Ohio | Department of Development

Final Proposal Evaluation

2011

Third Frontier Advanced Energy Program

January 2011

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This Report written by:

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PROPOSAL REVIEW TEAM

❖ TARATEC CORPORATION

- Edward Ungar, President (Quality Control)
- Paula Dunnigan, Project Leader
- Chuck Meadows
- Bill Munk
- Reed Slevin

❖ SIX (6) EXTERNAL REVIEWERS

- **Mr. Thomas J. Gross** is an energy consultant who retired from DOE after 30 years where he served as a Senior Executive and Member of the Board of Directors of Energy Efficiency and Renewable Energy (EERE) and Deputy Assistant Secretary for the Office of Transportation Technologies (annual budget of $300M). Mr. Gross held major roles in the following DOE programs: Partnership for a New Generation of Vehicles, FreedomCar Partnership, International Partnership for the Hydrogen Economy, and California Fuel Cell Partnership. His specific areas of expertise include hydrogen/fuel cells, vehicle batteries including nickel metal hydride, lithium-ion, and other types, biodiesel, and other alternative fuels.
- **Dr. Joseph M. Morabito** is a Director at Alcatel-Lucent. He was named a Bell Laboratories Fellow in 2004 for outstanding lifetime contributions to thin film surface and interface analysis and the development of new thin film systems that provide high density interconnections, thin film resistors, capacitors and cross-overs of high reliability and performance for the silicon integrated circuits (SICs) and hybrid integrated circuits (HICs) used in advanced telecommunications systems. Dr. Morabito is an expert in photovoltaic technologies and was a valuable advisor to the EPRI Solar Program for over 20 years. He has broad expertise in other distributed energy technologies and has published extensively on systems analyses linking various types of distributed energy generation with the smart grid. Dr. Morabito serves on the Board of Directors of the R&D Council of New Jersey.
- **Dr. Evan E. Hughes** is a specialist in biomass and waste as fuels for power generation via combustion, thermochemical gasification, biological gasification (e.g. anaerobic digestion, landfill gas, algae, etc.) and energy crops. He has managed technical projects involving fuel derived from municipal solid waste as well as biomass and alternate fuels (tires, plastics, paper, sawdust, other wood wastes, and energy crop fuels-both woody and herbaceous crops and crop residues). As the Manager, Biomass Energy at EPRI, he has worked with electric utilities, U.S. DOE, and the California Energy Commission. Dr. Hughes currently does project reviews and evaluations for one of the California utilities.
- **Mr. George A. Hay III** brings more than 30 years of experience with EPRI, DOE, and GRI in the areas of renewable energy and distributed generation for the electrical industry. He is a DOE proposal reviewer in the areas of biorefineries, advanced biofuels, and renewable manufacturing. Mr. Hay is currently working with the University of California and NREL on municipal/county/university applications of sustainable energy projects including solar, wind, biomass, landfill gas, energy storage, and fuel cells. He is an advisor to various committees of the New Jersey Clean Energy Program.
- **Mr. Norman D. Malcosky** has over 40 years of experience in the energy industry performing and managing research activities in fossil fuel exploration, alternative fuel vehicles, biofuels, and fuel cells. He has specialized in Liquefied Natural Gas, Compressed Natural Gas, and propane-fueled vehicles. Using his strong background in mechanical engineering, he has patented various types of industrial equipment for the natural gas industry. Mr. Malcosky retired from Battelle Memorial Institute in 2002 where he served as a Senior Research Scientist in Battelle's Transportation Group and Equipment Design and Mechanical Systems Group.
- **Dr. C. Fred Clark, Jr.** was a co-founder and co-owner of CeramPhysics (Westerville, OH) for 29 years where he combined the perspectives of a research scientist with those of a small-business entrepreneur. He was involved in all phases of contract research including proposal writing, contract administration, project management, patents, and licensing. Dr. Clark was involved in the development of a number of patented inventions involving unusual properties of ceramic materials including oxygen and NO_x sensors, SOFC electrodes, energy storage capacitors, oxygen removal technology, and improved dielectric insulation for high-temperature superconductors.

OVERVIEW OF PROPOSAL EVALUATION PROCESS

- Two-stage evaluation process
- The evaluation process is objective and robust. Its consistency has been evaluated through rescoring. Results were found to be independent of the composition of the individual review panels and consistent year-to-year.
- The objective of the **First Stage Evaluation** is to rank the proposals on the basis of which best meet the RFP requirements and then to select the highest-ranking proposals for more in-depth evaluation.
  - The cut-point is based on significant score differences and best use of evalution resources. Taratec recommends a cut-point and ODOD selects the cut-point.
- The objective of the **Second Stage Evaluation** is to rank the highest-scoring proposals from the First Stage on the basis of the quality of investment for the State of Ohio.
  - Ohio job and revenue creation/retention that is likely to occur within 3–5 years
  - Company viability and business functions that are planned in Ohio
  - Potential of the project to contribute to a cluster of related companies in an industry that Ohio is trying to build

PROPOSAL EVALUATION PROCESS

❖ FIRST STAGE EVALUATION

- Conflict of Interest evaluation for each reviewer
- Each proposal is read by 3 reviewers (internal and external)
- Proposal is scored by each reviewer using a scoring instrument (34 questions) based on the RFP criteria
- All scores from each reviewer are entered into a database
- Reviewers provide written comments on areas of concern or those requiring clarification
- A list of proposals ranked on the basis of their average scores is produced
- Taratec meets with ODOD to establish the competitive range (cut-point) for each competition
- Proposals scoring above the cut-point advance to the Second Stage Evaluation

❖ SECOND STAGE EVALUATION

- Reviewer comments are integrated into the construction of a customized set of written questions for each applicant
- Applicants have one week to submit written responses
- Face-to-face meeting (90 minutes) for reviewers and applicants to discuss issues
- Final trade secret identification by applicants
- Preparation of 2-page project write-up
- Risk-benefit scoring by the entire review team
- Scores entered into the database
- Final recommendations developed
- Preparation of materials for consideration by the Third Frontier Commission

SCORING METHODOLOGY

SUMMARY OF FIRST STAGE EVALUATIONS

	TFFCP	TFPVP	**TFAEP**	Total
LOIs Submitted	25	33	**93**	151
Proposals Received by ODOD	12	18	**47**	77
Proposals Evaluated by Taratec	12	15	**43**	70
Recommended for 2nd Stage	7	9	**19**	35
TFRDF Available	$7M	$7M	**$7M**	$21M
TFWCF Available	$1M	$1M	**$1M**	$3M
Cumulative TFRDF Requested	$6.9M	$7.5M	**$16.9M**	$31.3M
Cumulative TFWCF Requested	$57K	$163K	**$3.2M**	$3.4M

SCORING METHODOLOGY *(continued)*

SECOND STAGE EVALUATION FACTORS

❖ TECHNICAL RISK

- Technical Reach— (40%)
  Does the project require technology development beyond prior practice and is it practical to attain?
- Resource Limitations— (40%)
  Does the project team have sufficient resources in terms of people, facilities and funds to attain the project goals?
- Technology Protection— (20%)
  Have provisions been made to protect the technology by patent and trade secret?

❖ COMMERCIAL RISK

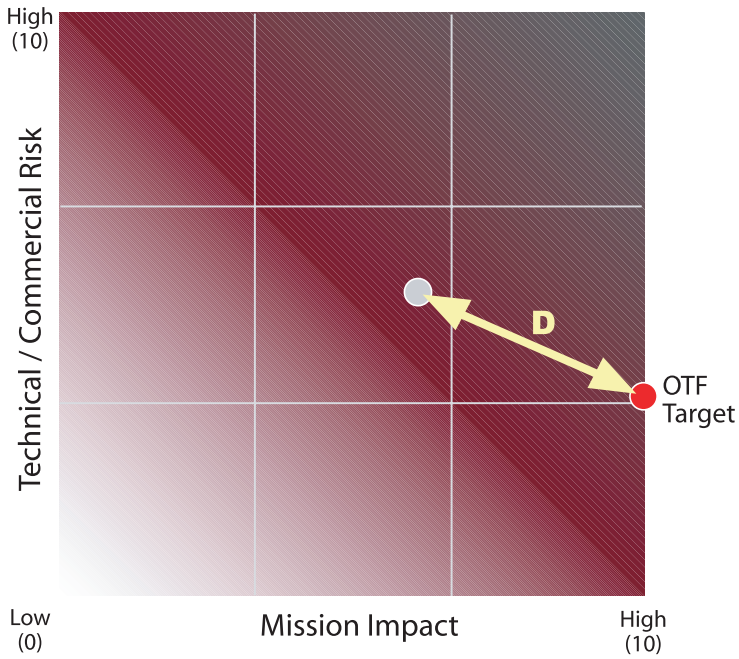
- Path to Market— (40%)
  Does the project team have a credible path to market, customer knowledge, pricing strategy, sales force, etc.?
- Corporate Stability— (40%)
  Does the project team have the financial resources available or committed to bring this product to market?
- Commercial Infrastructure— (20%)
  Does the project team have access to established distribution channels?

❖ MISSION IMPACT

- Cluster Formation— (25%)
  Does the applicant buy from, sell to, or otherwise contribute to the formation of a technology or industry cluster in Ohio?
- Ohio Economics— (50%)
  Does this project show a credible path to substantial job and revenue creation in Ohio in 3–5 years?
- Business Model— (25%)
  Is the proposed business model viable and will it lead to new business growth in Ohio?

SCORING METHODOLOGY *(continued)*

- Two 2-dimensional scoring matrices
  - One for Technical Risk
  - One for Commercialization Risk
  - Both risks are plotted against Mission Impact
- Target for Technical Risk is (10, 3.5)
- Target for Commercial Risk is (10, lowest value)
- Project's final score is based upon sum of D1 and D2



2011 TARGETS

	Technical Risk	Commercial Risk	Mission Impact
Fuel Cell	3.50	2.07	10.00
Photovoltaic	3.50	2.40	10.00
Advanced Energy	**3.50**	**2.13**	**10.00**

TARGET DEFINITION FOR OHIO'S THIRD FRONTIER CLUSTER PROGRAMS

The targets for Technical Risk, Commercial Risk, and Mission Impact have been set based on the profile of projects that are most likely to meet the intent of the Third Frontier Cluster Programs to develop new technology businesses that will produce economic development in Ohio in the 3- to 5-year timeframe. These targets were set after consultation with ODOD and the Third Frontier Commission.

Mission Impact

Ohio is seeking to fund the projects that will result in the highest economic development impacts for the dollars invested. Therefore, the target for mission impact has been set at the maximum of 10.

Technical Risk

Since economic development results are desired in a relatively short timeframe, projects selected for funding should be relatively mature, i.e., in the late Incubating or Demonstrating Stage with a functional prototype.

Projects that contain relatively little technical challenge, represent product line extensions, or are close to market are likely to score low on technical risk, i.e. 1 or 2. These types of projects would be candidates for internal funding by the applicant company, could attract investment, or would be bankable. They would not have the level of risk intended for this program.

At the other end of the spectrum, there will be projects that are still in early stages of development and have a number of significant technical and cost issues remaining to be resolved. These projects are frequently classified as Imagining or early Incubating Stage. They are likely to have technical risk scores in the range of 7–10. These projects would be candidates for federal R&D funding in the form of SBIRs or NIH grants. Only after they reach greater technical maturity would they be attractive candidates for the Third Frontier Cluster Programs.

The ideal level of technical risk for these three cluster programs has been set at 3.5. It is believed that this level of technical risk presents the optimum probability of achieving the intended economic development outcomes within the targeted timeframe.

Commercial Risk

The cluster programs are intended to serve the needs of both start-up companies and companies that have on-going business.

Existing companies frequently have well-developed distribution channels and some degree of financial stability resulting in low commercial risk scores. However, they may require assistance in new product development to reach a level of product maturity that will allow them to compete for scarce internal resources. Proposals from these companies will typically have commercial risks that score in the range of 1.5–2.5.

It was decided that these companies should not be penalized for having "too low of a commercialization risk." Therefore, for each competition, the target for commercial risk is set as the floor or at the lowest value of all proposals in the competitive range. This ensures that no proposal is penalized for having the ability to bring its product into the marketplace.

2011 TFAEP

Third Frontier Advanced Energy Program

Summaries of Proposals in Competitive Range

RECOMMENDATIONS FOR FUNDING
2011 Third Frontier Advanced Energy Program (TFAEP)

RECOMMENDED FOR FULL FUNDING

	OTF NO.	APPLICANT	OTF $ REQUESTED	OTF $ CUMULATIVE	WRIGHT $ REQUESTED	WRIGHT $ CUMULATIVE
1.	TFAEP 11-393	Advanced Battery Concepts, LLC (ABC)	$1,000,000	$1,000,000	$0	$0
2.	TFAEP 11-325	MesoCoat, Inc.	$1,000,000	$2,000,000	$1,000,000	$1,000,000
3.	TFAEP 11-347	Delphi Automotive	$1,000,000	$3,000,000	$0	$1,000,000
4.	TFAEP 11-312	Inorganic Specialists, Inc.	$1,000,000	$4,000,000	$0	$1,000,000
5.	TFAEP 11-340	SuGanit Systems, Inc.	$1,000,000	$5,000,000	$1,000,000	$2,000,000
6.	TFAEP 11-306	Adsorption Research, Inc. (ARI)	$1,000,000	$6,000,000	$0	$2,000,000
7.	TFAEP 11-315	GEM Energy Management, LLC	$1,000,000	$7,000,000	$0	$2,000,000
TOTAL FUNDS REQUESTED				**$7,000,000**		**$2,000,000**

IF FUNDING IS AVAILABLE

	OTF NO.	APPLICANT	OTF $ REQUESTED	WRIGHT $ REQUESTED
8.	TFAEP 11-345	Calgon Carbon Corporation	$1,000,000	$350,000
9.	TFAEP 11-320	AFS Technology, LLC	$ 150,000	$0
10.	TFAEP 11-336	Polyflow LLC	$1,000,000	$600,000
11.	TFAEP 11-303	Nanotek Instruments, Inc.	$ 999,996	$0
TOTAL FUNDS REQUESTED			**$3,149,996**	**$950,000**

Note: Two applicants with proposals that made the competitive range contacted ODOD and requested that their proposal be withdrawn from the 2011 TFAEP competition. Their withdrawal occurred prior to the face-to-face meetings between the applicant and the reviewers. For this reason, only 17 proposals completed the second round of the evaluation and are included in this summary.

2011 Third Frontier Funding Cycle Advanced Energy Program Final Round Scores

SCORE		City	County	OTFRD $ Requested	OTFRD $ Cumulative	WRIGHT $ Requested	WRIGHT $ Cumulative
Targets - Mission Impact: 10 Commercial Risk: 2.13 Technical Risk: 3.5							
83.8	**TFAEP 11-393** Advanced Battery Concepts, LLC (ABC) Rapid Commercialization of GreenSeal™ Advanced High Energy Batteries Technical Risk: **3.27** (R: 3.33 L: 3.00 P: 3.67) Commercial Risk: **2.87** (P: 1.67 S: 4.00 I: 3.00) Mission Impact: **8.09** (C: 7.67 E: 8.67 M: 7.33)	Port Clinton	Ottawa	$1,000,000	**$1,000,000**	$0	**$0**
80.5	**TFAEP 11-325** MesoCoat, Inc. High Power Density Coating System for Infrastructure Technical Risk: **3.8** (R: 5.00 L: 3.00 P: 3.00) Commercial Risk: **4.6** (P: 4.00 S: 5.00 I: 5.00) Mission Impact: **8.25** (C: 7.00 E: 9.33 M: 7.33)	Euclid	Cuyahoga	$1,000,000	**$2,000,000**	$1,000,000	**$1,000,000**
80.2	**TFAEP 11-347** Delphi Automotive Aluminum-shielded Large Size/Battery Cable Development for Electric Vehicle/Hybrid Electric Vehicles (EV/HEV) Technical Risk: **4** (R: 6.00 L: 2.33 P: 3.33) Commercial Risk: **2.13** (P: 3.33 S: 1.33 I: 1.33) Mission Impact: **7.59** (C: 7.00 E: 7.67 M: 8.00)	Warren	Trumbull	$1,000,000	**$3,000,000**	$0	**$1,000,000**
74.9	**TFAEP 11-312** Inorganic Specialists, Inc. Lithium Ion Material Commercial Demonstration Project Technical Risk: **4.53** (R: 3.33 L: 6.00 P: 4.00) Commercial Risk: **5.66** (P: 5.33 S: 5.33 I: 7.00) Mission Impact: **8.09** (C: 8.00 E: 8.67 M: 7.00)	Miamisburg	Montgomery	$1,000,000	**$4,000,000**	$0	**$1,000,000**
72.7	**TFAEP 11-340** SuGanit Systems, Inc. Pilot-scale Demonstration of Lignocellulosic Fuel Ethanol Technical Risk: **4.8** (R: 5.33 L: 5.00 P: 3.33) Commercial Risk: **5.6** (P: 5.33 S: 5.67 I: 6.00) Mission Impact: **7.75** (C: 6.00 E: 8.33 M: 8.33)	Toledo	Lucas	$1,000,000	**$5,000,000**	$1,000,000	**$2,000,000**
71.0	**TFAEP 11-306** Adsorption Research, Inc. (ARI) Upgrading Landfill Gas to Pipeline Quality Natural Gas via Pressure Swing Adsorption Technical Risk: **4.40** (R: 3.67 L: 5.00 P: 4.67) Commercial Risk: **4.07** (P: 3.33 S: 4.00 I: 5.67) Mission Impact: **6.75** (C: 6.67 E: 7.33 M: 5.67)	Dublin	Franklin	$1,000,000	**$6,000,000**	$0	**$2,000,000**
70.5	**TFAEP 11-315** GEM Energy Management, LLC Modular Integrated Energy Systems for Critical Operations Technical Risk: **3.33** (R: 2.67 L: 3.00 P: 5.33) Commercial Risk: **3** (P: 4.00 S: 2.00 I: 3.00) Mission Impact: **6.42** (C: 5.33 E: 6.33 M: 7.67)	Walbridge	Wood	$1,000,000	**$7,000,000**	$0	**$2,000,000**

