U.S. Department of Energy
Energy Efficiency and Renewable Energy

Discussion on the Systems Driven Approach to Research Planning

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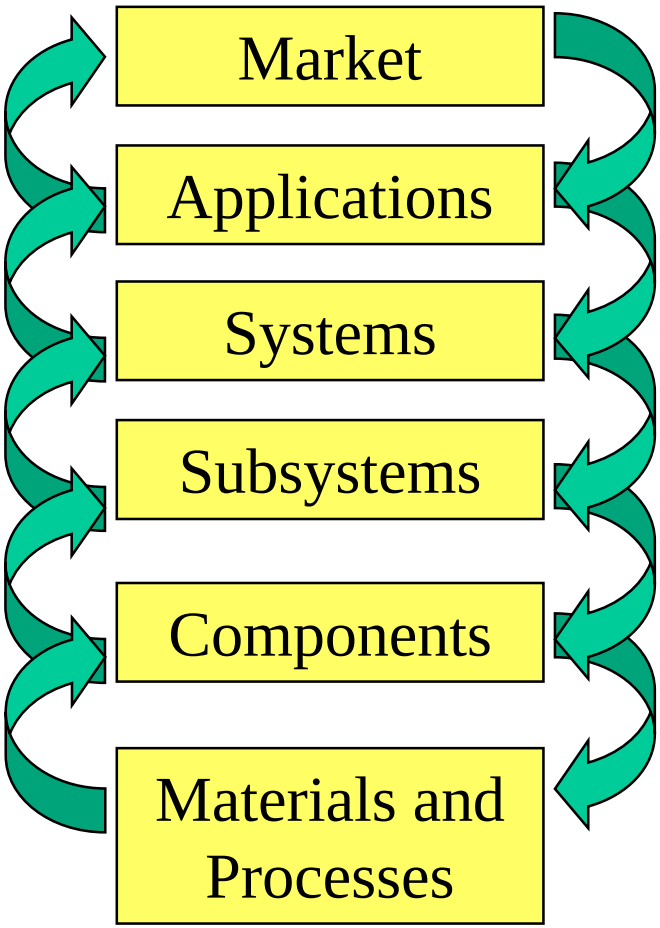
Objective of a Systems Driven Approach

- A framework and analysis tools that will allow us to explore alternative technology pathways and identify critical technology needs to guide planning and management of our entire solar technology portfolio.

Systems Driven Approach



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?

Systems Driven Approach Direct Benefits

- Improve models of key markets and applications
- Develop and document consistent methodology
- Analyze benefits of solar applications – particularly in relation to DOE, OMB, 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 – Help focus efforts

