Overview of Solar Energy Grid Integration Systems Awards

DOE Solar Energy Technologies Program
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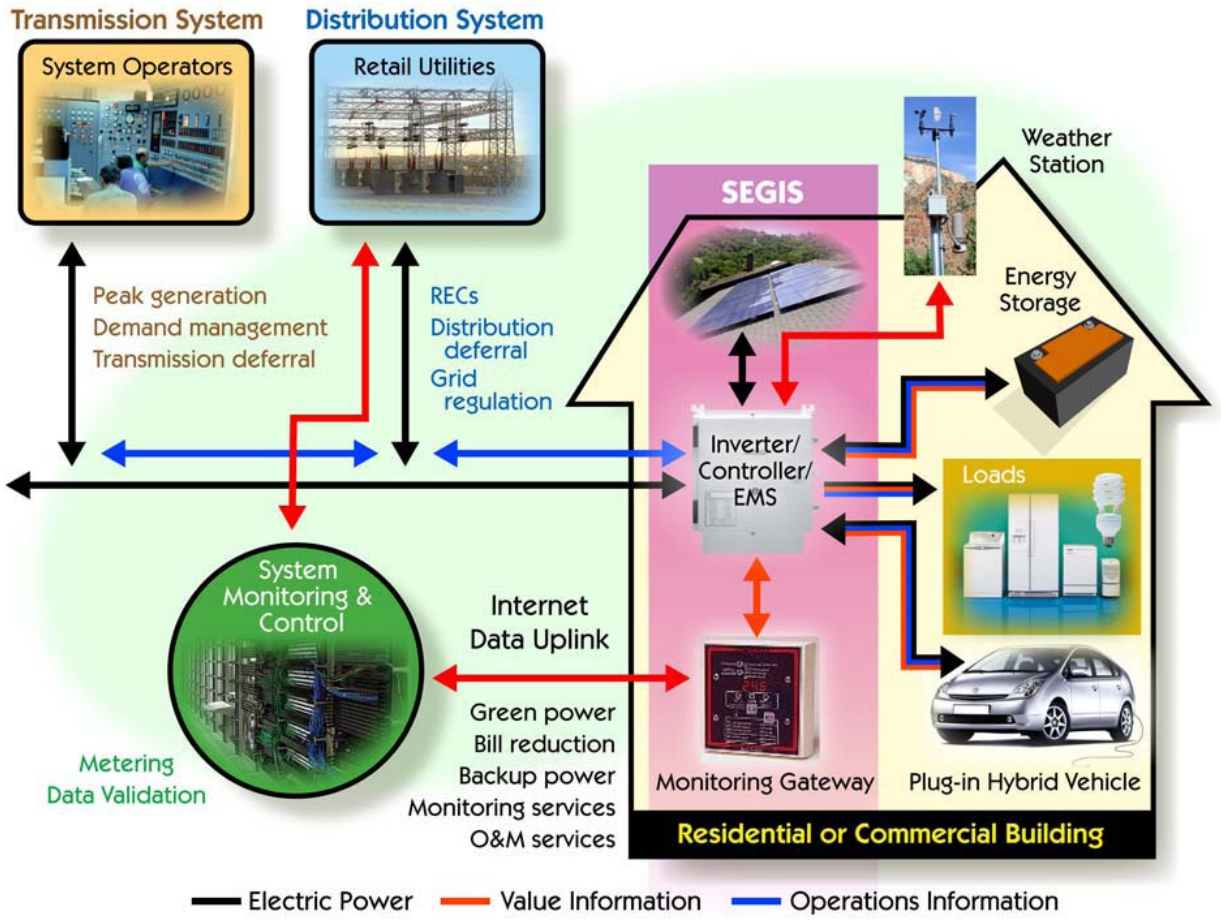
SEGIS Overview

- **SEGIS Embraces and Supports the DOE Solar Energy Technologies Program**
  - Solar America Initiative Technology Pathway Partnership (TPP) Agreements
  - The Renewable Systems Interconnection Program
  - The Revolutionary "Smart Grid" Development under the Office of Electricity Delivery and Energy Reliability's efforts
  - Energy Storage / Energy Management Programs