2011 Third Frontier Funding Cycle Advanced Energy Program Final Round Scores

SCORE		City	County	OTFRD $ Requested	OTFRD $ Cumulative	WRIGHT $ Requested	WRIGHT $ Cumulative
Targets - Mission Impact: 10 Commercial Risk: 2.13 Technical Risk: 3.5							
67.7	**TFAEP 11-345** Calgon Carbon Corporation Development and Commercialization of Advanced Activated Carbons for Energy Storage Applications Technical Risk: **4.27** (R: 6.00 L: 3.00 P: 3.33) Commercial Risk: **2.67** (P: 4.00 S: 1.67 I: 2.00) Mission Impact: **6.08** (C: 6.33 E: 5.33 M: 7.33)	Columbus	Franklin	$1,000,000	**$8,000,000**	$350,000	**$2,350,000**
65.3	**TFAEP 11-320** AFS Technology, LLC Tire Fuel Delivery System For Cement Kilns With Calciners Technical Risk: **4.33** (R: 3.33 L: 5.00 P: 5.00) Commercial Risk: **3.73** (P: 5.00 S: 3.33 I: 2.00) Mission Impact: **5.92** (C: 4.33 E: 6.33 M: 6.67)	Tipp City	Miami	$150,000	**$8,150,000**	$0	**$2,350,000**
64.1	**TFAEP 11-336** Polyflow LLC Semi-Works Demonstration of Polyflow's Waste to Fuels Processor Technical Risk: **4.67** (R: 4.33 L: 5.00 P: 4.67) Commercial Risk: **5.33** (P: 4.00 S: 5.33 I: 8.00) Mission Impact: **6.25** (C: 6.00 E: 7.00 M: 5.00)	Akron	Summit	$1,000,000	**$9,150,000**	$600,000	**$2,950,000**
62.9	**TFAEP 11-303** Nanotek Instruments, Inc. Nano Graphene-enabled Supercapacitors for Electric Vehicle, Renewable Energy, and Modern Grid Technology Applications Technical Risk: **4.6** (R: 6.00 L: 4.33 P: 2.33) Commercial Risk: **4.6** (P: 5.00 S: 4.00 I: 5.00) Mission Impact: **5.83** (C: 7.00 E: 5.00 M: 6.33)	Dayton	Montgomery	$999,996	**$10,149,996**	$0	**$2,950,000**
57.6	**TFAEP 11-350** Tremont Electric Incorporated Advancing Production and Development for Full Commercialization of nPower® Kinetic Energy Harvesting Devices Technical Risk: **4.53** (R: 4.33 L: 5.33 P: 3.33) Commercial Risk: **4.80** (P: 4.67 S: 5.00 I: 4.67) Mission Impact: **5.17** (C: 5.00 E: 5.00 M: 5.67)	Cleveland	Cuyahoga	$852,216	**$11,002,212**	$0	**$2,950,000**
56.7	**TFAEP 11-384** International Health Monitoring Systems, Inc. (IHMSI) Wind Rotor Blade X-ray CT for In-line Process Monitoring and Control for Wind Rotor Blade Manufacturing for Global Markets Technical Risk: **6.34** (R: 6.67 L: 6.67 P: 5.00) Commercial Risk: **5.53** (P: 3.33 S: 6.33 I: 8.33) Mission Impact: **5.67** (C: 7.00 E: 5.00 M: 5.67)	Dayton	Montgomery	$1,000,000	**$12,002,212**	$0	**$2,950,000**
56.5	**TFAEP 11-392** Catacel Corporation Novel Catalyst to Reduce Cost of On-site Hydrogen Generators Technical Risk: **4.6** (R: 4.00 L: 5.00 P: 5.00) Commercial Risk: **4.26** (P: 3.33 S: 5.33 I: 4.00) Mission Impact: **4.92** (C: 3.00 E: 4.67 M: 7.33)	Garrettsville	Portage	$607,488	**$12,609,700**	$0	**$2,950,000**

2011 Third Frontier Funding Cycle Advanced Energy Program Final Round Scores

SCORE		City	County	OTFRD $ Requested	OTFRD $ Cumulative	WRIGHT $ Requested	WRIGHT $ Cumulative
Targets - Mission Impact: 10 Commercial Risk: 2.13 Technical Risk: 3.5							
56.1	**TFAEP 11-348** Echogen Power Systems, Inc. Development of State-of-the-Art Heat Exchangers for Transforming Waste Heat to Power	Akron	Summit	$1,000,000	**$13,609,700**	$0	**$2,950,000**
	Technical Risk: **6.74** (R: 7.67 L: 6.67 P: 5.00) Commercial Risk: **5.6** (P: 5.33 S: 6.00 I: 5.33) Mission Impact: **5.75** (C: 6.00 E: 5.33 M: 6.33)						
54.6	**TFAEP 11-331** Intelligent Grid Solutions, LLC (IGS) Commercialization of Tailored Home Energy Management Solutions	Akron	Summit	$918,104	**$14,527,804**	$244,000	**$3,194,000**
	Technical Risk: **6.2** (R: 6.00 L: 6.00 P: 7.00) Commercial Risk: **5.33** (P: 4.00 S: 6.00 I: 6.67) Mission Impact: **5.25** (C: 5.33 E: 5.67 M: 4.33)						
50.1	**TFAEP 11-307** Chemtex International, Inc. Integrated Biorefinery Application Center	Sharon Center	Medina	$993,486	**$15,521,290**	$0	**$3,194,000**
	Technical Risk: **5.8** (R: 5.33 L: 7.00 P: 4.33) Commercial Risk: **5.52** (P: 6.30 S: 4.00 I: 7.00) Mission Impact: **4.57** (C: 5.67 E: 4.30 M: 4.00)						

Ohio Department of Development

2011 TFAEP Evaluation Summary

Third Frontier Advanced Energy Program

Advanced Battery Concepts, LLC (ABC)

Rapid Commercialization of GreenSeal™ Advanced High Energy Batteries

TFAEP 11-393 Final Score: 83.8 Rank: 1

Previous Ohio Investment

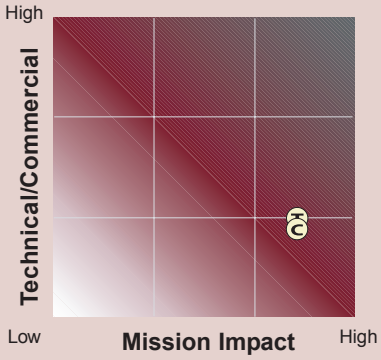
Advanced Battery Concepts, LLC (ABC) has not received a prior OTF award.

Project Description

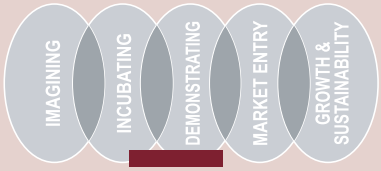
ABC has developed, tested, and produced a bipolar electrode technology (GreenSeal™) that promises to increase the lifetime energy of a traditional lead acid battery by eight times. The electrodes have been incorporated into a generation-1 battery design and prototypes were fabricated and successfully laboratory tested. In this 2-year project, ABC proposes establishing a production capability for the GreenSeal™ electrode, incorporating the electrode into a generation-2 battery design and initiating limited volume production of the generation-2 batteries. Upon meeting defined performance and production cost goals, the production capability for both the electrodes and generation-2 batteries will be increased to a level supporting the initial target markets. Crown Battery is active in the project and will use its manufacturing facilities in Fremont, OH for battery pasting operations. GreenSeal™ battery manufacturing will initially take place at the Crown Battery Renewable Energy Center (CBREC) in Port Clinton, OH. The University of Toledo will focus on the utility of GreenSeal™ batteries for grid solar-power management, a longer-term market opportunity.

Key Issues

- ABC is a Midland, MI-based company that has received support from the State of Michigan and Michigan-based investors. It will maintain its headquarters and R&D in Midland but has moved its manufacturing equipment and capabilities to the CBREC in Port Clinton, OH and intends to manufacture electrodes and batteries at that facility. Crown Battery, also an investor, intends to be ABC's initial licensee and electrode customer, and its Ohio economic impact projections from successful GreenSeal™ Battery commercialization are significant.
- The final location for ABC's electrode full-scale manufacturing facility has not been determined. While it may be in Ohio, this will not be decided until the product demonstrates market readiness, investment sources are committed, and the Crown partnership is finalized.
- The technology enables Crown Battery, a preeminent Ohio deep-cycle battery manufacturer, to expand its leading position in several markets and access other growing markets for energy storage such as renewable power generation.



Stage of Development



County Location

Funds Requested

TFRDF Request:	$1,000,000
WCF Request:	$ 0
TOTAL Request:	$1,000,000
Cost Share:	$1,285,209

Collaborators

- Crown Battery Manufacturing Company
- University of Toledo

Technical Risk

Overall Score = 3.27

Technical Reach

Prototype and "one-off" GreenSeal™ electrodes and batteries have been produced and have successfully metperformance objectives. The key challenges of edge cell ruptures and inter-cell leakage have been resolved with through ABC's proprietary assembly methods. Thousands of electrodes have been produced in the laboratory, and nearly 100 batteries have been fabricated with voltage capacities ranging from 2V to 48V. Optimizing the battery pasting process is expected to increase the active battery material utilization, already twice that of traditional lead-acid batteries, by 10% to 20%.

Resource Limitations

ABC is a Midland, MI start-up company specifically formed to develop and commercialize GreenSeal™ batteries. Its initial investor funding (includes Crown Battery) and the TFAEP grant will be sufficient to support the project proposed. Additional investor support is expected to close in 2011 for continuing manufacturing operations and commercialization activities at the CBREC. Crown's participation provides strong manufacturing know-how and market access.

Technology Protection

ABC has a U.S. patent pending that covers the GreenSeal™ electrode and provisional patent disclosures that cover the proprietary assembling methods (ViaLock™ and RapidSeal™). Patent applications for other GreenSeal™ features that allow the use of lead-acid batteries in environments not presently possible have also been submitted (BipolarPLus™, Endo-Cool™ and Endo-Safe™).

Commercialization Risk

Overall Score = 2.87

Path to Market

Crown Battery is an active participant in the project and an investor in ABC. It intends to be the first licensee of the technology. Crown's specific interest is in batteries for golf carts, floor scrubbers, and other similar markets in which it currently has an established market position. Licensing arrangements with battery manufacturers for markets outside Crown's interests will also be pursued.

Corporate Stability

ABC is not yet revenue-producing and will rely on its investors to support its operations until licensing and product revenues are achieved. It is leasing space at the CBREC for initial electrode and battery production. Sufficient space for manufacturing expansion in planned and exists at CBREC. Crown Battery is a long-term Ohio deep-cycle battery manufacturing company with over 450 employees that has increased revenues by 400% over the last decade.

Commercial Infrastructure

ABC will initially manufacture and market electrodes from the CBREC and license battery manufacture to established battery companies such as Crown, its initial partner. Battery manufacturers may also elect to license electrode manufacture. Crown has established market channels with major battery markets in material handling systems, floor care, recreational equipment, and electric vehicles among others.

Mission Impact

Overall Score = 8.09

Cluster Formation

While ABC is headquartered in Michigan and its R&D operations will remain there, its manufacturing/assembly equipment has been moved to the CBREC in Port Clinton where initial products will be produced. The project positions Crown Battery to continue its growth as a major supplier of energy storage products and opens a new path for products for renewable energy systems. The University of Toledo's expertise at its Power Electronics Lab is leveraged in the project.

Ohio Economics

The proposed project immediately creates 10 new jobs at ABC's facilities at the CBREC, growing to 35 in 2013 and 65 in 2015. ABC revenues are estimated at $1.5M in 2013 and $25M in 2015. Crown Battery projects creating 10 new jobs during the project (Year 2) and 75 in 2013 growing to 125 in 2015. Sales of new batteries produced would begin in 2014, producing revenues of $76M in 2015. Crown and ABC may also form a new joint venture for grid-scale applications that would create 10 to 30 new jobs between 2013 and 2015.

Business Model

ABC will produce GreenSeal™ batteries and electrodes at the CBREC facility. Battery production will be for demonstration and product introduction purposes while electrode manufacture will be on a production-scale and sales will be made to licensed battery manufacturers. ABC projects that its electrode sales will be its dominant revenue source. Crown Battery intends to be the first battery licensee and will purchase electrodes initially, although in the long-term it will probably license that technology also for in-house production.

Prior Ohio Investments

- *None*

Ohio Department of Development

2011 TFAEP Evaluation Summary

Third Frontier Advanced Energy Program

MesoCoat, Inc.

High Power Density Coating System for Infrastructure

TFAEP 11-325 Final Score: 80.5 Rank: 2

Previous Ohio Investment

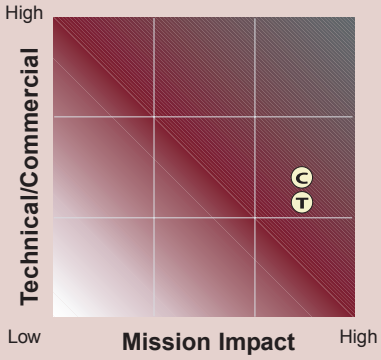
MesoCoat, Inc. has been involved as a seed-round investment from Jumpstart under Grant Number TECH 07-017 from the Entrepreneurial Signature Program Pre-Seed Fund. The title of this grant was "Building Business and Industries from Distinctive Technologies in Northeast Ohio." MesoCoat was approved for a $350,000 convertible debt seed investment in July 2008.

Project Description

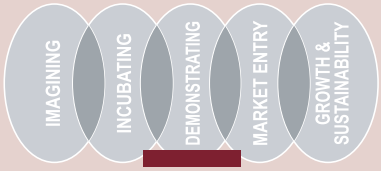
The U.S. Department of Energy (DOE) sponsored a program to develop materials for ultra-super critical (USC) coal-fired boilers that operate at higher efficiency with lower carbon dioxide emissions. The materials must provide creep resistance, fatigue resistance, coal-ash corrosion resistance, and oxidation resistance at steam conditions of 1,400°F at 5,000 psi. MesoCoat has obtained exclusive rights to the Oak Ridge National Laboratory (ORNL) technology for an advanced coating material and high density fusion cladding process that enables coated surfaces of complex shape boiler components to withstand the harsh conditions of the USC coal-fired boiler more than five times longer than current materials. Called the CermaClad™ coating process, it uses a high-intensity, focused plasma arc lamp to fuse nanocomposite coating materials to the inside and outside surfaces of steel pipes and other complex shapes. MesoCoat has third-party verifications of the suitability of the coating, so it now must demonstrate that the coating can be applied to large, complex surfaces at a reasonable cost. In this 2-year project, MesoCoat proposes to build an initial production-scale coating facility to demonstrate the cost effectiveness of the CermaClad™ coated parts. MesoCoat's parent company, Powdermet, will supply the materials. The University of Akron will receive Wright Capital funds to build a small-scale coating facility at the University of Akron.

Key Issues

- The coating technology proposed represents an advanced material development, but the applications targeted are related to advanced energy end-uses such as tubes for ultra-super critical boilers, wind turbine bearings, and tubes and vessels used for biofuel production.
- This project proposes building a production-scale facility before fully investigating and resolving coating failures observed in coupon testing. While the project team is confident the problems can be resolved at the production-scale level, it raises the technical and commercial risk associated with the project.
- The initial production plant in Ohio will add and retain a reasonable number of new jobs and has the potential to generate significant sales revenues for Ohio companies in the targeted period.



Stage of Development



County Location

Funds Requested

TFRDF Request:	$1,000,000
WCF Request:	$1,000,000
TOTAL Request:	$2,000,000
Cost Share:	$2,116,555

Collaborators

- University of Akron

Technical Risk

Overall Score = 3.80

Technical Reach

CermaClad™ coated substrate test coupons have, for the most part, performed well. MesoCoat must produce larger, complex shapes to demonstrate field suitability. Babcock &Wilcox plans to conduct wear testing, fire-side testing, steam-side oxidation testing, and other testing. MesoCoat proposes to build a facility capable of coating production-size parts for field evaluations. There have been performance problems with some coatings, and MesoCoat is aware that it may have to resolve coating problems on production-size parts. MesoCoat feels this higher risk approach is necessary to get the proposed product to market. Part of the scale-up challenges will be to develop robotically controlled application equipment for pipe IDs, pipe ODs, and other complex surfaces.

Resource Limitations

MesoCoat obtained approximately $12M from DOE, DOD, Jumpstart, NASA, NIST and private investors (Series A and B financing). MesoCoat has milestone-based options for another $16M in Series C financing during Year 1 of the project, and has plans to raise another $8M from federal sources over the next two years. OTF funding would help MesoCoat sustain and progress in the critical period between 'Series B' and 'Series C' investments and leverage other funding efforts. The CEO of MesoCoat has proven experience in developing start-up companies with new, high tech products and in raising funds. MesoCoat has excellent technical capabilities, including hiring one of the technologists from ORNL who was involved with the coating project.

