Systems Driven Approach to Solar Workshop: Concept and Objectives

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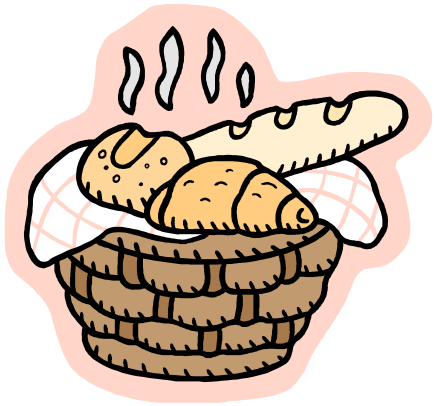
Workshop Schedule

Tuesday, December 17

- Define systems approach and what it involves
- Explore systems approach applied to program management
- Review current activities and approach to systems analysis
- Dinner, discuss solar market and trends



Wednesday, December 18

- Discuss and analyze the systems approach in:
  - –distributed generation,
  - –off-grid,
  - –utility scale,
  - –buildings
- Discuss systems approach model (input, output, process, etc.)
- Develop a consensus on next steps

Objective

- Start developing the requirements and specifications for a solar systems framework that will allow us to explore alternative technology pathways and identify critical technology needs to guide planning and management
- Establish logical steps to achieved measured progress toward a functional systems capability

Example: Advanced Vehicle Simulator (ADVISOR)

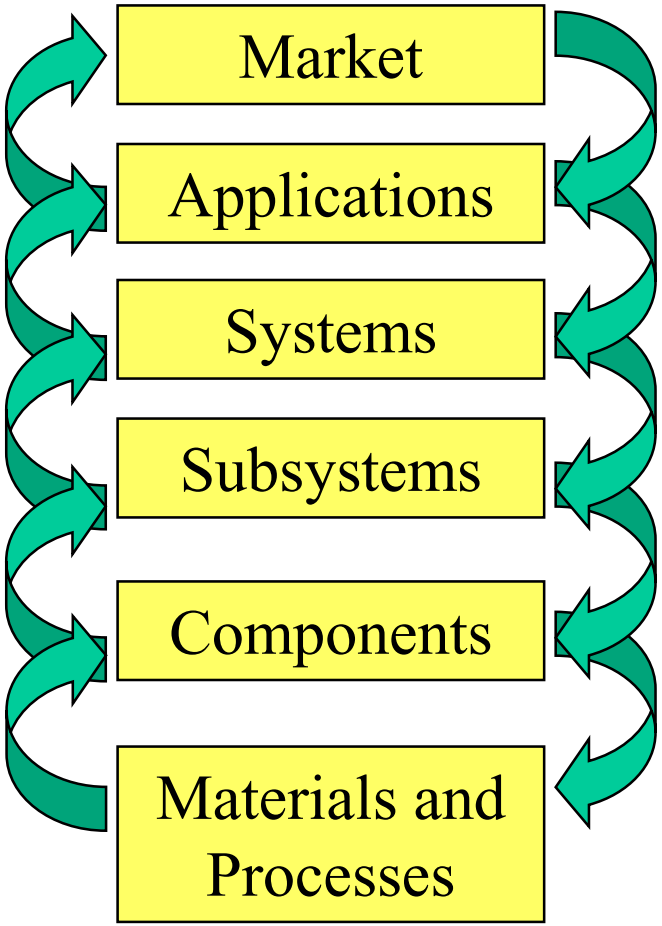
Capabilities

- Codes process for product development
- Automates and facilitates product design and analysis
- Identifies and draws methodologies and roadmaps

Benefits

- Allows concurrent product development
- Reduces learning curve for advanced technology
- Decreases throughput and cost with higher quality results
- Technology targets can be modeled and verified

Framework for Analysis



What is the population of flat commercial roofs, by state and utility?

What are the high-value uses of solar on flat commercial roofs?

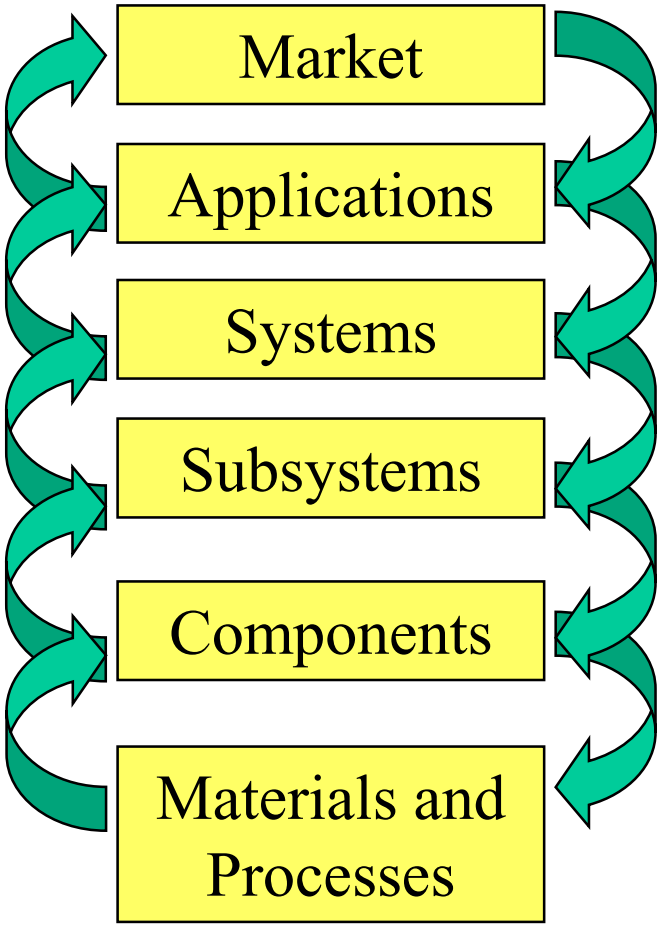
What are the performance and cost characteristics of a flat-roof solar system for heat and/or power?