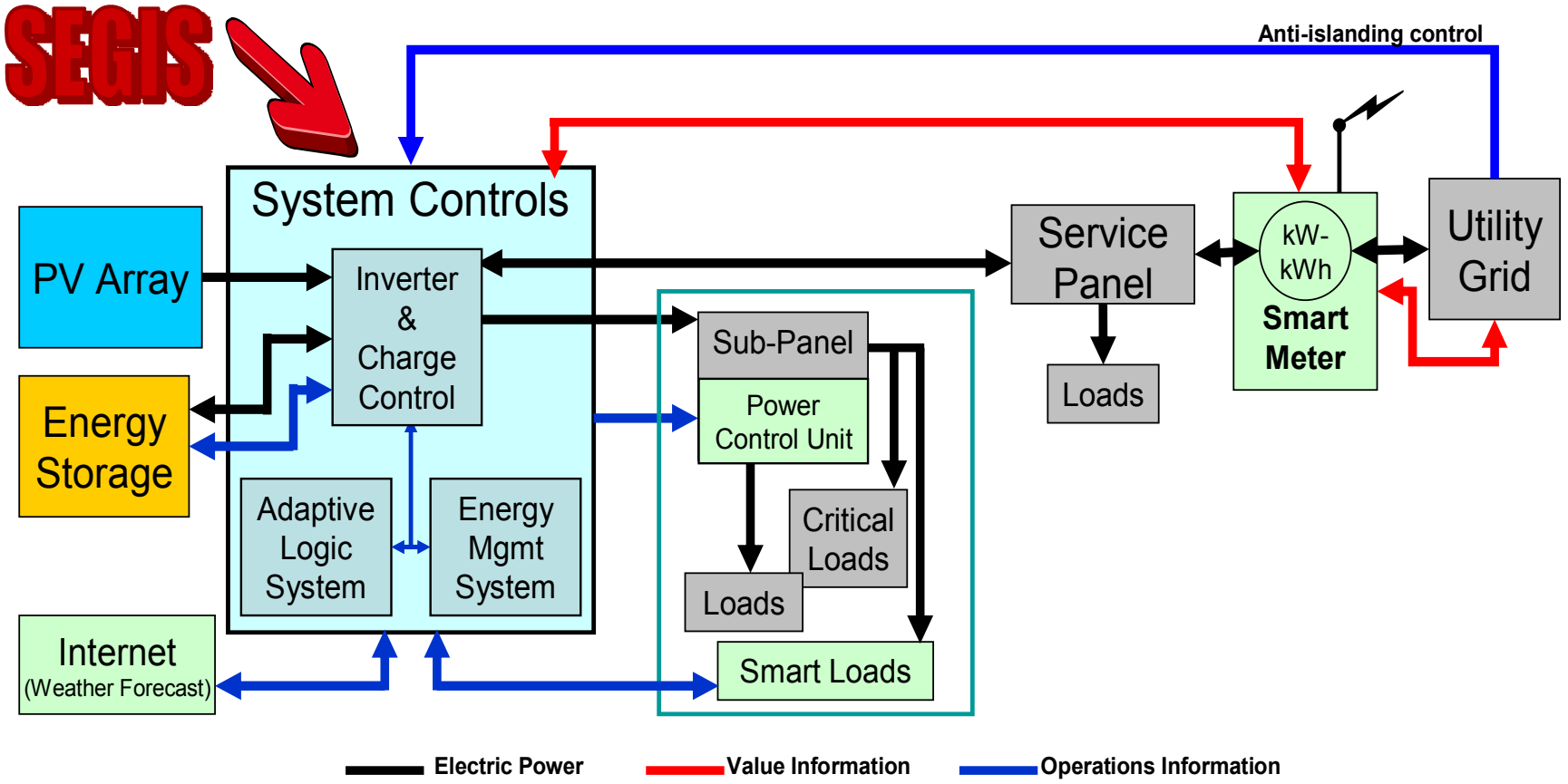
- **SEGIS is an Industry Partnership Collaborative Program, focusing on U.S. leadership**
  - Projects are coordinated and funded by Sandia National Laboratories for the U.S. Department of Energy

The goal of the Solar America Initiative is to reduce the cost of solar photovoltaic technologies so that they become cost-competitive by 2015.

WHAT IS SEGIS?
THE HEART OF THE PV SYSTEM



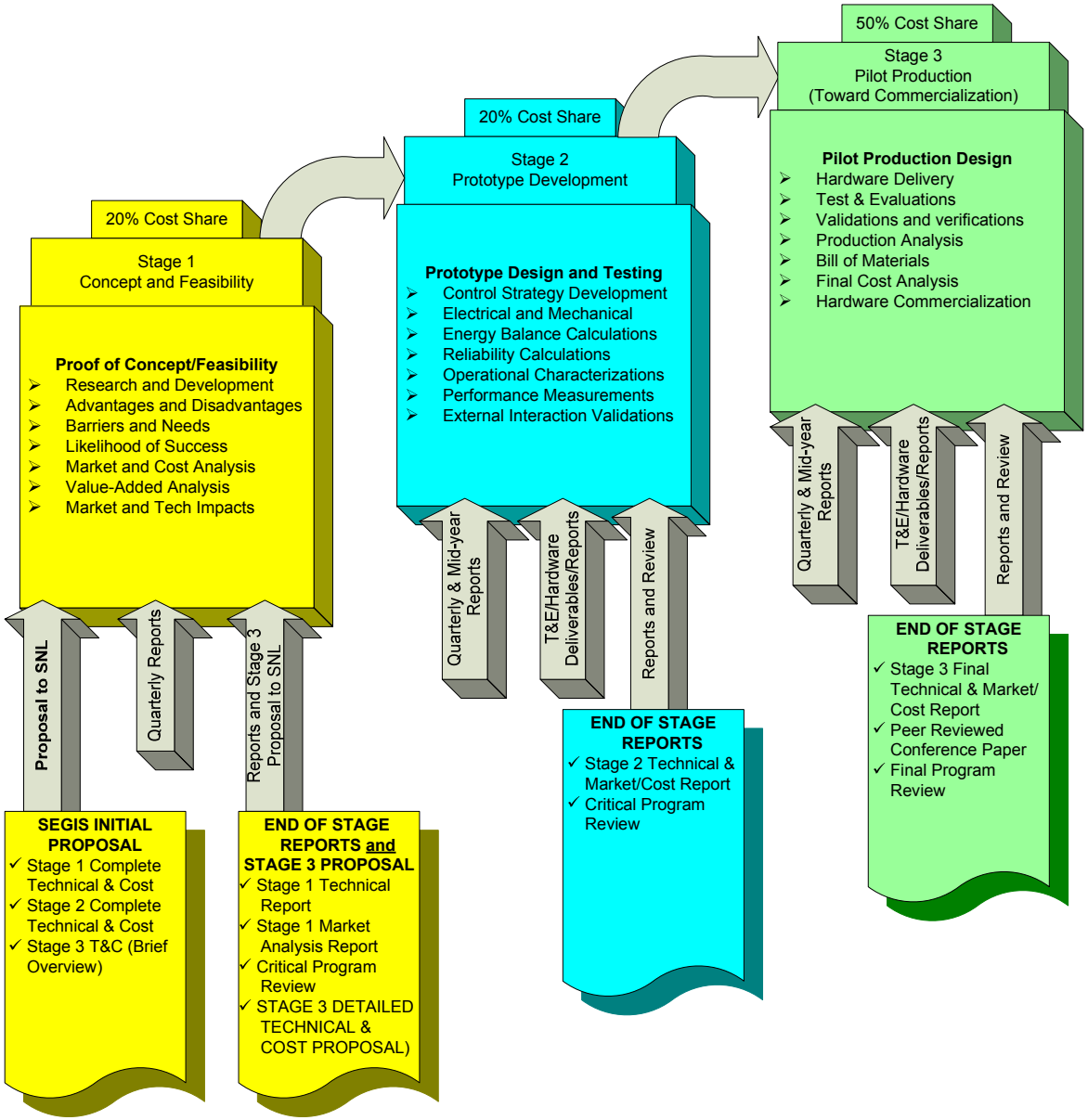
SEGIS Is THE First Critical Step to Enabling PV for Higher Penetration into More Intelligent Utility Grids, Using Advanced Power Handling, Energy Storage/Management, and System Supervision



