Systems Driven Approach to Inverter R & D

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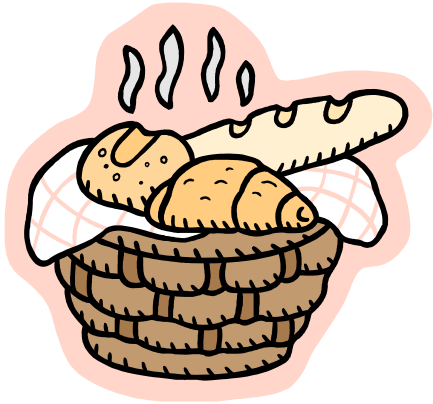
Workshop Schedule

Wednesday, April 23

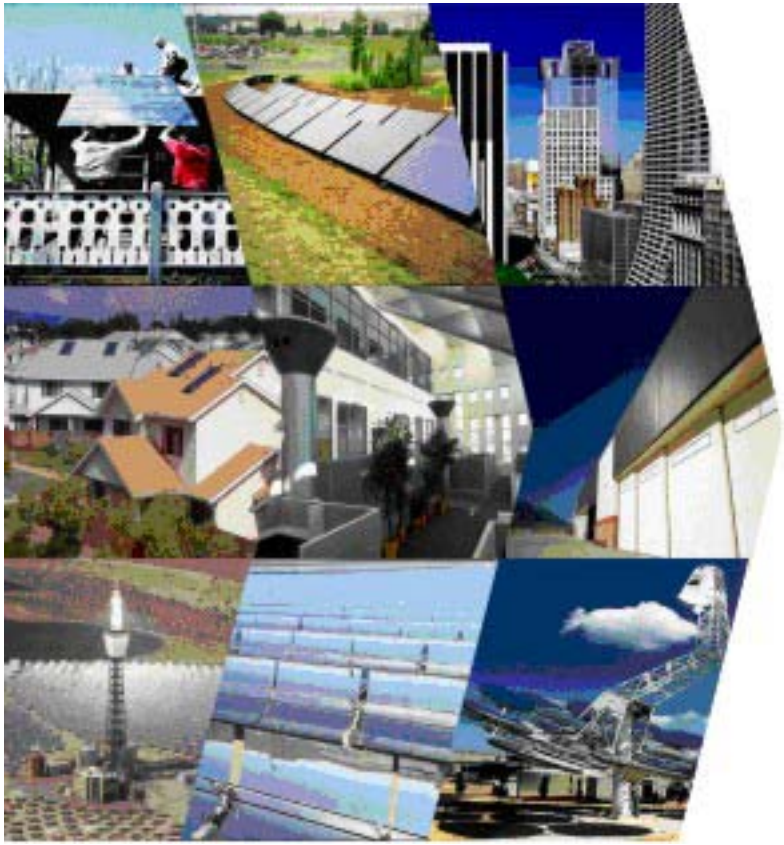
- Outline guidelines for the workshop
- Review systems approach and what it involves
- Explore systems approach framework applied to inverter issues
- Industry and DOE Program perspectives on inverters
- Discuss inverter market and trends



Thursday, April 24

- Discuss university perspectives on inverter development
- Discuss high reliability inverter requirements
- Discuss low cost inverter requirements
- Develop a consensus on next steps

Objective



Explore methodology for a new generation of inverters for PV and establish a baseline understanding of current inverter status.

Examine factors influencing efficiency, reliability, cost, maintenance, manufacturability, and cross-technology applications.

Discuss potential R&D targets and tradeoffs.

Input for a 5-year plan for inverter R&D.

