPC) rolls.

The analytical tools being pursued by the universities and modeled by DCT involve application of Reliability-Based Design Optimization (RBDO).

Detailed Review:

- **Level of Scientific Merit**

The proposal does a good job of detailing the variables affecting sheet steel product quality. While the science behind the project is not especially innovative or new, its potential impact on Ohio's economy is significant enough that it is in-line with the goals of the RCP.

The proposal included the draft memorandum of understanding between ArcelorMittal and its partners on sharing and protection of IP. This helped the committee assess IP issues associated with the proposal.

The applicants provided a clear definition and discussion of the RBDO tools demonstrating that the academic and business collaborators have the credentials to undertake the project.

- **Commercial Potential**

The applicants did not provide a clear description of project deliverables. Also, the applicants did not clearly explain how RBDO application would reduce defects in AM's mill products. The committee was also concerned that the AM plant currently seemed to be so far behind its competition in terms of quality.

Once the RBDO tools and methods are robustly applied and demonstrated at AM, the committee felt that strong potential exists to expand the application to other Ohio manufacturing industry.

The marketing and outreach plan did not show how the RBDO tools and their transfer to other Ohio and non-Ohio steel corporations would occur while there is still so much reliance on academic partners to develop more mature process models for rolling technology. It seems that the RBDO tools (in their present form of models and databases on specific mills, etc.) can only be offered to steel companies via consulting contracts with one of the collaborators (Deformation Control Technology, Inc.), and this would seem to inhibit larger-scale dissemination and application of the optimization technologies that would be developed by this project.

- **Leadership and Management Quality**

The project team has demonstrated a good understanding of marketplace needs in new steel technology. In particular, the information provided in the proposal on Ohio's needs and market opportunities was well-researched.

- **Impact on Ohio**

Applicants admit that there is not a strong motivation for AM to transfer new roll technology to its competitors in Ohio, so the burden lies largely on Deformation Control Technology, Inc. and other organizations, such as the Edison Materials Technology Center (EMTEC), to apply and transfer the RBDO methods to other manufacturers in Ohio.

- **Budget and Cost Share**

The proposal includes a strong cost-share commitment by ArcelorMittal's Cleveland plant, which is capable of supporting the application of specific RBDO tools that can most directly reduce key defects in mill products.

Review Summary:

The committee does not recommend that this proposal be funded. It seems that the product quality issues faced by the ArcelorMittal plant are most directly related to plant hardware and less to deficiencies that can be easily corrected by the portfolio of software tools and methods that would be developed if this proposal were funded. The RBDO component of this proposal appears to address plant-level training issues rather than to develop a new product or platform technology suite that could be commercially sold and marketed on a larger scale.

EPS RCP 08-097
Food Industry Sensor Technology Institute
Ohio State University Research Foundation

Proposal Summary:

Proposed Budget		
	State Funds	Cost Share
Operating Funds	$3,034,259	$3,034,307
Capital Funds	$0	$0
Subtotal	$3,034,259	$3,034,307
TOTAL	$6,068,566	

This is a proposal by The Ohio State University Research Foundation to establish a Food Industry Sensor Technology Institute (FISTI). The mission of the Institute will be to develop and demonstrate sensor technologies that address the needs of the food industry and to commercialize these sensor technologies through industry collaborations. The FISTI will involve a partnership among Ohio universities, the Center for Innovative Food Technology (CIFT), and Rockwell Automation.

Sensor technologies developed by FISTI will be commercialized by a multi-phase process that will include level and wash-down sensors (imaging phase), chemistry and leak sensors (incubating phase), and integrated sensor nodes (demonstrating phase). A new food sensor test-bed and certification facility at Ohio State University, anchored by recently constructed food science and technology pilot facilities, will serve as the foundation for testing new sensor technologies developed through the FISTI.

Detailed Review:

- **Level of Scientific Merit**

The food industry has an unquestionable need for accurate, sensitive, and specific sensors that provide real time/near real time measurements of product quality and safety. This proposal describes several types of sensors that may meet the requirements of the food industry. Most of the described sensor technologies are not novel and similar types of sensors are under development or have been developed by other universities and companies. Furthermore, some of the sensor technologies are not easily incorporated into food processing operations, which require robust platforms that can rapidly handle large numbers of samples containing complex food matrices. Described technologies such as immunomagnetic separation (IMS) and infrared spectroscopic identification of food-borne pathogens do not appear to consider the diversity of pathogens that might be found in foods, the difficulties of processing large numbers of food samples rapidly for multiple pathogens (multiplexing) with a time-consuming procedure (IMS), and problems that might be encountered with IMS capture efficiency, antibody sensitivity and specificity, and cost effectiveness.

- **Commercial Potential**

One of the goals of the FISTI will be to communicate with the food industry to determine its sensor needs. However, it is not apparent that such communications have occurred in the preparation of this proposal. Food processing companies generally desire low cost, robust sensors or other devices that rapidly and accurately measure food quality and contamination. The proposed sensors do not adequately address these challenges. Furthermore, the food processing companies typically prefer low cost off-the-shelf technologies that do not require additional research and development. The proposal also does not appear to recognize existing competing technologies and their potential impact on the success or failure of FISTI product commercialization and return on investment.

- **Leadership and Management Quality**

The personnel listed in the proposal are qualified in their respective fields. The FISTI organizational structure, management plan and its proposed governance, which encompasses various entities, are well conceived. The proposed budget is reasonable, although much of the budget is devoted to personnel and little to equipment and expendable supplies, items which one would expect to be instrumental in research and development of new sensor technologies.

