Back-up Documentation for Business Meeting November 14, 2012

EISG Program Solicitation 11-02, 11-02G, 11-02TE, 11-02TNG

TRUSTEES OF THE CALIFORNIA STATE UNIVERSITY. Possible approval for the eighteen grant proposals totaling $1,508,507 from the four solicitations of the Energy Innovations Small Grant (EISG) Solicitation 11-02 (Electricity), 11-02 G (Natural Gas), 11-02TE (Transportation Electricity) and 11-02TNG (Transportation Natural Gas) programs. These grants were competitively selected and are capped at $95,000. Contact: Raquel Kravitz. (10 minutes)

List of recommended grants are:

1. Electrical (11-02E)
Eleven Proposals recommended for funding valued at $934,091

Project Title: Adaptive Power Flow Controls for Distribution Circuits with Renewables
Principal Investigator: Hen-Geul Yeh, California State University, Long Beach, CA
Rank: 1
Amount: $49,999
Project Summary: To perform a feasibility study by designing and developing an adaptive control scheme for distribution circuits with renewable energy generators, such as Photo Voltaic (PV) cells. The intermittency and rapid fluctuation of renewable power output require the design of advanced volt-ampere reactive (VAR) control schemes in smart grid distribution systems. Renewable generators, such as PV cells, throughout a distribution circuit result in real power injections to the system that can cause power system problems such as loss of proper voltage regulation when PV penetration level gets high enough. The DC/AC inverters that connect PV cells, wind turbines, or batteries to the grid can serve as additional controllers because they can pull or push reactive power at a much faster timescale and with much finer resolution than current technologies such as shunt capacitors and load tap changers.

Project Title: Wireless Sensors for Underground Electricity Cables
Principal Investigator: Ryan Hanley, SmartSense Energy, Inc., San Francisco, CA
Rank: 2
Amount: $95,000
Project Summary: To determine the feasibility of a first-in-class sensing solution for electric utilities' underground cable networks. This solution will enable low-cost fault detection, condition-based maintenance and performance monitoring on an underserved but critical portion of the grid. This project aims to introduce the first sensors that both *predict* and *detect* underground faults using micro-scale sensors. While competitors currently offer underground faulted circuit indicator sensors that detect faults, none have developed the ability to predict faults before they occur. With this improved sensing capability, utilities could design changes to

their networks more efficiently, plan grid reinforcements more accurately, and prioritize costly underground cable replacements.

Project Title: Development of a Low Leakage Retrofittable Outside Air Damper
Principal Investigator: David Springer, Davis Energy Group, Inc., Davis, CA
Rank: 3
Amount: $75,000
Project Summary: To create a reliable, low leakage, low pressure drop outside air "vent" damper for use with residential cooling systems. The improved damper technology will serve to improve performance, reliability, and installation process; facilitate compliance with Title 24 standards requirements; and reduce cost and improve cost-effectiveness. This project focuses on the damper only which will reduce airflow and minimize damper air leakage.

Project Title: Proof-of-Concept Solar Energy Converter using Internal-Photoemission and Plasmonic Perfect Absorbers
Principal Investigator: Bala Krishna, Pacific Integrated Energy, Inc., San Diego, CA
Rank: 4
Amount: $94,328
Project Summary: To determine the feasibility of a metal-semiconductor Schottky diode geometrically configured to form a meta-material that acts as a near perfect absorber of light to aid Photo Voltaic (PV) cells. Standard PV cells use semiconductors to absorb light, create free-carriers, separate them with built-in electric field and transport those carriers to generate power. Perfect absorbers absorb light more efficiently. This project will be the first combination of internal photoemission and perfect absorption which should create an optimized energy producing device operating at visible wavelength. If successful, this device will create a new class of solar cell.