Systems Driven Approach Indirect Benefits

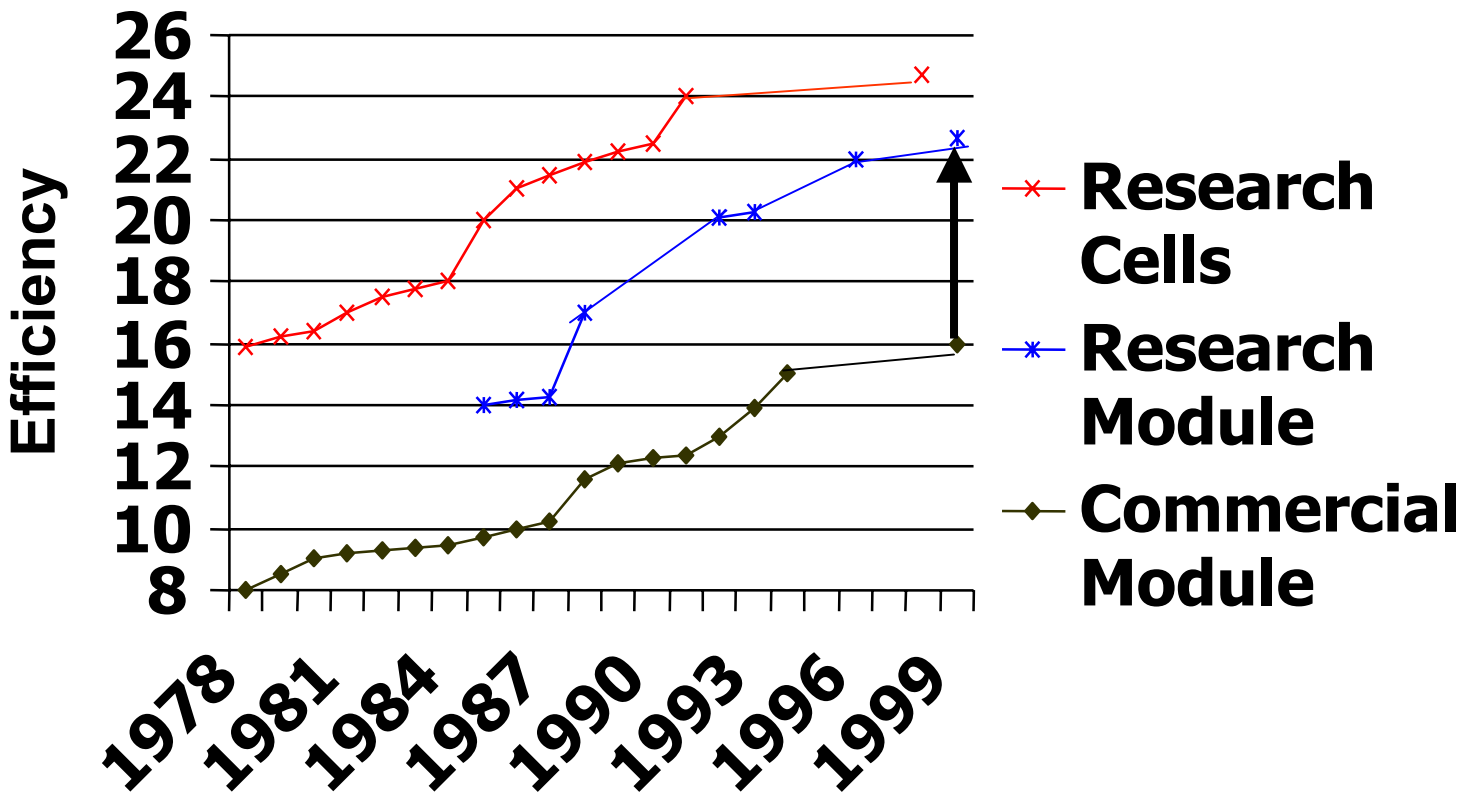
- Align technology development efforts and objectives across EERE technologies
- Develop cost and performance models/equations that compare solar technologies to their competition using the same value assumptions, i.e., peak power, reliability, dispatch…
- Provide better explanations for how our research investments will influence our energy, security, and environmental potential
- Capture knowledge and expertise from senior researchers and managers

