PROJECT SELECTIONS FOR DOE PHASE III *XLERATOR* SMALL BUSINESS PROGRAM

Biomass Technologies: Harvesting/Dewatering Technology for Algal Biofuels

Renewable Algal Energy, LLC (Kingsport, Tenn.) - Algal Biodiesel via Innovative Harvesting and Aquaculture Systems - Renewable Algal Energy LLC, will leverage its experience in algal aquaculture, harvesting, and extraction, to demonstrate at small commercial-scale, improved, low cost, energy-efficient methods for harvesting and dewatering algae that contribute to an algal oil product that is cost-competitive with petroleum. The integration of their technology with up- and down-stream processes will reduce technical and economic risks for future scale-up to a full-scale commercial process. **DOE Funding: $3,000,000**

Buildings: Solid State Lighting Products made from Organic Light-Emitting Diodes

Universal Display Corporation (Ewing, N.J.) – Energy Saving Phosphorescent OLED Luminaires. Universal Display Corporation (UDC) and Acuity Brands Lighting propose to develop a general purpose luminaire targeted at high-end commercial and institutional building spaces using UDC's "striped" phosphorescent OLED (PHOLED^{TM}) panels. The proposed target luminaire will have a total luminous output of 4,000-5,000 lumens, a tunable correlated color temperature of 2700K to 4000K, an overall luminaire efficacy (including driver) of over 70 lm/W, an initial panel luminous emittance of 6,000 lm/m^2, and a lifetime of 25,000 hrs. The fundamental objective is to develop an economically viable, energy-efficient, near-term commercial product that can compete directly with linear fluorescent technology. **DOE Funding: $2,000,000**

Fuel Cell Technologies: Advanced Materials for Fuel Cell Technologies

Dynalene, Inc. (Whitehall, Pa.) — Large Scale Testing, Demonstration and Commercialization of the Nanoparticle-based Fuel Cell Coolant. Dynalene will demonstrate a patented fuel cell coolant that showed significant potential in Phase I and Phase II research for improving fuel cell durability and reducing system size, weight, and operating cost. The coolant, which contains ion-exchange nanoparticles and non-ionic corrosion inhibitors, will undergo long-term (5000-hour) testing under freeze-thaw conditions. Testing will be conducted in-house as well as in subcontractor facilities. The Phase III research will test the coolant under severe fuel cell operating conditions such as temperature cycling and high electric fields to validate the previous encouraging results using the coolant. **DOE Funding: $1,000,000**

Giner Electrochemical Systems, Inc. (Newton, Mass.) — Dimensionally Stable High Performance Membrane. Giner will scale-up a process for producing a dimensionally stable membrane (DSM™) for use in fuel cells. The membrane exhibits exceptional in-plane (i.e., X-Y) dimensional stability with changes in relative humidity and temperature. Consequently, the membrane is not only suitable for freeze/thaw cycling but also for relative humidity cycling during normal fuel cell operations. This project will take the membrane

molding methods that were generated in Phase II, apply them to a roll-good process and demonstrate that these membranes retain the necessary properties for scale-up to a continuous process. **DOE Funding: $1,500,000**

Fuel Cell Technologies: Bio-Fueled Solid Oxide Fuel Cells

InnovaTek Inc. (Richland, Wash.) — Power Generation from an Integrated Biomass Reformer and Solid Oxide Fuel Cell. InnovaTek will integrate and demonstrate a Solid Oxide Fuel Cell system (3 to 30 kilowatts) for distributed energy generation using a non-food, renewable biomass power plant and a proprietary steam-reforming process. The bio-oil that will be used in the process is made from agricultural and forestry residuals, such as wood saw dust, through the fast pyrolysis process. This integrated power system can reduce the burden on the electrical grid and decrease the use of fossil fuels in electricity generation. It will provide additional environmental benefits through zero net carbon emissions and lower NO_x emissions compared to conventional combustion-based technologies. **DOE Funding: $2,200,000**

