CHANGING WHAT'S POSSIBLE

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PROJECT DESCRIPTIONS

Centralized Generation

Aquanis, Inc. – East Greenwich, RI

Active Aerodynamic Load Control for Wind Turbines – $3,515,113

Aquanis will develop advanced plasma actuators and controls to reduce aerodynamic loads on wind turbine blades, facilitating the next generation of larger (20+ MW), smarter wind turbines. The technology contains no moving parts, instead using purely electrical plasma actuators on the blade that set the adjacent air in motion when powered. This system can change the lift and drag forces on wind turbine blades, to reduce blade mechanical fatigue and enable the design of larger and cheaper blades. Currently effective at laboratory scales, Aquanis plans to improve the plasma actuator capabilities and field test a much larger prototype system on a wind turbine.

University of Illinois Urbana-Champaign – Champaign, IL

Megawatt-Scale Power-Electronic-Integrated Generator with Controlled DC Output – $2,056,280

The University of Illinois Urbana-Champaign aims to create the world's most efficient, reliable, and compact wind energy conversion system. Instead of following the traditional approach of building the electrical generator separately from the power electronics converter and then connecting both to convert the turbine's mechanical power into electrical power, the team will concurrently design (co-design) the generator and converter to substantially reduce the size and weight of the system. The expected results are a significant reduction in the cost of the turbine's main structures (i.e., tower, nacelle, foundation), and an increase in turbine efficiency and reliability.

Zap Energy, Inc. – Seattle, WA

Electrode Technology Development for the Sheared-Flow Stabilized Z-Pinch Fusion Reactor – $6,767,334

Zap Energy will advance the fusion performance of the sheared-flow stabilized (SFS) Z-pinch fusion concept. SFS Z-pinch drives electrical current through a plasma to create magnetic fields that compress and heat the plasma toward fusion conditions. Under this project, the team will raise the electrical current, reduce physics risks relating to plasma stability and confinement, and develop the electrode technology and plasma-initiation techniques necessary to enable the next steps toward a functional SFS Z-pinch fusion power plant. This could provide nearly limitless, on-demand, emission-free energy with negligible fuel costs.

Distributed Generation

Arizona State University – Tempe, AZ

Sensor Enabled Modeling of Future Distribution Systems with Distributed Energy Resources – $2,800,000

Arizona State University will develop learning-ready models and control tools to maintain sensor-rich distribution systems in the presence of high levels of distributed energy resources (DER) and storage. The approach will include topology processing algorithms, development of load and DER models for system planning and operation, distribution system state estimation, optimal DER operational scheduling algorithms, and system-level DER control strategies that leverage inverter controls' flexibility. The project will alter distribution system operation from today's reactive, load-serving, and outage mitigation-focused approach to an active DER, load, and outage-managed, market-ready approach.

Georgia Tech Research Corporation – Atlanta, GA

Resilient, Cyber Secure Centralized Substation Protection – $2,351,000

Georgia Tech Research Corporation will design an autonomous, resilient and cyber-secure protection and control system distributed to each power plant and substation on the grid. The technology will integrate protective relays into an intelligent protection scheme to validate grid data, detect hidden failures or cyberattacks, replace compromised data, and provide a full system report with minimal delay. This approach eliminates complex coordinated protection settings and transforms the protection practice into a simpler, intelligent, automated and transparent process. This solution corrects the effects of hidden failures, eliminates mismatched settings, and reliably detects unusual system faults, significantly advancing the path forward for grid reliability and management.

University of Michigan – Ann Arbor, MI

Overcoming the Technical Challenges of Coordinating Distributed Load Resources at Scale – $2,800,000

The University of Michigan will develop load-control strategies to improve grid reliability in the face of increased penetration of distributed energy resources (DER) and low-cost renewable generation. As the electricity generation mix changes to include more renewables, load shifting is essential. Today, there are few load shifting strategies in use at grid scale capable of balancing current levels of renewable energy production. The team will develop three testing environments to identify issues the grid faces if it is to integrate increased levels of energy from renewable generation and test their network-aware, non-disruptive load control approaches. This method could improve credibility for load-control mechanisms at scale and lower costs to power providers and consumers alike.

