2008 Solar Annual Review Meeting

Session: Grid Integration/Inverter - SEGIS Solicitation
Organization: Sandia National Laboratories

Ward Bower
Sandia National Laboratories
Albuquerque, NM, 87185-1110
wibower@sandia.gov
Ph: 505-844-5206

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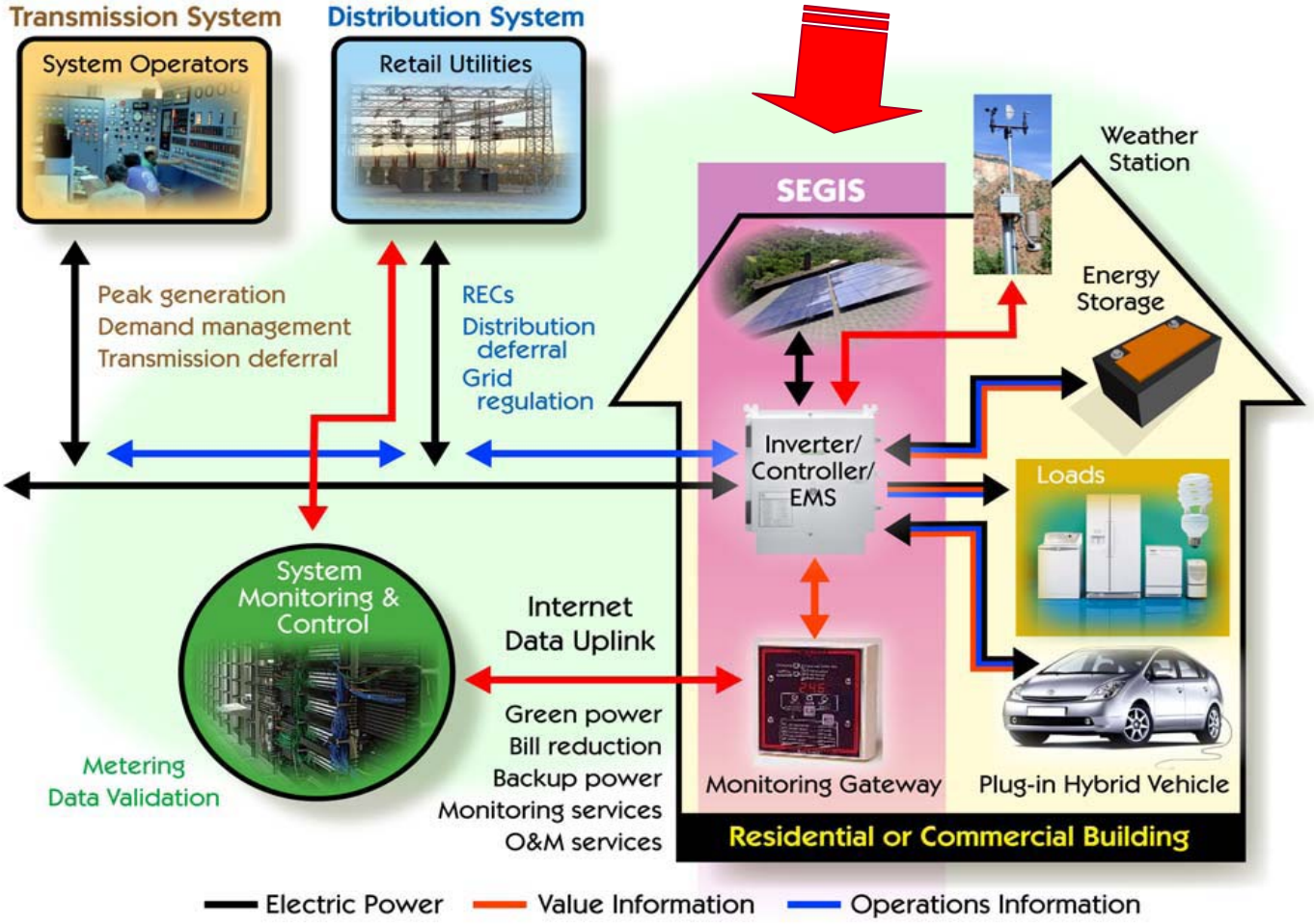
SEGIS IS THE HEART OF THE SYSTEM