Project Title: Fast Demand Response and Energy Efficiency using Duct Pressure
Principal Investigator: David S. Watson, Individual, San Anselmo, CA
Rank: 5
Amount: $95,000
Project Summary: To determine the feasibility, costs and benefits of a wireless Pressure Optimization System to provide dispatchable fast-acting Demand Response and ongoing energy efficiency, while assuring proper air flow and comfort to occupants of medium and large commercial buildings. Most variable air volume (VAV) systems consist of a single duct air static pressure sensor that is set by a technician to meet design air flow conditions. These duct systems are frequently over-pressurized. This results in wasted fan energy. Though there have been many attempts to find a solution, most have not gone beyond the demonstration phase. This project will measure and dynamically adjust the fan duct static pressure so that the variable speed drive supply fan will meet the needs of the VAV system with the highest demand.

Project Title: Non-Optical Concentration of Solar Energy for Low Cost Rooftop CHP
Principal Investigator: Jeffrey, Lee, Solar Stream Innovations, Chino Hills, CA
Rank: 6

Amount: $95,000
Project Summary: To determine the feasibility of using a vacuum insulated heat pipe to aggregate the small heat inputs of several evacuated tube insulated heat pipes into a single high temperature output in order to increase the heat-to-electricity conversion efficiency of a rooftop solar Combined Heating and Power system. Current evacuated tube solar collectors are designed to merely heat water and are not designed to sustain peak temperatures in a manner capable of constantly supplying high temperature heat for electricity generation. The proposed research will remove these limitations and further improve operating functionality. This will result in not only an improved solar collector capable of providing higher levels of water heating in the winter, but also a collector capable of enabling rooftop solar electricity generation. By enabling a low cost, rooftop installation and a single installed system can simultaneously produce heating and electricity for a structure. A Combined Heating and Power system will enable solar space heating in addition to the current state of mainly only water heating, as excess solar heat generated during the summer can be converted to electricity.

Project Title: Residential Energy Intelligence (Res-Intel-) Model
Principal Investigator: Hal T. Nelson, Policy Consultants, LLC, Claremont, CA
Rank: 7
Amount: $49,840
Project Summary: To develop residential electricity monitoring and demand analysis software that integrates multiple databases to identify space conditioning mechanical failures as well as increase the effectiveness and efficiency of residential demand side management programs. Current residential energy monitoring and demand analysis software either ignores vintage, end use intensity, and household income, or rely on customers to voluntarily “opt-in” to report these variables, creating information failures due to low participation rates for energy audits and web surveys. Residential Energy Intelligence (Res-Intel) Model is a cutting edge energy demand analysis tool that can maximize the effectiveness and efficiency of residential DSM (demand side management) programs, by using publicly available data to “lock-in” building data. No other software tools systematically harvest publicly available data, but instead rely on customer reported data which massively reduces participation in monitoring and demand analysis. Res-Intel can perform a statistical “mini” home energy audit for electricity monitoring and energy savings estimates.

Project Title: NOx Control with Hydrogen-Rich Biogas from Two-Phase Digestion
Principal Investigator: Rafael Jimenez-Flores, CA Polytechnic State University, San Luis Obispo, CA
Rank: 8
Amount: $94,924
Project Summary: To develop a low-cost NOx (Nitrous Oxide) control method by increasing the concentration of H2 (Dihydrogen) in the biogas stream through a two-phase anaerobic

digestion to strip H2. This project seeks to demonstrate a new and potentially low-cost method for reducing NOx emissions from small scale generators or boilers that use biogas. This gas can then be burned in common Internal Combustion engines with a decreased or eliminated reliance on high cost and high maintenance NOx removal technologies such as catalytic converters. Thermodynamics indicate that decreasing the dissolved H2 concentration in the first acid-phase digester will accelerate the generation of the H2 product.

Project Title: Task Ambient Daylighting
Principal Investigator: Erik Page, Erik Page & Associates, Inc., Fairfax, CA
Rank: 9
Amount: $95,000
Project Summary: To determine the feasibility of an innovative lighting controls system for daylight harvesting - a process by which electric lighting is automatically reduced when an adequate level of daylight is present. This novel Task Ambient Daylighting approach would base lighting controls on direct measurements of task plane illuminance, rather than indirect measurements and assumptions used by daylight harvesting systems currently on the market. Basing daylight harvesting on actual measured task-plane illuminance would yield systems that are more accurate and less complicated than traditional approaches, which could accelerate the market penetration of these energy-savings devices.