Electrical Efficiency

Harvard University – Cambridge, MA

GaN NMR Spectrometer Integrated Circuits towards Broadly Distributed On-line Monitoring and Management of Subsurface Oil/Gas Reservoirs and Downstream – $1,683,819

Harvard University will develop miniaturized nuclear magnetic resonance (NMR) electronics to provide detailed information on composition and environment in subsurface oil exploration and production. NMR is most commonly found in magnetic resonance imaging (MRI) machines, and the electronics are extremely large and unwieldy to apply to field use. By building their device with gallium-nitride-based (GaN) circuitry, the team seeks to greatly miniaturize the NMR system and enable it to withstand the high temperatures found in a deep drill hole. The miniature NMR system, which will combine the GaN circuits and a permanent magnet, can be far more broadly disseminated throughout geological formation, enabling long-term distributed imaging of Earth's subsurface and transforming oil discovery and production across mature fields, deep water fields, and unconventional oil/gas reservoirs.

Hewlett Packard Enterprise – Palo Alto, CA

Ultra-Energy-Efficient Integrated DWDM (Dense Wavelength Division Multiplexing) Optical Interconnect – $3,506,711

Hewlett Packard Labs will develop a low-energy consumption, ultra-efficient, high-speed technology for transmitting data as light in high-performance computing systems and data centers. The team will combine recent breakthroughs in low-cost laser manufacturing technology and ultra-efficient photonic tuning technology with their established in-house technology platform. It will demonstrate a fully integrated optical transceiver capable of sending data faster than 1,000 gigabytes per second over 40 simultaneous channels, even in rigorous practical operating conditions with widely varying temperatures.

Qromis, Inc. – Santa Clara, CA

P-Type Gallium Nitride Doping by Controlled Magnesium Diffusion – $773,368

Qromis Inc. will develop improved fabrication methods for gallium nitride (GaN), ultimately enabling higher-performing, manufacturable, and scalable GaN power devices. One of the greatest challenges facing GaN device production today is selectively fabricating p-type regions on the surface of the semiconductor. The team seeks to improve this process using magnesium (Mg) diffusion, in which molecules move from an area of high concentration to a lower one. In particular, Qromis seeks to understand what controls Mg diffusion in order to better leverage the phenomenon for the production of high-performance GaN devices. If successful, the Qromis team hopes to accelerate the adoption of GaN power devices in power conversion circuits.

Sonrisa Research, Inc. – Santa Fe, NM

A New Class of SiC Power MOSFETS with Record-Low Resistance – $1,369,282

Sonrisa Research will develop a new class of power transistors using silicon carbide (SiC), a semiconductor material that can handle higher voltages, frequencies, temperatures, and power levels than the state-of-the-art silicon with greater reliability. The project team will use the Fin-Type Field-Effect Transistor (Fin-FET) geometry popular in advanced silicon integrated circuits, but in a different configuration to meet the needs of high-power applications like powering electric vehicles, efficient motor drives and power supplies, connecting wind and solar farms to the grid, and supplying large data centers that process information on the Internet.

Stanford University – Stanford, CA

Exploring the Limits of Cooling for Extreme Heat Flux Applications: Data Centers and Power Electronics – $1,302,264

Stanford will develop a novel cooling technology, the Extreme Heat Flux Micro-cooler, to improve reliability and performance in power electronics. The cooler employs a novel liquid wicking, thin-film evaporator, with microchannels to route liquid and extract vapor. This significantly increases heat flux thereby reducing device temperature. The novel design could enable ten times more heat transfer than today's state-of-the-art cooling technologies. Improved cooling devices could greatly increase efficiency, reliability, and performance for microprocessors and power electronics and therefore reduce energy-related emissions such as greenhouse gases.