TDA Research Inc. (Wheat Ridge, Colo.) — Bio-fueled Solid Oxide Fuel Cells. TDA Research will demonstrate a low-cost, high-capacity sorbent that can remove both hydrogen sulfide and organic sulfur species from biogas, reducing their concentration to the parts per billion level. TDA originally developed the sorbent to remove sulfur-bearing odorants from natural gas and liquefied petroleum gas. In this Phase III project, TDA will extend the use of the sorbent to biogas by integrating it into a 10-kW Solid Oxide Fuel Cell system, where it will desulfurize the incoming gas, in order to prevent degradation of the fuel cell stacks and poisoning of the catalysts used in the fuel processor. The system will use a biogas from an anaerobic digester at a wastewater treatment plan. **DOE Funding: $1,900,000**

Geothermal Technologies: High-Temperature-High-Volume Lifting

Composite Technology Development, Inc. (Lafayette, Colo.) – Commercialization of High Temperature Electrical Insulation. Composite Technology Development, Inc. in partnership with Von Roll USA (Schenectady, N.Y.) and Wood Group ESP (Oklahoma City, Okla.) will optimize and scale up production of advanced electrical insulation materials for use in commercial electronic submersible pumps and motor lead extensions. Existing wire insulation materials are inadequate for the high-temperature environments encountered in Enhanced Geothermal Systems and limit the reliable use of downhole lifting systems. Successful SBIR Phase I and II projects demonstrated the reliable performance of newly developed inorganic composite materials for electrical insulation at high-temperatures. Material properties of these composites, such as electrical resistivity, are superior to currently used polymer insulations at 250 °C and higher. The use of these materials in electronic submersible pumps will enable the long-term operation of lifting systems at high-voltages and high-temperatures for continuous energy production from Enhanced Geothermal Systems. **DOE Funding: $2,000,000**

Industrial Technologies: Mitigation of Heat Losses, Fouling, and Scaling in Key Manufacturing Unit Operations

Altex Technologies Corporation (Sunnyvale, Calif.) - Low Cost Microchannel Heat Exchanger. Altex has discovered an innovative manufacturing process for compact heat exchangers that uses low cost materials and fabrication techniques that can form the high performance channels at much reduced cost. Under the Phase III project the WASHEX manufacturing process will be refined and introduced into a high volume field application. Analysis of results from earlier phase projects indicated that WASHEX could be manufactured at up to 75 percent lower cost than existing high performance heat exchangers. **DOE Funding: $1,470,000**

Los Gatos Research (Mountain View, Calif.) – Advanced Laser-Based Sensors for Industrial Process Control. Los Gatos Research proposes to develop advanced laser-based sensors for industrial process control monitoring in high-temperature, harsh environments found in steel, glass, and syngas (synthetic gas) manufacturing. These sensors will increase manufacturing efficiency, save energy, decrease harmful emissions, and reduce costs. **DOE Funding: $990,000**

Industrial Technologies: Integrated Reaction-Separation Using Non-Thermal Processes

Exelus, Inc. (Livingston, N.J.) – Launching A New Route To Styrene Monomer. Styrene monomer is a vital commodity chemical that consumes vast amounts of energy in its production. A new, energy-efficient route to styrene using novel process chemistry is being developed in this project, enabled by a breakthrough catalytic material. This new technology has the potential to slash energy consumption and greenhouse gas emissions from styrene production by 40 percent or more while also making U.S. styrene producers significantly more competitive in the global market by cutting their cost of production by 30 percent. Commercialization of this new route for the manufacture of styrene will save the energy equivalent of millions of barrels of oil annually in the U.S. while also making U.S. producers more competitive globally, saving jobs and increasing exports. **DOE Funding: $500,000**

KSE, Inc. (Amherst, Mass.) - Reduction of Distillation Usage in the Manufacture of Ethanol by Reactive Water. This project will substantially eliminate the reliance on distillation for water removal from biomass-derived ethanol, yielding both energy and cost savings. In this process a novel reagent is added to the crude ethanol to convert water into a highly volatile product, which is readily removed from the ethanol at substantially reduced energy input. The reagent is regenerated off-line, by reversing the reaction and producing water, which is then removed by simple decanting and phase separation. Reactive dehydration could also be applicable to the production of many other industrial chemicals for which water must be removed. **DOE Funding: $3,000,000**