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Solar Energy Grid Integration Systems Program (SEGIS)

OVERVIEW

- **SEGIS is a 3-year effort and part of the SAI. Cost share contracts will be placed for Stage 1 (9-mo Concept), Stage 2 (1-year prototype development) & Stage 3 (1-year stage to advance toward commercialization)**
- **It is THE critical LINK in the upcoming Renewable System Interconnection (RSI) Program**
- **It focuses on ADVANCED R&D through industry (partners) for hardware AND methodologies that easily integrate PV and the utility grid to enable high penetration of PV systems.**
- **The solicitation is a collaboration between Sandia, the DOE, and industry/utility partners.**

Relevance to the SAI

The SEGIS R&D supports the SAI and Supplements TPPs

Recipient	Inverter work?	BOS?	System Controller	Energy Management?	Inverter and Energy Management (EM) Funding ($)	Total $ and Total % for Inverter + EM	Short Description of Inverter and Energy Management Related Work	Revolutionary (Leap Frog) Work?	Evolutionary Work?	Evolutionary Details	Proposed Syst Int?	Proposed Inverter Power Ratings	Proposed MTBF	Inv Mfg	BOS Mfg
Amonix	Y	Y	Y Integrated mechanic-cal tracker with inverter	**NONE**	$48k + $48k @ Amonix =**$96k** Proposal for inverter work seems to be dependent on another Xantrex Grant for Inverter Development.	Total =$36.2M **INV = 0.27%**	Inverter, Field Wiring, Security; Integrate inverter, controls hydraulics into a single unit; integrate communications for better tracking accuracy. Combine concentrator peak tracking with MPPT.	**NONE SPECIFIED.**	**LIKELY** Dependent upon Xantrex winning a different award. Plans to work with Xantrex to test new inverter design	Inverter Specs and goals basically parroted the final FOA goals	**YES** With mechanical tracker	30kW - 70kW	For inverter MTBF=3yr?	Xantrex	Amonix Design; JOL Enterprises f/wiring
Boeing	Y	Y	Y Tracker controller to allow multiple units	**NONE**	**$1.1M** with substantial cost share but with some that appears to predate any award.	Total =$45.4M **INV = 2.4%**	Output capacitors in separate assembly (Note: input capacitors are more likely to fail) Advanced diagnostics in inverter. Modular inverter design to allow component field replacementAdvanced switching design and remote monitoring. Cost, Reliability, Optimization	**NONE SPECIFIED** Major breakthroughs in reliability, mfg, cost, inferred and not detailed	**LIKELY**: Work with PV Powered and SCE.	Basically searching for and using state-to-the-art components. Move to transformerless Cabinet and thermal management improvements	**YES** Plans for modifying the Boeing plant for system designs	Initially dual 137 kVA in parallel 275kVA in 2006. Then to 375kVA in 2015. Noted confusion	5,10 to 20yr in 2015	PV	Boeing
BP Solar	Y	Y	Y MPPT Controller REDESIGN to high voltage <600V	**NONE**	**NONE** from DOE; **Cost share** from Xantrex =$840k	DOE=$19.9M CS=$21.1M Total =$41.1M **INV =2.0%**	Use of the HRII inverter deliverable with modifications. **Independent** Fat Spaniel communications to be added	**NONE**	NONE Xantrex subcontract to supply complete residential power conversion system; using a HRII deliverable	Design a new high-voltage charge controller for up to 600V	**YES**	VA, 48 60A	ars		and ASU