Example: Advanced Vehicle Simulator (ADVISOR)

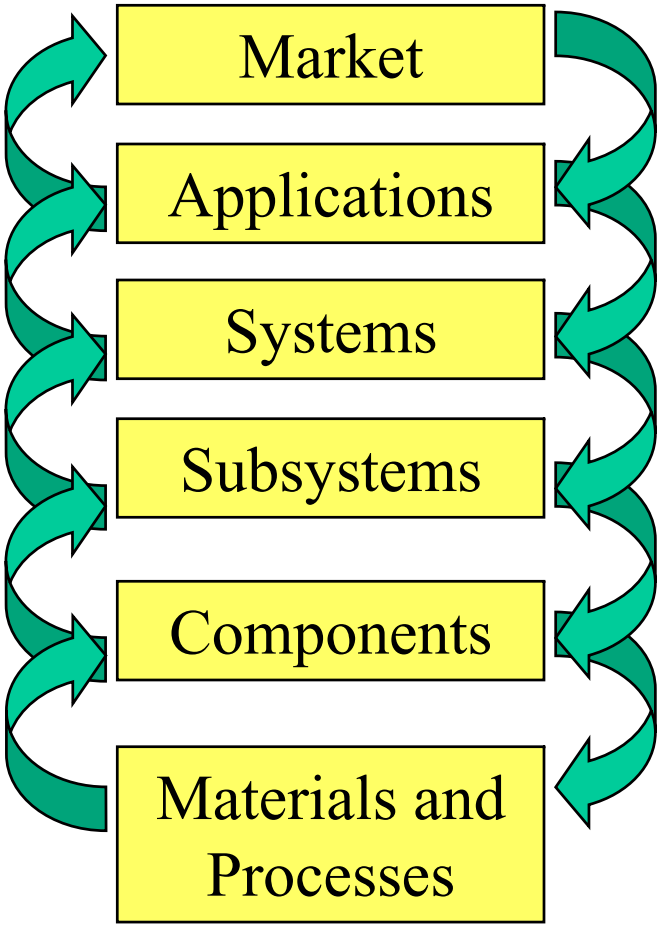
Capabilities

- 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 SDA



What are the highest-value applications for inverters?

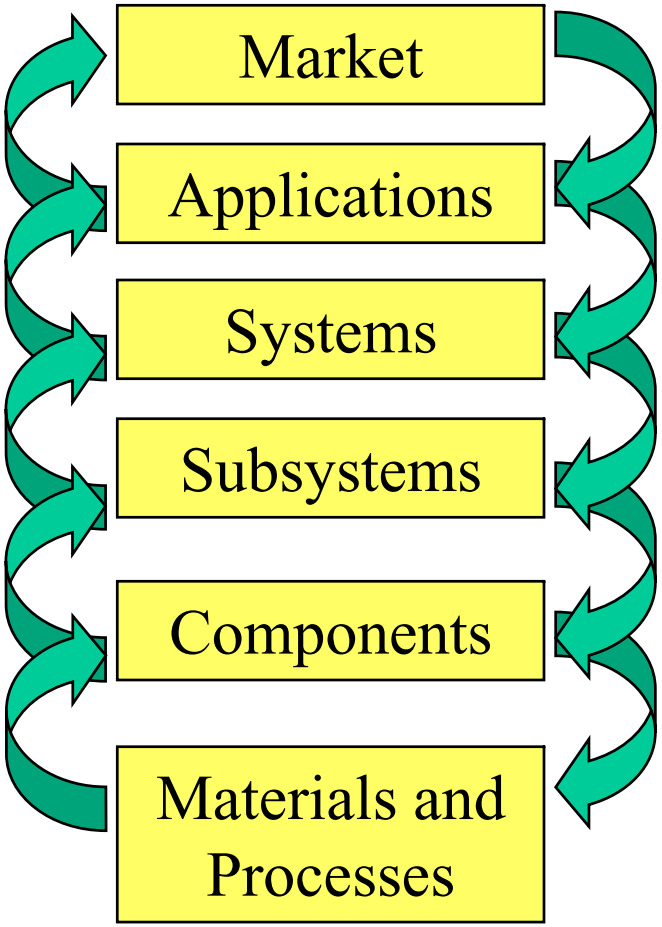
What are the performance and cost characteristics of an inverter for the largest markets?

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?