Technology Protection

MesoCoat has all rights to 9 patents (2 from ORNL, 7 from Powdermet), has filed 4 foreign patents, and is developing 4 more in that are focused on the use of nanoparticle-modified metal coatings and the high power density powder coating process. MesoCoat plans to file additional patents, if warranted, during the course of the project.

Commercialization Risk

Overall Score = 4.60

Path to Market

Even though no end-users or next-stage suppliers are financially involved in this project, MesoCoat has an excellent path to market. Babcock & Wilcox, a major OEM for large steam power plants, will be performing wear tests on MesoCoat samples. Syncrude is interested in coated components for its oil tar sand projects, and Petrobras, Chevon, and Exxon have expressed interest for their oil and gas pipelines. MesoCoat also has past and current collaborations with DOE, DOD, NIST, NASA, US Steel, Timken, GE and others for applications in marine coatings, infrastructure coatings, and other energy coating markets.

Corporate Stability

Parent company, Powdermet, formed start-up MesoCoat in 2007 to provide a metal coating service for nanocomposites cermets. MesoCoat currently employs approximately 21 people.

Commercial Infrastructure

MesoCoat currently resides in an expandable 12,000 square foot facility in a Euclid nanotechnology center. MesoCoat plans to build its first production-scale facility in Euclid to prove out equipment designs, to confirm production costs, to produce small quantities of production-size parts for field testing, and to generate low quantity, initial sales. MesoCoat would eventually like to have 1 or 2 coating facilities in Ohio to service local markets as well as other coating facilities outside Ohio. All coating facilities will receive the coating raw materials from the current Powdermet location in Ohio.

Mission Impact

Overall Score = 8.25

Cluster Formation

The project will utilize Ohio companies and labor. Babcock & Wilcox will perform testing on coated samples. The University of Akron will build a fusion coating facility for small shapes, and assist MesoCoat in analysis of coatings. The Case Western Reserve University's Swagelok Center for Surface of Materials (SCSAM) will perform microstructural characterizations of sample coatings and interfaces. During and after the project, Powdermet will supply the coating materials to all R&D and production facilities.

Ohio Economics

MesoCoat expects market entry in 2011 with initial sales of $2M from the first line at the Ohio plant, growing to $22M in 2012, $150M in 2013, and more than $200Min 2015. MesoCoat also forecasts 45 new and retained jobs in Ohio by 2013, and cumulative 51 new and retained jobs in Ohio by 2015.

Business Model

MesoCoat will target four specific business markets: consumable feedstock sales; application equipment sales and service; coating applications service; and maintenance, repair and overhaul (MRO). MesoCoat will construct captive and regional coating plants that will serve large end-users, value chain partners, and end-user plants. MesoCoat will support the plants and value chain partners with Powdermet materials (consumable feedstocks) and equipment. MesoCoat will set-up captive coating plants, sell franchises with license arrangements, and set-up JVs.

Prior Ohio Investments

- Building Business and Industries from Distinctive Technologies in Northeast Ohio, 2008, $350,000

Ohio Department of Development

2011 TFAEP Evaluation Summary

Third Frontier Advanced Energy Program

Delphi Automotive

Aluminum-shielded Large Size/Battery Cable Development for Electric Vehicle/Hybrid Electric Vehicles (EV/HEV)

TFAEP 11-347	Final Score: 80.2	Rank: 3

Previous Ohio Investment

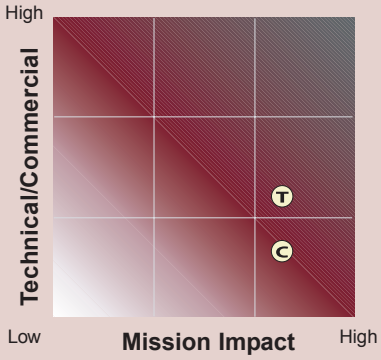
Delphi Automotive has not received a prior OTF award.

Project Description

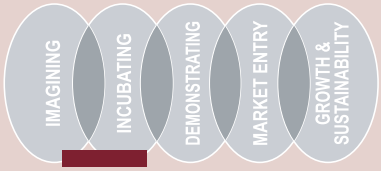
Delphi proposes to develop the materials, products, and processes necessary to produce aluminum shielded, large-size battery cable to replace the currently used copper cables being used in electric and hybrid electric vehicles. Aluminum cables offer a cost-effective, lighter weight cable alternative for these vehicles and potentially other applications where high voltage cable capacity is required. In the 2-year project, Delphi will manufacture and test an array of materials associated with the aluminum conductor, inner cable jacket, braided shielding and outer cable jacket. Delphi claims to have the cable-making processes in place that are unique to its facilities that will enable it to successfully overcome the technical and commercial challenges related to introducing the new cable product. YSU will assist Delphi in materials evaluations using unique analytical equipment purchased with earlier OTF grant funding.

Key Issues

- Delphi will proceed with its plans for improved cable systems to serve the hybrid and plug-in vehicle markets with or without the OTF support. However, the OTF support would accelerate the development process and will help sway the "make or buy" decision toward making the product internally at the existing Warren, OH facilities.
- The product is currently at the conceptual stage with material and process challenges yet to be addressed. Delphi's experience and capabilities in similar system developments should allow the transition to a market-ready product in a 2-year period and appear reasonable.



Stage of Development



County Location

Funds Requested

TFRDF Request:	$1,000,000
WCF Request:	$ 0
TOTAL Request:	$1,000,000
Cost Share:	$2,328,292

Collaborators

- Youngstown State University

Technical Risk

Overall Score = 4.00

Technical Reach

The project proposed involves development of the optimal insulation material, wire strand size, cable system materials and termination design. Specification development, wire and material testing will lead to design and build of the new cable-making process and machinery. The project ends with cable produced for customer evaluation.

Resource Limitations

Delphi is supporting the proposed effort by purchasing the necessary cable fabrication equipment that represents about two-thirds of the project's cost total. Leveraging Delphi's expertise with the new equipment appears to allow Delphi to transition from an Imagining Phase technology to a market-ready product within the project's timetable.

Technology Protection

Delphi possesses an extensive portfolio of trade secrets, patents, and other IP related to high voltage cables, terminations and other components that will cover the large-size battery cable proposed and its manufacture.

Commercialization Risk

Overall Score = 2.13

Path to Market

Delphi has two business lines related to electronic products. The Electrical and Electronics Systems line includes wiring assemblies, cable, and hybrid vehicle products. The Connector Systems line also includes hybrid vehicle-related products. Delphi has nearly a 25% and an over a 10% market share in these markets respectively. It is currently working with and supplying products to virtually all of the hybrid and all-electric vehicle manufacturers.

Corporate Stability

Delphi Packard is a multi-billion dollar per year company. It emerged from bankruptcy as a privately held company in 2009 and has been profitable each quarter since that time.

Commercial Infrastructure

Delphi has established marketing, sales and service channels for its electronics products. It is currently supplying product to the virtually all of the automotive companies introducing hybrid and plug-in electric vehicles.

Mission Impact

Overall Score = 7.59

Cluster Formation

Delphi Automotive is an Ohio anchor company in the automotive supply chain. It has its headquarters and design and engineering center in Warren, OH, as well as 3 manufacturing sites there. One of these, the cable manufacturing plant, provides 85% of the cable for the North American market.

Ohio Economics

Delphi projects that the manufacturing the new cable product in Ohio will product will produce about $12M in sales revenues and attract $3.2M in investment by 2013, creating 27 new jobs in Warren. By 2015, the revenues will be $15M annually and a total of 40 jobs created. However, the final decision to "make or buy" the cable (probably from overseas) has not been made, and the OTF award will strongly support the "make" decision.

Business Model

The business model for the cable product is already in place with Delphi providing product to the targeted markets. The only decision remaining in the business model is whether to "make or buy" the cable product. Delphi favors the "make" approach as it provides the most profit potential and maximum flexibility for market customization and expansion.

Prior Ohio Investments

- *None*

Ohio Department of Development

2011 TFAEP Evaluation Summary

Third Frontier Advanced Energy Program

Inorganic Specialists, Inc.

Lithium Ion Material Commercial Demonstration Project

TFAEP 11-312 Final Score: 74.9 Rank: 4

Previous Ohio Investment

Inorganic Specialists received a $250,000 Technology Merit award in 2008 to optimize its carbon nanofiber (CNF) paper for use as an anode material in lithium ion batteries. Ultramet was to optimize the silicon coating process, and Inorganic Specialists was responsible for the binder application leading to prototype anodes available for testing by Dalhousie University (Canada). Inorganic Specialists successfully completed this project and demonstrated the capability of its silicon-coated CNF paper.

Later, Inorganic Specialists was able to leverage the results of its TFAEP project into a $2.5M ARPA-E project when it was selected by DOE as one of 37 near-term, high-potential projects out of 3700 submissions in all areas of advanced energy. In its ARPA-E project, Inorganic Specialists has demonstrated superior cycling life, rate capability, and low first-cycle loss with its silicon-coated CNF anodes. Its ability to tailor the properties of its CNF paper and its low-cost manufacturing process made Inorganic Specialists attractive to the DOE. In 2011, Inorganic Specialists will produce anodes using the pilot papermaker and pilot silicon coater in its ARPA-E project.

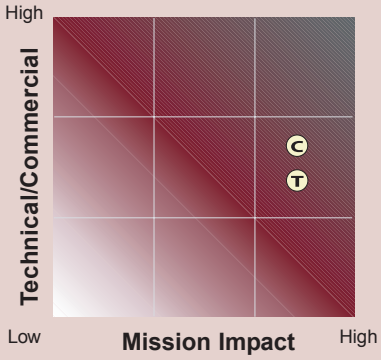
Project Description

In this project, Inorganic Specialists is seeking funding to move the pilot CNF papermaker from South Carolina and to install it at Mound Advanced Technology Center in Miamisburg. This equipment is custom-built and allows continuous CNF paper production. The move would take place in mid-2011. Utilities and plumbing at the proposed site would have to be configured and safety and control systems would be installed on the equipment.

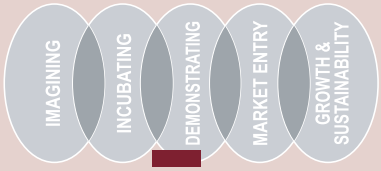
After the relocated equipment is operational in Ohio, Inorganic Specialists will seek to commercialize plain CNF paper for a variety of applications such as lithium ion anodes, other battery materials, composites, electromagnetic shielding, resistive heating products, and fuel cell gas diffusers. The pilot papermaking equipment will be used to provide large quantities of material for evaluation. OTF funding would be used to support new hires for equipment operation, an office manager, and a technical professional. Three battery prototype builders are participating and will evaluate the material. Silicon coating will be done in CA until the end of the ARPA-E program in 2011. The coating equipment will be moved to Ohio in 2012 to form a complete production line, and funding from this request would support transition work and training of an operator.

Key Issues

- As an early-stage company, Inorganic Specialists depends upon its founder for technical direction. The company will have to broaden its management team and alter its internal structure to acquire the additional skills needed to commercialize this product.
- In the near future, Inorganic Specialists expects to negotiate a JV with Ultramet and raise significant external funding. These will be challenges that are new to the company.
- The ARPA-E program is assisting Inorganic Specialists in making many high-level connections. Both the number of contacts and the uniqueness of the product may make it difficult for Inorganic Specialists to maintain its focus.



Stage of Development



County Location

Funds Requested

TFRDF Request:	$1,000,000
WCF Request:	$ 0
TOTAL Request:	$1,000,000
Cost Share:	$1,010,400

Collaborators

- Ultramet (Pacioma, CA)
- Southeast Nonwovens (Clover, SC)
- Mound Technical Solutions
- EaglePicher Technologies (Joplin, MO)

Technical Risk

Overall Score = 4.53

Technical Reach

Equipment for both portions of the silicon-coated CNF paper line (papermaking and silicon infusion) is already operational and has produced product with the desired electrochemical performance for lithium ion batteries. The ARPA-E program has been a major contributor in advancing the anode technology to this point. This project would move both pieces of equipment to Ohio, and it appears that the remaining technical challenges are primarily engineering in nature. The project's goal is to generate sample CNF paper with the specific properties required for various end-use applications, and the applicant has already made CNF paper into capacitors, composites, thermal conduction material, lightning strike protection material and fuel cell material.

Resource Limitations

Inorganic Specialists is an early stage company dependent upon government grants. Its revenues are in the range of $1M annually. Its selection as an ARPA-E winner has provided a broad support team from DOE that is assisting the company in its technical development and commercialization activities. This team includes expertise in venture capital, marketing, and patents, as well as technical expertise. DOE's interest is to stimulate the commercialization of this technology as rapidly as possible, and the support team has already demonstrated its value in helping Inorganic Specialists make the business connections it needs with battery prototype manufacturers. It appears Inorganic Specialists may be eligible for up to $10M of funding for next phase manufacturing scale-up from NIST or DARPA with the endorsement of ARPA-E.

Technology Protection

Inorganic Specialists claims that it controls the key anode IP. A patent application covering the right to make and use silicon-coated nanofiber paper was filed in 2006. Full patents have issued to the applicant for Carbon Supercapacitor Electrode Materials (5,993,996) and Carbon Electrode Material (6,479,030). A Thompson Hine attorney states, "We have not identified any U.S. patent that would be infringed by Inorganic Specialists' manufacture, use, or sale of the aforementioned nanofiber paper for use in a lithium ion anode."

Commercialization Risk

Overall Score = 5.66

Path to Market

The marketing strategy of Inorganic Specialists involves testing by EaglePicher, Envia, and NEI. The latter two companies have their own cathode technologies and plan to use the anode from Inorganic Specialists in full-cell testing. In addition, Inorganic Specialists is receiving requests for CNF paper from a wide variety of contacts that it has made through the ARPA-E program for various end-use applications. Material to satisfy these requests has not been available, but this Ohio production line will allow Inorganic Specialists to explore the full potential of this unique product.

Corporate Stability

This is a small, young company with limited current revenues beyond grant income. It will require new staff to execute this project. Its future prospects, however, are significantly enhanced by its direct involvement with the ARPA-E program which is already providing access to potential collaborators and funding sources. If this sampling program produces successful results, Inorganic Specialists could exhibit rapid growth, but this might occur through internal manufacturing, a JV, or an acquisition.

Commercial Infrastructure

ARPA-E is providing Inorganic Specialists with marketing exposure through its Energy Innovation Summit, an elite forum that includes energy companies, auto manufacturers, investors, government agencies, and universities. The DOE team already has facilitated contacts with auto OEMs and battery manufacturers. Inorganic Specialists has a plan to hire internal additional staff to manage the sampling program and to work with potential end-users.

Mission Impact

Overall Score = 8.09

Cluster Formation

Miamisburg-Mound Community Improvement Corporation is working with Inorganic Specialists to relocate the manufacturing assets and is contributing cost share in the form of DOE dollars. This relocation appears to be strategically important to the planned redevelopment of the Mound Advanced Technology Center. Inorganic Specialists is working with Mound Technical Solutions on the design and installation of controls and automation for the production equipment. Connections with other Ohio organizations that could function as suppliers or end-users include: ASI, Cornerstone Research, Faraday Technology, Materials Research Institute, and AFRL.

Ohio Economics

Inorganic Specialists anticipates having three paper-making lines in operation by 2013. These lines are expected to create a total of 30 jobs and $15M in annual revenue. By 2015, the three lines will be in 2-shift operation creating a total of 60 jobs and generating $30M in annual revenue. Large conventional papermakers want to get into the CNF paper business and have been contacting Inorganic Specialists to learn more about the technology.

Business Model

Inorganic Specialists and Ultramet intend to form an alliance to secure major support ($10M) for a second scale-up of the manufacturing equipment. This is expected to take 6-12 months and will produce sufficient product to result in an extensive build of battery product for qualification testing. At this point, Inorganic Specialists could license the Ultramet technology and set-up the entire manufacturing operation in-house or the team could select a suitable manufacturer who is already in a closely related business. Since Ultramet knows the deposition industry, it would try to select a suitable manufacturing partner in Ohio.

Prior Ohio Investments

- Optimizing Carbon Nanofiber (CNF) paper for use as an anode material in lithium ion batteries, 2008, $250,000

Ohio Department of Development

2011 TFAEP Evaluation Summary

Third Frontier Advanced Energy Program

SuGanit Systems, Inc.

Pilot-scale Demonstration of Lignocellulosic Ethanol

TFAEP 11-340 Final Score: = 72.7 Rank: 5

Previous Ohio Investment

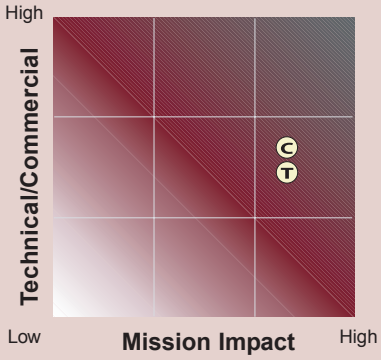
SuGanit Systems, Inc. received a $1M TFAEP award in 2009 to scale-up its cellulosic ethanol process. This work was based upon an earlier Technology Merit award to UT of $250,000 in 2008 to demonstrate the various steps in the process. SuGanit has been working with feedstocks of corn stover and poplar and has successfully scaled-up its cellulosic biomass to ethanol process to 10 kg of biomass per run with up to 5 runs per day. In its current project, it has demonstrated that the ionic liquid used to pretreat the biomass could be recovered and reused at greater than 99% efficiency. Its process for co-fermenting the mixed C5 and C6 sugars with native strain yeast is yielding 80–85% ethanol. These accomplishments significantly improve process economics and reduce the risk in proceeding to the next stage of scale-up. SuGanit and UT have attracted grants of nearly $4M including SBIR support from DOE and USDA and grants from NSF.