Solar Technologies: Lowering the Cost of Photovoltaics

Applied Nanotech (Austin, Texas) - High Capacity Manufacturing of Non-Contact, Printable Metallic Inks for Silicon Solar Cells. Applied Nanotech is developing a new metallic ink that can be used to make electrical connections to solar cells. This new approach will allow companies to make thinner solar cells to save on the amount of silicon used. This is yet another innovative way of reducing the cost of solar cells. **DOE Funding: $1,600,000**

Microlink (Niles, Ill.) - Backside Contact Multijunction Solar Cells for High Concentration Applications. Solar cell materials are expensive; one method of reducing cost is by using less semiconductor material and concentrating the sun's energy on in. By doing so, efficiency jumps from 25 percent to 42 percent and costs go down. Even with these benefits, this technology is still expensive. Microlink is helping reduce the cost even further by shrinking the cells in three dimensions. They have created a process to create smaller as well as thinner solar cells, something previously not possible. In addition, Microlink has found a way to move the metal grid used to collect the energy the cell creates to the back of the cell thereby increasing the amount of light that can be captured. **DOE Funding: $1,600,000**

Ultrasonic Technologies (Tampa, Fla.) - Resonance Ultrasonic Vibration (RUV) Technology as an Industrial Tool for Silicon Solar Manufacturing. Solar cells are getting thinner and are being processed faster. This means that cells are getting more fragile and detection equipment has not been able to overcome the time constraint needed to manage the detection of damage in these fragile cells. Even a very small crack in a cell can cause it to break in processing and hold up the line, or eventually cause it to be failed and thrown out at the very end of the line after going through the expense of being created. If these cells could be eliminated periodically in process, the manufacturing line would be able to create more cells at a lower cost. Ultrasonic Technologies has found a way to do just that. Their equipment lightly vibrates each cell as they pass by, damaged cells vibrate in a different way than intact cells and Ultrasonic's statistical software analyzes the behavior of each cell and rejects cells with excellent accuracy. This technology will greatly benefit the industry and is ready to scale up. **DOE Funding: $1,400,000**

Vehicles Technologies

Electron Energy Corporation (Landisville, Pa.) - High Performance Permanent Magnets for Advanced Motors. Electron Energy Corporation's Phase III effort will further the development of standard grades of high resistivity magnets through pilot production, beta site testing, and commercialization. These high resistivity magnets can reduce motor eddy current and increase motor efficiency, as well as address cost reduction by testing automated production processes. This program can impact hybrid vehicle markets and wind energy industries through this improved magnet composition, helping to revitalize the once-strong U.S. manufacturing base for permanent magnets. **DOE Funding: $3,000,000**

Materials Innovation Technologies, LLC (Fletcher, N.C.) - Advanced Materials for Lightweight Vehicles. Materials Innovation Technologies will develop low cost carbon fiber composite manufacturing technology to address the need for cost-effective, high volume production, lighter-weight components for automobiles and other vehicles by designing, manufacturing and testing several target components. This project will (1) develop rapid processing technologies for carbon fiber reinforced polymers for use in primary and secondary structures of passenger vehicles; and (2) show that the concepts can be cost-effectively incorporated into the high-rate, high-volume manufacturing of commercial passenger vehicles. **DOE Funding: $3,000,000**

Strategic Polymer Sciences, Inc. (State College, Pa.) - Compact High Temperature DC Bus Capacitors for Electric Vehicles. Strategic Polymer Sciences will develop advanced compact DC bus film capacitors for electric vehicle power inverters using novel electroactive polymer dielectric compositions with high temperature stability, high dielectric constant, low dielectric loss tangent, and low leakage current. Prototype capacitors will meet DOE capacitor targets and enable significant reduction in electric vehicle power inverter size and cost. **DOE Funding: $1,000,000**

Advanced Wind Technologies Systems

Compact Membrane Systems, Inc. (Newport, Del.) – Water Removal from Lubricating Fluid via Compact Membranes. This project will develop a novel membrane-based technology for continuous on-line dewatering of lubricating oils, initially for wind turbine gearboxes. When hydraulic fluid is circulated on one side of the chemically-resistant membrane and a vacuum is applied to the other side, water is removed from the hydraulic fluid. Decreasing water concentrations in lubricating oil from 290 to 30 parts per million can increase turbine bearing life by as much as 400 percent. With this lubricant moisture control technology being developed by Compact Membrane Systems, the wind turbine industry may be able to significantly reduce disruptive and costly gearbox replacements. **DOE Funding: $2,900,000**