- **Impact on Ohio**

The proposal is overly optimistic in its prediction of the market share that FISTI sensors will capture and the potential revenue and jobs that will be created within five years. Without additional evidence that food processing companies would be interested in the sensors described in the proposal and with the lead that has been taken by current competing technologies, it is difficult to envision the estimated revenue stream. Consequently, the impact of the FISTI and its programs on Ohio is considered minimal

- **Budget and Cost Share**

The budget and cost share information appears reasonable.

Review Summary:

This is a proposal to form a Food Industry Sensor Technology Institute at Ohio State University to develop, demonstrate, and commercialize sensor technologies that will address product quality and safety issues of the food industry. The proposal describes examples of sensor technologies that might address these problems, but these examples are neither novel nor innovative. Furthermore, the proposers do not appear to be aware of competing technologies and requirements of the food industry. There is a noticeable absence of supporting letters from potential food industry partners for the described sensor technologies, especially when it is indicated that the proposed sensor projects will be pursued in response to requirements articulated by the food industry en users. The organizational structure and management plan of the proposed Institute are reasonable. The budget heavily focuses on personnel salaries. The commercialization potential of the proposed food sensors is limited, given the proposal deficiencies, and, consequently, the economic impact of this investment for Ohio is limited. The proposal would have been strengthened by documentation from the food industry that the proposed sensors would be of interest to and used by the end users. The committee does not recommend that this proposal be funded.

EPS RCP 08-112
Improving Site Security by Utilizing Layered Sensing
University of Dayton Research Institute

Proposal Summary:

Proposed Budget		
	State Funds	Cost Share
Operating Funds	$4,410,000	$5,890,348
Capital Funds	$590,000	$290,000
Subtotal	$5,000,000	$6,180,348
TOTAL	$11,180,348	

The University of Dayton Research Institute (UDRI) proposes to lead a collaborative group of nine entities (five headquartered in Ohio) with six prospective commercialization collaborators (three headquartered in Ohio) in a partnership with CT Solutions, LLC of Mt. Laurel, NJ to leverage Ohio sensor technology and to position a combination of Ohio-based companies as both technology and market leaders in the area of "universal situation awareness" for site surveillance. The UDRI, working through the Wright Center of Innovation, Institute for the Development and Commercialization of Advanced Sensor Technology (IDCAST) is requesting $5 million in ERCP grant funding to be matched with $6.18 million from the collaborators—including $2 million from the Air Force Research Laboratory, $2 million from CT Solutions, and $600,000 from Dayton International Airport. If approved, the UDRI and the various collaborators would develop and implement two parallel systems, one demonstration site security and surveillance system at Dayton International Airport and the other, a technology, development, testing and certification system at the IDCAST facility in Dayton.

A key objective is to facilitate an ongoing presence in Ohio for key CT Solutions, LLC personnel and to build an evolving sensor development and demonstration laboratory in Dayton. This development /demonstration platform would position IDCAST collaborators, and other Ohio companies, "to enjoy rapid proof of market viability and subsequent economic benefit." The proposal projects creation of 74 jobs and sales of 45 advanced surveillance systems (at an average selling price of $1 million each) over the next five years. The UDRI-led collaboration team projects sales of 25 such systems each year thereafter.

Detailed Review:

- **Level of Scientific Merit**

UDRI has identified a host of Ohio-based companies with an apparent interest in site security; but the proposal provided insufficient information for the committee to be able to understand what technologies are currently used and where improvements are required. The science behind the contemplated technology improvement programs is not clearly addressed.

- **Commercial Potential**

The committee could see that this is an emerging market opportunity with tremendous growth potential, but the proposal did not make clear how, or if, the collaborative team plans to commercialize sensor-based site security technology. Development and implementation of a viable marketing plan is required "to enjoy rapid proof of market viability and subsequent economic benefit." Market growth is realized by sales, not "by scaling and replicating the system, including all of the embedded sensors, in critical infrastructure applications."

- **Leadership and Management Quality**

The committee had considerable reservations about leadership and management quality, which it viewed as a critical factor for success. CT Solutions, LLC—the reported technology and marketing lynchpin, and prize for Ohio—appears to be a home-based business in New Jersey with less than five employees and a very minimal website. The committee did not see evidence of the management team/structure nor the marketing plan required to sell 25 site-specific million-dollar projects per year.

- **Impact on Ohio**

The committee did not see how UDRI could lead a commercial development, technology demonstration, translation, and sales support program to achieve these deliverables. This proposal is long on demonstration, and painfully short on commercialization. While there may be a strong case for commercial exploitation of Ohio's leading position in sensor technology, it is not offered in this proposal.

- **Budget and Cost Share**

The committee was not convinced of the need for such a large ($5 million) grant. Of the $11 million total, nearly $9 million goes directly or indirectly for three years of salaries, fringe benefits and travel expenses across as many as ten separate entities. The committee did not see how this set of collaborators could accelerate development of intellectual property inherent in these technologies; and then position, brand, price, and sell systems based on these technologies without a strong commercially-oriented lead entity.

Review Summary:

The committee does not recommend that this proposal be funded, but encourages the proposal team to resubmit at a future opportunity taking into account the following suggestions for improvement.