SEGIS Development Efforts

- SEGIS is a “System” development program focused on meeting new requirements for interconnecting PV to the electrical grid.
- SEGIS focuses on new developments and filling the existing gaps for the expanding PV and other renewable electricity generation into the national electrical grid.
- SEGIS is developing the intelligent hardware and software that strengthens the ties of intelligent grids, micro-grids, PV, energy management, energy storage and other distributed generation.

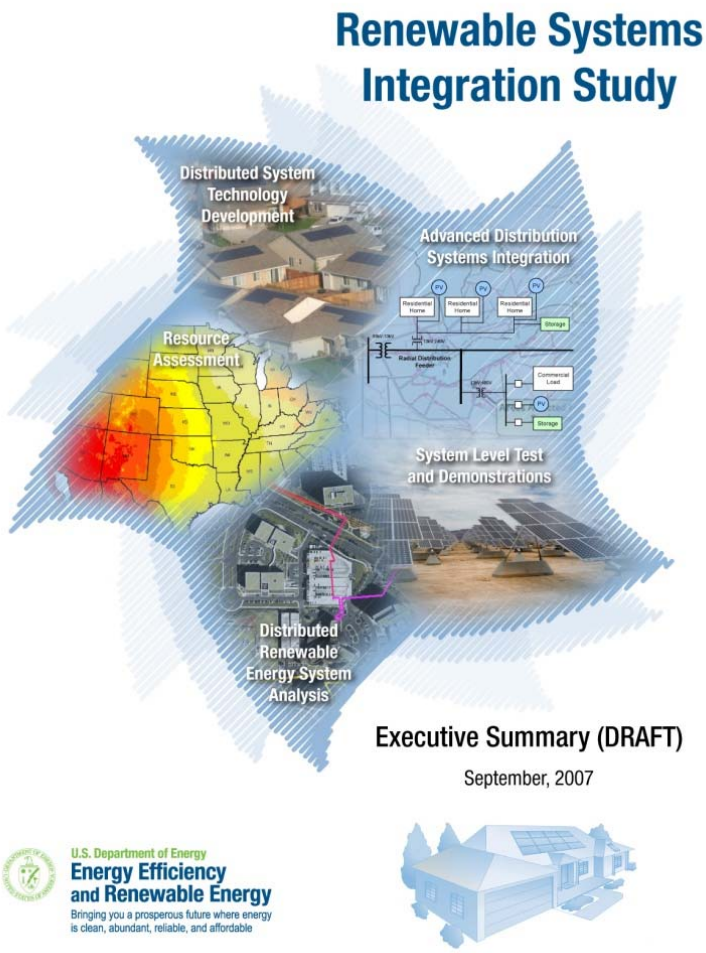
The 3-Stage SEGIS Solicitation

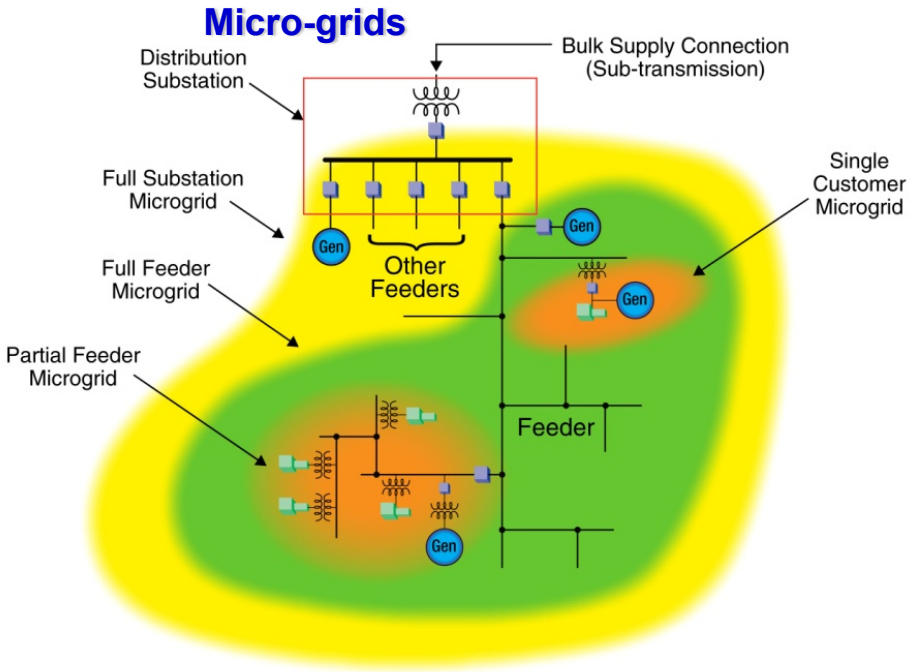


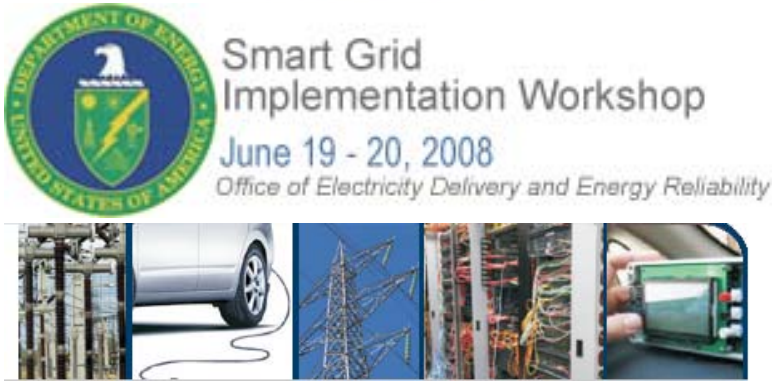
The SEGIS Solicitation

- SEGIS R&D is staged over 3 years to bring the “BEST” ideas (from small and large companies) forward through competitive bids and evaluations of progress and likelihood of success.
- Three “Stages” provide a “Best Value” R&D for the SETP and PV Industry.
- Cost share from industry is staged (20%,20%,50%) to ensure that good ideas are introduced and then advanced to commercialization.