Project Description

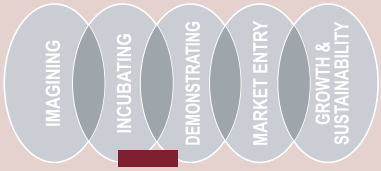
This project is intended to allow SuGanit to scale-up its cellulose to ethanol process to the pilot plant-scale capable of handling 1 tpd of biomass. In this project, the unit operations for pretreatment, ionic liquid recycling, saccarification, and fermentation will be resized, redesigned, and automated. A portion of the thermal energy requirements of the plant will be met using compound parabolic solar concentrators. Operation of the process will be optimized using AQUIFAS process simulation software. Process data from the pilot plant will be used to attract venture capital investment to support construction of a 40-tpd demonstration plant and a 400-tpd commercial plant. Operation of the pilot plant for 1500-2000 hours is required to meet DOE requirements for loan guarantees. Process scale-up is expected to be completed in 12 months, and process optimization and operation will require an additional 12 months. Wright Capital funds of $1M are being requested by UT to purchase the needed process equipment which will be installed on campus.

Key Issues

- SuGanit is a start-up company, and its current financial state is fragile. The company has initiated a relationship with a firm in London to secure external investment to fund the next stages of process scale-up, but success in acquiring funds is likely to be linked with the performance of the 1-tpd pilot plant.
- Competition from better-funded cellulose-to-ethanol teams can be expected to intensify as the price of gasoline increases. This will make it necessary for SuGanit's process to demonstrate significant competitive advantages.
- Plans for additional scale-up (after this project) in the Toledo area appear to be fairly well developed with commitments for feedstocks and facilities well along. Local customers for the product have been identified, but those relationships are not yet in place.
- SuGanit's long-term goals extend far beyond Ohio. While its first commercial plant may be built in Ohio, it is unclear how much of its future business will be centered in Ohio.



Stage of Development



County Location

Funds Requested

TFRDF Request:	$1,000,000
WCF Request:	$1,000,000
TOTAL Request:	$2,000,000
Cost Share:	$2,000,000

Collaborators

- University of Toledo

Technical Risk

Overall Score = 4.80

Technical Reach

While this project's risk has been lowered significantly by the team's accomplishments during its earlier award, this scale-up to a pilot plant still presents both technical and economic risks. The team has demonstrated each of the unit operations and has attained targeted yields and economics for each step. However, automating the entire process is likely to present unanticipated challenges.

Resource Limitations

In addition to SBIRs from DOE and USDA and two awards from NSF, the founder of SuGanit is willing to provide a personal guarantee for the remaining cost share that has been pledged for this project. SuGanit has engaged the services of an investment consulting firm to help raise its first round of capital which is estimated to be in the range of $10 million. This funding is expected to support new product development and to fund a 40-tpd demonstration facility.

Technology Protection

In 2010 UT received a patent for saccharifying cellulose. UT filed two utility patents covering pretreatment of the biomass and fermentation of xylose and hexose sugars using native yeasts. Two provisional patents covering other process steps have also been filed. SuGanit has an exclusive license with UT covering these patents based upon its sponsorship of faculty research in the College of Engineering. SuGanit engages professional legal counsel to manage its IP portfolio.

Commercialization Risk

Overall Score = 5.60

Path to Market

SuGanit projects having a 40-tpd demonstration plant operational in Q1 2012 and a 400-tpd commercial scale plant by 2015. SuGanit already has an option to purchase a facility to locate the demonstration plant in Toledo. The Toledo-Lucas County Port Authority has been assisting in identifying a site for the commercial plant. Funding for both facilities will involve DOE loan guarantees and bond issues. SuGanit already has commitments in place for feedstock supply for the demonstration plant.

Corporate Stability

SuGanit was founded in January 2006 and is located at the R&D Center at the Clean Energy Incubation Center in Toledo. It has laboratory space for process scale-up in the engineering building at UT. The company currently has 7 full-time and 4 part-time employees. It is an early-stage company that has been largely dependent upon government grants that have totaled nearly $4 million.

Commercial Infrastructure

SuGanit has been demonstrating its ability to put together a feedstock supply chain and has specific plans for product sales to support the facilities that are likely to be built in Northwest Ohio during the next 2-4 years. The company has the technical competence to support both a demonstration plant and a first commercial plant in Ohio. Additional capabilities in the marketing and financing of new plants will be required, but these are not likely to be put in place until the first Ohio plants have demonstrated success.

Mission Impact

Overall Score = 7.75

Cluster Formation

A study done by OSU's extension division showed that the Northwest region of Ohio could support multiple 10 MGPY cellulosic ethanol plants with feedstock transportation limited to 19 miles. SuGanit has already engaged in discussions and has agreements with potential feedstock suppliers in the region. Two large refineries in the Toledo area use large quantities of ethanol and have expressed interest in taking the product. Specific take-off agreements will be discussed once the pilot-scale process is successful.

Ohio Economics

The pilot-scale facility will create 4 new jobs and retain 2 jobs. SuGanit expects to have 63 jobs by 2013. The 40-tpd demonstration plant should be fully operational by 2013 and will generate annual revenue of $3.8M and create 15 jobs. When the commercial-scale plant is operational, it will generate $25M and create 40 jobs. SuGanit expects to have a second Ohio plant leading to similar job and revenue creation. An additional 10 jobs will be created in SuGanit's R&D as the demonstration plant is repurposed to produce other products. SuGanit projects that it will have a total of 105 jobs by 2015.

Business Model

SuGanit's R& D is located in Ohio, and the company states that Ohio would be the headquarters for its U.S. activities. Both the demonstration plant and first commercial plant are planned in Ohio. After 2013, the company anticipates global activity, and its business model will include both JV and self-financed facilities. The company plans to rely on incentives from DOE for large-scale cellulosic ethanol production. After commercial facilities are underway, the demonstration plant will be used for process development for alternate products such as lactic and succinic acids.

Prior Ohio Investments

- Scale-Up of Cellulosic Ethanol Process Based on Novel Biomass Pretreatment and Efficient Co-Fermentation, 2009, $999,900
- Simultaneous Saccharification-Fermentation for Co-Fermentation of C5 and C6 Sugars from Biomass (UT), 2008, $250,000

Ohio Department of Development

2011 TFAEP Evaluation Summary

Third Frontier Advanced Energy Program

Adsorption Research, Inc. (ARI)

Upgrading Landfill Gas to Pipeline Quality Natural Gas via Pressure Swing Adsorption

TFAEP 11-306	Final Score: 71.0	Rank: 6

Previous Ohio Investment

Adsorption Research, Inc. (ARI) has not received a prior OTF award.

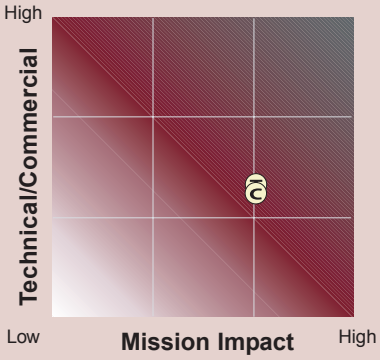
Project Description

ARI is seeking funding to design, fabricate, and place into operation a commercial demonstration facility of its *AdvanSorb™-LFG* process that is intended to upgrade landfill gas (LFG) to high Btu gas which is suitable for commercial pipelines, compressed natural gas (CNG), or liquefied natural gas (LNG). This upgrading process is based on pressure swing adsorption (PSA). In Stage 1, the pretreatment stage, siloxanes, VOCs, and sulfur-containing compounds are removed. In Stage 2, carbon dioxide is removed. In Stage 3, nitrogen and oxygen are removed. ARI has been invited to install this process at the Rumpke landfill in Hamilton County, Ohio where LFG will be upgraded to meet the purity specifications of pipeline grade gas, CNG or LNG. While previous lab-scale tests have provided data for U.S. and PCT patent filings, more robust process and economic data from a demonstration plant are needed to secure investment in additional plants. Work at the demonstration plant will focus on maximizing the energy efficiency, reducing CAPEX, and maximizing revenues from the product.

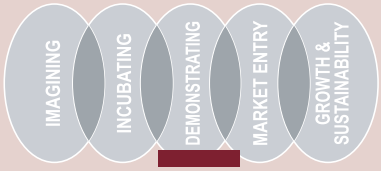
In this project, the work plan will begin with validation of Stage 1 and testing new absorbent materials. Stages 2 and 3 will be optimized to minimize energy consumption and meet gas purity criteria. The equipment skids for the demonstration plant will be constructed by several Ohio manufacturers, component suppliers, and subcontractors. This demonstration plant will be sized to operate at 3,000 standard cubic feet per hour (SCFH). ARI will conduct one or more 1,000-hour campaigns and collect operating and engineering data. Finally, activities will be focused on market entry with fundraising, updating the business and marketing plans, and hiring and training staff. The goal of ARI and CEC will be to identify and assess prospective sites with the intent of securing a sales contract for at least one 1,000 standard cubic feet per minute (SCFM) LFG upgrading system by the end of the 24-month project.

Key Issues

- This market will be driven by economics and cost-effectiveness of the process. While ARI's economic analyses and *pro forma* statements appear encouraging, they have been based on a complete engineering design using laboratory data and robust computer simulations. Actual economics from a working plant will be required to attract investment in additional plants, and both the price of natural gas and the operating parameters could have an adverse effect.
- ARI believes that its technology is the only known process that can remove enough of the contaminants of LFG to guarantee salability of the upgraded gas. The incorporation of adaptive control allows the ARI process to operate efficiently despite fluctuations in LFG flow, composition, or temperature. Upgraded gas can be transported through the public distribution system to points where the consumer can use it, and it will satisfy renewable portfolio standards for electric utility turbines.
- In May 2010, ARI was invited to propose its process to a program that is similar to OTF but is located in Virginia. It has successfully passed the first evaluation for the Virginia program. If that grant is awarded, ARI would have to establish its headquarters in Virginia.



Stage of Development



County Location

Funds Requested

TFRDF Request:	$1,000,000
WCF Request:	$ 0
TOTAL Request:	$1,000,000
Cost Share:	$1,000,000

Collaborators

- Clean Fuels Ohio
- GSF Energy (Pittsburgh, PA)
- Sauer, Inc.
- Rumpke Consolidated Companies, Inc.
- Civil & Environmental Consultants, Inc.
- Dublin Technical Systems, Inc.

Technical Risk

Overall Score = 4.40

Technical Reach

ARI has already commercialized the main separations—carbon dioxide from methane (second stage) and nitrogen from methane (third stage)—and has actual systems operating at customers' facilities. Laboratory-scale work has been done using simulated LFG at 2 standard liters per minute. Based on past experience scaling-up PSA systems, adsorption systems are straightforward to scale-up, and significant technical hurdles are not anticipated with the demonstration plant operating at 3,000 SCFH.

Resource Limitations

ARI has a well-qualified team, and its founder is recognized as one of the world's foremost adsorption experts. As a consequence of the recent business downturn, ARI is not sufficiently capitalized to meet its matching funds obligations relative to this proposal. The founder and his wife have agreed to allocate personal funds into ARI, either in the form of a personal guarantee on a bank loan or by placing funds in escrow sufficient to meet the company's matching funds commitment. The company is currently debt-free, except for a loan from the owners, and currently has 11 prospective projects tracking over $3M beyond this one and a similar one for the State of Virginia.

Technology Protection

In 2007, ARI filed for both U.S. and PCT patent coverage on the PSA technology for upgrading LFG. The U.S. patent application has not been published because of the need for review by a defense agency. ARI's patent attorney has been told that its status is 5 months to first office action. ARI is confident in its IP position because the founder has filed 13 previous patents and every one has issued. ARI and its attorney have performed a thorough patent review and have not identified any significant competing prior art.

Commercialization Risk

Overall Score = 4.07

Path to Market

Rumpke, a project collaborator, is based in Cincinnati and has 5 landfills in Ohio. It is supplying both the landfill site in Hamilton County and the LFG for this project. Rumpke is evaluating this technology for commercial use at other Rumpke sites across the U.S. Currently GSF Energy, another project collaborator, operates 2 different PSA systems at the Rumpke Sanitary Landfill and neither can remove nitrogen or oxygen.

Corporate Stability

ARI is family-owned, and it has operated as a separations R&D company in Dublin for 18 years. The company currently has 7 full-time employees. ARI serves major multinational companies such as Dow, DuPont, BASF, and BP, and it focuses on solving industrially difficult separations problems. Its projects typically include the design, piloting, scale-up, and supervision of PSA applications. ARI intends to raise new equity funding of approximately $1M from the Ohio Tech Angel Fund or other local venture funds to fund expansion of its executive team and sales/marketing staff. It intends to rely on progress payments to minimize the need for working capital.

Commercial Infrastructure

ARI intends to hire its own sales force as soon as the demonstration plant provides evidence of its viability. When this occurs, the valuation of the company will increase, and it should be possible to obtain external funding to expand its staff without massive dilution of ownership. The company also intends to work with engineering channel partners that service the landfill industry. ARI intends to sell turnkey plants with remote monitoring. OSU will provide long-term staffing assistance in the form of interns, co-ops, and graduates. These skilled technical service engineers will be supplied by a tailored curriculum to be implemented at OSU's Department of Chemical Engineering.

Mission Impact

Overall Score = 6.75

Cluster Formation

ARI estimates that the installation cost, including pipeline interconnects, will be 0.75-1.50 times the cost of the plant ($2.2 million/ plant). For plants built in Ohio, these additional funds would flow to companies like CEC that would be responsible for site preparation and project management. Other Ohio companies will participate in the capital equipment for the plants. Equipment skids will be produced initially by Sauer Group and later by DeFabco, United McGill and Sterling Process (all Ohio companies). DTS Services will provide electronics, sensors, and control systems. It appears that ARI will try to build its first plants in Ohio where there are more than 75 available landfills.

Ohio Economics

ARI anticipates selling its first plant in 2013 for over $2 million. The company projects that it will create 8 jobs by 2013 and 21 jobs by 2015 based upon total revenues of $2.4M and $12.7M respectively. Three of its Ohio collaborators, DTS (instrumentation and control), Sauer Group (skid manufacture), and CEC (site engineering & construction), have projected their Ohio job growth in their letters of commitment. They plant to create an additional 14.5 jobs in 2013 and 42.75 jobs in 2015 bringing total Ohio job creation to 22 in 2013 and 63 in 2015.

Business Model

ARI intends sell plants, services, and consumables (adsorbents). It will form a new company (Newco) in 2012 after the demonstration plant has become operational and process economics have been confirmed. Newco intends to provide technical expertise, remote monitoring services, and field support as well as sales and marketing functions. The company plans to pursue federal grant opportunities as well as venture capital investment. It will rely on Ohio contractors to produce the equipment needed for its plants, and several of the collaborators in this project will fill that role.

Prior Ohio Investments

- *None*

Ohio Department of Development

2011 TFAEP Evaluation Summary

Third Frontier Advanced Energy Program

GEM Energy Management, LLC

Modular Integrated Energy Systems for Critical Operations

TFAEP 11-315	Final Score: 70.5	Rank: 7

Previous Ohio Investment

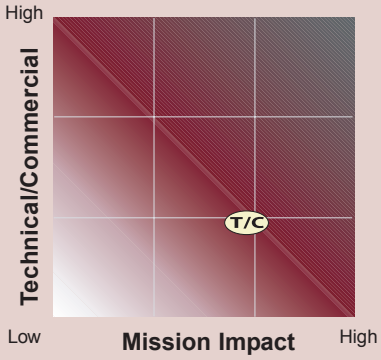
GEM Energy Management, LLC has not received a prior OTF award.

Project Description

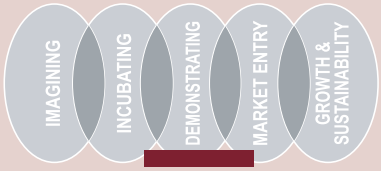
GEM, through its Ohio-based subsidiary, BHP Energy, designs and builds natural gas powered combined heating and power (CHP) systems, brand named ReliaFlex. Components for the ReliaFlex are shipped to the customer's location, assembled and installed at the customer's mission critical facility site. The goal of this 2-year project is to develop a modular, factory-built version of the ReliaFlex Suite of products called the Modular Mission Critical Power System (MMCPS). The MMCPS is a prepackaged, CHP system comprised of natural gas powered microturbine generators, a heat exchanger for recapture of waste heat, an absorption chiller, integrated bypass controls, and an uninterruptable power supply (UPS). During the first year of the project, the MMCPS will be designed, subsystems optimized and a prototype built and delivered to the University of Toledo. The prototype demonstration will run for 12 months. The project will conclude with a plan for production scale-up. The ReliaFlex MMCPS modules will target "mission critical" customer sites (data centers and universities) ready for connection. These systems can be seamlessly integrated into existing infrastructures with reduced site-specific engineering and minimal site labor. JDRM Engineering will help with the design of the modular system. The first modular system will be delivered to and installed at the University of Toledo.