State University of New York Polytechnic Institute – Albany, NY

Smart SiC Power Integrated Circuits (Scalable, Manufacturable, and Robust Technology for SIC Power Integrated Circuits) – $2,103,459

The State University of New York Polytechnic Institute will develop a scalable, manufacturable, and robust technology for silicon carbide (SiC) power integrated circuits. These devices open the door to myriad high-performance energy applications, including automotive, industrial, electronic data processing, and energy harvesting. The team will develop highly scalable SiC integrated circuits and support devices, establish a manufacturable process, and demonstrate the devices' functionality.

University of California-Santa Barbara – Santa Barbara, CA

FRESCO: Frequency Stabilized Coherent Optical Low-energy Wavelength Division Multiplexing (WDM) DC Interconnects – $3,750,000

The University of California-Santa Barbara will develop a low power, low-cost solution to overcome power and bandwidth scaling limitations presented by the emergence of hyperscale data centers and related exponential growth in global data traffic. The FRESCO transceiver leverages recent advances in fundamental laser physics to enable terabit, coherent optical (light-based) data transmission inside data centers using an ultra-pure and ultra-stable laser signal. The outcome of the project will be an integrated photonic package capable of connecting to 100 terabit-per-second networking switches over coherent optical short-reach data center fiber links. This effort could disrupt the way data centers, data center interconnects, and terabit Ethernet switches are built, drastically reducing their global energy consumption.

University of Colorado Boulder – Boulder, CO

Nanomanufacturing of Nanophononic Devices: Ultra-High ZT Thermoelectrics for Efficient Conversion of Waste Heat – $2,500,000

The University of Colorado Boulder aims to revolutionize thermoelectrics, semiconductor devices that convert heat flow into electricity without moving parts or emitting pollutants, by creating a "nanophononic" thermoelectric device. This concept relies on a newly discovered phenomenon where tiny structures added to a thin solid membrane's top and bottom slow the flow of heat down the membrane by atomic vibrations (phonons). The device will convert waste heat to electricity at twice the efficiency of today's best thermoelectric devices. Since 60% of energy generated globally is wasted as heat, project success should significantly lower fuel consumption, energy costs, and global emissions. The research is conducted in collaboration with National Institute of Standards and Technology and Colorado School of Mines.

Grid

Sandia National Laboratories – Albuquerque, NM

Transformers for a Modernized Grid – $1,200,000

Sandia National Laboratories will develop advanced core materials for grid-level electrical transformers, improving efficiency and resiliency. Current transformers feature copper windings surrounding a magnetic core that amplifies the magnetic field generated by the coil, but at the expense of energy losses. The project team's new core material seeks to increase electrical efficiency by at least 10% while enabling a 50% reduction in transformer size. The core will be robust, withstanding electromagnetic pulses (EMPs) and geo-magnetic disturbances (GMDs) that threaten today's grid. Sandia will also develop a revolutionary polymer additive for transformer oil that transitions to a heat-conducting solid at high temperatures. This polymer can be added to existing transformers as a retrofit and included in new transformer oil. By dramatically increasing heat conduction away from transformer windings (coils) during high-current events, the resiliency of transformers to EMP and GMD will be increased.

Siemens Corporation Corporate Technology – Princeton, NJ

Renew100 - Reliable Power System Operation with 100% Renewable Generation – $3,000,000

Siemens Corporation Corporate Technology will develop an operator support system and grid planning functionality able to function with 100% renewable generation, a scenario currently unattainable as today's power systems require at least 25% of power to be supplied by synchronous generators. ReNew100 features automatic Controller Parameter Optimization (CoPO) and model calibration technologies that help ensure power system reliability as the generation mix changes. Successful test results will be a milestone toward the goal of a power system with more than 30% renewable energy generation from wind and solar over a year.

University of Minnesota – Twin Cities, MN

Rapidly Viable Sustained Grid – $3,864,840

The University of Minnesota (UMN) will develop a net-load management framework that rapidly identifies neighborhood-units to support grid infrastructure and enable ultrafast coordinated management. UMN's project will rethink power recovery from near blackout conditions with a focus on rapid energization and maximizing power duration. This approach could fundamentally change the way large contingencies are managed. It would transition power systems and critical infrastructure transition from fragile to robust using intelligent, self-organizing control for coordinated resources, enhanced resiliency and increased use of renewable energy sources. The communication and control layer coupled with rapid decision-making methods for managing local sources and loads will coordinate power resources and leverage renewable energy sources to support the grid in contingencies such as failure of aging infrastructure or catastrophic weather events.