Where Does SEGIS Fit In The Future?







Advanced Grid-tied Inverter, Charge Controller, Energy Monitor and Internet Gateway

(Apollo Solar)

Technologies Addressed

High efficiency Grid-tied Inverter System, Communications Portal, Charge Controller, Energy Management System.

Description

Apollo Solar will develop advanced modular components for power conversion, energy storage, energy management and a portal for communications for residential solar electric systems. The inverters, charge controllers, and energy management systems will have provisions to communicate with utility energy portals for implementation of the seamless two-way power flows of the future.

Resources ($)

DOE Max (3 stages)	DOE Stage1 (max)	Cost Share per stage
$6,250K	**$250K**	**20% - 20% - 50%**

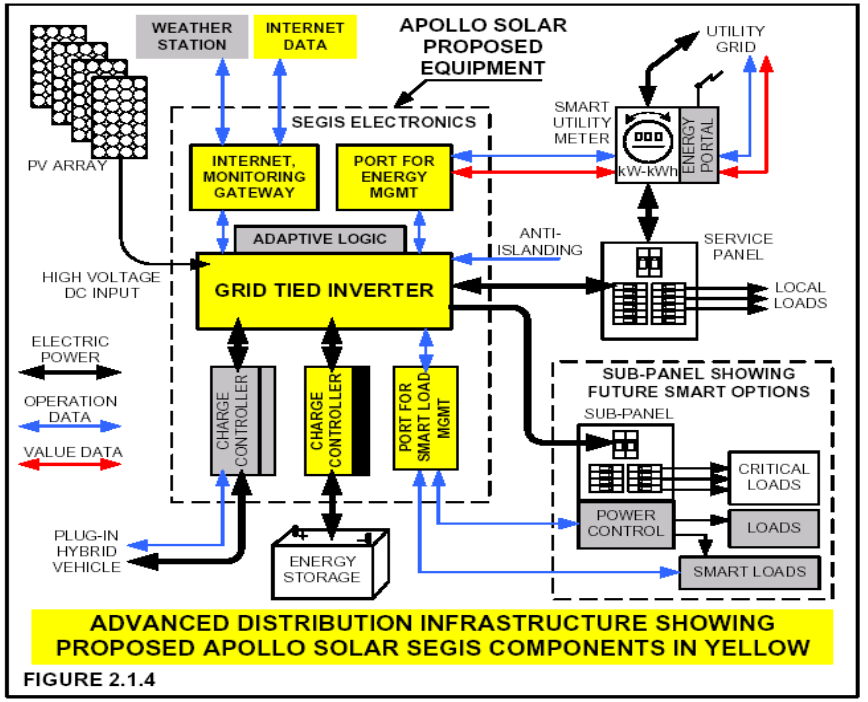


FIGURE 2.1.4

Participants

Lead

Apollo Solar:
John Pfeifer

SEGIS - Emerson PV Inverter

Edison Materials Technology Center (EMTEC)