Key Issues

- The project proposed appears to be a rather straightforward engineering effort that converts an on-site system to a modular, packaged system. GEM is seeking TFP support for this project because it has not been able to acquire bank financing, as banks do not appear willing to support CHP construction projects based on real estate as collateral.
- GEM has established itself as a provider of CHP systems for critical power applications. It has obtained customer interest and a commitment from a large data center operator (name is proprietary) for the modular unit assuming success with the Toledo demonstration.



Stage of Development



County Location

Funds Requested

TFRDF Request:	$1,000,000
WCF Request:	$ 0
TOTAL Request:	$1,000,000
Cost Share:	$1,395,000

Collaborators

- University of Toledo
- JDRM Engineering, Inc.

Technical Risk

Overall Score = 3.33

Technical Reach

An initial objective of the project is to design and build a prototype version of the proposed MMCPS. ReliaFlex systems, using the same basic components as those proposed for the MMCPS, have been assembled and installed on-site at" mission critical" end-user locations since 2002. Consequently, there do not appear to be any significant technical challenges for GEM's engineers to overcome beyond optimizing the components for integration into a modular system. Thus, the early project tasks are to determine typical end-user requirements in order to intelligently select the appropriately sized components and to assemble a series of standard, modular systems.

Resource Limitations

GEM and its parent companies have the technical expertise, experience, and financial assets to succeed in this venture. The University of Toledo (UT) is providing $895,000 in cash cost share that supports about one-half the cost of the prototype ReliaFlex MMCPS construction and installation at UT.

Technology Protection

GEM's experience in developing, installing and operating its ReliaFlex system is the basis for its IP rather than patents. The technology is based on commercially available components, so it does not appear there are any patents that prevent it from operating in this arena. GEM expects new IP will likely be generated during this project, and it will utilize retained council to address decisions as to patent filings and/or maintaining certain technologies as trade secrets.

Commercialization Risk

Overall Score = 3.00

Path to Market

GEM has already established customer relationships that have developed through its current ReliaFlex product. Gem's MMCPS has generated interest from several potential end users/customers, including Harbec Plastics (NY), a site management company, and a large data center operator. The University of Toledo is an active participant in the project and has committed to installing the prototype system.

Corporate Stability

GEM Energy Management is a specialty energy services contractor incorporated in 2009 and located near Toledo. It employs approximately 100 people in Toledo and another 500 in the field. GEM is a profitable subsidiary of Rudolph/Libbe Companies, a large, nationwide provider of construction services.

Commercial Infrastructure

GEM has a large fabrication facility adjacent to its headquarters in Walbridge (Toledo), Ohio. This facility has the capacity to allow GEM to fabricate and assemble up to five ReliaFlex MMCPS units each year. These production capabilities will be sufficient to allow GEM to progress through the two-year project period and the year immediately following. In later years, GEM will need to acquire a larger facility to be able to meet demand for the system. GEM has been selling to the target market for several years using its own sales infrastructure. GEM will approach the market for modules via three sales models: direct sales to end-users, sales to end-users through third-party sales partners, and leasing the modules to end-users for monthly fees. The leasing model is a new sales method for which GEM must develop its infrastructure.

Mission Impact

Overall Score = 6.42

Cluster Formation

GEM has its headquarters and production facilities in Ohio, employs Ohio labor, and uses the Ohio supply chain. The University of Toledo will receive the first ReliaFlex MMCPS. JDRM Engineering (Sylvania, OH) is collaborating in the proposal to assist in the design of the modularization.

Ohio Economics

By 2013, GEM expects to generate $4M in annual sales and employ 12 people as a result of this project. By 2015, GEM expects to generate $18M in annual sales and employ 28 people as a result of this project.

Business Model

As a routine part of business, GEM designs, manufactures, and sells its line of on-site power generation systems to mission critical organizations in the USA and the world. This is a product addition into its current business model. GEM will approach the module market via three paths: direct sales to end-users, sales to end-users through third-party sales partners, and leasing the modules to end-users for monthly fees. GEM will increase usage of its production facilities by assembling modules internally instead of relying on field-built systems.

Prior Ohio Investments

- *None*

Ohio Department of Development

2011 TFAEP Evaluation Summary

Third Frontier Advanced Energy Program

Calgon Carbon Corporation

Development and Commercialization of Advanced Activated Carbons for Energy Storage Applications

TFAEP 11-345	Final Score: 67.7	Rank: 8

Previous Ohio Investment

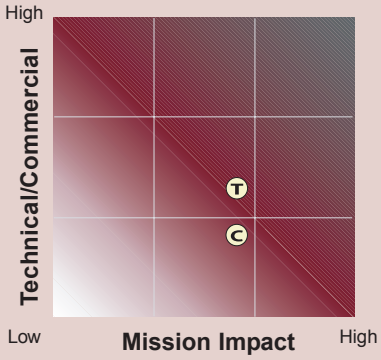
Calgon Carbon Corporation has not received a prior OTF award.

Project Description

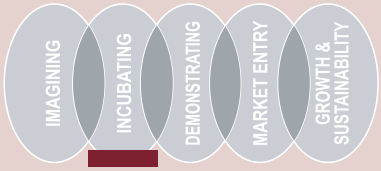
Calgon intends to develop two activated carbon products that will meet the requirements of the ultracapacitor energy storage industry. The first product will be a drop-in product that will have the cost and performance of the activated carbon that Maxwell Technologies, the leading ultracapacitor producer, is currently purchasing from foreign suppliers because there are no domestic suppliers. This product will permit rapid market entry (2011) and allow Calgon to establish a presence in this growing market. Manufacture of this material will require the addition of equipment for inert high-temperature treatment and improved acid washing ($478K each—OTF and cost share) to the manufacturing plant in Columbus. The second product will be an advanced activated carbon that has improved volumetric capacitance with 70–80% lower raw material cost. Material samples will be tested for initial capacitance, ESR, leakage current, and durability in an Energy Storage Prototype Fabrication Laboratory at Case. The equipment to be purchased for this laboratory includes a roll-coater ($110K), winding machine ($70K), vacuum drying apparatus ($10K), electrolyte filling system ($15K), can-closing machine ($20K), and burn-in chamber ($25K). Testing of both materials and fabricated prototypes will be done by Maxwell. This advanced activated carbon product is expected to be commercialized by 2013.

Key Issues

- Calgon has current production operations not only in Ohio but also in KY and MS, and some sites are better suited to production of this material than others. The proposal claims that OTF funding will trigger a management site decision and commitment to execute the project in Ohio. It would also accelerate the commercialization schedule for the product.
- Ohio involvement will be limited to the production of activated carbon material in Columbus and the material testing and generation of ultracapacitor samples at Case. Calgon has structured this project so that no OTF funding would be used to support R&D activities that will take place at its research facilities in Pittsburgh. Maxwell's testing work will be done in CA.
- Some Case-proposed salaries for this project appear excessive and should be reviewed.



Stage of Development



County Location

Funds Requested

TFRDF Request:	$1,000,000
WCF Request:	$ 350,000
TOTAL Request:	$1,350,000
Cost Share:	$1,479,288

Collaborators

- Case Western Reserve Univeristy
- JME, Inc.
- Maxwell Technologies, Inc. (San Diego, CA)

Technical Risk

Overall Score = 4.27

Technical Reach

The production of the activated carbon for the "drop-in" product is not expected to present any technical challenges and should be accomplished with installation of the new manufacturing equipment. Development of the advanced activated carbon using coal-based precursors is at a much earlier stage. While initial laboratory work with these precursors looks promising, there are many issues yet to be investigated and resolved.

Resource Limitations

This is a strong team with demonstrated capabilities in activated carbon research and production, fabrication of prototypes, and ability to make and sell ultracapacitors. The funding for this proposal appears to be sufficient to meet the goals of the project. Internal resources from Calgon are expected to be sufficient to commercialize this material if it can demonstrate that it meets the cost and performance requirements from Maxwell.

Technology Protection

Calgon has an extensive patent portfolio related to carbon materials. It recently filed a provisional patent covering its work on the low-cost, coal-based precursors. Calgon has completed a patent landscape study and believes that there are no patent barriers that would inhibit the completion of its OTF proposal. The team has a plan in place for managing the IP that is developed from this project.

Commercialization Risk

Overall Score = 2.67

Path to Market

Maxwell is a collaborator in this project and a committed end-user and has been working with Calgon since 2008. Calgon appears to understand the performance requirements for Maxwell's current products. While Maxwell has shown evidence of working with multiple producers of carbon materials in order to advance the performance of its ultracapacitors, its relationship with Calgon is focused on existing end-use applications and targets cost reductions for a key raw material. This approach is likely to speed the market penetration of this material. Adoption will be further enhanced by the entry of a viable domestic supplier into the ultracapacitor supply chain.

Corporate Stability

Calgon Carbon Corporation is the world's largest supplier of activated carbon and innovative treatment systems, and this business segment had sales of $358.2M in 2009. The company has manufacturing facilities and offices in North America, Europe, and Asia. It has the industry's most advanced R&D center in Pittsburgh plus 16 operating centers and 23 sales and service centers.

Commercial Infrastructure

Calgon has a worldwide sales and marketing network that offers carbon technologies in over 700 distinct market applications. The company has already completed extensive market research on the ultracapacitor opportunity, and in 2009, it identified this market opportunity as one of three strategic growth initiatives. In 2010, the company became the majority shareholder of a Japanese carbon company, renamed Calgon Carbon Japan that has provided access to the ultracapacitor market.

Mission Impact

Overall Score = 6.08

Cluster Formation

Novolyte, one of the world's leading manufacturers of specialty electrolyte materials, is an Ohio company. It will supply the commercial electrolyte formulation for testing at Case in conjunction with Calgon's activated carbon materials. Testing at Case will be performed by JME, Inc., an Ohio company that is well known for its expertise in ultracapacitors. The facilities at Case will also be available to other Ohio companies that desire to formulate their materials into ultracapacitors and batteries.

Ohio Economics

Configuring the Columbus manufacturing facility for the "drop-in" product in 2011 followed by commercial introduction of the advanced activated carbon for ultracapacitors in 2013 is expected to create 10 new jobs and generate $7.3M in annual revenues by 2013. Job creation is expected to reach 19 positions and $12.2M in annual revenues by 2015.

Business Model

Calgon Carbon Corporation is headquartered in Pittsburgh. Calgon anticipates that growth in the ultracapacitor market will require a significant increase production capacity by 2015. If this growth occurs in Columbus (contingent upon this award), it will require Calgon to make an investment on the order of $20M in its manufacturing facilities. There are no plans to relocate other business functions to Ohio.

Prior Ohio Investments

- *None*

Ohio Department of Development

2011 TFAEP Evaluation Summary

Third Frontier Advanced Energy Program

AFS Technology, LLC

Tire Fuel Delivery System for Cement Kilns with Calciners

TFAEP 11-320	Final Score: 65.3	Rank: 9

Previous Ohio Investment

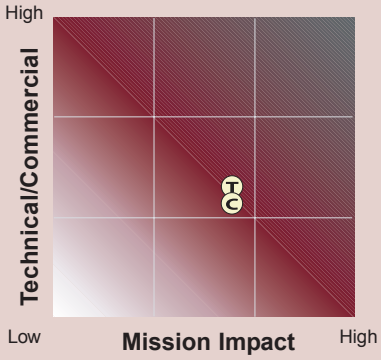
AFS Technology, LLC has not received a prior OTF award.

Project Description

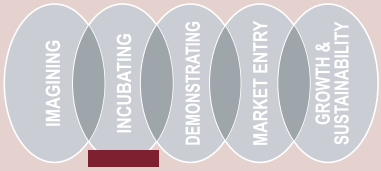
AFS has developed a new suspension tire delivery and support system that allows modern precalciner cement kilns to burn whole tires as a solid waste, supplemental fuel source. This technology enables cement kiln operators to increase the rate of fuel substitution by 2-to-3 times over existing tire burning methods, decrease emissions of nitrous oxide (NO_x), and reduce the frequent maintenance and downtime experienced with existing tire-burning systems. In this 2-year project, AFS will design and build a demonstration system comprised of interface components that can be quickly installed on the kiln system during a kiln shut-down. The balance of components can be installed during normal kiln operation. AFS and its collaborators will create a palletized, working prototype of this technology to install and demonstrate at cement plants as part of a "road show." Collaborator Weldments, Inc., an Ohio steel fabrication shop, will make the critical components for this first demonstration system, and all subsequent commercial systems. A commercial goal of this project is to obtain sales commitments from 2 customers for test burn demonstrations by the end of the project.

Key Issues

- Due to the modest TFP funding request, the cost share requirement is within the cash reserves of AFS, but it is expected that customer support from demonstration "buy-ins" will be forthcoming early in the project. If such "buy-ins" are not timely, the cost share requirement will strain AFS's finances.
- AFS appears to have technical competence and market connections to convert what is currently a conceptual design into a demonstrable and marketable product within the targeted TFP time frame.



Stage of Development



County Location

Funds Requested

TFRDF Request:	$	150,000
WCF Request:	$	0
TOTAL Request:	$	150,000
Cost Share:	$	150,000

Collaborators

- Weldments, Inc.

Technical Risk

Overall Score = 4.33

Technical Reach

AFS began developing its system in 2003 and since has designed, built and delivered whole tire, suspension-burning systems for 4 cement kiln locations. To improve performance of these systems, AFS designed its novel suspension system, a more reliable method of suspending the tire in the kiln's high-temperature, high-velocity gas stream assuring the tire remains in place and is fully combusted. AFS will build its first suspension system of this type in this project.

Resource Limitations

AFS is an engineering firm with many years of experience designing, selling, and installing equipment for cement kilns and appears capable of overcoming the technical challenges presented in this project. Its cost share will come from commitments from kiln operators for test burns using the proposed system and internal funds. It is common in cement kiln industry for companies to pay for demonstrations of new technology with a prepayment of 50%. AFS will close on 3 such commitments by month 5 of the project.

Technology Protection

Cadence Environmental Energy, an Indiana engineering firm specializing in emission control equipment, owns the base patent for a suspension tire burning system for precalciner kilns. AFS has an arrangement with Cadence allowing AFS to build whole tire burning systems. AFS has filed a provisional patent that covers its unique tire suspension technology and as part of this project, a formal patent application will be prepared and filed. International filings will also be considered prior to market entry.

Commercialization Risk

Overall Score = 3.73

Path to Market

Although no kiln operator is listed as a collaborator to the project, AFS has been in direct contact with the domestic and international cement kiln operators using whole tire burning systems and has based its design and project plan on feedback from those operators. AFS is currently lining up demonstrations for its proposed suspension system with several kiln operators. It is close to closing one and will close 3 by month 5 of the project.

Corporate Stability

AFS Technology designs, builds and installs automated material handling systems to enable cement kilns to use alternative fuels, such as tire-derived fuel, refuse-derived fuel and biomass. AFS has been in business for over 20 years, employs 10 FTEs and generates approximately $1M annual sales.

Commercial Infrastructure

AFS has an existing sales and marketing force that serves the international cement kiln industry. Its marketing is led by the company president who is well-known in the industry. AFS technology applies only to the most modern kilns, and it estimates the global pool for its system is currently from 250 to 300 kilns, doubling by 2020.

Mission Impact

Overall Score = 5.92

Cluster Formation

AFS Technology has developed long-standing relationships with the fabricators, machine shops and hardware/electronics suppliers it uses to produce its systems. Because of the low-quantity, custom-designed nature of this specialty equipment, sourcing the local supply chain is the most advantageous approach for speed, quality and cost control. About 80% of the fabrication work for historic turnkey systems has been sourced in Ohio. Ohio applications for the AFS technology are very limited.

Ohio Economics

AFS projects it will create 5 new jobs by 2013 and retain 2 existing jobs. Sales in 2013 are projected at $7.2 million. By 2015 AFS and its collaborator, Weldments Inc., will have created a total of 10 jobs. Annual sales in 2015 are estimated at $18M. All sales will be to cement companies outside of Ohio.

Business Model

Since all new and many existing (modern) cement kilns use precalciner systems, the AFS system can be retrofitted to existing modern kilns or integrated into new kilns. Targeted market areas are where large volumes of waste car and truck tires are generated, for example, China (where nearly 50% of the world's cement production is occurring). AFS plans to sell its unique tire suspension burning system directly to the companies operating cement kilns with precalciners inside and outside the USA.

Prior Ohio Investments

- *None*

Ohio Department of Development

2011 TFAEP Evaluation Summary

Third Frontier Advanced Energy Program

Polyflow LLC

Semi-Works Demonstration of Polyflow's Waste-to-Fuels Processor

TFAEP 11-336 Final Score: 64.1 Rank: 10

Previous Ohio Investment

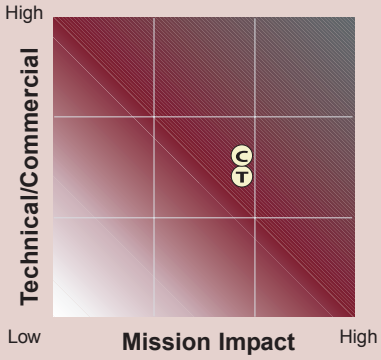
Polyflow LLC has not received a prior OTF award.