A more credible business development plan (especially marketing) is needed. The proposal needs to provide a better explanation of the technology used to produce current sensor-based site security systems, and elaborate on specific objectives (improvements and/or enhancements) of the technology development program(s) contemplated. More information is required on the science behind the contemplated technology improvement programs, as well as examples of targeted applications and customers. The value proposition(s) need elaboration. The proposal needs to explain why $5 million is required to accelerate and support ongoing development of sensor-based technologies, products and systems, while, at the same time, the commercialization plan is so poorly developed and resourced. If CT Solutions, LLC is the collaboration team's Lead System Marketer, details on its sales and marketing plan are required. Given that this will be a "system sell," there are myriad issues that need to be addressed including the following: who identifies market opportunities and targets customers; who selects and positions the system(s) to be offered; how will project collaborators be favored (in the selection process); who sets the (system) price and who negotiates terms; who has (and provides) access to capital (e.g., working capital); who takes the order and makes delivery commitments; who collects and distributes the sales revenues; how are revenues to be apportioned; what agreements are required; how will project collaborators be favored and for how long; how does Ohio (and/or the Ohio-based supplier) benefit from the plan; and will customers require a warranty and how will that process work. A broader question is whether there is a more appropriate prospective Lead System Marketer/Collaborator. If so, that entity should be recruited and featured in a subsequent application.

BIO RCP 08-077
Next Generation MRI Systems
Hyper Tech Research, Inc.

Proposal Summary:

Proposed Budget		
	State Funds	Cost Share
Operating Funds	$2,672,234	$3,437,129
Capital Funds	$327,766	$0
Subtotal	$3,000,000	$3,437,129
TOTAL	$6,437,129	

This proposal is built on collaboration between Hyper Tech, Inc., Siemens Magnet Technology, and Ohio State University (both the Laboratory for Applied Superconductivity and Magnetism and the Medical School) for utilizing magnesium diboride ($MgB_{2)}$ wires produced by Hyper Tech in Magnetic Resonance Imaging (MRI) systems produced by Siemens. The intended market for this product is very clearly the medical imaging community. The main collaborator (Siemens) currently holds a 50% market share for MRI superconducting magnets. Hyper Tech also has collaborations with Philips and GE (with Philips including a letter of support). These three companies represent 90% of the superconducting MRI systems in the world. The main driver for pursuing this technology is the current and predicted shortage of helium (He) in the world. Current superconducting magnet MRI's operate using a liquid He bath to keep the low-T_c superconductors below their transition temperature. By replacing these materials with MgB_2 (T_c ~ 39 K), it should be possible to use alternative cooling methods (conduction cooling via cryo-compressors), thus saving some amount of He over the lifetime of the magnet. The challenge is to bring the performance of the MgB_2 wires up to the standards needed for implementation in superconducting MRI systems.

Detailed Review:

- **Level of Scientific Merit**

In general, the proposed level of scientific merit in this proposal is good. The scientific objectives are clearly stated and for the most part original, but overall there is an unsatisfactory level of detail in the proposed experimental plan. This is not to say that the project is not feasible, but many significant details regarding some of the more important tasks are glossed over. For example, in Task 3, three research areas are listed but the challenges associated with each of them are not addressed. In Task 4, a list is provided of things to 'work on' to help lower the cost, but an implementation plan is omitted. In Task 14, Hyper Tech states it will "produce wire to meet Siemens specifications, wire size, shape, Cu/SC ratio, close to desired filament size, thermal conductivity, bend radius, normal resistivity, mechanical properties, insulation, and the best J_c and J_e at the time of shipment." The committee realizes that specific target numbers cannot be given due to intellectual property issues, but at the very least a more detailed approach as to how each of these properties will be addressed is necessary.

Finally, regarding the main driver of replacing the low-T_c superconductor with MgB_2, the conduction cooling system is not explained in any detail. A complete tutorial on such systems is not needed, but a discussion of the basic method and materials is required. That is, if it is a 2-stage cryo-compressor cooling system the efficiency should be discussed along with the projected actual savings in He. A calculation on the impact of the reduced efficiency should be given, as well. That would provide a much better context for the committee to provide a fair review.

- **Commercial Potential**

The level of commercial potential for this proposal is very good. The market analysis and implementation is thorough. The proposers have clearly identified the three major MRI suppliers and discussed their

ongoing collaborations with them (with letters from Siemens and Philips included), which is a major asset to this proposal. The stage of market development is clear and Hyper Tech undoubtedly understands its position with respect to the current technology. Sufficient proof-of-principle seems to have been achieved in smaller coils and development of specialty MRI systems is underway with other Hyper Tech collaborators not involved with this proposal. The analysis of all competing technologies is not entirely complete, however. There is a clear advantage over current technology (low-T_c superconducting magnets), but the advantage over competing high-T_c (YBCO and BSCCO-based) technology is not described or quantified in any detail. With the cost and performance of these technologies improving rapidly, and with product on the market, a more careful analysis of the benefits of MgB_2 wires over these technologies is critical.

- **Leadership and Management Quality**

The leadership and management quality of the proposers is excellent. There is a demonstrated commitment of the lead applicant and collaborators, and leadership seems to be demonstrated in all critical phases of this project. Hyper Tech seems to have a strong track record on prior Third Frontier grants.

- **Impact on Ohio**

If successful, the impact of this work on Ohio would be good. After 3 years, seven jobs are predicted and after 6 years, 94 jobs are predicted. The amount of new sales from new MRI systems and retrofitted systems is significant. With Siemens having such a strong presence in Ohio there is no doubt a large impact in Ohio would result.

- **Budget and Cost Share**

The budget is satisfactory for the proposed work.

Review Summary:

Overall this is a very good proposal. The level of commitment from collaborators and potential customers is a huge asset. It is consistent with Ohio's priorities. The potential market is good and has been thoroughly analyzed. However, the general lack of specifics on the experimental details and implementation, the lack of any real discussion on the cooling system (efficiency and potential He savings), and the lack of a detailed analysis of other superconducting technologies raises questions. The committee does not recommend that this proposal be funded. The team is encouraged to address these concerns and resubmit this proposal in the future. There is a clear need for these, or similar, technologies.