How do monolithic components affect the reliability & cost of inverters and disposable inverters?

Framework for SDA



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

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

What are the major markets for inverters today?

- Can several standard inverter designs serve a majority of the markets?
- What markets are synergistic enough to use common inverter technologies?
- What is the inverter industry doing to address tomorrow's markets?
- Can larger inverter market segments serve new developing applications or does this violate economic rules?
- What new markets are expected and how might these new markets affect future inverter designs and packaging for developing technologies?

What is the state of inverter technologies today and how is it expected to change in the next 5 years?

- What is the status of power electronics for all inverter ratings today? Where is it expected to go?
- Are power electronics the cost drivers in inverter manufacturing, or are inverters the cost drivers in power electronics? What are the tradeoffs?
- Is power electronics the reliability driver in inverter performance? What are the reliability drivers?
- At what point do cost/reliability tradeoffs make disposable inverters economical?
- What changes in power electronics technology would significantly improve inverter performance and reliability?

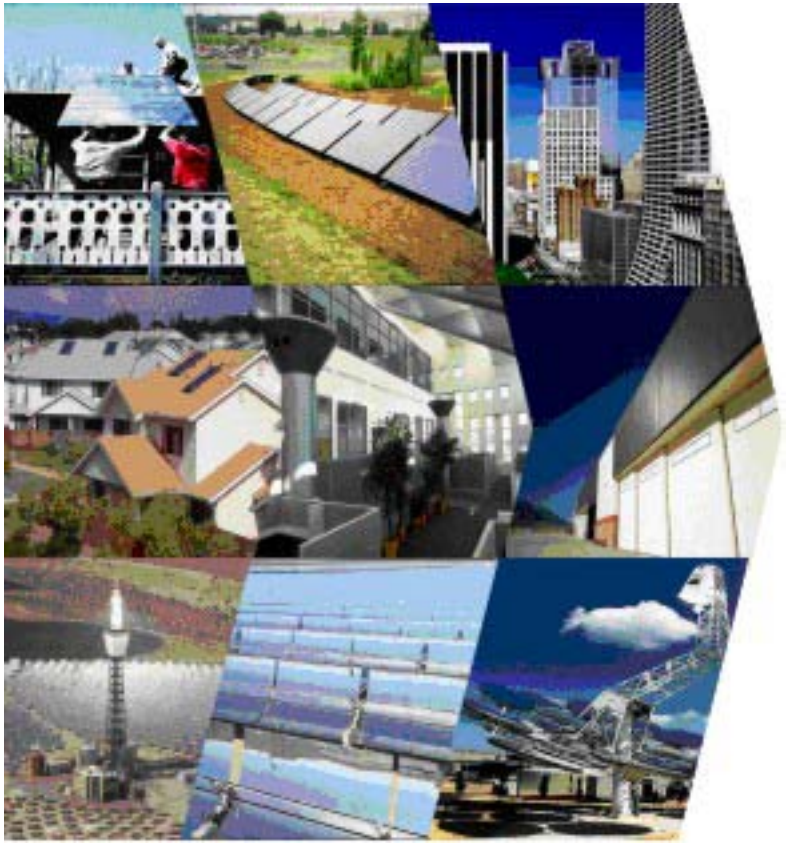
Why a 5 year plan for inverter development?

- Can a coordinated effort across technologies (DOE solar, DER, Storage, Transportation, and others) enhance the R&D environment to improve the performance, costs and reliability of inverters for all applications?
- Can a set of generic inverter cores be used to handle all of the technologies?
- Can a concerted development plan result in economical inverter MTFF rates of 15 years or more for all applications?
- Can this concerted effort result in inverter lifetimes of 30 years?

What is the best mix of components to make a system?

- What are reasonable cost, performance, reliability, and lifetime goals for the various components and subsystems of inverters?
- 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 electricity from PV?
- 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 for inverters
- Basic framework and elements of a five year plan for inverter R & D
- Schedule and next steps/assignments for starting the process and creating near-term, mid-term and final deliverables