Project Title: Low-Cost, Ultra-Thick Electrode Batteries for Grid-Level Storage
Principal Investigator: Bryan Ho, Ballast Energy, Inc., Berkeley, CA
Rank: 10
Amount: $95,000
Project Summary: To determine the feasibility of using ultra-thick lithium-ion electrode plates to deliver long life, low cost, large capacity energy storage at below $150 per kilowatt hour for grid storage applications. Commercial and industrial users now pay more because of time-of-day electric pricing. Energy storage for electric grid using batteries saves money for users and increase reliability. Existing lead-acid battery storage suffers from short life and low energy density. Although sealed lithium ion batteries are longer lived and have high energy density, the individual batteries are too small and have low capacity. This project proposes to develop low cost, ultra thick electrode batteries.

Project Title: Real-Time Photovoltaic Cell Assessment Tool (RCAT) for Degradation Estimation
Principal Investigator: Abraham Ishihara, Modoc Analytics, LLC, Palo Alto, CA
Rank: 11
Amount: $95,000

Project Summary: To build a working prototype of a Real-time Cell Assessment Tool (RCAT) that can be used in the field to rapidly detect Photo Voltaic module degradation and failure. Critical to the economic viability and long term performance of large-scale solar arrays is the ability to detect faulty modules that may have degraded due to unanticipated environmental stresses. The key features of RCAT that enable detection and prediction of module performance in the field are: Actively controlled shading screen using Polymer Dispersed Liquid Crystal (PDLC) technology; Rapid IV data acquisition using a curve tracer; and Real-time system identification algorithms that leverage optimized asymptotic methods for rapid computation with minimal CPU cycles.

2. Natural Gas (11-02G)
Two Proposals recommended for funding valued at $189,895

Project Title: Renewable Energy Integrated Gas Network (REIGN)
Principal Investigator: Kevin E. Mahaffy, Protomatrix, Oak Hills, CA
Rank: 1
Amount: $94,989
Project Summary: To determine and demonstrate the feasibility of a high pressure air-compressing wind turbine using an innovative, hydraulic approach. This technology, called Renewable Energy Integrated Gas Network, or REIGN, is aimed at improving the efficiency of natural gas turbines to a calculated 75% by supplementing the system with compressed air generated by wind turbines and stored in underwater reservoirs. In the proposed system, air is compressed by a wind turbine and then stored until needed in an ocean-bottom based reservoir. This approach allows more of the energy from natural gas to be turned into electricity since natural gas is not being used to power a compressor. This technology has the potential to save natural gas in California, reduce emissions by approximately 550,000 tonnes of carbon dioxide per year, and enable savings in natural gas purchases of approximately $53 billion dollars per year.

Project Title: Advanced Bioreactor Recycling System for Producing Energy and Synthetic or Substitute Natural Gas (SNG)
Principal Investigator: Reinhard Seisser, University of California, San Diego, San Diego, CA
Rank: 2
Amount: $94,906
Project Summary: To determine the potential total methane (and other energy) production from an advanced anaerobic bioreactor which employs the concept of landfill material recovery for energy production enabling re-use of the bioreactor cell. In a bioreactor landfill, biodegradable material decomposes at a higher rate; methane production is accelerated; other fugitive gaseous emissions are limited and long-term monitoring and remediation may be simplified. The current proposal expands this concept by mining or reclaiming the residual material after anaerobic gas production has ended. At this point, the landfill mass can be recovered and residual carbon containing materials can be further converted to energy and fuels such as SNG. Plastics and much of the lignocellulosic materials are still present as they do not decompose readily by biochemical means. These materials can be further converted to energy and fuels by

methods such as gasification. This could allow the same bioreactor cells to be reused for new municipal solid waste.