Appendix B
Evaluation Worksheet

Evaluation Criteria	Score 0-5*
A. Level of Scientific Merit	
Scientific objectives are original and innovative; novel concepts, approaches or methods are employed	
Project has potential for new discoveries and understanding; advances beyond previous studies can be expected	
Project is scientifically and technologically feasible; conceptual framework, design, methods and analyses are adequately developed	
B. Commercial Potential	
Size of opportunity: • Proposal accurately assesses market and has realistic assumption about market share that could be captured • Proposal demonstrates understanding of global marketplace and can compete for international business opportunities	
Identified stage of market development: Proposal demonstrates understanding of the commercialization process and the resource requirements for commercialization	
Potential for products: • Focused commercialization opportunity areas are identified • Project has achieved proof of principle • Technologies and products have a competitive advantage over existing and alternative technologies	
Degree of customer readiness: • Proposal addresses needs of end-users • A collaborator is a potential customer whose input has been built into the proposal	
Degree of sustainable competitive advantage: Proposal demonstrates that a competitive advantage can be maintained beyond the three-year Project period	
C. Leadership and Management Quality	
Demonstrated leadership assets: • Proposal demonstrates commitment of the Lead Applicant and Collaborator(s) • Leadership is demonstrated in all critical phases, including research, IP protection, regulatory compliance, product development, leveraging of funding, and commercialization	
Vision for Success: Proposal presents a compelling vision of the project's goals, potential achievements and importance to the state of Ohio	
Potential for Leverage: Lead applicant and Collaborators demonstrate potential to leverage additional funds during and beyond requested initial State support	
Past Performance (if applicable): Lead applicant has demonstrated successful performance on prior Third Frontier grants	
D. Impact on Ohio	
Proposal demonstrates key impacts including job creation, new sales, companies created or attracted to Ohio, leveraged funding	
Proposal demonstrates industrial support from the State's relevant industry sector	
Proposal demonstrates integration with existing relevant State research capabilities	
Proposal involves and engages relevant anchor companies within the State of Ohio	
Proposal integrates and builds on prior Third Frontier Project investments	
Proposal is consistent with State and Regional Priorities	
E. Budget and Cost Share	
Budget is justified and adequate to meet the goals of the proposal	
Cost share letters are provided and are sufficiently detailed	

*A score of 0 should be used to indicate that the applicant either did not address the requirement or that the applicant completely failed to meet the requirement. A score of 5 should be used to indicate that the applicant meets the requirement exceptionally well.

Appendix C
Committee Roster

S. Michael Hudson, *Co-Chair*
Rolls-Royce North America (retired)
Indianapolis, Indiana

Judy Nagengast, *Co-Chair*
Continental Design & Engineering, Inc
Anderson, Indiana

Daniel Akins
The City College of New York
New York

Sundar V. Atre
Oregon State University
Oregon Nanoscience and Microtechnologies Institute
Corvallis

Douglas N. Ball
Boeing Commercial Airplane Group
Renton, Washington

Charles E. Catlett
Argonne National Laboratory
Argonne, Illinois

Demir Coker
Oklahoma State University
Stillwater

Chiara Daraio
California Institute of Technology
Pasadena

Brady J. Gibbons
Oregon State University
Corvallis

Daniel Lim
Florida Center of Excellence for Biomolecular Identification and Targeted Therapeutics
University of South Florida, Advanced Biosensors Laboratory, Tampa

Manish Mehta
National Center for Manufacturing Sciences
Ann Arbor, Michigan

Trent M. Molter
University of Connecticut
Sustainable Innovations, LLC
Glastonbury, Connecticut

Allan D. Murray
Ecoplexus, Inc.
Lake Orion, Michigan

Arthur L. Patterson
Global Trade and Information Services, Inc.
Carmel, Indiana

Lloyd Robeson
Air Products and Chemicals, Inc. (retired)
Macungie, Pennsylvania

Mariam Sticklen
Michigan State University
East Lansing

T.S. Sudarshan
Materials Modification, Inc.
Fairfax, Virginia

J.W. (Jim) Wheeler
Thomas P. Miller and Associates
Greenfield, Indiana

Staff

Marcia S. Smith, Director, Aeronautics and Space Engineering Board
Paul Jackson, Associate Program Officer
Alan Angleman, Senior Program Officer
Sarah Capote, Program Associate
Sandra Wilson, Program Assistant

Appendix D
Biographical Sketches of Committee Members and Staff

CO-CHAIRS

S. MICHAEL HUDSON is vice chairman (retired) of Rolls-Royce North America. Mr. Hudson assumed the position of Vice Chairman, Rolls-Royce North America in early 2000 and continued in that role through his retirement in the spring of 2002. Mr. Hudson served in several positions at Allison, including chief engineer for advanced technology engines, chief engineer for small production engines, supervisor of design for the Model 250 engines, chief of preliminary design and chief project engineer in vehicular gas turbines. From 1962 to 1968, he was employed by Pratt & Whitney Aircraft, working in aircraft engine design, installation and performance, engine development and demonstration, and industrial and marine engine application engineering. His honors include membership as a fellow of the Society of Automotive Engineers and the Royal Aeronautical Society, an honorary fellow of the American Helicopter Society and an associate fellow of the American Institute of Aeronautics and Astronautics. Mr. Hudson has served as chairman of the SAE's Aerospace Council. He has also been on their Aerospace Program Office Committee and their Finance Committee. He has served as chair of the National Research Council's (NRC's) Committee on Technology Pathways as well as the Committee to Review Proposals for the 2007 State of Ohio Wright Centers of Innovation and the Research and Commercialization Program in Engineering and Physical Sciences. He has also been a member of the NRC Committee on Assessing the Integrated Plan for A Next Generation Air Transportation System. Mr. Hudson graduated from the University of Texas with a degree in mechanical engineering.