Project Description

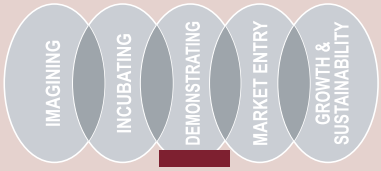
In this 18-month project, Polyflow will develop and demonstrate a 2.5-ton commercial module that will convert waste polymers into high-value petroleum products such as gasoline, diesel fuel, and virgin polymer feedstocks. The waste stream will use typical polymer wastes that would otherwise go into landfills. The conversion process is based on low-temperature, timed-control pyrolysis and that has been successfully demonstrated in smaller units. The process is protected by two patents and by proprietary intellectual property. The goal of the project is to build a unit that handles more waste than has been used for past demonstrations while monitoring and adjusting the process parameters that control the formation of the petroleum products. Once developed, the 2.5-ton unit design will serve as the building block for modular eight-unit commercial systems. In the commercial unit, gases that evolve from the process will used to heat the system. It is estimated that 13% of the original mass will remain as char.

Key Issues

- There is a question as to whether the intellectual property, including the patents, will be broad enough to protect Polyflow from competitive inroads. If its tests are successful and its value proposition meets expectations, it will likely lead to rapid competitor "look-alike" processes being offered. A first-to-market position will help sustain Polyflow's business.
- The cost share for this project is required at project initiation to cover the initial cost of the 2.5-ton unit. Although a valid cost share letter has been furnished, there was a change in the cost share provider. It will be important to verify the project's cost share availability at the time of contracting if this project is selected for funding.
- Polyflow will require significant additional investment to move to commercialization. The recent commitment of initial funding is encouraging, but more will be needed, and possible investors indicate their support is contingent upon successful demonstration in the 2.5-ton unit.
- The site of the first modular demonstration facility will depend on the preferences of the initial investors. While Ohio opportunities exist and the semi-works plant will be in Ohio, there is no assurance if or when a full-scale Ohio facility will be constructed.



Stage of Development



County Location

Funds Requested

TFRDF Request:	$1,000,000
WCF Request:	$ 600,000
TOTAL Request:	$1,600,000
Cost Share:	$1,729,044

Collaborators

- Youngstown State University
- City of Stow
- Defense and Energy Systems, LLC
- PolyOne Corp.
- Chemstress Engineering

Technical Risk

Overall Score = 4.67

Technical Reach

Polyflow has previously demonstrated successful conversion of a wide range of different types of waste polymers resulting in consistently high-value petroleum products. The process is insensitive to the percentage mix of different polymers and therefore should be able to accept most polymer waste streams with little or no sorting. It has been demonstrated that the waste polymers do not need to be cleaned or otherwise prepared before entering the conversion units, and it is claimed that the process is insensitive to the presence of small amounts of non-polymer materials.

Resource Limitations

The funds requested appear to be adequate to build and test the proposed modules. The technical team is strong, and Polyflow has done a good job of involving outside expertise for evaluating the high-value petroleum output products. This expertise includes that at Youngstown State and also at potential customers.

Technology Protection

While Polyflow has two patents protecting its IP, the basic process, pyrolysis, is an old and well-established method and cannot be patented. The key to Polyflow's intellectual property is in defining a unique range of process conditions, controls and parameters. Polyflow has applied for international patent protection and while there is little question about Polyflow's right to practice the technology, it is possible that Polyflow's patent protection might be inadequate to cover the range of parameters that will be encountered in commercial operation.

Commercialization Risk

Overall Score = 5.33

Path to Market

Polyflow has identified a first customer as the city of Stow, OH. If the value proposition claimed by Polyflow is confirmed by the tests proposed, there is reason to assume it can attract the necessary capital to sell production units and thus produce the jobs and income to Ohio as projected. Polyflow has made a good case that it has a better waste conversion process than its competitors. Polyflow is in contact with a wide variety of capital sources for carrying out the process commercialization, but their commitment is contingent upon successful demonstration of the process outlined in this OTFAEP proposal.

Corporate Stability

Polyflow was started two years ago and has attracted some investment capital. It exists solely to promote the waste-to-fuel technology. It has received a major commitment of an additional $1.6M contingent upon approval of the OTFAEP funding. The principals in the company appear to be fully committed to the company and the process.

Commercial Infrastructure

Polyflow cannot currently afford to support a sales and marketing staff, and it intends to add these staff members after successful demonstration of the technology and upon acquiring the initial capital investment. There is the potential for licensing the technology to established companies that have sales and marketing staffs.

Mission Impact

Overall Score = 6.25

Cluster Formation

Polyflow will rely on Chemstress to build component parts of its waste-to-fuel modules and if Polyflow is successful, it could be a lucrative business for Chemstress. Youngstown State University is heavily involved in the testing of the products produced during the tests, and equipment purchased with Wright Capital Funds will expand the capabilities of YSU. Defense and Energy Systems of Youngstown is assisting Polyflow in developing waste-to-fuel modules for additional markets.

Ohio Economics

Polyflow projects annual revenues of $8M by 2013 and the creation of 50+ jobs from commissioning of a single Ohio processing facility. By 2015, with the assumption that modular facilities have been constructed at five major population centers in Ohio, Polyflow projects annual revenues of $40M and 138 Ohio jobs, not including the additional jobs created at Chemstress.

Business Model

Polyflow intends to have headquarters in Ohio consisting of engineers and sales and marketing staff. Chemstress will make initial units in Ohio, but future manufacturing may take place largely outside of Ohio. Polyflow is a two-year-old start-up and has only one potential product, the waste to energy process. At this time the business model is not completely developed, and it could include licensing, contract manufacturing, and involvement of outside sales and marketing companies.

Prior Ohio Investments

- *None*

Ohio Department of Development

2011 TFAEP Evaluation Summary

Third Frontier Advanced Energy Program

Nanotek Instruments, Inc.

Nano Graphene-enabled Supercapacitors for Electric Vehicles, Renewable Energy, and Modern Grid Technology Applications

TFAEP 11-303 | Final Score: 62.9 | Rank: 11

Previous Ohio Investment

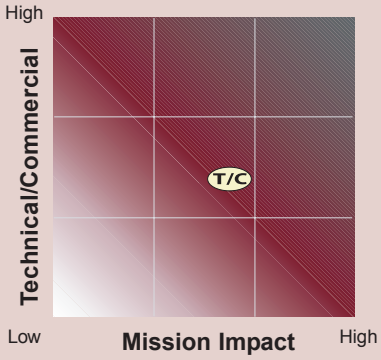
Nanotek Instruments, Inc. received an Ohio Research Grant (ORCGP) in 2009 to purchase the equipment necessary to produce lithium-ion (Li-ion) anode materials by 2012. The project was also to support the construction of a pilot-scale anode and battery manufacturing facility in Dayton. Nanotek has leveraged the ORCGP funds to obtain additional federal grants supporting anode material and battery development and has set up a complete pilot-scale production line for making prototype Li-ion batteries in the form of button cells, pouch cells and prismatic cells.

Project Description

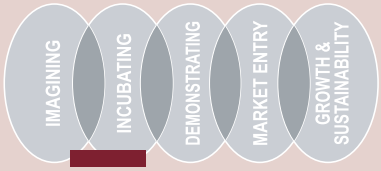
Nanotek proposes expanding the use of its nano graphene platelet (NGP) materials to electrodes for supercapacitor applications. In this 2-year project, Nanotek proposes building a pilot production line for prototyping supercapacitors and electrodes. Nanotek's manufacturing arm, Angstron Materials, will build a pilot-scale production line for supercapacitor-grade NGPs. Maxwell Technologies, the leading supercapacitor manufacturer, will evaluate the performance of the Nanotek prototypes. Specific technical challenges to be addressed include the fabrication of curved graphene sheets, optimization of the graphene coating and the production of cylindrical cells. Commercialization activities involve the prototype product evaluations and patent application filings. Investor and strategic partner or customer commitments will be sought during Year 2 of the project.

Key Issues

- Nanotek has made impressive strides in developing the NGP technology and materials, but the specific product proposed in this project is at an early stage of development and has not achieved performance validation.
- Commercialization success will depend on a strategic partnership between Nanotek and a supercapacitor manufacturer that is not yet committed. Maxwell Technologies, the leading supercapacitor manufacturer has expressed interest and will evaluate Nanotek prototypes, but future involvement will not be explored until after the evaluation process is completed.
- The economic impact for Ohio will center on Angstron's sale of NGP materials to supercapacitor manufacturers. Projections for the amount and timing of materials required have not been fully determined at this point making the job and revenue projections speculative. The potential for attracting a supercapacitor manufacturer to Ohio is even more speculative at this time.



Stage of Development



County Location

Funds Requested

TFRDF Request:	$	999,996
WCF Request:	$	0
TOTAL Request:	$	999,996
Cost Share:	$	999,996

Collaborators

- Angstron Materials, Inc.
- Maxwell Technologies, Inc. (San Diego, CA)

Technical Risk

Overall Score = 4.60

Technical Reach

The production of supercapacitor-grade NGPs does not appear to present any serious technical challenges, but only requires a dedicated processing line. The production of curved graphene sheets does involve material (binders and coating) issues that will need to be addressed in the project. At this point the solutions to the material issues have been theorized, but not yet proven. Nanotek is confident that these issues can be resolved in the first year of the project.

Resource Limitations

Nanotek is an established R&D company and a recognized leader in graphene technology. Angstron, its "sister" company, is a materials manufacturing operation and is the leading producer of NGP materials. The project funding leverages federal grants and early investor support and appears sufficient to enable the prototype production proposed, but follow-on commercialization support will rely on investments and partners not yet established.

Technology Protection

Nanotek has a strong portfolio of patent and patent applications covering NGP technology. Nine patent applications and one issued patent specifically cover supercapacitor applications. The issued patent (2009) is the world's first patent issued on using graphene as a supercapacitor material. The curved graphene technology is covered in five of the applications.

Commercialization Risk

Overall Score = 4.60

Path to Market

Nanotek's plan is to provide R&D and NGP technology support with Angstron producing NGP materials for sale to a current supercapacitor manufacturer such as Maxwell Technologies. The supercapacitor manufacturer will be responsible for establishing the sales, service and support for the end-product markets.

Corporate Stability

Nanotek has been in business for over 13 years as an R&D organization successfully procuring federal grants to remain income positive. In the last few years it has attracted early investor support and has spun-off Angstron Materials to produce NGP materials. Angstron provides a royalty revenue stream back to Nanotek, but although Angstron is the leading producer of NGP materials, its sales to date are generally for evaluation and demonstration purposes.

Commercial Infrastructure

Nanotek and Angstron will sell technology and materials to the ultimate supercapacitor manufacturers that will provide the commercial infrastructure for the end-product sales. The path for Nanotek/Angstron sales will be through partnerships with the supercapacitor manufacturers. If Maxwell's prototype evaluation validates the benefits of Nanotek's technology, it is the potential initial partner.

Mission Impact

Overall Score = 5.83

Cluster Formation

Nanotek and Angstron represent Ohio supply chain companies serving the energy storage (battery and supercapacitor) and fuel cell industries. It is well understood that energy storage is the key to improving the performance and economics of renewable energy production, electric vehicles and other distributed energy systems. Nanotek believes that if NGPs become the materials of choice for Li-ion anode and supercapacitor electrodes, the end-product manufacturers may choose to locate new production facilities near the material source—Dayton, OH.

Ohio Economics

Nanotek projects that successful completion of the propose project will result in 2 new jobs at Nanotek and 8 at Angstron by 2013. Angstron revenues from NGP sales for supercapacitors are estimated between $1M and $2M. By 2015, new job creation at Nanotek and Angstron will reach 7 and 38, respectively. Angstron revenues for supercapacitor material sales are estimated to exceed $7M.

Business Model

Nanotek's business model is to remain an R&D organization supporting new and customer specific applications related to NGPs. Its prototyping facilities will be used as a technical support center. Angstron will sell NGP materials to supercapacitor manufacturing partners such as Maxwell. A joint venture may be set up for NGP-based supercapacitor production.

Prior Ohio Investments

- Commercialization of Nano Graphene Composite Electrodes for Lithium Ion Batteries, 2009, $350,000

Ohio Department of Development

2011 TFAEP Evaluation Summary

Third Frontier Advanced Energy Program

Tremont Electric Incorporated

Advancing Production and Development for Full Commercialization of nPower® Kinetic Energy Harvesting Device

TFAEP 11-350 Final Score: 57.6 Rank: 12

Previous Ohio Investment

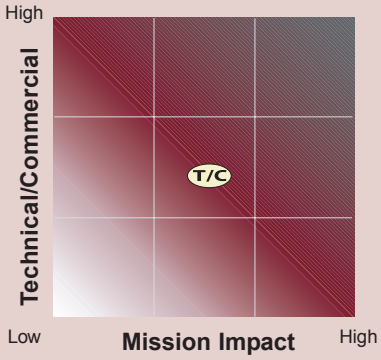
Tremont Electric Incorporated has not received a prior OTF award.

Project Description

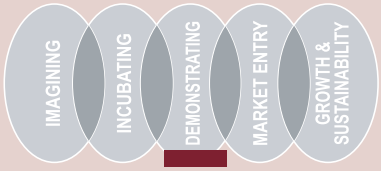
Tremont has developed and sold a limited quantity of an introductory Gen-1 version of its consumer oriented "nPower® PEG" (Personal Electric Power), a wearable, kinetic energy harvesting device to provide recharging power to hand-held consumer electronic devices. The device is a small tubular product with an internal cylindrical core connected to springs so that as the device is moved during walking, jogging, or other vigorous activity. The core oscillates inside a wire-wound coil, thereby inducing a micro-current that is proportional to amount of oscillation. The induced micro-current is used to recharge a battery or operate a low current electronic device. For this 2-year project, Tremont requests OTF funding to support engineering design and product development to overcome some defined technical issues experienced with the Gen-1 unit and to scale-up for larger volume production of this improved Gen-2 device. The University of Akron will work on resolving the technical shortcomings, and Nottingham Spirk will focus on the product design, concept generation, concept evaluation, product testing, and market analysis. Tremont plans to be selling the nPower® PEG during the first year of the project.

Key Issues

- Tremont has existing product in the market and has a reasonable plan to improve product performance and reduce production costs.
- The field use of the Gen-1 version of the nPower® PEG highlighted some significant technical issues that need to be resolved, and although Tremont has a defined plan for addressing these issues, there is a concern whether they can be resolved in the timeframe proposed.
- A survey of potential customers provided positive feedback on the device features and cost, but the unit pricing still appears to be a market-limiting factor.



Stage of Development



County Location

Funds Requested

TFRDF Request:	$	852,216
WCF Request:	$	0
TOTAL Request:	$	852,216
Cost Share:	$	859,611

Collaborators

- University of Akron
- Nottingham-Spirk Design Associates

Technical Risk

Overall Score = 4.53

Technical Reach

Tremont has produced and sold a Gen-1 version of the nPower® PEG in small quantities, and realized a few performance characteristics must be improved for mass-market adoption. Tremont will rely upon the University of Akron to improve the product performance in three areas: power capture and delivery efficiency; range of frequency responses; and removal of nuisance magnetism. For mass production, the manufacturing cost must be lowered by reducing the electronics to a small, low-cost micro-circuit board, and by finalizing a low-cost, lighter-weight design.

Resource Limitations

Tremont appears to have qualified management with past successful experiences in start-up companies, engineering, and marketing consumer electronics. To date Tremont has raised a total of approximately $1M seed capital from equity investors, which has been used to fund initial development, production, and promotion of the Gen-1 commercial prototype. A combination of private capital and cash from sales of the commercial prototype will sustain basic operations for at least 18 to 24 months, excluding R&D. Tremont is currently raising up to $1M additional capital in order to fund this project, and the OTF award would have a positive impact on efforts to secure private capital.

Technology Protection

The CEO of Tremont holds two patents directly related to the product proposed, with apparent room to operate in this arena. Tremont intends to file additional patents in the future.

Commercialization Risk

Overall Score = 4.80

Path to Market

No end-users or mass marketing organizations are directly involved in this project. Tremont has contracted for market surveys and found positive consumer feedback. Tremont has used the internet and web-site for direct sales of the Gen-1 version of the nPower® PEG to early-stage adopter consumers.

Corporate Stability

Tremont Electric is a start-up company formed in 2007, and the nPower® PEG is its first product. Although the company started showing modest revenue in 2010 from sales of the Gen-1 commercial prototype of the nPower® PEG, it is still dependent on outside capital to sustain operations and fuel growth.

Commercial Infrastructure

Low production quantities, less than 1,000 per month, have been made in the corporate offices of Tremont, and will continue to be made internally at those limited levels. Delta Systems Inc., a contract manufacturer in Streetsboro, Ohio, will make the product when production requirements exceed 1,000 units per month. The Tremont low-quantity production facility will be maintained for further product development efforts. Tremont has used the internet and its web-site for direct sales of the Gen-1 version of the nPower® PEG, and plans to continue its use for Gen2. In addition, Tremont plans to expand its market path through major consumer retail organizations and licensing to major consumer electronic OEMs.

Mission Impact

Overall Score = 5.17

Cluster Formation

Located in an SBA Hub zone, this project plans to add to the NorTech Northeast Ohio Advanced Energy Cluster. In addition to using Ohio employees, Tremont plans to purchase 90% of its components from at least nine companies in the Ohio supply chain. Current outsourced production from another state will be relocated to an Ohio contract manufacturer. Larger production quantities, more than 1,000 units per month, will be made at an Ohio contract manufacturer.