Native American Technologies (Golden, Colo.) – Onsite Manufactured, Self-erecting Wind Turbine Tower. This project will develop a full-scale prototype of a self-erecting wind turbine tower that can be manufactured onsite, removing the requirement for a large crane and easing several transportation constraints associated with large tower sections. Both of these benefits will lead to a decrease in deployment-related costs. Such towers will also enable the construction of taller towers than are possible today, providing access to the stronger winds that exist at higher altitudes. Taller towers allow for more energy to be captured at a given site, opening up previously undesirable locations for wind farm development. **DOE Funding: $3,000,000**

Princeton Power Systems, Inc. (Princeton, N.J.) – Distributed Generation Transformer for MW-Scale Wind Turbines. Using commercially available switches, Princeton Power Systems will develop a 1.5 megawatt AC to AC converter that transforms “wild AC” from the generator at 700 volts alternating current into conditioned AC power at 13,800 volts alternating current, in a package with peak efficiency of 97.5 percent. The technology

provides conditioning and voltage transformation in one step and an integrated terminal for connecting distributed power generation sources to energy storage and transmission infrastructure. The technology will enable lighter turbines that operate more efficiently, significantly reduce the cost of "balance of plant" components like transformers, and help resolve grid support issues for areas with large amounts of wind generation. **DOE Funding: $1,800,000**

Webcore Technologies, LLC (Miamisburg, Ohio) – Reducing Cost and Weight of Wind Turbine Blades Using An Engineered Core Material. Webcore's TYCOR platform is designed to replace balsa wood as the preferred core material used in wind turbine blades, providing a reliable, long-term, regional supply solution to the dependency on balsa and PVC. Finished sheets are preforms made with dry fiber and foam, with final mechanical properties achieved via infusion molding. TYCOR delivers comparable or better blade structural performance to balsa wood and PVC foam, while reducing blade weight and cost. As blade size continues to increase, the advantages of TYCOR over the competition become even more pronounced. **DOE Funding: $1,800,000**

Fossil Energy Research and Development

Faraday Technology, Inc. (Clayton, Ohio) - Electrodeposited Manganese-Cobalt Alloy Coating for Solid Oxide Fuel Cell Interconnects. Solid Oxide Fuel Cells (SOFCs) represent a potential high efficiency, low cost electricity generation solution. Current systems rely on costly interconnect materials between the individual cells that represent 45 percent of the total material cost for a typical stack. New materials and manufacturing processes are desired to reduce these costs. Faraday Technology has developed an electro deposition process as an effective and economical manufacturing method for coating SOFC interconnect materials with a manganese-cobalt alloy that can then be directly inserted into a SOFC fuel cell stack without post deposition annealing steps. The process provides valuable insight into producing a manufacturing process that will minimize the number of production steps and hence the total system cost. **DOE Funding: $992,000**

Membrane Technology and Research, Inc. (Menlo Park, Calif.) – Field Demonstration of CO_2 capture from Coal-Derived Syngas. Integrated gasification combined cycle (IGCC) power plants are a relatively new technology that will allow the use of carbon capture and storage with a much lower cost and lower energy penalty than current post-combustion capture methods. Membrane Technology and Research, Inc. (MTR) has developed a low-cost and energy-efficient membrane process for CO_2 capture that separates H_2 and CO_2 from coal derived syngas. The Phase III program will produce a complete industrial-scale pilot system and complete a pilot-test of the membrane system. **DOE Funding: $1,500,000**