JUDY NAGENGAST has been the CEO of Continental Design and Engineering, Inc. since 1987. Her company has expanded over 30% for thirteen consecutive years, during this time she was able to increase the growth of Continental's employees from 4 to nearly 400 employees and gain $40 million in annual revenues. During her time at Continental, Ms. Nagengast was given the opportunity to take on the position of interim director for Flagship Enterprise Center on a part-time basis. She held this position for a year and a half while maintaining her involvement with Continental. Ms. Nagengast has served as a member of the NRC Committee to Review Proposals for the 2007 State of Ohio Wright Centers of Innovation and the Research and Commercialization Program in Engineering and Physical Sciences. Some of the awards received by Ms. Nagengast include: U.S. Small Business Administration, Small Business Person of the year for the state of Indiana (1998); Ernst & Young, Indiana Heartland Entrepreneur of the Year Award–category of Woman Owned Businesses (1997); Indiana University, Kelley School of Business, The Johnson Center for Entrepreneurship & Innovation, Growth 100 Awards 1997, 1998 & 1999 (for being one of the fastest growing 100 companies in Indiana); Madison County (Indiana) Business Hall of Fame Laureate (2000); and the Richard Lugar Achievement award for Support of Education (1997).

MEMBERS

DANIEL AKINS is a professor of chemistry at City College of New York. He is also the director of the CUNY Center for the Analysis of Structures and Interfaces (CASI). Dr. Akins' research focus is on quantum properties of molecular nanostructures and the exploitation of such properties for formulating new nanomaterials with uses in molecular photonic devices (MPDs) and/or chemical sensors. He is the recipient of several awards, including the Presidential Award for Excellence in Science, Mathematics, and Engineering Mentoring (PAESMEM), the Faculty Service Award as well as the Distinguished Lecturer award. Dr. Akins' research focus is on quantum properties of molecular nanostructures and the exploitation of such properties for formulating new nanomaterials with uses in molecular photonic

devices (MVDs) and/or chemical sensors. He received his B.S. at Howard University and his Ph.D. from University of California at Berkeley in 1968.

SUNDAR ATRE is an associate professor in the Industrial and Manufacturing Engineering Department at Oregon State University. Dr. Atre's association with the Industrial and Manufacturing Engineering Department involves the integration of nanomaterial synthesis techniques and silicon and non-silicon microfabrication techniques. His research interests include advanced materials and manufacturing techniques for multiscale architectures, with applications in transport, energy, medical, communications and consumer sectors. Dr. Atre obtained his B.S. in chemical engineering from Indian Institute of Technology in India and his Ph.D. in materials science and engineering from Pennsylvania State University.

DOUGLAS BALL is the chief engineer of the Enabling Technology and Research unit within the Airplane Performance and Propulsion organization of Boeing Commercial Airplanes. He is currently responsible for all technology development in aerodynamics, propulsion and acoustics in support of the company's commercial airplane product lines. Since joining the Boeing Company in 1977 he has been involved in many projects that pertain to aerodynamics configuration, including CFD methods development, high lift design, nacelle design and integration, and wing design. Mr. Ball has also taken the lead on the High Speed Civil Transport program and the 747X program. He received his B.S. in aeronautical/astronautical engineering from The Ohio State University in 1974 and his M.S. in 1975.

CHARLIE CATLETT is the chief information officer at Argonne National Laboratory. Mr. Catlett is also the director of Argonne's Computing and Information Systems Division and a senior fellow at the Argonne/University of Chicago Computation Institute. He is responsible for a laboratory-wide "Digital Laboratory" initiative, aimed at applying information technology to improve and integrate science, business, and information-sharing capabilities. From 2004-2007 he was director of the National Science Foundation's TeraGrid project, which was a collaboration of fourteen universities and laboratories employing middleware and a dedicated optical network to provide integrated High-Performance services to over 4,000 researchers and educators across the U.S. Before he joined Argonne in 2000, Mr. Catlett was the chief technology officer at the National Center for Supercomputing Applications (NCSA) at the University of Illinois. He is the recipient of numerous honors including the "Founder's Award" presented by the Global Grid Forum, the Argonne's "Director's Award" and "Pacesetter" Award. Mr. Catlett currently serves on a number of committees including the Science and Policy Advisory Committees for Internet2, the National Lambda Rail, and NSF's Global Environment for Networking Initiatives (GENI).

DEMIR COKER is an assistant professor in the Mechanical and Aerospace Engineering department at Oklahoma State University. Dr. Coker's research focus is primarily related to the experimental and computational investigation of friction and adhesion of interfaces from nano- to macro- scales, static and dynamic failure mechanics (heterogeneous materials), and mechanical behavior of nano-scale materials and nano-composites. He has authored 18 articles in journals, many of which were peer reviewed. Dr. Coker received his B.S. in aeronautical engineering from the Middle East Technical University, his Masters degree in applied mathematics from Wright State University and aerospace engineering from University of Dayton. He obtained his Ph.D. in aeronautics from the California Institute of Technology.