Ohio Economics

Tremont already has a small quantity manufacturing facility that uses Ohio employees. Tremont expects to begin sales in 2011 and hire nine new employees. By 2013 annual revenues are forecasted to be $4.2M with a cumulative total of 39 employees. By 2015 annual revenues are forecasted to be $6.7M with a cumulative total of 93 employees. The employee projections made place the revenue-to-employee ratio outside that typically seen for small- to medium-sized manufacturing companies.

Business Model

Tremont plans to build the company with sales of the nPower® PEG to mass consumer electronic markets via internet, retail stores, private labeling, and licensing OEMs. As Tremont moves into international markets, it expects to partner and may set-up local manufacturing operations for those specific markets. The production facility at Tremont headquarters will be maintained for additional product development for other markets, including military applications.

Prior Ohio Investments

- *None*

Ohio Department of Development

2011 TFAEP Evaluation Summary

Third Frontier Advanced Energy Program

International Health Monitoring Systems, Inc. (IHMSI)

Wind Rotor Blade X-ray CT for In-line Process Monitoring and Control for Wind Roter Blade Manufacturing for Global Markets

TFAEP 11-384	Final Score: 56.7	Rank: 13

Previous Ohio Investment

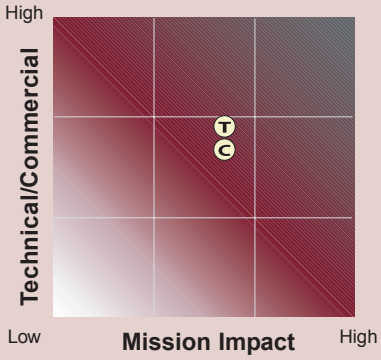
International Health Monitoring Systems, Inc. (IHMSI) has not received a prior OTF award.

Project Description

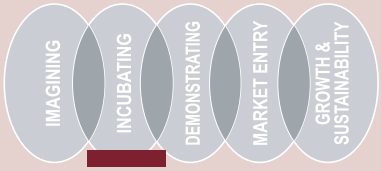
Large wind turbines typically use three rotor blades that are commonly up to 50-m long. The blades are molded in two halves into thin shells made from composites of glass fibers bonded together with a resin. The two shells are bonded together at their edges using an internal strut to provide strength. Flaws in the shells or bonding joints result in expensive blade rejection and can lead to failure during use. This 2-year project proposes developing an x-ray computed tomography system that will provide 100% examination of the blades as they come off the assembly line. Detecting flaws at this stage of production allows repairs to be made while the blade is still on the manufacturing floor reducing rejected product levels and improving overall blade quality. IHMSI will base its proposed Wind Rotor Blade X-ray Computed Tomography (WRBCT) system on current technology used by FMI Technologies for its medical X-ray CT system. The work plan includes developing and/or integrating the x-ray generators, detectors, and algorithms needed for its system. The WRBCT will examine the blades and automatically mark areas that require further inspection and repair.

Key Issues

- Molded Fiber Glass Companies (MFG) is currently making large turbine blades at its Iowa manufacturing facility and has committed to supporting the testing of IHMSI's system. Its Ohio plant produces other wind turbine component products and has the facility capacity to add blade manufacturing if and when Lake Erie region wind farms are constructed.
- Because of the size and composition of the blades, 300-kV x-rays will be required. IHMSI will rely on FMI for X-ray source and detector design. This sized system is over twice that of detectors used in FMI's current medical product.
- IHMSI has given assurances that no TFRDF funds will be spent outside the US. The cost share funds budgeted for Fraunhofer IZFP-D are for labor provided by Fraunhofer personnel working in Ohio.



Stage of Development



County Location

Funds Requested

TFRDF Request:	$1,000,000
WCF Request:	$ 0
TOTAL Request:	$1,000,000
Cost Share:	$1,020,295

Collaborators

- Molded Fiber Glass Companies
- Fraunhofer Institute for Non-Destructive Testing (Dresden, Germany)
- University of Dayton
- IDCAST
- FMI Technologies, Inc.

Technical Risk

Overall Score = 6.34

Technical Reach

There are no adequate flaw detection technologies presently available to blade manufacturers. The currently used technology is ultrasonic imaging that does not detect small flaws and requires experienced personnel to interpret. IHMSI has demonstrated that X-ray CT can detect smaller flaws and provide easily interpreted readout. The major technical challenge appears to be in the detector design for a system that is over twice the size of detectors built and used by members of the project team.

Resource Limitations

IHMSI's cost share is from its collaborators, and it relies heavily on the resources available from its collaborator and "sister" company, FMI. It has no current R&D contracts and plans to use a relationship with Sandia to leverage federal funding to support the WRBCT development. FMI is currently developing X-ray CT equipment for medical applications. IHMSI will use the University of Dayton and Fraunhofer IZFP-D to develop the required algorithms for successful deployment of the technology. IHMSI intends to raise capitalization funds of $3–5M and will initiate activities toward that end as the project progresses.

Technology Protection

IHMSI has applied for patents, but has not received any office action yet. Freedom-to-operate searches are ongoing and the initial opinion is that there is no blocking IP. Any IP developed by Fraunhofer in the US will be jointly owned and will be utilized by Fraunhofer in Europe. IHMSI is relying on FMI's IP, on FMI's past experience, on the experience developed by IHMSI during the project, and on being the first to market to sustain its competitive advantage.

Commercialization Risk

Overall Score = 5.53

Path to Market

IHMSI presents a compelling value proposition for its WRBCT that has been validated by its collaborator, MFG. It has identified two potential first-users; including MFG. IHMSI is only in the discussion stage with other potential buyers, but has identified the blade manufacturing sites in the U.S. that may be candidates for the WRBCT system. To bring the WRBCT to full commercialization, IHMSI will require additional capital the source of which has not yet been established.

Corporate Stability

IHMSI is a start-up and has no current sales. It will rely heavily on FMI as the source of the key WRBCT components and on FMI's experience and capability to raise the investment capital that will be needed to commercialize the WRBCT. The President of IHMSI is also the President of FMI. FMI's main source of funding ($18M) to date has been investment from China.

Commercial Infrastructure

IHMSI currently has no sales and marketing personnel and has not fully developed its plans for establishing the sales infrastructure. IHMSI's market forecasts are based on obtaining a 50% market penetration of the projected number of potential blade manufacturing lines that will in operation over the next five years and beyond.

Mission Impact

Overall Score = 5.67

Cluster Formation

IHMSI plans to manufacture all WRBCT systems in Dayton using equipment purchased exclusively from FMI in Akron. MFG, a major collaborator, is headquartered in Ohio and produces other wind turbine components here (e.g. nacelle enclosures), but has blade production facilities out-of-state. MFG plans to purchase WRBCT systems for its existing lines from IHMSI if the project is successful. If FMG can sell blades for the projected construction of wind generators in Lake Erie, MFG would expand its Ashtabula plant to produce these blades.

Ohio Economics

IHMSI has projected sales of $4.62M and 15 new Ohio jobs by 2013 and $8.5M in sales and 50 new Ohio jobs by 2015. These projections are based on a 50% market penetration of the projected wind turbine blade manufacturing lines worldwide. These impacts appear optimistic based on IHMSI's timeline for completion of the prototype testing, which will not occur until the end of the second year of the project.

Business Model

IHMSI plans to create a manufacturing line for its technology in Dayton by 2013 and sell its product worldwide. It intends for its headquarters to also be in Dayton, and its staff will be expanded to include marketing and engineering personnel.

Prior Ohio Investments

- *None*

Ohio Department of Development

2011 TFAEP Evaluation Summary

Third Frontier Advanced Energy Program

Catacel Corporation

Novel Catalyst to Reduce Cost of On-site Hydrogen Generators

TFAEP 11-392	Final Score: 56.5	Rank: 14

Previous Ohio Investment

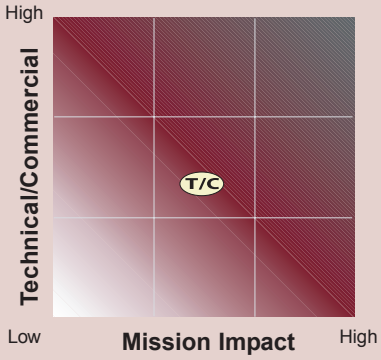
Catacel Corporation has been awarded five previous TFP awards related to developing inexpensive heat exchangers and catalyst coating techniques for high temperature fuel cells and hydrogen production systems. It also collaborated on another TFFCP project with Technology Management Inc. (TMI) aimed at producing a low-cost heat exchanger for TMI's SOFC. The applicant claims the TFP support has leveraged an additional $1.5M in federal funds, $1M in shareholder investment and revenue growth of over $2M.

Project Description

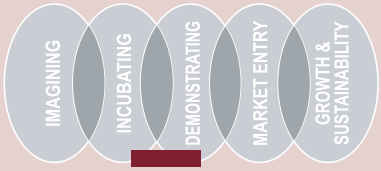
Catacel proposes adapting a version of its Stackable Structural Reactor (SSR®) catalyst technology for use in a hydrogen generation system (PowerTap™) being commercialized by Nuvera Fuel Cells. The Catacel SSR® is a catalyst-coated foil design that replaces the ceramic pellet-based reactor currently used in the PowerTap™. In the 2-year project, Catacel and Nuvera will collaborate to iterate the design of the SSR® to fit the configuration most appropriate for the PowerTap™, evaluate the SSR®-based PowerTap™ design and develop and implement a manufacturing system at Catacel that will meet the Nuvera product demand.

Key Issues

- The Ohio economic impact from the project is realistically estimated, but is moderate at best. The impacts will be directly tied to the growth of the fuel cell/on-site hydrogen application, a market that is in its infancy.
- Nuvera is the specific customer for the product proposed, and it will manufacture its product in Massachusetts. While Nuvera is working with Ohio companies such as Crown Equipment on the application of fuel cells for lift trucks, it is premature to claim additional Ohio economic benefit from the successful introduction of the PowerTap™.
- Catacel has established itself as an industry leader in catalyst technology development and is working with many in the fuel cell and hydrogen industries.



Stage of Development



County Location

Funds Requested

TFRDF Request:	$	607,488
WCF Request:	$	0
TOTAL Request:	$	607,488
Cost Share:	$	679,766

Collaborators

- Nuvera Fuel Cells (Billercia, MA)

Technical Risk

Overall Score = 4.60

Technical Reach

Catacel's SSR® technology is currently being evaluated in Turkey at a large-scale hydrogen production plant, again as a replacement for catalyst-coated ceramic pellets. For the Nuvera application, a miniaturized and customized SSR® prototype has been hand-built. In this project the hand-built design will be integrated into a full-scale "drop-in" unit for the PowerTap™, tested, and optimized.

Resource Limitations

Catacel has demonstrated its ability to produce metal-coated catalyst products that have solved a variety of customer cost, reliability and performance issues. Nuvera has already commercialized the PowerTap™ product and has the resources to manufacture, sell and service the product containing the Catacel SSR®. The project funding appears to be sufficient to meet the project objectives. The cost share is predominantly the unrecovered indirect costs of Catacel and Nuvera.

Technology Protection

Catacel plans to file for patents on the specific foil-based structure used in this application but presently is keeping that as a trade secret. Much of Catacel's technology is based on such trade secret know-how, but it does hold 14 patents and has a dozen more pending that cover its primary technology platforms, the heat exchange platform (HEP) and SSR® platform.

Commercialization Risk

Overall Score = 4.26

Path to Market

Nuvera is the exclusive customer for the specific product proposed. Nuvera is active in the project and is committed to evaluating and implementing the Catacel SSR® in its PowerTap™ product. However, the Nuvera product should open markets for similar SSR®-based products. Nuvera's target market for initial PowerTap™ sales is facilities operating lift truck vehicles, complementing its fuel cell products sold to lift truck manufacturers and end-users.

Corporate Stability

Catacel is a small but stable company that is attempting to transition from a custom catalyst system developer to a volume-producing manufacturer of catalyst-based solutions. Catacel is profitable and intends to close on its first equity capital investment in 2011.

Commercial Infrastructure

Catacel has hired a sales manager and is establishing its marketing and sales infrastructure for its catalyst-based platforms. For the specific SSR® product proposed, no infrastructure is needed, as Nuvera will purchase product directly.

Mission Impact

Overall Score = 4.92

Cluster Formation

Successful development of the Nuvera SSR® product will further establish Catacel as a supplier of high performance, cost-effective products for advanced energy technology developers and manufacturers. Nuvera will continue to manufacture its products in Massachusetts, but does use some Ohio suppliers for its fuel cells and the PowerTap™.

Ohio Economics

Initial sales of Catacel's Nuvera-specific product are based on projected PowerTap™ sales and on very conservative estimates of sales to other fuel cell integrators. Catacel's Nuvera sales will begin in 2013, and projections are for 4 new jobs at Catacel by 2013 and revenue of $600K that year. Total sales for smaller format SSR® designs will reach $2M annually by 2015 and Catacel's new employment will grow to 14. The potential for a much greater impact exists, but it is dependent upon growth of fuel cell usage at sites where hydrogen generation is needed. Catacel does not control that market growth.

Business Model

Catacel is transitioning from a custom catalyst manufacturer to a catalyst-based product manufacturer and has hired a marketing/business development manager to steer that transition. In the near-term, Catacel will continue its direct sales approach and rely on its established customer connections.

Prior Ohio Investments

- Low Cost, High Temperature Heat Exchanger and Reactor Platform for Fuel Cell Applications, 2006, $400,403
- Heat Exchanger Demonstration on TMI's Solid Oxide Fuel Cell System, 2007, $613,457
- A Novel Desulfurizer-embedded Process for Sulfur-laden Logistic Fuels, 2007, $751,713
- Durability and Performance Evaluation of Catalysts on Metals, 2008, $759,502
- High Volume Coating Process for Fuel Cell Inserts, 2008, $445,614

Ohio Department of Development

2011 TFAEP Evaluation Summary

Third Frontier Advanced Energy Program

Echogen Power Systems, Inc.

Development of State-of-the-Art Heat Exchangers for Transforming Waste Heat to Power

TFAEP 11-348 Final Score: 56.1 Rank: 15

Previous Ohio Investment

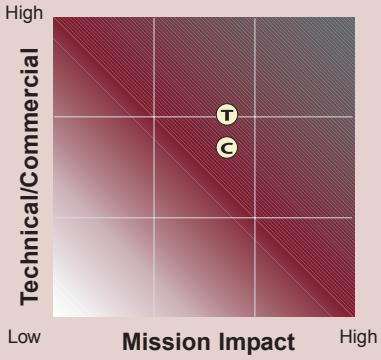
Echogen Power Systems, Inc. received a 2009 RCP grant to complete the initial development of its heat engine technology, build a full-scale demonstration prototype for customer evaluation, and initiate customer development. Echogen indicates it has completed the 3-year project one year early, creating 7 new jobs and attracting $4M in additional investment. The initial demonstration at AEP is nearing its field test completion, and a letter of intent to host a 7-MW system has been obtained.

Project Description

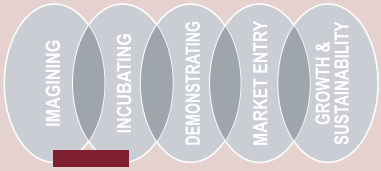
Echogen proposes developing and building a state-of-the-art heat exchanger that leverages supercritical carbon dioxide (CO_2) technology and micro-channel heat exchangers to provide a smaller, less expensive heat exchange solution for recovering waste heat from industrial processes. In the 2-year project, Echogen will develop 3 to 5 conceptual systems based on its own micro-channel design and on designs using Velocys' micro-channel technology. A final design will be down-selected, and a 250-kW prototype waste-to-heat exchanger (WHX) prototype will be designed, built, and laboratory tested. EWI will support the manufacturing process development of the final WHX design, and CWRU will upgrade its existing test rigs and provide subassembly endurance and characterization testing. Echogen will conduct the complete WHX core testing.

Key Issues

- The micro-channel WHX design is at the conceptual stage. Although the project will evaluate two separate design approaches improving the chances for technical success, working prototypes based on either technology platform have not yet been constructed adding risk to meeting the development schedule proposed.
- While Ohio companies have been identified as candidates for the ultimate manufacture of the WHX, a selection has not yet been made, and so a manufacturer is not involved in the project. EWI will serve the role of process designer and will need to transfer that capability to the manufacturer.
- Echogen has identified several potential customers for its heat engine system and is currently testing a system without a heat exchanger at AEP to verify the engine-side performance. However, the project proposed does not include field-testing of the WHX integrated system at any of the candidate customers, and this appears to be a post-project activity.



Stage of Development



County Location

Funds Requested

TFRDF Request:	$1,000,000
WCF Request:	$ 0
TOTAL Request:	$1,000,000
Cost Share:	$1,000,000

Collaborators

- Edison Welding Institute (EWI)
- Velocys, Inc.
- Case Western Reserve University (CWRU)

Technical Risk

Overall Score = 6.74

Technical Reach

The WHX designs envisioned by Echogen are at the conceptual stage, but are expected to offer a superior cost/performance solution for potential end-users. The Velocys technology has been demonstrated for use with liquid-to-liquid chemical reactors, but not for gas-to-liquid heat exchange as is required for the Echogen heat engine. The project will lead to a first generation WHX that will be performance tested in the laboratory.