Technologies Addressed

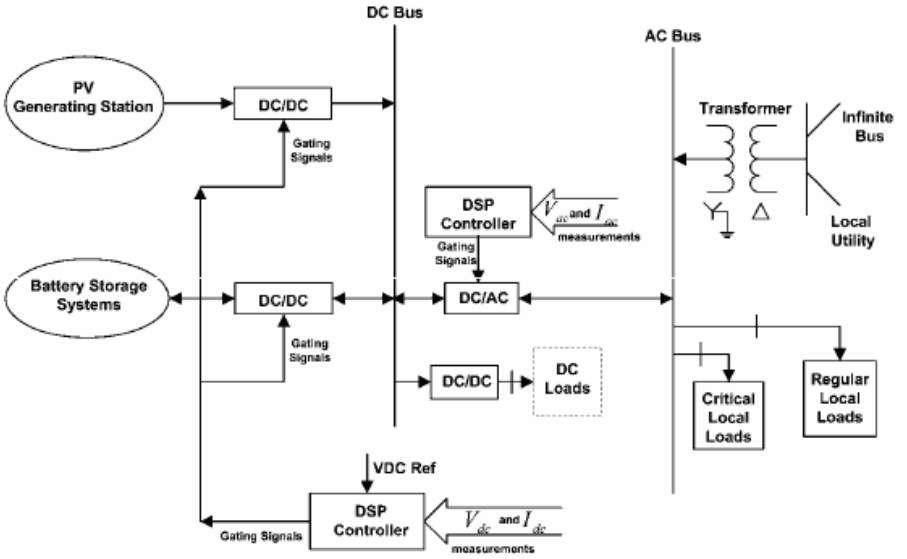
Large Scale Inverter (up to 2-MVA), Energy Storage, Energy Management, Integrated Controller.

Description

EMTEC and its team will develop, 3-phase, highly efficient, small footprint, innovative power conversion, energy storage and energy management components for commercial- and utility-scale PV systems. The new products will include an integrated grid controller that works in conjunction with customer smart meters to respond to time of day pricing signals. The total system provides improved economics for distribution and will minimize fluctuations in supply and demand of electricity.

Resources ($)

DOE Max (3 stages)	DOE Stage1 (max)	Cost Share per stage
$6,250K	**$250K**	**20% - 20% - 50%**



Participants

<u>Lead</u> Emerson	Liebert Corporation	EMERSON Network Power
Jon VanDonkelaar (EMTEC) EMTEC	Hull and Associates	K&H Energy Services, A division of Hull & Associates, Inc.
	Ohio State University	THE OHIO STATE UNIVERSITY

Nano-inverter, VAr Control & Energy Management System Methodologies
(Enphase Energy)

Technologies Addressed

High efficiency Nano-inverters, Control Modules, Integrated System, Energy Management, VAr Compensation.

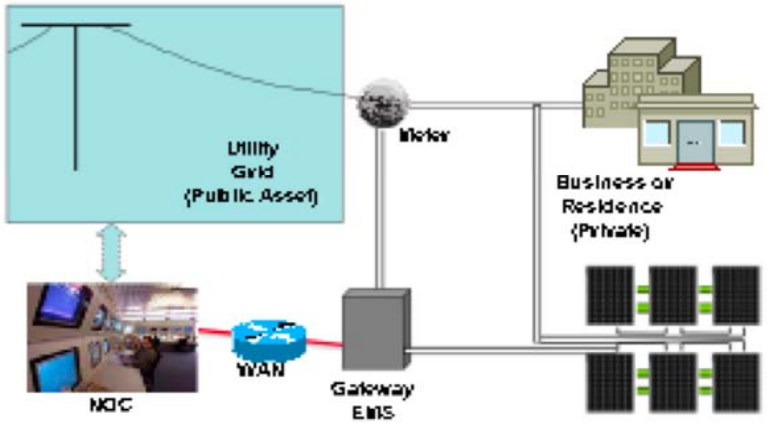
Description

Enphase Energy and team will develop a complete module-integrated solar electric solution managed by an energy management system (EMS). The EMS will also interface with utilities to allow advanced control for modular utility-interactive applications.

Resources ($)

DOE Max (3 stages)	DOE Stage1 (max)	Cost Share per stage
$6,250K	**$250K**	**20% - 20% - 50%**

Nano-inverters and EMS



Participants

Lead		
Enphase Energy, Inc.		
Dr. Steve Sheppard		[e] enphase ENERGY

Grid Integration of High-penetration Solar Energy
(General Electric Global Research)

Technologies Addressed

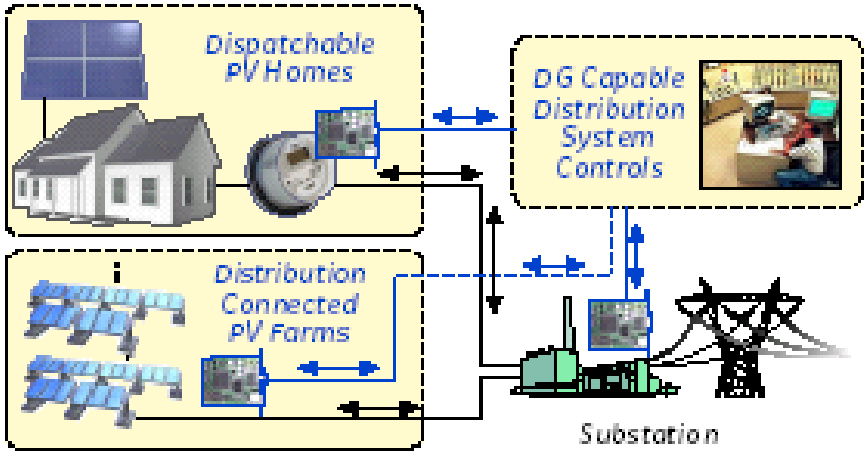
Advanced Inverter Controls, Energy Storage, Demand Response, Residential Energy Management, Utility Distribution Automation.

Description

GE and its team will advance residential PV generation coordination with energy storage, responsive loads, and demand side management programs. New and enhanced three-phase inverter and distribution system control concepts will be developed to meet anticipated new requirements for grid connectivity.