CHIARA DARAIO is an assistant professor of aeronautics and applied physics at the California Institute of Technology. Her research interests include novel approaches to the design, development and testing of multi-scale acoustic metamaterials; phononic crystals; responsive soft matter; highly nonlinear solitary waves; mechanical and electronic properties of carbon based nanomaterials and biomaterials. Dr. Daraio has been the recipient of numerous honors and awards including the Richard von Mises Prize (2008), the De Carli Medal (AIM young investigator award, 2006) and the MRS Gold Medal Graduate Student Award (2005). She published over 40 peer reviewed papers, one book chapter and three patents. She is a

member of several societies including SigmaXi, the Materials Research Society, the Applied Physics Society, and The Minerals, Metals and Materials Society. Dr. Daraio obtained her Bachelor's and Master's Degrees in mechanical engineering and metallurgy from the University Ancona, her Master's and Ph.D. in materials science and engineering from the University of California, San Diego.

BRADY GIBBONS is an assistant professor of mechanical engineering at Oregon State University. Dr. Gibbons' research interests include microstructure, processing, and property relationships in functional thin film materials, with a focus on processing, novel instrumentation, and integration science; novel dielectric, superconducting, semiconducting, and pyroelectric materials for energy conversion and energy storage; ferroelectric and piezoelectric thin films; crystallography and diffraction characterization methods; and spectroscopic ellipsometry. Over the course of his career, he has received awards that include the R&D 100 Award for "Flexible Superconducting Tape" and the Los Alamos Award through the Materials Science and Technology Division. Dr. Gibbons is active in several professional societies. He has served as the Technical Program Co-Chair of the 16th International Symposium on the Applications of Ferroelectrics, as a member of the Materials Research Society and the Institute for Electronics and Electrical Engineers. He received his B.S. in materials engineering from Rensselaer Polytechnic Institute, his M.S. in ceramic science from the Pennsylvania State University, and his Ph.D. in materials from the Pennsylvania State University.

DANIEL LIM is Distinguished University Professor of Microbiology in the Department of Biology and the Center for Biological Defense at the University of South Florida. The primary focus of his research is the characterization of virulence mechanisms in pathogenic bacteria and development of innovative technologies to rapidly detect and identify infectious diseases and bacterial pathogens in food, water, air, and on surfaces. His current research involves the development of fiber optic and array biosensor assays for the rapid detection of pathogenic microorganisms. These innovative assays have been used to successfully detect Bacillus spores, E. coli, and other microorganisms directly from ground beef, apple juice, powder, and potable water. Dr. Lim is a fellow of the American Academy of Microbiology and recently received the Christopher Columbus Fellowship Foundation's 2004 Homeland Security Award in the biological, radiological, and nuclear field. He received a B.A. in biology from Rice University and a Ph.D. in microbiology from Texas A&M University.

MANISH MEHTA is director of collaboration programs at the National Center for Manufacturing Sciences (NCMS) since 2001. His responsibilities include assessing emerging manufacturing-related technology needs in the national interest, and developing collaborative research and development projects with NCMS' defense, industrial and academic members. Dr. Mehta is also executive director of Technologies Research Corporation (TRC), a subsidiary of NCMS, established to provide professional technology management services for new technologies and alliances. Besides serving as the director of the Aluminum Metal Matrix Composites Consortium (a supplier group hosted by NCMS), he is the convener of the Steel Joint Industry Alliance of steel-making, forging, heat treating, powder metal and end user industries and trade organizations, formed to promote greater cross-industry leveraging in research. Dr. Mehta has since developed and managed complex collaborative projects sponsored by the Department of Defense, the National Institute for Standards and Technology, the Department of Energy and National Science Foundation. Dr. Mehta obtained his B.S. in mechanical engineering from Bangalore University, India, and M.S. and Ph.D. in industrial engineering from the University of Cincinnati, Ohio. He is also a graduate of the executive program of the University of Michigan Business School.

TRENT MOLTER is a research scientist and business development officer for the Connecticut Global Fuel Cell Center, whose mission is to be a world leader in fuel cell research and education. The Connecticut Global Fuel Cell Center was recently awarded nearly $2 million from the U.S. Department of Energy to research the effects of impurities on fuel cell performance and durability. Dr. Molter leads this team with a focus on improving reliability and performance of proton exchange membrane (PEM) fuel

cells. Dr. Molter also serves as President/CEO of Sustainable Innovations, LLC, a company focused on the development of technologies and products for human sustainability. In 1996, Dr. Molter co-founded Proton Energy Systems to commercialize hydrogen energy products. There he led technology, engineering, and new business activities and was instrumental in efforts to capitalize the company, securing private equity financing, and culminating in a successful IPO in 2000. Dr. Molter holds 34 U.S. patents related to human life support, hydrogen, and fuel cells. He has a Ph.D. in materials science and engineering from the University of Connecticut, a M.S. in metallurgy from Rensselaer Polytechnic Institute, and a B.S. in chemical engineering from Clarkson University.

ALLAN MURRAY is president of Ecoplexus Inc., an automotive technology services company. He spent most of his career at Ford Motor Company and has held a number of positions including technology director for the Partnership for a New Generation of Vehicles (PNGV) Program, a government-industry partnership to develop advanced, affordable fuel-efficient vehicles; and manager, Technology Strategy, Plastic and Trim Products Division. As technology director of the PNGV Program, Dr. Murray led government-industry research and development teams pursuing advanced vehicle construction, power trains, fuel cells, batteries, and power electronics. He has extensive experience in bringing advanced automotive technologies and products from concept through production and has a broad-based knowledge of automotive systems and economics. Dr. Murray served as chairman and president of the non-profit Michigan Materials and Processes Institute, the first automotive engineer elected a fellow of the Society of Plastics Engineers, and a member of the Society of Automotive Engineers. He has a Ph.D. and M.S. in metallurgical engineering and materials science from Carnegie Mellon University; a B.S. in metallurgical engineering, University of British Columbia; and an M.B.A., Wayne State University.