Mikro Systems, (Charlottesville, Va.) – Commercialization of Advanced Turbine Blades for IGCC Power Plants. Turbine blade design is a key component for the efficiency, emissions, and operating costs of power plants, and improvements to these blades will require increased firing temperature, reduction of cooling air. These factors are governed by the operating temperature range for the blades, which is in turn governed by the

internal blade cooling capabilities. Mikro Systems has developed a novel approach for the core production process of two distinct integrated gasification combined cycle (IGCC) Row 1 turbine blades, and has developed the process to the point where it is feasible to rapidly commercialize. The Phase III project will take the new design through the manufacture of a "test set" of blades with advanced cooling features. **DOE Funding: $1,500,000**

Nuclear Energy - Advanced Instrumentation and Control, Radiation Resistant Sensors, and Wireless On-Line Monitoring Systems for Nuclear Power Plant Applications

Analysis and Measurement Services (AMS), Inc. (Knoxville, Tenn.) - On-line Monitoring Implementation in Boiling Water Reactors. AMS has previously developed an advanced continuous on-line monitoring (OLM) system for existing pressurized water reactor (PWR) nuclear power plants that measures PWR equipment performance, plant health, and monitors and trends data from key safety parameter instrumentation systems. Boiling water reactor (BWR) power plants, however, are more complex than PWRs because the combined boiling water and saturated steam conditions inside the fuel core and reactor vessel present different challenges. BWRs must use unique types of sensors, including in-core "neutron noise" sensors, compensating collapsed-liquid level instruments, and power-versus-flow stability monitoring systems. AMS will develop a commercial-grade, integrated OLM system for BWRs using specialized analysis methods, BWR-specific instrumentation, and the existing BWR Stability Safety Monitoring system parameters and measurements and perform laboratory demonstration tests. AMS will deploy their BWR OLM system in an existing BWR nuclear power plant during start-up conditions and normal operations. **DOE Funding: $2,500,000**

Analysis and Measurement Services (AMS), Inc. (Knoxville, Tenn.) – In-Containment Application of Wireless Technology for On-line Condition Monitoring in PWRs. AMS previously developed an integrated wireless on-line monitoring (WOLM) technology system for passively monitoring nuclear power plant equipment located outside of the reactor containment building. In this project, AMS will assemble and test a complete, commercial-grade WOLM system for use inside large pressurized water reactor (PWR) containment structures, which have reinforced-steel rods meshed into very thick concrete structures. AMS will find strategic in-containment locations, use existing electrical penetrations, and focus on in-containment equipment that does not have instrumentation data transmitted by existing cables to the reactor control room panels (e.g., sump pump vibration, containment floor water levels, temperatures inside instrument calibration panels). AMS will deploy their in-containment WOLM system inside an existing PWR power plant's containment for use during plant outage periods and when the reactor is normally operating. **DOE Funding - $2,800,000**

Luna Innovations, Inc., (Blacksburg, Va.) – Low-Drift Ultra-High Temperature Fiber Optic Thermal Sensors. Luna has developed and tested fiber optic (FO) sensors and FO materials for drift-free thermocouples (T/Cs) for very high temperatures (1000° C) under low neutron flux level conditions. Previous Luna SBIR projects evaluated FO materials and sensor designs suitable for in-core T/C applications and developed more robust FO T/C sensors and irradiated them. Initial FO sensor neutron radiation testing was performed at one

U. S. university research reactor at low temperature low neutron fluence conditions. Another FO sensor irradiation test has begun using another university research reactor that has an in-core heater system that can heat specimens up to 800°C. But these university reactors have such low neutron flux levels that it would take many years to irradiate FO sensors and materials to reach fluence levels needed for demonstrating their robust radiation-tolerant capabilities for deployment in existing and future Generation IV reactors. This project will design, fabricate and use a specialized experimental test rig for an accelerated irradiation campaign in the Idaho National Laboratory Advanced Test Reactor (ATR) with simultaneously high temperature levels (800-1400°C) and neutron flux levels, and perform post-irradiation examinations and calibration checks. An ATR lead-out experiment allows for a six-nine month irradiation time while simultaneously achieving both high neutron fluence level goals and high temperature conditions to match the extreme operating conditions found in current light water reactors and future Gen IV designs, including very high temperature gas-cooled reactors. **DOE Funding: $2,900,000**