Dow Chemical	Y	Y	Y Controller for multiple power stages	**NONE**	Dow Building Solutions to Fund Fronius for next Gen. DOE=$250k CS =$250k **Total=$500k**	Total= $19.6M **INV = 2.5%**	New transformer-based inverter with higher eff, improved power harvest, easier installation, communications, enhanced serviceability. **Details not provided**. Modular inverter concept with up to 15 power stages. Details not provided. Includes power stages similar to existing and will need means to coordinate operation.	**NONE SPECIFIED**			**YES** BIPV inte proposed		ndancy. Warranty to 10y		w Building Solutions
GE	Y	Y	N	**NOT SPECIFIC** Energy Monitor proposed GE Demand side Energy Management	DOE=$ 1.6M to Xant CS = $3.3M w/ Xant **Total = 4.9M** Costs @ GE part of Complex Task 5 with undertermined	Total = $46.7M **INV = 10.**	Reside		Activ Fault t use of		YES Vertical integration @ GE for new home construction discussed.	PBD	15-20y MTBF	Xantrex and GE	GE
GreenRay	Y	Y	N	**NONE**	**Total = $1.0 M** micro inverter	Total = $ 7%	integrati		**YES** Quick co to module Wireless co	nation of short lived components Quick connect moving toward plug and play	**YES** Total AC Module integration	400W micro-inverter	30 yr but TBD with progress	GreenRay Final Mfg is Xantrex	GreenRay/Sanyo
Konarka	N					$8.8M = 0%			**NONE** for inverters or energy management	**NONE**	**NO**	N/A	**N/A**	N/A	??
MiaSole	Y				$1.6	$47.5		**NONE SPECIFIED** Mentioned development of module-integrated micro-inverters but no details were provided. Large scale roll-roll with inverter integrated	**LIKELY;** The mfg is just now producing its first U-I inverter. The learning curve will be difficult given the schedules.	Staged Failure is offered as an option for optimization?	**YES** Commercial and Res Proposed. Building integrated product proposed for PV in the roof	300W micro-inv 1500W res inv 100W micro-inv Panel Int- dc-dc asic based mini 1500W detatchable inverter	30 yr but TBD with progress	Exeltech for micro inv. Others included	Univ of CO for system manage-ment schemes
NanoSolar	Y					Total =$39.9M **INV = 4%**	Conergy will reduce inverter cost by 38%. Systems integration included. Note: the Conergy inverter is yet to be introduced into the US. The proposal seems to focus on testing and bringing a current Conergy inverter design to meet US requirements. Details were missing	**NONE**	**NONE** for inverters or energy management	**NONE** described for inverter	Minimal	Starting with 110kW going to 140kW	Not discussed	Conergy	SunLink and Sun Technics
Practical	N			**NONE**	**NONE**	Total = $9.8M **INV = 0%**	Concentrator System Integratoin with No inverter development or energy management work	**NONE**	**NONE** for inverters or energy management	**NONE** described for inverter	**YES** but no discussion about inverter	N/A	N/A	None	
SunPower	Y	Y	N	**NONE**	**$2.0M**	Total =$42.5M **INV = 4.7%**	Residential and Concentrator systems integration. Evolve GT inverter hardware with studies for capacitor temperatures and improvements in cost and performance	**NONE SPECIFIED**	**LIKELY;** The mfg is now producing the GT U-I inverter. The evolution was not specified.	**NONE** described for inverter; Couldn't find details about the inverter work for the concentrator system.	**YES**	4kW	10 now, 15 in 2015	Xantrex	
United Solar	Y	Y	N	**NONE**	**Not found**	Total =$26.4M **INV = 0%**	Dual inverter developments with PVPowered and Solectria. Generally for inverters >75kW . Systems integration for low cost installation and deployment.	**NONE**	**LIKELY;** No details found	**NONE** details found	**NO**	150kW PV Powered will develop inverters from 75 -500kW Solectria will study optimizaton of inv for >100kW and the pros and cons of transformerless.	N/A	SatCon, **PV Powered, Solectria**, and SMA America	DEERs