ART PATTERSON is the executive director for Flagship Enterprise Center (FEC) in Anderson, Indiana. During his service at FEC, he has served a key role as the executive director for Anderson Certified Technology Park by initiating all of the required strategy statements, objectives, policies, budgets, procedures, contracts, agreements, real estate leases, press releases, presentations and related documentation. Mr. Patterson has also been responsible for establishment of the FEC's client-specific Client Support Program which identifies each client's strengths and weaknesses by overarching objectives of helping each client to develop a plan, build a competent management team, gain access to capital and achieve cash flow. He obtained his Bachelors Degree in economics and management services from Duke University and his Masters in marketing finance from Northwestern University. Mr. Patterson is a member of several professional affiliations and services including the Anderson YMCA Capital Fund Public Relations, the Anderson Center for Arts and the Premier Capitol Corporation.

LLOYD ROBESON (NAE) has been a principal research associate in corporate research at Air Products and Chemicals, Inc. since 1986. He received a B.S. in chemical engineering in 1964 at Purdue University and Ph.D. in chemical engineering from University of Maryland in 1967 and spent almost twenty years in polymer research at Union Carbide Corporation. Research areas include polymer blends, structure/property relationships, reactive extrusion compatibilization, engineering polymers, composites, biomedical polymers, dynamic mechanical analysis, emulsion polymer characterization, adhesion, polymer permeability, membrane separation, polymer utility in electrical/electronic/optoelectronic applications and water soluble polymers. Dr. Robeson has published 92 technical papers, holds 93 U.S. patents and coauthored a reference book titled "Polymer-Polymer Miscibility". He became a member of the National Academy of Engineering in 2001. Dr. Robeson has also served as a member of the NRC Committee to Review Proposals for the 2007 State of Ohio Wright Centers of Innovation and the Research and Commercialization Program in Engineering and Physical Sciences. Recent awards include Distinguished Chemical Engineering Alumnus 2001, University of Maryland; Distinguished Engineering Alumnus 2002, University of Maryland; Industrial Polymer Science Award, Polymer Division of the American Chemical Society (ACS) 2002; Applied Polymer Science Award of ACS 2003; University of

Maryland College of Engineering Innovators Hall of Fame 2003; Distinguished Chemical Engineering Alumnus 2004, Purdue University; and Distinguished Engineering Alumnus 2004, Purdue University.

MARIAM STICKLEN is a professor in the Department of Crop and Soil Sciences at Michigan State University. Since 1987, she has supervised and advised over 160 scientists. Dr. Sticklen has participated in several advisory roles at the National Academies. She is developing systems to eliminate or minimize human and environmental risks posed by transgenic crops. Her expertise includes production of biofuels-related industrial enzymes, polymers, and pharmaceuticals in transgenic plants. Her research activities also center on improvement of agricultural crops of developing countries (Africa, India, Indonesia, Pakistan, Iran, and Turkey), development of crops that are tolerant to extreme abiotic factors (such as drought, high salinity, and low temperature), and reductions of pests and applications of hazardous pesticides through gene discovery, cloning, and genetic engineering. Dr. Sticklen received her Ph.D. in horticulture at Ohio State University in 1981.

T.S. SUDARSHAN is President and CEO of Materials Modification, Inc. He is responsible for the management and technical development of innovative materials, processes, and techniques, and for the coordination of federally and industrially sponsored research programs within several industry and Government programs. Dr. Sudarshan has served as a member of the National Materials Advisory Board and has been involved in MMI with several research and development programs in the development of diamond thin films, solid lubricants for space structures, nontoxic lubricants for automobile applications, accelerated corrosion testing, synthesis and consolidation of nanostructured materials, development of lightweight carbon-carbon pistons and nanoceramics for armor. He has been the recipient of numerous awards and honors, including the Design News Award and R&D 100 for the microwave plasma technique–Nanogen and for the Plasma Pressure Compaction technique. He has served on numerous committees of the National Science Foundation, the National Institutes of Health, Department of Energy, blue ribbon panel for the U.S. Army and the Governors panel for nanotechnology in the Commonwealth of Virginia. He has also chaired several committees in professional societies such as TMS and ASM International. Dr. Sudarshan is the author of more than 150 papers and has been an invited speaker on more than 25 occasions. He is the co-editor of two journals, Materials and Manufacturing Processes and Surface Engineering for the past 20 years, and has co-edited 23 books on various aspects of surface modification technologies. He is a Fellow of ASM International and Fellow of the International Federation for Heat Treatment and Surface Engineering. Dr. Sudarshan received his undergraduate degree from the Indian Institute of Technology, Chennai in India and his Masters and Doctoral degrees from Virginia Polytechnic Institute and State University.

J.W. (JIM) WHEELER has a diverse background in business consulting, research, strategy and planning, economic analysis, public policy, and technology programs. He joined Thomas P. Miller and Associates (TPMA) in July 2005 to head up Economic Competitiveness, Policy and Research. His primary focus has been to serve as the policy lead in the development of the Strategic Economic Development Plan for Indiana. Prior to joining TPMA, he was director of Electricore's Midwest operations where he was charged with developing corporate-university partnerships in advanced technology development. As executive vice president for TechPoint—a merger between Indiana Technology Partnership (ITP) and Indiana Information Technology Association (INITA)—and President of ITP, Dr. Wheeler served as a leader for the statewide technology community's public policy and economic development initiatives (2002-2004), as well as managed special programs for information technology. In January 1997, he joined the Indianapolis office of Arthur Andersen as a senior manager to launch the Indiana Strategy, Finance and Economics Consulting practice. Prior to joining Arthur Andersen, Dr. Wheeler spent 19 years with the Hudson Institute, ultimately directing both international programs and defense industry research. He has been a past member of the NRC Committee to Review Proposals for the 2007 State of Ohio Wright Centers of Innovation and the Research and Commercialization Program in Engineering and Physical

Sciences. Dr. Wheeler completed his undergraduate studies at the University of Missouri and his masters and doctoral studies at Rutgers University, all in economics.