Resource Limitations

Echogen is a 2007 start-up and a pre-revenue company supported by grant funding and equity financing. Its management staff has experience in business development and has successfully led the efforts to raise the necessary capital and develop the prototype heat engine now being tested by AEP. EWI staff will be responsible for many of the technical issues in the project proposed.

Technology Protection

Echogen has one issued patent and 14 additional patents pending that cover the heat engine system. Echogen has an exclusive license for the supercritical CO_2 cycle technology from NASA. The WHX development may lead to new patent applications and/or trade secret IP. If the Velocys technology is used, it will license the technology to Echogen and the contracted WHX manufacturer.

Commercialization Risk

Overall Score = 5.60

Path to Market

Echogen has reviewed or is in the process of reviewing 38 specific opportunities for its heat engine system. Several companies, including 5 in Ohio have committed or plan to commit to installing Echogen waste heat recovery systems, and each of these are customers for the new WHX units. One customer has specifically indicated interest in testing and evaluating the WHX from the proposed project

Corporate Stability

Echogen will continue to rely on grant and investment support to complete the commercialization of its heat engine and microchannel WHX. While the heat engine itself is in the Demonstration Phase, the proposed WHX is still in the Imagining Phase. Echogen has raised over $6M in investment in 2010 and projects needing an additional $1M to $4M to complete a pilot-manufacturing run of the WHX.

Commercial Infrastructure

Echogen will pursue sales directly and through a domestic sales representative network it set up in 2010. This approach has already led to the identification of the opportunities mentioned earlier. Echogen has not determined whether it will set up a new manufacturing operation or contract the manufacturing, but the latter appears to be the more likely approach. In the near term, contract manufacturing will be used, and EWI has identified two qualified Ohio candidates for full-scale WHX manufacturing.

Mission Impact

Overall Score = 5.75

Cluster Formation

Echogen is collaborating with EWI to help establish the WHX supply chain in Ohio. The manufacturing needs of the WHX fits well into Ohio's core capabilities in equipment fabrication. Five potential Ohio component manufacturers and/or system assemblers have been identified. EWI will be retained after the project as a manufacturing process consultant. If the Velocys technology is the down-selected WHX design, Velocys, an Ohio company, will license the technology to Echogen and the manufacturer.

Ohio Economics

Echogen will create 3 new jobs during the course of the project. By 2013, 16 new hires will be added and another 2 by 2015. Sales revenue for Echogen generation will begin in 2013 and new equity investment will be raised. By 2015, annual revenue is projected to reach between $5M and $10M. Economic impact from the manufacturing of the WHX is projected to create up to 60 new jobs by 2015 and generate similar revenues to those of Echogen, but these are speculative until a manufacturer is selected.

Business Model

Echogen will pursue sales directly and through a domestic sales representative network it set up in 2010. It is likely that it will partner with a contract manufacturer, planned for Ohio, to produce the WHX. The WHX will be a component for its heat engine that reduces its cost and improves its performance resulting in a more attractive cost/benefit scenario for potential customers.

Prior Ohio Investments

- Center for Thermafficient® Technology Commercialization, 2009, $4,300,000

Ohio Department of Development

2011 TFAEP Evaluation Summary

Third Frontier Advanced Energy Program

Intelligent Grid Solutions, LLC (IGS)

Commercialization of Tailored Home Energy Management Solutions

TFAEP 11-331	Final Score: 54.6	Rank: 16

Previous Ohio Investment

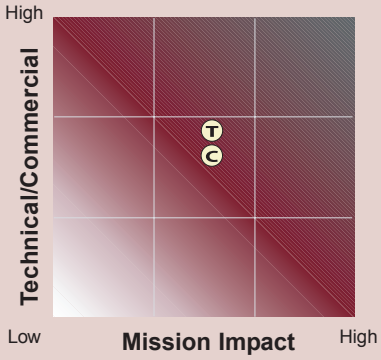
Intelligent Grid Solutions, LLC (IGS) has not received a prior OTF award.

Project Description

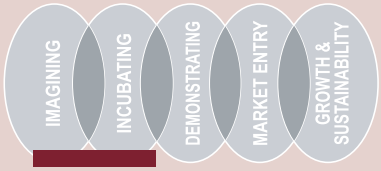
IGS is a smart grid services company with staff experience in utility communications and control systems engineering, operations and maintenance. While IGS is involved in grid automation enabled by smart grid technologies, this project focuses on home energy management (HEM) systems. In this 2-year project, IGS proposes to develop a portfolio of HEM solutions including an educational computer software system, "MyEnergy Dashboard" that provides remote control of energy use. The concept is that residential electrical energy customers will be able to select the most appropriate collection of home energy management products to monitor and regulate the energy-using devices in their homes. IGS will sell the appropriate interface devices and install them so residential users can make better utilization and lower the costs of their energy needs. The University of Akron will perform customer surveys to determine the types of energy saving products desired by consumers, test and characterize selected commercially available HEM systems, and write the "MyEnergy Dashboard" software so the consumer can determine which of the characterized products best suit his/her energy needs. GE will provide a base software system, electric appliances for characterization and consulting. FirstEnergy Solutions will assist with the market assessment and evaluation of the IGS HEM tools and First Communications will provide office space and telecommunications services. The University of Akron will keep the devices, appliances, and software purchased with the Wright Capital funds for its Home Energy Management courses.

Key Issues

- IGS' business model appears to follow a value-added reseller approach. It will provide commercially available energy management products and services that that are customized to individual customer needs through use of its HEM software and communications tools. However, it is not clear that sufficient customer demand has developed to support the market development proposed. Since the initial product task is to define customer needs and wants, the product is at a very early stage of development.
- There does not appear to be any significant technical challenges to overcome in developing the software for the product proposed.
- The market driver for the product will be time-of-day based electric rates and/or other energy conservation incentives/regulations. The implementation of these incentives may delay the sales revenues and jobs projected.



Stage of Development



County Location

Funds Requested

TFRDF Request:	$ 918,104
WCF Request:	$ 244,000
TOTAL Request:	$1,162,104
Cost Share:	$1,163,504

Collaborators

- FirstEnergy Solutions
- First Communications
- University of Akron
- GE Energy Services (Atlanta, GA)

Technical Risk

Overall Score = 6.20

Technical Reach

Intelligent Grid has not yet produced prototypes of the tools proposed. The first step of the project is to perform a market survey of FirstEnergy's Ohio residential consumers to determine which energy regulating devices and services are needed and/or wanted. One product to be developed is the "MyEnergy Dashboard", an educational software system that assists the consumer in selecting which product features and which control services best fit his/her needs. There do not appear to be any significant technical challenges to overcome for this software system, and it should be completed within the project time frame.

Resource Limitations

IGS will use OTF funds to finance a customer survey, characterize various appliances and HEM devices, and develop the "MyEnergy Dashboard" software system. Collaborators are supplying their personnel and overhead as cost share to assist in the project development efforts. IGS plans to attract funding from either an investment fund and/or from partners who see the advantages of marketing their HEM product lines through IGS marketing channels.

Technology Protection

IGS and its collaborators plan to file patents for any patentable intellectual property developed during this project. IGS foresees patents that are based on the implementation of particular communications technologies, control device technologies, display software and formats, and control capabilities which that will result from the products and services selected from "MyEnergy Dashboard". There do not appear to be any conflicting patents to prevent IGS from working in this area.

Commercialization Risk

Overall Score = 5.33

Path to Market

The end users of the proposed product are FirstEnergy's one million plus residential electric consumers in Ohio. A selected group of these customers will be involved in the survey, focus groups and field tests (estimated 5,000 homes). An IGS objective is to educate consumers on the energy-saving benefits of HME products, thereby assisting them is in adapting to the changes in energy usage patterns and pricing currently being implemented by utilities. Customer access will initially be through First Energy Solutions and GE Energy.

Corporate Stability

IGS was formed in 2009 by two major investors, FirstEnergy Solutions Corporation and First Communications, Inc., both of which are collaborators on this project. FirstEnergy Solutions Corporation, an energy supplier based in Akron, is an unregulated subsidiary of FirstEnergy Corporation. First Communications, Inc., founded in 1998 and headquartered in Akron, is a large integrated telecommunications carrier providing a full range of voice and internet services to small- and medium-sized businesses throughout the Midwest.

Commercial Infrastructure

IGS plans to hire and develop the sales, marketing, assembly, installation, and customer service infrastructure as the project progresses. IGS plans to maintain a warehouse in Ohio for inventory, final assembly, testing, and shipping.

Mission Impact

Overall Score = 5.25

Cluster Formation

IGS plans to establish a distribution center in the Akron area which will carry an inventory of HEM products to be marketed, an assembly area where IGS can assemble and test each HEM configuration before shipment to the customer. The HEM products (controllers and interfaces) that will be purchased, inventoried and resold will be purchased from existing suppliers, with emphasis on suppliers from Ohio when practical. Ohio labor will be utilized.

Ohio Economics

IGS plans to create jobs in Ohio directly through the staff required to select and market HEM products, and to assemble, integrate, ship, install, service and upgrade these products. IGS forecasts $4.2 million in annual sales revenues and employment of 27 persons in 2013. IGS forecasts $13.5 million in annual sales revenues and cumulative employment of 62 cumulative persons in 2015.

Business Model

IGS plans to use the educational "MyEnergy Dashboard" and a new business model to bring electric consumers into the energy efficiency arena. "MyEnergy Dashboard" will be an easily understandable tool that allows the average residential consumer to have the ability to compare any desired or selected HEM product based on the residential consumer's requirements. Its primary customer is First Energy and its business model appears to follow a value-added reseller approach in that commercially available energy management devices will be customized and integrated with IGS tools to provide ease of customer use. Revenues will come from the resale of the customized products and the installation and maintenance service costs.

Prior Ohio Investments

- *None*

Ohio Department of Development

2011 TFAEP Evaluation Summary

Third Frontier Advanced Energy Program

Chemtex International, Inc.

Integrated Biorefinery Application Center

TFAEP 11-307	Final Score: 50.1	Rank: 17

Previous Ohio Investment

Chemtex International, Inc. has not received a prior OTF award.

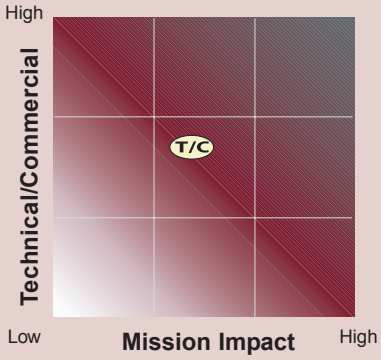
Project Description

Gruppo Mossi and Ghisolfi (M&G Group) has developed a process known as Proesa™ for converting cellulose to ethanol. This process has been piloted in a 1-tpd facility in Italy, and a 16-million gpy plant is under construction in Europe. The biomass used as a feedstock for this process includes four herbaceous crops that have been grown in Italy. Pretreatment of the cellulosic feedstock is done by steam explosion. Saccarification and fermentation to ethanol are done in a single step for C5 and C6 sugars using genetically engineered microbes.

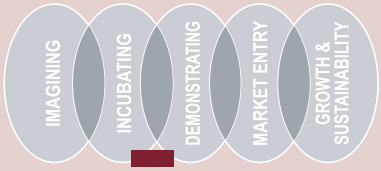
M&G Group would like to optimize this technology and demonstrate it to U.S. customers. It plans to assign responsibility for specific process areas in need of improvement to staff at its technical center in Ohio who will work on hydrolysate sourced from the facility in Europe. The goals of this project are to validate the preferred biomass crops, *Arundo donax* and fiber sorghum, in Ohio and to develop agronomic models for use by biorefineries that may be located in Ohio. Improvements to the processing technology include improving the separation processes to remove the fermentation inhibitors and evaluating the use of supercritical carbon dioxide as a substitute for the physical pre-treatment process of steam explosion.

Key Issues

- For biorefineries to be economically viable, the essential agricultural supply chain must be validated for each site since the feedstock material must be obtained locally. This will require data on crop yields and logistics. In the Midwest, the M&G Group is growing test crops in Ohio, Kentucky, and Tennessee.
- The process economics presented indicate that a second-generation plant can be viable at a petroleum price of $50/barrel. The cost of converting an existing ethanol plant from corn to cellulose has been estimated at $50M and can be expected to pay for itself within one year. The cost of building a new facility is estimated at $180M.
- While the economics of this cellulosic ethanol process appear promising, neither M&G Group nor Chemtex made any representations about the future businesses that they will create in Ohio. The information regarding a specific Ohio project appears to be at a level of early stage feasibility work. Specifics regarding project financing and participation have not been provided.



Stage of Development



County Location

Funds Requested

TFRDF Request:	$ 993,486
WCF Request:	$ 0
TOTAL Request:	$ 993,486
Cost Share:	$7,864,250

Collaborators

- The Ohio State University (OSU), Ohio Agricultural Research and Development Center (OARDC)
- University of Akron

Technical Risk

Overall Score = 5.80

Technical Reach

It is encouraging that The Ohio State University (OSU) has a 10-year-old stand of *Arundo donax* in Columbus that is producing 19.8 dry tons/acre (target is 15 dry tons/acre). Since *Arundo donax* takes 2–3 years to reach full maturity, it is unclear if crop yields from the planned field trials in this 24-month project will be sufficient to justify investment in an ethanol production facility. The work on the pretreatment and separation steps is expected to be challenging, but with an operating pilot plant and demonstration plant, these enhancements are not likely to be "show stoppers" if difficulties are encountered.

Resource Limitations

The biorefinery project was originally sponsored by M&G's PET business unit as a means of generating alternative feedstocks for its production process. That group has withdrawn its sponsorship, and the biorefinery process has been reconfigured to focus on the production of ethanol. When Chemtex was unsuccessful in obtaining an earlier OTF grant to build a proprietary 1-tpd biorefinery plant, it resulted in the lay-off of 28 employees, leaving 21 employees at Sharon Center. M&G is contributing cost share of $7.6M, $4.3M of it in the form of operating expenses and $1M for equipment for two years for the Integrated Biorefinery Application Center at Sharon Center. No financial arrangements for funding an Ohio pilot plant or ethanol production facility were presented.

Technology Protection

M&G Group has filed 11 patent applications regarding biofuel biochemical technology. These applications cover the biomass pretreatment process, the hydrolysis process, microorganisms, and lignin separation. These applications reflect the expertise and IP gained from the 1-tpd process installed in Italy. Any new IP developed from this work will be filed as Chemtex. Neither company is currently aware of any patent or patent application that, if granted, would prevent the practice of the technology in this proposal.

Commercialization Risk

Overall Score = 5.52

Path to Market

M&G/Chemtex is presently engineering eight industrial-scale, first-generation biofuel projects. Four of these projects are located in the U.S. (three in NE and one in MN), two in Italy, one in China, and one in Turkey. The company claims an excellent record of raising capital for its projects via private investors. It believes its lower capital and operating costs give it an advantage over international competitors because the products being produced from these first-generation plants are all commodities.

Corporate Stability

In 2003, Chemtex was acquired from the Mitsubishi Group by the M&G Group, which is privately held. The M&G Group was founded in 1953 as a polyethylene and polyvinyl chloride producer and subsequently expanded into PET manufacturing in the 1980's. Today it is the world's leading PET producer, and it has other business units specializing in acetates, and engineering. The company has 11 global manufacturing plants (one in the U.S.) and approximately 3,000 employees. Its annual turnover is approximately $3B, and it makes annual investments of $200–300M in facilities and $20M in research. The company has three R&D centers located in the U.S., Italy, and Brazil. Chemtex, a global engineering subsidiary, has its U.S. headquarters in Wilmington, NC and operates an R&D center in Sharon Center, Ohio that supports PET production processes.

Commercial Infrastructure

M&G Group believes that the largest market for this technology will be in the U.S. Chemtex intends to establish and operate the Integrated Biorefinery Application Center that could be used as a showcase for marketing purposes. Plans for creating a pilot plant in the U.S. or an operating a cellulose-to-ethanol facility in Ohio have not progressed to the point of discussing financial commitments or company involvement.

Mission Impact

Overall Score = 4.57

Cluster Formation

University of Akron will develop and evaluate the supercritical carbon dioxide-based biomass treatment that will be an alternative for the current steam explosion process. The Ohio Agricultural Research and Development Center (OARDC) and OBIC will provide agronomic input to the field studies that are planned. The availability of local feedstocks will be important for plant economics, and it is anticipated that the intended crops can be planted on marginal land allowing Ohio farmers to generate $44M in cellulose sales to each ethanol facility. Cost share of $2M will go to Berry Farm II in Wadsworth, OH to grow the biomass for this project.

Ohio Economics

This project is projected to result in the creation of 19 R&D jobs at Chemtex by 2013 and a total of 21 jobs by 2015. Revenues from this project would appear to be limited to investments by the M&G Group at the Sharon Center facility. No commitments have been made by the M&G Group beyond its cost share. If future plants are built in Ohio, each second-generation plant could be expected to create 63 jobs, and each conversion of a first-generation ethanol plant could result in 10 additional jobs. There are seven first-generation ethanol plants located in Ohio that could be retrofit candidates for this technology. The new or retrofitted facilities could potentially start-up in 2014.

Business Model

M&G Group would like to become the number one supplier of cellulosic biorefinery engineering and construction services. The technology exists today to engineer and design a commercial-scale plant that can be operational in 24 months. It appears that the engineering work for new facilities in the U.S. will be handled from the Chemtex headquarters in NC. The proposal's plans specifically involve only the R&D center in Sharon Center, Ohio.

Prior Ohio Investments

- *None*