University of Wisconsin-Madison – Madison, WI

A Persistence Meter for Nimble Alarming Using Ambient Synchrophasor Data – $648,396

The University of Wisconsin-Madison will develop an online monitoring tool to assess the stability of the power grid. The tool will determine options to increase grid stability as well as detect and isolate forced oscillations, which are often indicative of faulty control actions at plants and can be potentially dangerous if they excite a natural mode of the system. To accomplish this, the team will fine-tune the underlying computations, develop alarm and notification procedures, and design a user-friendly and practical tool interface. This approach could dramatically transform grid stability monitoring by increasing system confidence and economic efficiency in a nearly $400 billion U.S. industry.

Grid Storage

Massachusetts Institute of Technology – Cambridge, MA

Thermal Energy Grid Storage (TEGS) Using Multi-Junction Photovoltaics (MPV) – $1,500,000

The Massachusetts Institute of Technology (MIT) is developing key components for a new, cost-effective system with high efficiency to store electricity from renewables at the grid level and discharge it on demand. The system combines low-cost, very high-temperature energy storage with high-efficiency, innovative semiconductor converters used to transform heat into electricity. MIT's technology would store heat at temperatures above 2000°C (3600°F) and convert it to electricity using specialized photovoltaic cells designed to remain efficient under the intense infrared heat radiated from a high-temperature emitter. MIT will also develop several key balance of plant components that will enable the stable operation of the system for long periods of time without any discernable losses in conversion efficiency.

Southwest Research Institute – San Antonio, TX

Grid-Scale Electricity Storage at Lowest Possible Cost: Enabled by Pumped Heat Electricity Storage – $2,000,000

Southwest Research Institute (SwRI) is developing an advanced pumped heat electricity storage system based on a novel thermodynamic cycle to store energy in hot and cold fluids. This large energy storage system will help integrate renewables with the electric grid. This technology relies on system simplification, high round-trip conversion efficiencies, and low plant costs to surpass existing state-of-the-art energy storage technologies. At full scale the technology would provide more than 10 hours of electricity at rated power. SwRI will build a small kW-scale electric demonstrator to validate this novel technology.

Manufacturing Efficiency

Colorado School of Mines – Golden, CO

Efficient Hydrogen and Ammonia Production via Process Intensification and Integration – $2,047,676

The Colorado School of Mines will develop a more efficient method of generation of high purity hydrogen from ammonia for fuel cell fueling stations. Used primarily as a fertilizer, ammonia is the world's highest volume commodity chemical. Having 17.6% hydrogen, it also shows potential as a hydrogen carrier and carbon-free fuel. The team will develop a new technology to generate fuel cell quality hydrogen from ammonia using a membrane based reactor. The similar technology will be also developed for synthesis of ammonia from nitrogen and hydrogen at reduced pressure and temperature.

Otherlab, Inc. – San Francisco, CA

Hydraulically Actuated Near-Isothermal Compressor – $500,000

Otherlab is developing a gas compressor that has the potential to use 40% less energy than state-of-the-art devices. Their compressor will employ a highly conductive, high-surface-area heat exchanger to achieve a near-isothermal compression process. During this effort, Otherlab seeks to demonstrate the thermodynamic performance of its concept in a prototype device. If successful, Otherlab's concept has the potential to offer compelling energy efficiency benefits in many major industrial sectors.

Palo Alto Research Center, Inc. – Palo Alto, CA

Electrochemical Ammonia Synthesis with a Nitride Ion Conducting Electrolyte – $1,286,018

Palo Alto Research Center (PARC) will develop an ammonia generator capable of using intermittent energy delivered by renewable sources. The team will build an electrochemical device based on a solid-state electrolyte that converts nitrogen from the air and hydrogen to ammonia in a single step at temperatures and pressures far lower than today's dominant ammonia production technology, the Haber-Bosch process. The system will be modular and readily scalable, decoupling production scale from price and allowing it to produce ammonia for diverse customers, from industry to farms and beyond.