Understanding Tradeoffs

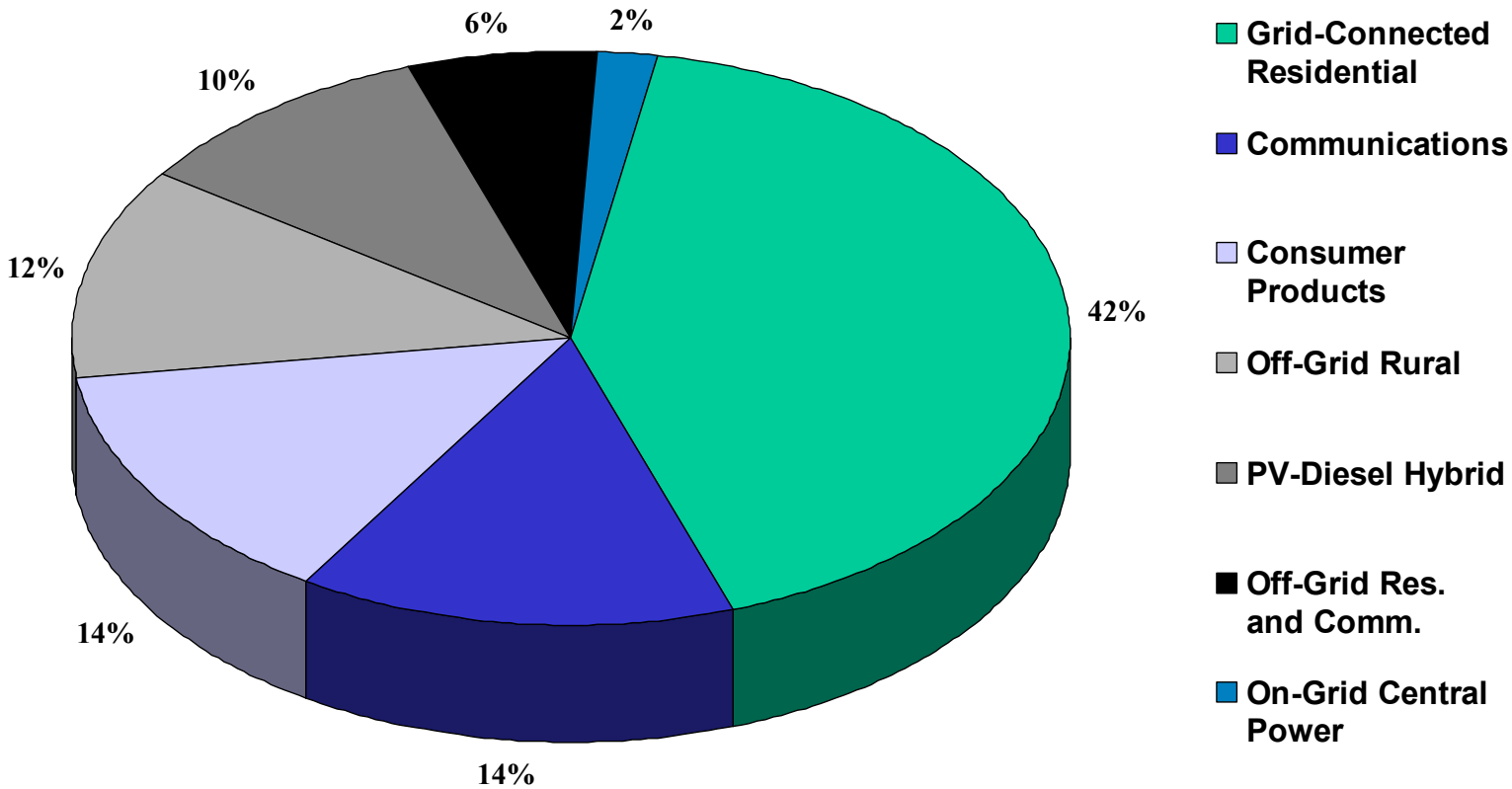
Impact of Efficiency & Direct Manufacturing Cost ($/W)

	$150/m2	$100/m2	$50/m2
8%	$1.9	$1.35	$0.63
10%	$1.5	$1	$0.5
12%	$1.25	$0.83	$0.42
15%	$1	$0.67	$0.33