3. Transportation Electrical (11-02TE)
Three Proposals recommended for funding valued at $194,589

Project Title: Analytic Tool to Support the Implementation of Electric Vehicle Programs
Principal Investigator: Andrew Burke, University of California, Davis, Davis, CA
Rank: 1
Amount: $50,000
Project Summary: This is a modeling project to develop an analytic tool that electric utilities, state, and local government can adopt to implement programs to support electric vehicles, including plug-in electric vehicles (PEV). This tool would compare the life-cycle cost of electric vehicles, costs within specific regions in California, and factors that affect the cost of owning plug in vehicles with other types of vehicles. This concept will fill the gap in estimating the marketability of PEVs and the full cost of PEVs. This information is not currently available at the level of analytical detail needed to readily identify target areas of PEV programs in specific regions in the state of California.

Project Title: Energy Efficient Vehicles Enabled by Thermo Electric Waste Heat Recovery
Principal Investigator: Andrew Miner, Romny Scientific, Inc., San Bruno, CA
Rank: 2
Amount: $94,691
Project Summary: To determine the feasibility of a new tubular energy generation module that reduces emissions and improves fuel economy in vehicles by converting exhaust heat into electricity. The proposed work will demonstrate a technology that can not only significantly increase the energy efficiency of vehicles in California, but can also be manufactured in a way to allow for broad adoption. The proposed module takes waste heat in a vehicle that is typically sent, unused, out the tail pipe and converts it into usable electricity. This electricity is produced by what is essentially a ‘free’ source of energy on the vehicle, and can then be used to charge the systems battery, power lighting, or run other auxiliary equipment. As a result, a vehicle’s load on the alternator is reduced, and system efficiency is increased.

Project Title: Potential Rooftop Photovoltaic Electricity for Sustainable Transportation in California
Principal Investigator: Roland Geyer, University of California, Santa Barbara, Santa Barbara, CA
Rank: 3
Amount: $49,898
Project Summary: To determine the technical feasibility of generating sufficient solar Photo Voltaic power for battery electric vehicles to meet local demand (vehicle miles traveled or VMT) in sustainable communities across California. Separate research studies on the three primary components of Solar Electric transportation: 1. solar insolation, 2. rooftop area per household

available for PV installation, and 3. driving patterns; has shown that all three vary with the location or socioeconomic characteristics of the communities. This study proposes to integrate these three separate themes to assess the potential capacity of distributed rooftop PV systems to meet community-scale demand for personal vehicle transportation across California.

4. Transportation Natural Gas (11-02TNG)
Two Proposals recommended for funding valued at $189,932

Project Title: Catalysis of Natural Gas for a Diesel Engine
Principal Investigator: David McCann, Discovery Fuel Technologies, LLC, Ventura, CA
Rank: 1
Amount: $95,000
Project Summary: To determine the feasibility of producing an Oxygenated fuel that will serve as the source of ignition and allow use of Natural Gas with a Diesel engine (compression ignition internal combustion engine). More efficient and affordable Natural Gas combustion can be achieved with existing Diesel engines. Discovery Fuel Technologies, LLC (DFT) will directly modify Natural Gas within the fuel system to produce an Oxygenated rich fuel stream that will allow use of Natural Gas with a Diesel engine. Natural Gas combustion at Diesel-like engine efficiencies will lead to a greater than 40% reduction in the cost of fuel, a greater than 40% reduction in harmful emissions (e.g., Nitrous Oxides, particulates, and Carbon Monoxide) and approximately 25% reduction in Carbon Dioxide production for California Ratepayers.

Project Title: Simultaneous Reduction of Nox/CO/CH4 Emissions from Natural Gas Engine, San Diego, CA
Principal Investigator: Robert Cattolica, the Regents of the University of California, UC San Diego.
Rank: 2
Amount: $94,932
Project Summary: To determine the feasibility of pollutant reduction from compressed natural gas (CNG) engines in a three-way catalyst using a novel control system. This project proposes a control system that maximizes the performance of three-way catalyst by monitoring the process on the catalyst conversion and preventing emission of Nox (nitrous oxide) or CO (carbon monoxide) during the lean or rich cycle. This will be accompanied by mounting real time sensor between two catalyst portion and monitoring when the conversion wave leaves the first catalyst and preventing escape from the second catalyst. It is expected that this will provide insight into Nitrous Oxide (Nox), Carbon Monoxide (CO) and Methane (CH4).