Resources ($)

DOE Max (3 stages)	DOE Stage1 (max)	Cost Share per stage
$6,250K	**$250K**	**20% - 20% - 50%**



Participants

Lead **General Electric**	Sentech	GE Global Research *Technology Development*
	NM Tech	SENTECH, Inc. *Marketing Analysis*
Rayette Fisher	AEP	New Mexico Tech *System Simulation and Validation*
	Duke	

Advanced PV Interface Providing Concurrent AC & DC Power Network Support

(Nextek Power Systems)

Technologies Addressed

Direct Coupling® Where DC Power Sources Directly Serve DC loads, Bi-directional Energy Gateway, System Control.

Description

Nextek's team will modify an existing power gateway design to incorporate bi-directional current flow, higher voltage operation, and added functionalities that include integrated communications and energy management for value-added PV utility interconnection and micro-grid applications. The advances will improve the Levelized Cost of Electricity (LCOE) of commercial systems while expanding applications for grid interconnection and energy management.

Resources ($)

DOE Max (3 stages)	DOE Stage1 (max)	Cost Share per stage
$6,250K	**$250K**	**20% - 20% - 50%**

Participants

Lead **Nextek**	Houston Advanced Research Center (HARC)	NEXTEK Power Systems Inc.
Paul Savage	Non-profit scientific organization to help bring products to market	

Economically Viable, Highly Integrated, Highly Modular SEGIS Architecture

(Petra Solar)

Technologies Addressed

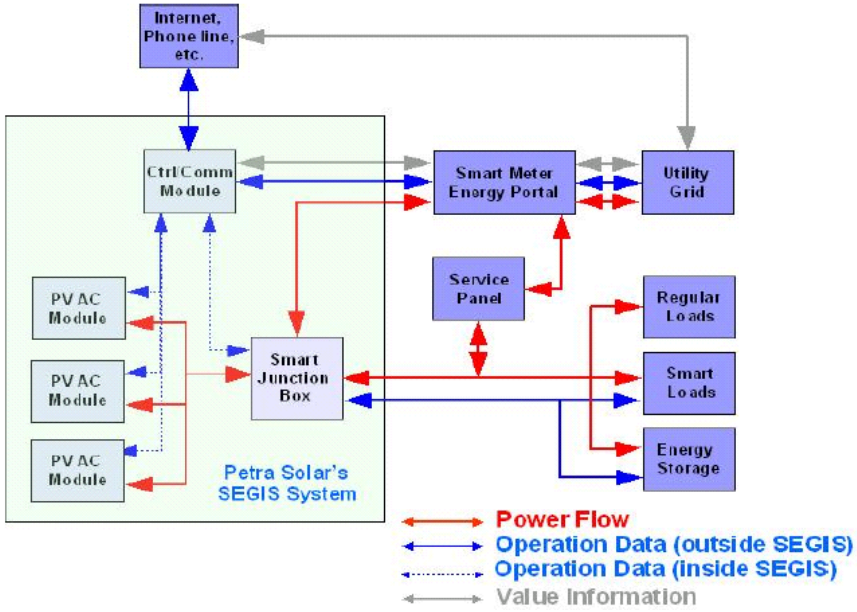
Intelligent Grid Interconnection, System Cost, Modularity, System Reliability, Safety, and Advanced Scalable Inverters.

Description

Petra Solar and its team will advance grid interconnection, cost reductions, system reliability, and safety through low cost, easy-to-install, modular and scalable inverter power architectures that are scalable from 5kW to 20kW. Advances include multi-layer control, communication architecture, monitoring and controlling a cluster of AC module inverters, and a strategic EMS switch junction box.

Resources ($)

DOE Total	DOE Stage 1	Cost Share (total)
$6,250K	**$250K**	**20% - 20% - 50%**



Participants

Lead **Petra Solar** Adje Mensah	Florida Power Electronics Center Florida Solar Energy Center Lakeland Electric Echelon BP Solar Evergreen Solar	PETRA SOLAR

Intelligent PV Inverter
(Premium Power Corporation)

Technologies Addressed

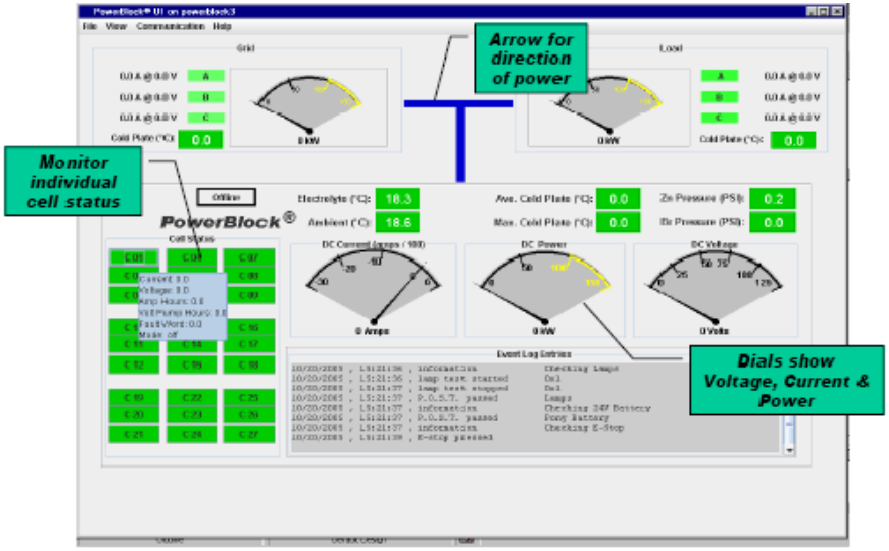
Intelligent PV system, Energy Management and System Optimization.