Exploring Performance Implications

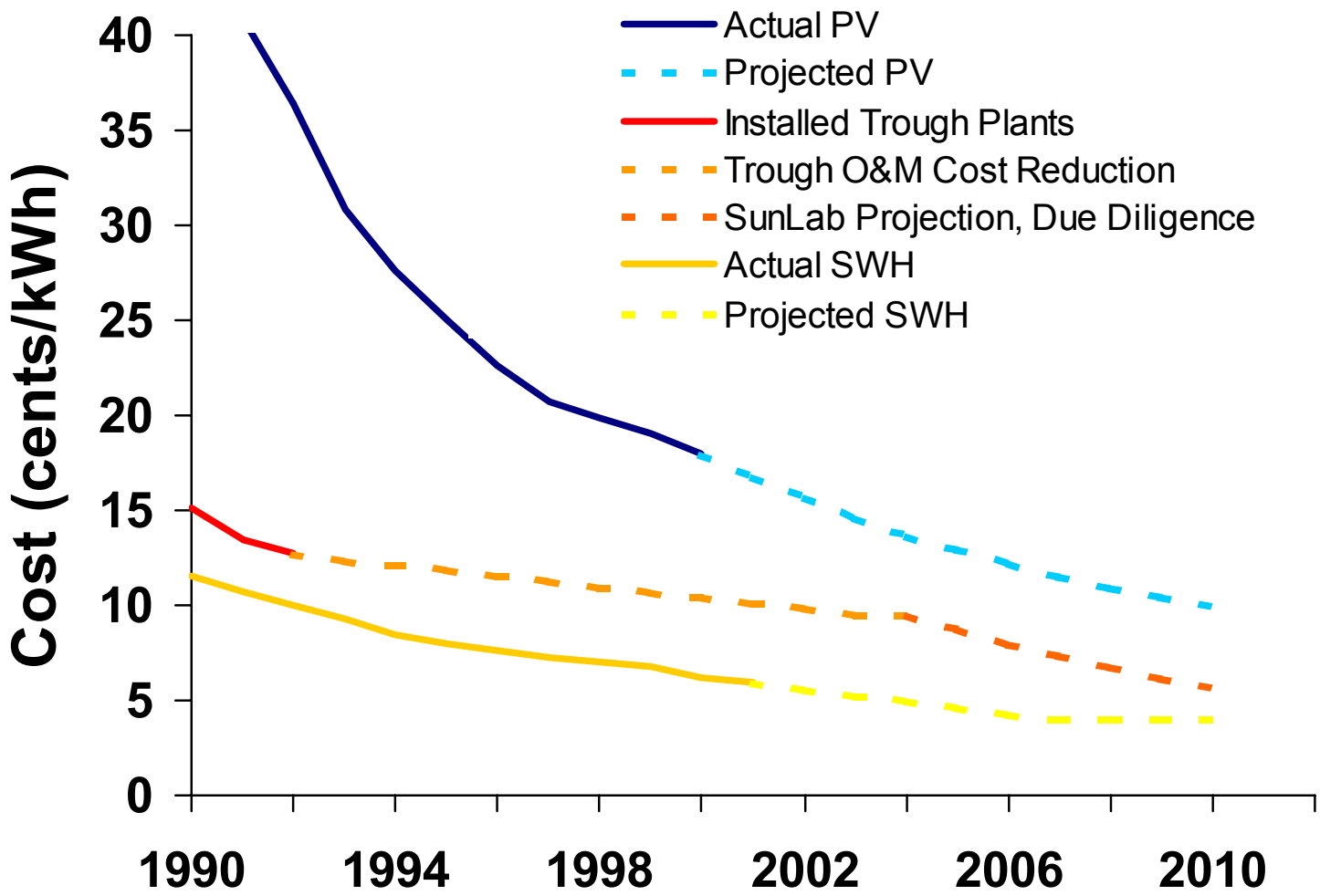


Understanding Markets and Their Implications for Technical Objectives and Investments