STAFF

MARCIA S. SMITH became the Director of the Aeronautics and Space Engineering Board on January 15, 2007. She is also the director of the NRC's Space Studies Board. Prior to joining the SSB in March 2006, Ms. Smith was a senior level specialist in aerospace and telecommunications policy for the Resources, Science, and Industry Division of the Congressional Research Service (CRS) at the Library of Congress. She had been with CRS since 1975, serving as a policy analyst for the members and committees of the U.S. Congress on matters concerning U.S. and foreign military and civilian space activities, and on telecommunications issues including the Internet (and formerly on nuclear energy). From 1985 to 1986, Ms. Smith took a leave of absence to serve as executive director of the U.S. National Commission on Space. A graduate of Syracuse University, Ms. Smith is the author or co-author of more than 220 reports and articles on space, nuclear energy, and telecommunications and Internet issues. Ms. Smith is an editor for *Space Policy*. She is a fellow of the American Institute of Aeronautics and Astronautics (AIAA), the American Astronautical Society (AAS; president, 1985-1986; board of directors, 1982-1985; executive committee, 1982-1987, 1988-1989), the British Interplanetary Society, the International Institute of Space Law (vice president, 2003-2006; board of directors, 1996-2003), and the International Academy of Astronautics (trustee, 1995-2001; co-chair, Space Activities and Society Committee, 1991-1997). She is a life member of the New York Academy of Sciences and the Washington Academy of Sciences (board of directors, 1988-1989) and is a member of Sigma Xi. Ms. Smith is the founder of Women in Aerospace (WIA), its president in 1987, and on its board of directors (1984-1990). She was a member of the board of directors of the Challenger Center for Space Science Education (2000-2003). Ms. Smith was an AIAA Distinguished Lecturer (1983-1988), the recipient of the 2006 AAS John K. Kennedy Astronautics Award, and was awarded the WIA Lifetime Achievement Award in 2003. Ms. Smith served on many AIAA and AAS committees and was a member of the NRC Committee on Human Exploration (1992-1993 and 1996-1997).

PAUL JACKSON is an Associate Program Officer for the Aeronautics and Space Engineering Board. He joined the NRC in 2006 and was previously the media relations contact for the Office of News and Public Information. He is the study director for a number of ASEB's current projects, including two Ohio-funded projects and the Committee to Assess NASA's National Aviation Operational Monitoring Service (NAOMS) Project. Mr. Jackson earned a B.A. in philosophy from Michigan State University in 2002 and an M.P.A in policy analysis, economic development, and comparative international affairs from Indiana University in 2006.

ALAN ANGLEMAN has been a Senior Program Officer for the Aeronautics and Space Engineering Board since 1993, directing studies on the modernization of the U.S. air transportation system, system engineering and design systems, aviation weather systems, aircraft certification standards and procedures, commercial supersonic aircraft, the safety of space launch systems, and other aspects of aeronautics and space research and technology. Previously, Mr. Angleman worked for consulting firms in the Washington area providing engineering support services to the Department of Defense and NASA Headquarters. His professional career began with the U.S. Navy, where he served for nine years as a nuclear-trained submarine officer. Mr. Angleman has a B.S. in engineering physics from the U.S. Naval Academy and an M.S. in applied physics from the Johns Hopkins University. He is also the pastor of Dickerson United Methodist Church and Forest Grove United Methodist Church in Dickerson, Maryland.

SARAH CAPOTE is a Program Associate for the Aeronautics and Space Engineering Board of the NRC. She joined the National Academies in 2002 and previously, was a senior program assistant with the Ocean Studies Board. Ms. Capote gained her B.A. in history from the University of Wisconsin-Madison

in the winter of 2001. Over the course of attaining her degree, she worked as an intern for the National Aeronautics and Space Administration. During her tenure with the National Academies, Ms. Capote has assisted with the completion of a number of studies. She currently works as a staff member on several ASEB studies, including: the Committee to Assess NASA's National Aviation Operational Monitoring Service (NAOMS) Project, the Committee to Review NASA's Exploration Technology Development Plan, and Committee for the Assessment of NASA' Aeronautics Research Program.

SANDRA WILSON is a Program Assistant for the Aeronautics and Space Engineering Board. She came to the NRC in 2007 and previously, was a temporary assistant for ASEB, the National Materials Advisory Board, and the Space Studies Board. During this time, she worked on the Independent Assessment of the Nation's Wake Turbulence R&D Program, The Assessment of NASA's Aeronautics Research Program, Assessing Corrosion Education and the Lunar Research and Technology Workshop. Mrs. Wilson previously served in a managerial capacity in the retail industry for two years. She is currently enrolled at Prince George's Community College, majoring in accounting.

Appendix E
Reviewer Acknowledgment

This report has been reviewed in draft form by Alexander Flax, consultant, in accordance with procedures approved by the Report Review Committee of the National Research Council (NRC). The purpose of this independent review is to provide candid and critical comments that will assist the institution in making its published report as sound as possible and to ensure that the report meets institutional standards for objectivity, evidence, and responsiveness to the study charge. The review comments and draft manuscript remain confidential to protect the integrity of the deliberative process.

Although Dr. Flax provided many constructive comments and suggestions, he was not asked to endorse the conclusions or recommendations, nor did he see the final draft of the report before its release. Responsibility for the final content of this report rests entirely with the authoring committee and the institution.