BOS <3% of TPP R&D

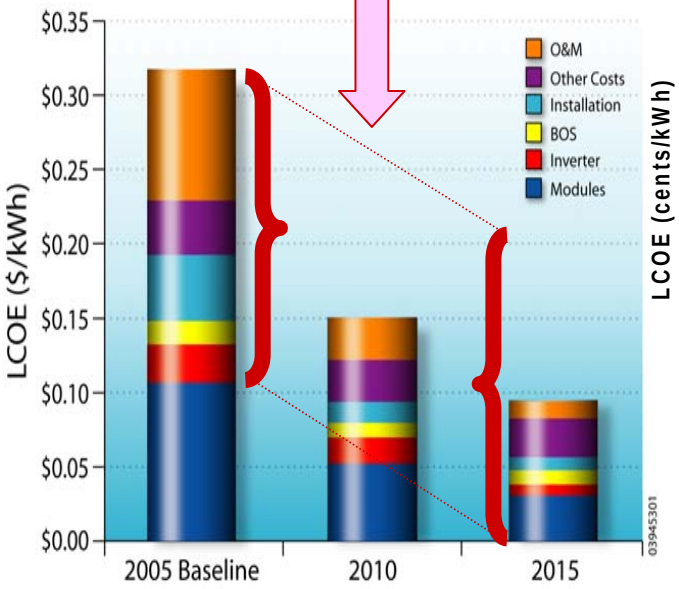
Relevance to the SAI

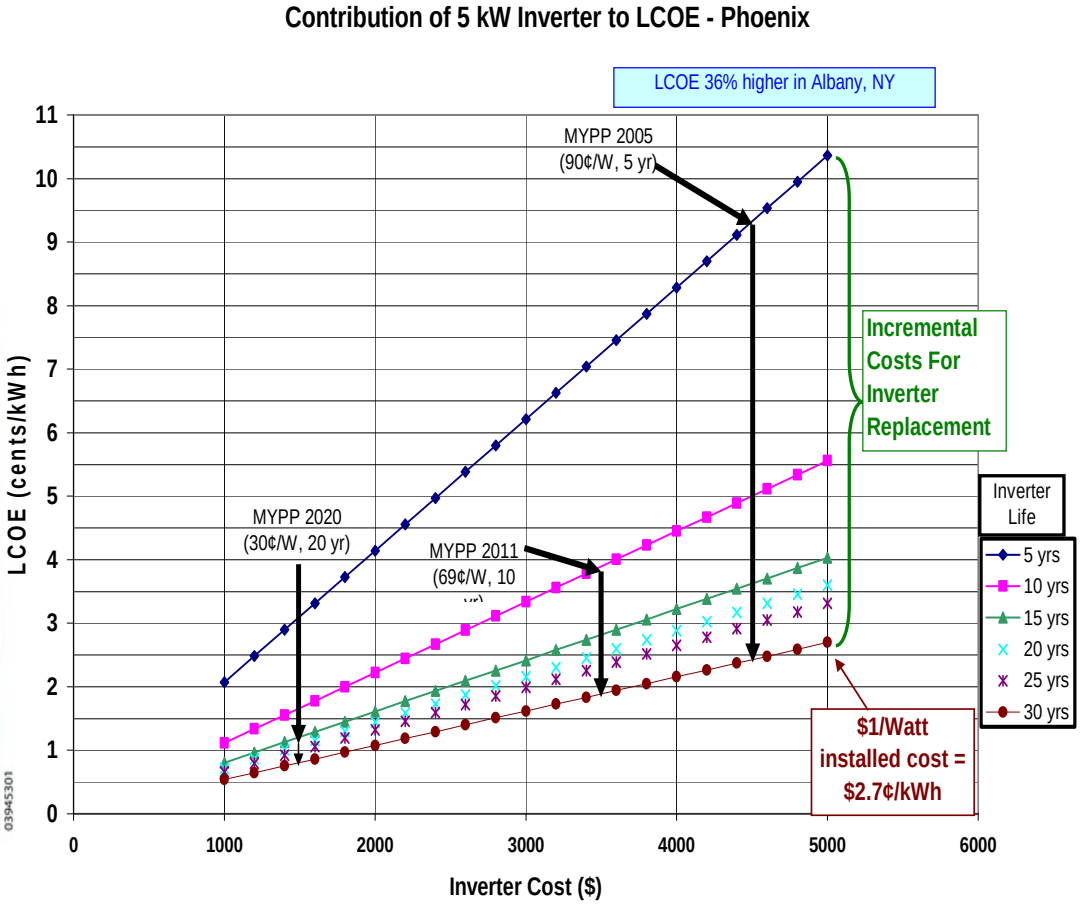
The overall goals of the project. Develop technology to:

- **Include energy management systems and/or smart loads, energy storage, and the electric utility to advance the intelligent integration of relatively large amounts of PV energy while maintaining or increasing grid reliability**
- **Improve component and system reliability and increase values of PV inverter/controllers/BOS/EMS while addressing value-added interfaces for grid integration**
- **Improve PV systems and enable the dispatch of solar energy/energy storage to maximize value, reliability, and safety.**

SAI Needs for SEGIS

All Non-module costs must be reduced.
Brackets show needed improvement





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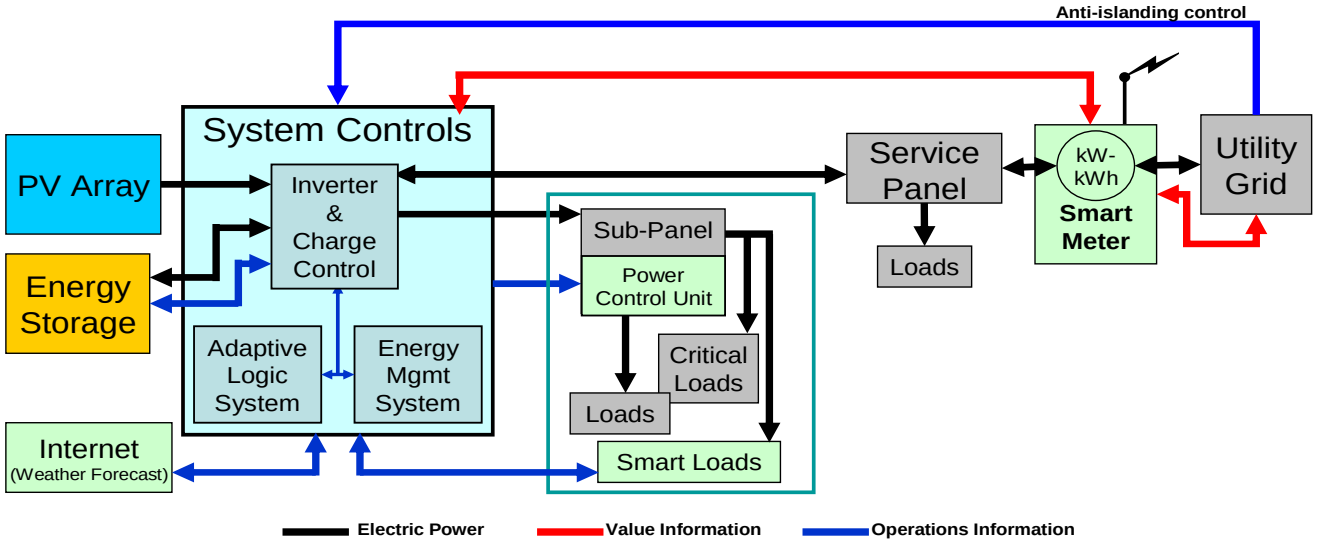
Relevance to the SAI

The potential impacts of SEGIS go beyond SAI goals



- **Expand the influence of PV to more than an intermittent and inflexible energy supplement**
- **Provide added value to owners, consumers and utilities**
- **Provide intelligent features for connection to future smart devices and intelligent grids**
- **Meet the LCOE and application goals of the SAI program**

The Budgets

The project budget includes 3 Stages over 3 years.