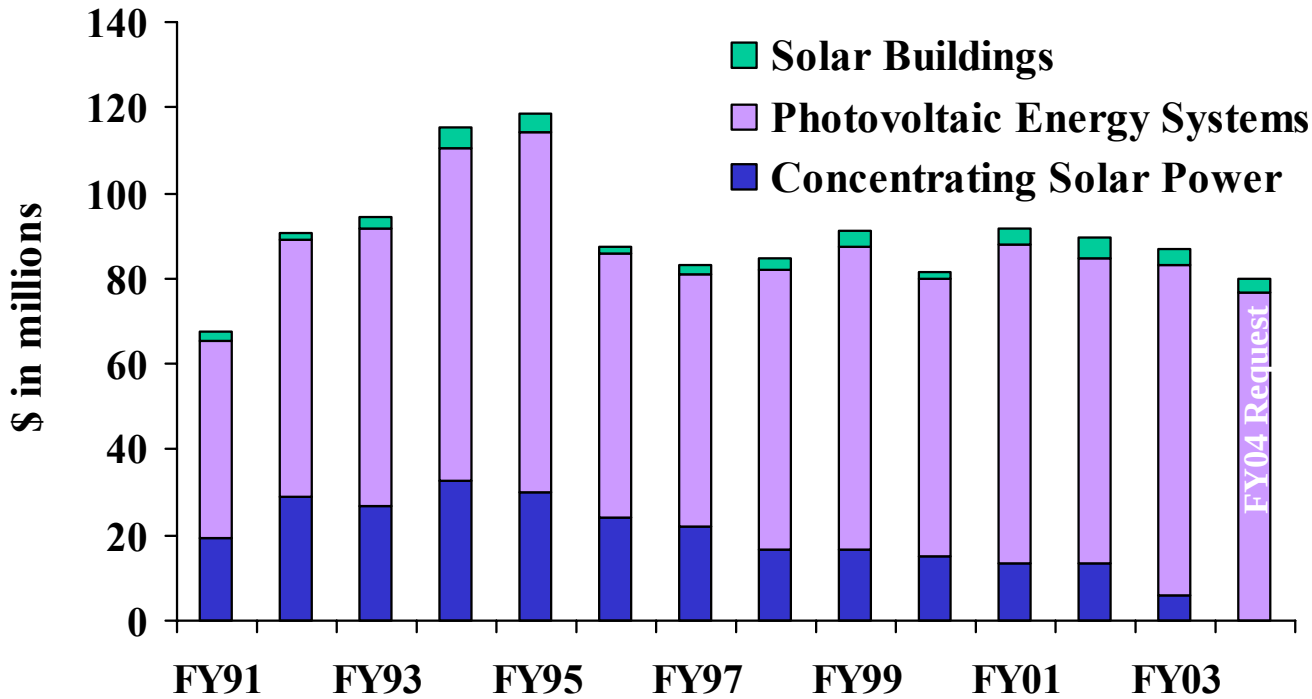


* 2000 PV market data, RenewableENERGYWorld, January-February 2003, Erik Lysen, based on data from Paul Maycock.

Examining Technology Impacts on Costs



Informing Investment and Management Decisions

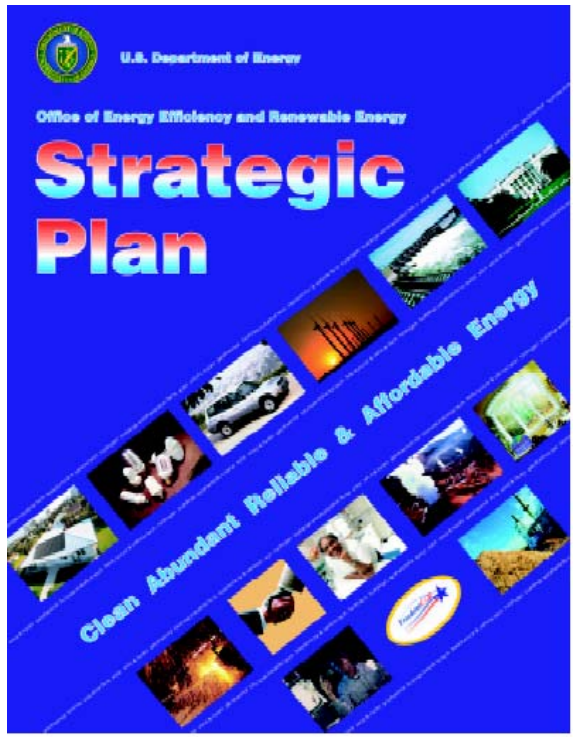


	FY91	FY92	FY93	FY94	FY95	FY96	FY97	FY98	FY99	FY00	FY01	FY02	FY03	FY04 Req.
Concentrating Solar Power	19.2	28.8	26.9	32.7	30.3	24.2	21.9	16.5	16.8	15.2	13.6	13.2	6	0
Photovoltaic Energy Systems	46.4	60	64.8	78	83.8	61.5	59.2	65.5	70.6	64.6	74.3	71.55	77	76.69
Solar Buildings	2	2	2.9	4.8	4.6	1.9	2.2	2.7	3.6	1.97	3.87	4.79	4	3

Proving Our Value

EERE Strategic Goals

- Reduce burden of energy prices on disadvantaged
- Increase viability and deployment of renewable energy
- Increase reliability and efficiency of electricity generation, delivery, and use
- Increase the efficiency of buildings and appliances
- Change the way EERE does business