What are the key factors in an inverter? A mounting subsystem? A heat recovery element?

How does a component like inverter software impact costs for interconnection? Reliability?

Are thin-films reliable components of roof systems? Can insulation/weatherproofing and module production be integrated to lower costs?

Framework for Analysis



- Data demands at each step
- Key factors to model
- Relationship between elements of framework/models
- Building off existing models/capabilities
- Priorities – where to start

Example of Inputs and Outputs

- Types of Input
  - Costs – system, O&M, subsystem replacement, life-cycle, first-cost, financing assumptions, incentives
  - Technical performance – efficiencies, durability, minimum/maximum capacity, response to load, power quality, dispatchability, storage capacity
  - Climate/insolation factors

- Types of Output
  - Varies – outputs from one stage become inputs for another
  - Output/Input require iterative process, ability to test sensitivities
  - Expected lifetime of panel
  - Energy generation projections
  - Recommendations

Direct Benefits

- Establish credible models of key markets and applications
- Develop and document consistent methodology
- Analyze benefits of PV, CSP and thermal applications – particularly in relation to GPRA, EERE priorities
  - Energy contribution
  - Carbon displacement
  - Oil displacement
  - Energy services to low-income households
  - Energy system reliability/security
- Create a process to continuously strengthen the rationale for the Program's portfolio of distributed and central energy
- Guide to R&D efforts

Indirect Benefits

- Prioritize Research & Development (R&D) work
- Align technology development efforts and objectives across fields
- Determine cost and performance equations that can be compared to competition for analysis
- Provide better explanations for how our research investments will influence our energy, security, and environmental potential
- Capture knowledge and expertise from senior researchers and managers

Modest Questions, Markets

- What is the mix of R&D we should be conducting to have the largest impact on the solar market? If we envision 2020, which mixes of central station, serving existing loads, rooftop, building heating and cooling, process heat, etc. should we consider?
- What are the current costs, future costs, and impact(s) on energy, security, and the environment? Can we identify technical, financial, and policy hurdles?
- What are the impacts of different levels of market penetration for solar applications on utility system reliability, peak demand, air quality, and other elements?
- What is the universe of flat roofs in the U.S.? What is their distribution among different regions and utility service areas?
- How many residential roofs have proper orientation for a simple flat-mount solar system? How many need other options?
- What are the real impacts on consumers of current incentives and regulations affecting solar energy, and how do those relate to the population of roofs we are after?
- How many dead systems are there now in place that could poison consumer perceptions of our current crop of products?

Modest Questions, Systems and Applications

- What is a system? What should be a systems' goals for performance, cost, and reliability?
- How can solar resource data facilitate and ensure confident designs and delivered electricity projections of solar energy conversion systems/products throughout the U.S.?
- Would operation of multiple systems – for example as a virtual utility – in combination with other generating options improve the overall energy system?
- What would combinations of solar technologies in zero energy communities, small central stations, or other configurations produce in terms of economic, environmental and energy benefits?
- What factors can help select end-use applications for solar energy conversion systems that will enhance the deployment and market for solar energy conversion systems, including the relative level of effort/funding that would be justified for investing in the development of "plug-and-play" PV systems?
- What is the market value of different applications? What is our potential contribution to the nation's energy supply, economy, and security and the corresponding environmental benefits?
- What levels of DOE R&D funding are needed to meet the goals for each of the major solar energy conversion systems and their major components?
- If funding is not sufficient, what can be done to achieve the largest market impact? What is the impact on the market of stretching out R&D?

Modest Questions, Subsystems

- Are inverters going to be an Achilles heel if we do get significant market penetration?
- Do some technology choices sacrifice reliability for reduced first costs -- and do we risk poisoning the market if systems don't last as long as they are expected?
- What is the value/cost trade-off of adding UPS capabilities to systems? If it is not good, are there improvements in batteries, wiring or configuration that could improve the value/cost tradeoff?

Modest Questions, Components and Processes

- What is the best mix of components to make a system?
- What are the financial models we should be applying to solar and how do they change with the market?
- What are the reasonable cost, performance, reliability, and lifetime goals for the various components and subsystems of solar energy systems?
- For what subsystems or components would it be most valuable to find new technological alternatives?
- What do changing marketplace requirements imply for subsystem and component R&D needs?
- What are economic or other values of system and component attributes like aesthetics, color, size, flexibility, modularity, etc.?
- What are the relative impacts of inverter efficiency and cost ($/Wp) vs. service lifetime (reliability) on the levelized cost of delivered electricity from a grid-connected PV system?
- What are the cost and technical targets for each component and subsystem?

Our Task

- Consensus on expectations for what a systems approach can/should deliver
- Basic framework and elements of an effective systems approach
- Schedule and next steps/assignments for starting the process and creating near-term, mid-term and final deliverables