Syzygy Plasmonics, Inc. – Houston, TX

Photocatalytic Ammonia Decomposition for Hydrogen Production – $750,000

Syzygy Plasmonics will develop a system that uses light to catalyze reactions inside a traditional chemical reactor. The team will construct a reactor that can be used for small-to-medium-scale generation of fuel cell quality hydrogen from ammonia, to be incorporated into existing infrastructures like hydrogen refueling stations for fuel cell vehicles. By using light instead of heat to drive the ammonia decomposition, the reactor can keep temperatures much lower, which reduces energy consumption, carbon emissions, and operational and capital costs while enhancing flexibility.

Via Separations – Cambridge, MA

Scalable Graphene Oxide Membranes for Energy-Efficient Chemical Separations – $2,850,000

Via Separations will develop a novel membrane made from highly robust sheets of graphene-oxide, a material known for its mechanical strength and relative thermal stability, to replace energy-intensive conventional industrial chemical separation processes. The team will demonstrate cost-effective, highly selective and high-throughput membranes for chemical separations where polymer membranes are incompatible. When implemented at scale, these membranes could reduce the energy consumption of industrial separations processes by up to 90%, reduce total costs by 50%, and reduce carbon dioxide (CO2) emissions by more than a gigaton.

Transportation Energy Conversion

Achates Power, Inc. – San Diego, CA

Highly Efficient Opposed Piston Engine for Hybrid Vehicles ("HOPE-Hybrid") – $2,000,000

Achates Power will develop an opposed-piston engine suitable for hybrid electric vehicle applications, using a unique engine design that minimizes energy losses typical in conventional internal combustion engines. A motor-generator integrated on each engine crankshaft will provide independent control to each piston and eliminate all torque transmitted across the mechanical crankshaft connection, thus reducing engine size, mass, cost, friction, and noise. The application of high-bandwidth power electronics will further improve engine efficiency through the real-time control of the piston motion and combustion process. If successful, the proposed technology will offer light- and heavy-duty vehicle manufacturers a cost-effective solution to improve vehicle fuel efficiency and reduce transportation carbon dioxide (CO_2) emissions.

Advanced Magnet Lab, Inc. – Melbourne, FL

Homopolar Machines Enabled with Brushless Field Electron Emission Current Transfer – $541,184

Advanced Magnet Lab (AML) is developing a reliable, contact-free current transfer mechanism from a stationary to a rotating electrode to allow direct current (DC) electrical machines, motors, and generators to achieve unprecedented power and torque density. This technology, a reimagining of the first electric "homopolar" motor invented by Michael Faraday, would provide current transfer without the need for the costly sliding contacts, brushes, and liquids that have limited DC electrical engine efficiency and lifetime. AML's contact-free current transfer would achieve 99% efficiency in DC electrical motors with 5-10 times the power and torque densities available in existing DC technologies.

Georgia Tech Research Corporation – Atlanta, GA

High Power Density Compact Drive Integrated Motor for Electric Transportation – $2,982,389

Georgia Tech will develop a new approach to internally cool permanent magnet motors. The technology could dramatically improve electric motors' power density and reduce system size and weight. To do so, the team will integrate the motor and drive electronics into a unique system packaging incorporating an embedded advanced thermal management system. They will also develop wide bandgap power electronics packaging to enable high-power density operations at higher temperature. The new design could substantially increase the power and torque density above the state of the art and enable more energy-efficient electric trucks, buses, and, potentially, aircraft.