Description

Premium Power will develop an inverter system that makes PV economically viable in terms of investment cost, operating cost, and system lifetime. An intelligent PV system that optimizes the value will be developed for commercial and utility scale applications with an advanced inverter having energy management and optimization capabilities.

Resources ($)

DOE Max (3 stages)	DOE Stage1 (max)	Cost Share per stage
$6,250K	**$250K**	**20% - 20% - 50%**



Participants

Lead Premium Power		
William O'Donnell		

Premium Power

Demand Response Inverter
(Princeton Power Systems)

Technologies Addressed

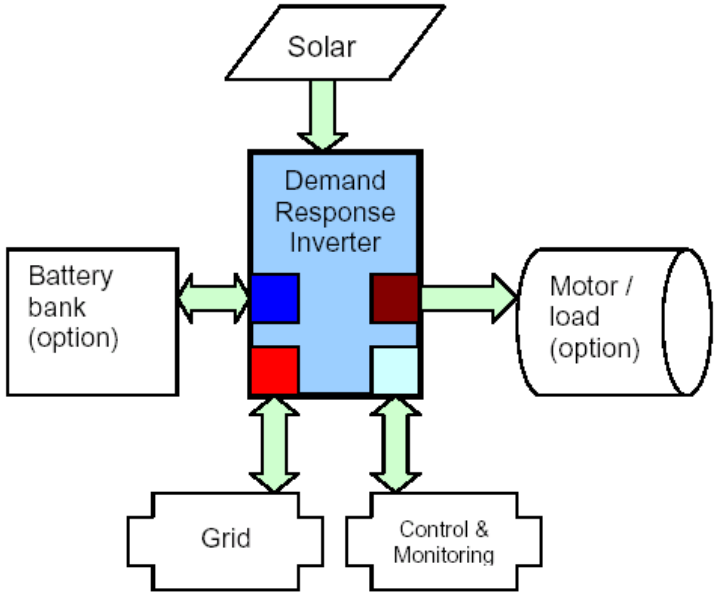
Demand Response Inverter, Load Control, Energy Storage, High Efficiency Components, Grid Integration.

Description

Princeton Power's team will develop a complete design for a 100-kW "Demand Response Inverter" based on its unique inverter technology. The design will be optimized for low-cost, high-quality manufacture, and will integrate control capabilities including dynamic energy storage and demand response through load control.

Resources ($)

DOE Max (3 stages)	DOE Stage1 (max)	Cost Share per stage
$6,250K	**$250K**	**20% - 20% - 50%**



Participants

Lead **Princeton Power Systems, Inc.**	TDI Power Corp. Worldwater and Solar Technologies Gaia Power Technologies	PRINCETON POWER SYSTEMS WORLDWATER & SOLAR TECHNOLOGIES TDI POWER Gaia
Mark Holveck Darren Hammell		

Maximum Power Point Tracking, Advanced EMS and Utility Integration

(PVPowered)

Technologies Addressed

Optimized Performance Algorithms, Advanced Data Collection, Communications and Energy Management Systems (EMS).

Description

PV Powered and its team will develop a suite of maximum power point tracking (MPPT) algorithms to optimize energy production from the full range of available and emerging PV module technologies. The work will also develop integration of communications with facility energy management systems and utility grid management networks.

Resources ($)

DOE Max (3 stages)	DOE Stage1 (max)	Cost Share per stage
$6,250K	**$250K**	**20% - 20% - 50%**

Participants

Lead **PVPowered**	Portland General Electric	PVPowered™ Simply More Reliable Solar
Dr. Steve Hummel	South Dakota State University	
	Northern Plains Power Technologies	

Alternating Current PV Module with System Interface
(SmartSpark)

Technologies Addressed

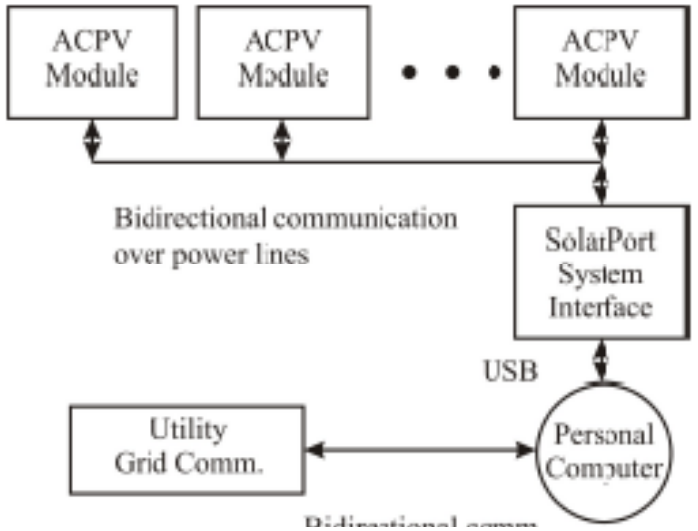
AC PV Module, Grid Integration Interface, Diagnostics, Data Logging.

Description

SmartSpark's team will design, construct, test, and commercialize an alternating-current photovoltaic (ACPV) module with a grid-integration system interface. The ACPV module will be accompanied by an advanced system interface that provides system diagnostics, performance, data logging, and utility interconnection.