Electricity Delivery and Energy Reliability

Arkansas Power Electronics International, Inc. (Fayetteville, Ark) - Commercialization of Silicon Carbide Power Modules for High Performance Energy Applications. This project will move silicon carbide power electronic modules into commercial production, allowing power electronic systems, such as those found in almost everything electronic from energy storage to solar inverters to electric vehicles, to operate more efficiently. Over the past ten years, with SBIR support, APEI has been developing next generation power electronics using silicon carbide (SiC)-based systems with the capability of reducing electrical energy waste by 90 percent over current silicon systems, and has received an R&D 100 award for its innovative work. This grant will support long-term testing of prototypes, optimize the manufacturing process, and commercially release the SiC power modules. **DOE Funding: $500,000**

Clever Fellows Innovation Consortium, Inc, (Troy, N.Y.) - Reliable, Practical Kilowatt-Class Cryogenics for Superconducting Devices. Practical cryogenic refrigeration is needed to realize the full capacity and reliability benefits of high-temperature superconductivity (HTS) in the electrical grid, as present cooling technologies lack the reliability, efficiency, cost, and interface to support HTS devices in commercial applications. Coolers of the new Flexibly-Attached Remote (FAR) acoustic-Stirling type, first achieved in Phase II at capacities sufficient for utility-scale HTS device cooling, can do so. The project will address cost reduction, minor design updates to better match changed superconductor cooling targets, capacity improvements, and user familiarization to advance from laboratory prototypes to market acceptance and commercial implementation. **DOE Funding: $620,000**

FieldMetrics, Inc. (Seminole, Fla.) - A Low-Cost Modular Optical Voltage Sensor for Power Transmission Applications. Because investment in the United States power grid infrastructure has not kept pace with increased energy demands, existing power lines must operate close to conservative safety limits. Advanced instrumentation can simultaneously improve efficiency and maintain reliability by enabling accurate, real-time information. A low-cost modular optical voltage sensor has been designed for deployment on power lines

over the full range of distribution and transmission voltages. The modular sections can be produced in high volume using advanced manufacturing techniques to dramatically reduce the cost compared to conventional equipment. The project will test field-ready hardware and provide the sensors to utilities for field trials. **DOE Funding: $500,000**

Infinia Corporation (Kennewick, Wash.) - Innovative High-Efficiency Maintenance-Free Cryocooler to Support High Temperature Superconductor (HTS) Commercialization. Cryocoolers that provide high capacity, high reliability, high efficiency, and long life with little or no maintenance are essential for high temperature superconductivity (HTS) market development. Cryocoolers maintain the low temperatures needed for HTS power transmission; HTS cables can provide three to ten times the electricity-carrying capacity of conventional cables. Infinia's innovative Multi-Cylinder Cryocooler addresses commercial needs in a very cost-effective manner due to a unique integration of Infinia's proven long life, high reliability, maintenance-free technology with its patented high capacity Stirling cycle configuration. This grant will produce refined second and third generation units that could culminate in a real world field demonstration at an HTS installation. **DOE Funding: $1,500,000**

Infotility, Inc. (Boulder, Colo.) - Commercializing the GridAgents Suite: Photovoltaics Integration Plus (PVI+) Software. The proposed PVI+ software will enable adaptive, self healing distribution networks and optimized microgrids by responding rapidly at local levels to safely and seamlessly integrate distributed resources, such as photovoltaics and plug-in electric vehicles, into grid operations. Benefits include accelerated adoption and increased penetration of distributed renewables, increased distribution system reliability, and improved asset utilization within the distribution system. The project includes an R&D phase, followed by demonstrations and commercialization. **DOE Funding: $500,000**

Underground Systems, Inc. (Armonk, N.Y.) - Low Cost Real Time Monitoring System for Overhead Transmission. This project will bring to commercial readiness the PowerDonut3^{TM} (PD3), a robust intelligent transmission and distribution (T&D) sensor that monitors and manages disturbance events in T&D systems. PD3 has the capability to improve the power delivery of existing power transmission systems, especially where variable output, renewable generation is involved. The project will conduct a large scale demonstration evaluation of the PD3 system, integrating wind, hydro and thermal renewables, and will develop a visualization system and performance dashboard for system operators. The final system will be refined using actual field results and packaging for commercial applications. **DOE Funding: $480,000**