Ecolectro, Inc. – Ithaca, NY

Modular Ultrastable Alkaline Exchange Ionomers to Enable High-performance Fuel Cells and Electrolyzer Systems – $1,700,000

Ecolectro is developing alkaline exchange ionomers (AEIs) to enable low-cost fuel cell and electrolyzer technologies. Ecolectro's AEIs would be resilient to the harsh operating conditions present in existing alkaline exchange membranes that prevent their widespread adoption in commercial applications. This technology would be simple, cost effective, and well-suited to large-scale processing. Further, Ecolectro's AEIs would demonstrate comparable durability and improved efficiency over state-of-the-art proton exchange membranes.

Ionic Materials, Inc. – Woburn, MA

Novel Polymer-enhanced Rechargeable Aluminum-Alkaline Battery Technology – $2,000,000

Ionic Materials will develop a more energy dense (by volume and mass) rechargeable battery based on an aluminum-alkaline chemistry. At the center of Ionic Materials' innovation is a new polymer-based material that suppresses the formation of unwanted chemical products that prevent aluminum-alkaline batteries from recharging. Aluminum is highly abundant in earth's crust and costs much less than cobalt, nickel, and lithium, key elements in today's state-of-the-art batteries. Aluminum-alkaline chemistries are also inherently safer than lithium ion, making them appropriate for use in electric vehicle and residential applications.

Lawrence Berkeley National Laboratory – Berkeley, CA

Metal-Supported SOFCS for Ethanol-Fueled Vehicles – $3,170,000

Lawrence Berkeley National Laboratory is developing a metal-supported solid oxide fuel cell (MS-SOFC) stack that produces electricity from an ethanol-water blend at high efficiency to enable light-duty hybrid passenger vehicles. Current LBNL MS-SOFCs can heat up from room temperature to their ~700°C operating temperature in seconds without thermal expansion cracking and tolerate rapid temperature changes during operation, and are mechanically rugged. However, they currently operate using ethanol fuel, converted into hydrogen and carbon monoxide prior to entering the fuel cell in a process called reforming. The team will adapt these MS-SOFCs to handle liquid ethanol-water fuel directly, while maintaining their high performance and durability, and will tackle challenges around assembly of cells into stacks to increase power output.

Pinnacle Engines – San Carlos, CA

Design and Demonstration of an Electrification-Enabled Full-Featured Opposed Piston 4-Stroke Engine for Hybrid and Range Extender Applications – $8,000,000

Pinnacle Engines will electrify its four-stroke, spark-ignited, opposed-piston engine to improve fuel efficiency and reduce its cost. Electric motor-generators on each crankshaft will improve engine efficiency by modifying the piston dynamics and resulting combustion process. In addition, Pinnacle will employ high rates of exhaust gas recirculation and a low temperature combustion strategy, which will improve knock tolerance and reduce heat loss, pumping work, and NO_x emissions. Pinnacle's proposed technology will reduce fuel consumption beyond that of state-of-the-art series hybrid electric vehicles.

Sila Nanotechnologies, Inc. – Alameda, CA

Drop-In Replacement Materials from Abundant Resources to Double Energy in EV Batteries – $3,100,000

Sila Nanotechnologies will develop a class of drop-in cathode replacement materials to double the energy stored in lithium-ion batteries, the most popular battery chemistry used in a wide range of applications, including electric vehicles. The Sila team will replace conventional nickel and cobalt-based cathode materials approaching their theoretical performance limits with new materials in a nanostructured composite that greatly increases the battery's energy density. Sila Nanotechnologies will pair their new cathode material with a silicon-based anode, enabling the battery to outperform current lithium-ion cells while using existing cell assembly infrastructures to reduce cost and the risk of technology adoption.

Los Alamos National Laboratory – Los Alamos, NM

Stable Diacid Coordinated Quaternary Ammonium Polymers for 80-230 °C Fuel Cells – $2,900,000

Los Alamos National Laboratory will develop polymer fuel cells that produce electricity for electric vehicles in the low to intermediate temperature range of 80-230 °C without first warming and humidifying the incoming fuel stream. The team's concept uses a new polymer-based membrane design that provides high conductivity across a wide temperature range, simplifying the system components necessary to keep the cell running effectively, and streamlining design and reducing costs. Developments from the project may be useful for other energy conversion technologies, such as ammonia production and high-temperature direct liquid fuel cells.