Resources ($)

DOE Max (3 stages)	DOE Stage1 (max)	Cost Share per stage
$6,250K	**$250K**	**20% - 20% - 50%**



Participants

Lead **SmartSpark**	Evergreen Solar Innovolt Inc.	SMARTSPARK ENERGY SYSTEMS
Jeff Layton		

Development, Validation and Commercialization of Grid-Smart Inverters for Wider PV Technology Utilization

(Florida Solar Energy Center at UCF)

Technologies Addressed

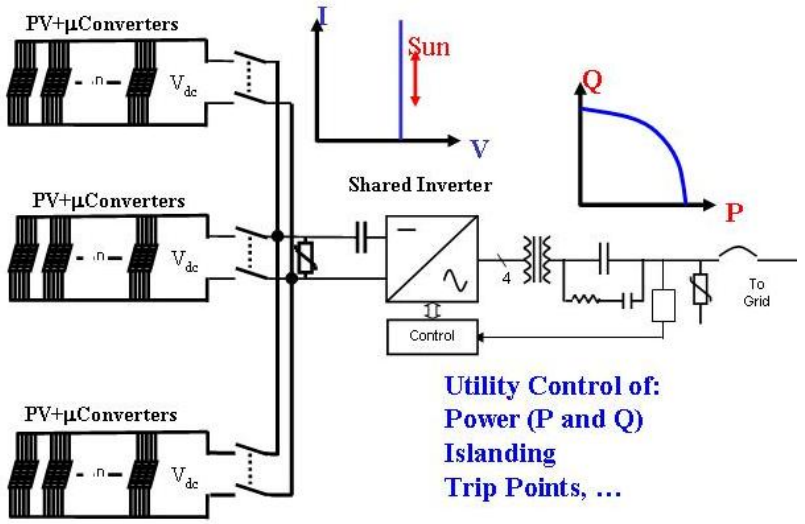
Utility Control of Enhanced Inverter Features, Disturbance-tolerant Anti-Islanding, Shared Inverter, Energy Storage, Building Interaction.

Description

The FSEC and UCF team will develop new concepts and enhance intelligent grid development. A "shared" inverter serving multiple residential or commercial PV arrays located at a distribution transformer will be developed. Work includes battery storage, utility control, communication, monitoring, or building energy management systems (BEMS). An "anti-islanding" strategy that allows PV to remain on line during grid disturbances will improve grid stability. New inverter architectures will bring more stability.

Resources ($)

DOE Max (3 stages)	DOE Stage1 (max)	Cost Share per stage
$6,250K	**$250K**	**20% - 20% - 50%**



Participants

Lead		
University of Central Florida Robert Reedy (FSEC/UCF)	SatCon SENTECH Inc. EnFlex SunEdison	Northern Plains Power Technologies Lakeland Electric Utilities

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A RESEARCH INSTITUTE OF THE UNIVERSITY OF CENTRAL FLORIDA

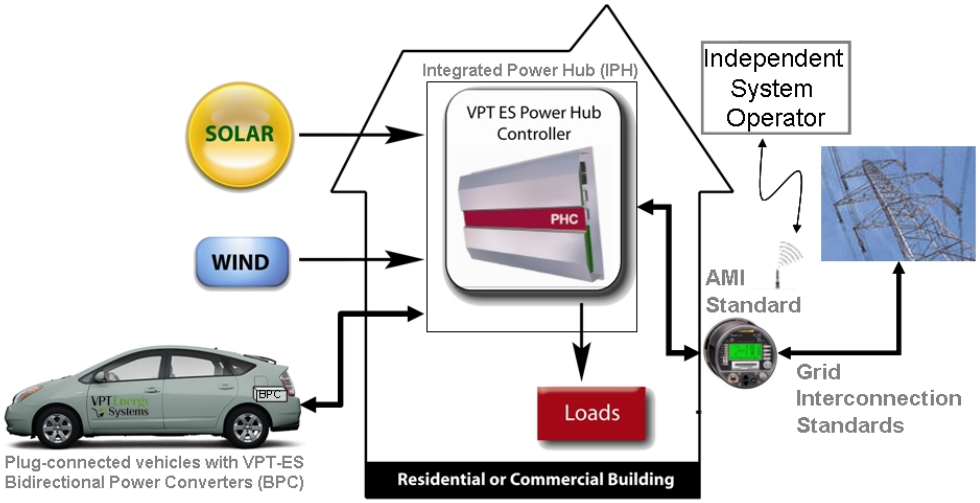
Inverter Control, Vehicle-to-Grid Integration using Bidirectional Power Converter, Integrated Power Hub and Power Hub Controller
(VPT Energy Systems)

Technologies Addressed
Vehicle integration with grid systems, Bi-directional Power Inverter/Rectifiers, Integrated Systems for Distributed Resources.

Description
VPT and its team will develop components and overall system designs for integrated energy systems that include plug-connected vehicles and distributed energy resources. The R&D includes: controllers that add sophisticated grid interoperability, active anti-islanding including intentional islanding control to existing inverters; a bidirectional power converter designed for plug-connected vehicles; and integration systems for DC/AC grid-interactive distributed energy resources such as solar and wind.

Resources ($)

DOE Max (3 stages)	DOE Stage1 (max)	Cost Share per stage
$6,250K	**$250K**	**20% - 20% - 50%**



Participants

Lead	Team Members	
VPT Energy Systems	Center for Power Electronic Systems at Virginia Tech	Solar Connexion
Dr. Glenn Skutt	Plug-In Conversions Corp.	Breakell Inc.
		Delta Electronics

VPT Energy Systems