Sandia National Laboratories SEGIS Solicitation						
Project Beginning Date	FY07 Budget	FY08 Budget	FY09 Budget	FY10 Budget	FY11 Budget	Total Budget
4/19/2007	$0	$ 3.0M	$9.0M	$10.0M	$2.0M	$ 24M

Stage 1 capped at $250k/contract — 20% Cost Share (11-12)

Stage 2 capped at $3M/contract — 20% Cost Share (3-4)

Stage 3 capped at $3M/contract — 50% Cost Share (3-4)

Project Specific Information

Projected Work & Accomplishments (April '07 to March '08)

All work and accomplishments have been and are on target

Milestone	*Action*	*Accomplishments*
SEGIS Announcement Workshop	Completed April 19, 2007	More than 80 participants. General goals prioritized
SEGIS Technical Workshop/Reports	Completed May 9, 2007	More than 120 participants Detailed Goals prioritized
Funding Opportunity Announcement (FOA)	FOA nearly completed when project was assigned to SNL	DOE FOA efforts abandoned for new RFP
SEGIS Concept Paper	Completed October 2007	Provided SEGIS objectives and goals WRT "High Penetration"
SEGIS RFI	Completed October 30, 2007	Provided input and "Bidders List"
SNL/DOE Web Pages	Active November 2007	Provided program information
SEGIS RFP	Completed November 28, 2007	Provided proposal requirements
Proposals Received	Completed Feb 4, 2008	27 Proposals received
Proposals Evaluated	Completed Mar 20, 2008	Clarifications/financial continues

Project Specific Information

Projected Work & Accomplishments (April '08 to Sep '08)

Milestone	*Action*	*Accomplishments*
Contracts Placed	**Planned June 25, 2008**	**Stage 1 & Stage 2 contracts with planned downsizing (Stage gate)**
Kickoff Meetings	**Planned July 2008**	***Validate SOW and Schedules***
SNL/DOE Information Web Page with Prospectus	**Planned July 2008**	***Public Informational Page***
First "Quarterly Report" Reviews	**Planned Sep 2008**	***Interim "Stage Gate" to be quarterly event***
Provide SEGIS inputs for "Industry Advisory Group"	**Planned Sep 2008**	***Industry Advisory Group to be active by Sep 30, 2008.***
Planning activities for maximizing impacts in the RSI Program	**Summer 2008**	***Provides updates and needs for the RSI program***
Preparation for Transition to Stage 2	**Fall 2008**	***Provides necessary contracting details and contingencies***

Development of Futuristic, Integrated, Modular, Economical SEGIS System Components Prospectus Sample (XYZ Inc.)

Technologies Addressed

Issues of high penetration, smart grid interactivity, cost reductions, system reliability improvements, safety and value added features

Description

Delivery of a highly integrated, controller/inverter with scalable power of yy kW to zz kW, an intelligent control/communication master controller, and an EMS system for system energy management

Resources ($)

DOE Total	DOE Stage 1	Cost Share (total)
$4,000K	**$200K**	**$6,500K**

Innovation & Advances

Participants

Lead **XYZ Inc.** **John Doe**	**Power Electronics Center** **Major Manufacturing Facility** **Utility Consortium** **Communication Developer**	**USA Center for Dev** **Giant Industry Partners** **Your Electric Company** **Solar Telecom**

Looking Forward

- **Contractors (up to 12) will complete Stage 1 (conceptual) in March/April 2009.**
  - **The SEGIS R&D activities are critical to a successful SAI program and there is no need to modify the AOP and existing plans. The SEGIS program is also scheduled to become a critical effort in the planned Renewable Systems Integration Initiative.**
  - **One positive outcome is that a number of very innovative developments will be further funded (DOE/VC) to fruition**
- **Stage 2 downsizing selections (3-4) will be based upon accomplishments, likelihood of success for advancing PV system values and the impacts on the nation's PV and renewable energy resources**
- **Stage 3 continuation will be based upon accomplishments, commercialization advances, and the overall value of the development.**
- **All progress of all stages will be posted on related web pages.**

The SEGIS Program