University of California, San Diego – La Jolla, CA

Low-Cost, Easy-to-integrate, and Reliable Grid Energy Storage System with 2nd Life Lithium Batteries – $1,894,705

The University of California, San Diego (UC San Diego) is developing a universal battery integration system that utilizes second-life batteries from electric vehicles. Over the next decade, millions of electric vehicle batteries will be retired worldwide. These batteries can be utilized in a "second life" to provide inexpensive stationary storage for homes, businesses, and the electricity grid. It is challenging, however, to combine batteries with different ages and usage histories. In this project, UC San Diego will develop a modular power converter matrix to control power flow to connected battery modules. UC San Diego will also incorporate advanced life cycle control modeling and optimization algorithms to condition batteries for resale and create a scalable, low-cost stationary storage system.

University of Delaware – Newark, DE

Advanced Alkaline Membrane H2/Air Fuel Cell System with Novel Technique for Air CO_2 Removal – $1,979,998

The University of Delaware team will develop a hydroxide exchange membrane fuel cell capable of using the oxygen in ambient air—in addition to hydrogen—as one of its inputs. This method eliminates a significant barrier to using such cells in transportation applications, when carrying oxygen onboard the vehicle or scrubbing carbon dioxide from air is impractical. The team will build an electrochemical "pump," based on a special membrane, to remove efficiently cell-damaging CO_2 from the ambient air stream without limiting system performance. The same principle could be applied to direct carbon capture from air for any system with excess reductant.

Vanderbilt University – Nashville, TN

Bipolar Membranes with an Electrospun 3D Junction – $965,000

The Vanderbilt University team will develop a new membrane featuring a three-dimensional water splitting or water formation junction region, prepared by an electrospinning process. The team's membrane will require significantly lower voltages than conventional ones to operate electrochemical cells, and it will increase efficiency thanks to its 3D fiber networks. The membranes will be useful in electrodialysis, electrolysis, and fuel cell applications.

Transportation Fuels

Kampachi Farms, LLC – Kona, HI

KRUMBS–Kyphosid Ruminant Microbial Bioconversion of Seaweeds – $3,341,894

Kampachi Farms will develop a new, highly efficient process for the conversion of marine macroalgae seaweeds into a variety of bioproducts, including biofuels. The team will work with its partners to isolate, optimize and deploy microbial consortia and individual microorganisms capable of rapidly digesting macroalgal biomass in a highly scalable way. The technology is intended to leverage domestic marine biomass resources to reduce the need for imported energy and significantly lower greenhouse gas emissions relative to traditional petroleum derived fuels and products.

Transportation Vehicles

University of Maryland – College Park, MD

Superstrong, Low-cost Wood for Lightweight Vehicles – $3,600,000

The University of Maryland will further develop its "super wood" approach to replace steel in the automotive industry. Over three years, the project will improve super wood's properties to achieve the ability to withstand pressure of 1 gigapascal (or 145,038 pounds per square inch), and meet the requirements of a low-cost automotive structural material. The super wood could reduce vehicle manufacturing costs by 10-20% and manufacturing energy by up to 80% on a component level and by about 28% on a vehicle level.

Supercool Metals, LLC – New Haven, CT

Thermoplastic Forming of Bulk Metallic Glasses for Energy Efficiency in Transportation – $3,323,373

Supercool Metals LLC will explore manufacturing processes for lightweight structural metal parts to enable more energy-efficient transportation. Lightweighting is a necessity for the automotive and aerospace industries, and increasingly important for the transition to hybrid and fully electric vehicles. Bulk metallic glasses (BMGs), which will be used, are complex alloys with significantly higher mechanical properties (e.g., strength, toughness, corrosion resistance) than conventional alloys. Supercool Metals will explore possibilities for commercial thermoplastic forming-based processes focused on blow molding lightweight BMG. This approach will improve energy efficiency during manufacturing and in service, as BMGs enable lightweighting opportunities and advanced design concepts.