Proving Our Value

OMB Applied R&D Investment Criteria

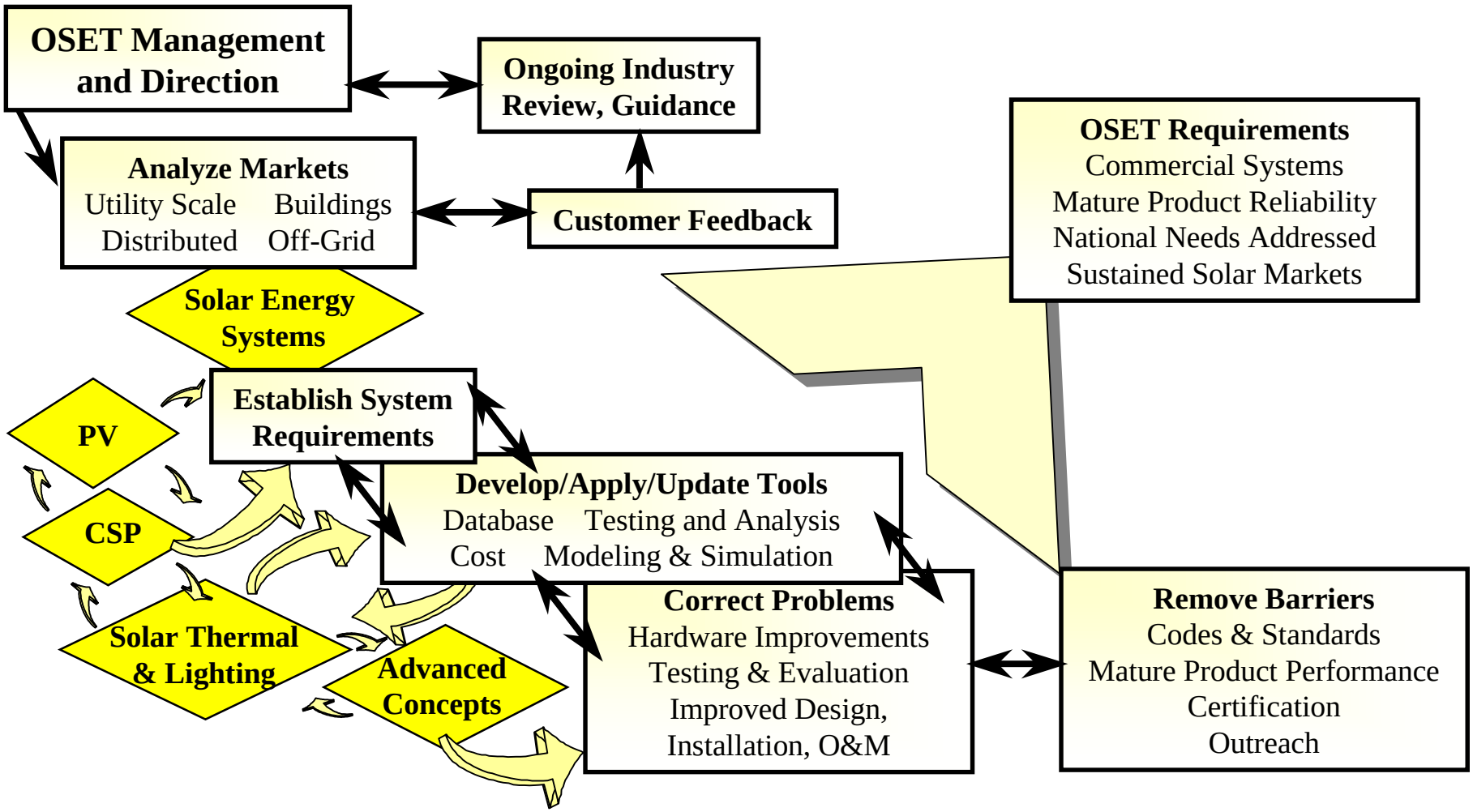
- How well does plan build on existing technology, complement related RD&D, and propose technically feasible federal activities?
- How well does plan incorporate performance indicators?
- How well does planning incorporate “off-ramps” and clear end point?
- What is expected number of years to commercialization?
- What is extent of technological risk?

Where are We Going with the Systems-Driven Approach?

Systems Driven Approach Workshop

- Held on December 17-18, 2002
- Preliminary requirements and specifications for a solar systems driven approach:
  - to explore alternative technology pathways and
  - identify critical technology needs to guide planning and management
- Establish logical steps to achieve measured progress toward a functional systems driven approach
- Four Markets examined, based on Industry Roadmap:
  - Distributed Generation
  - Off-Grid
  - Utility Scale
  - Buildings

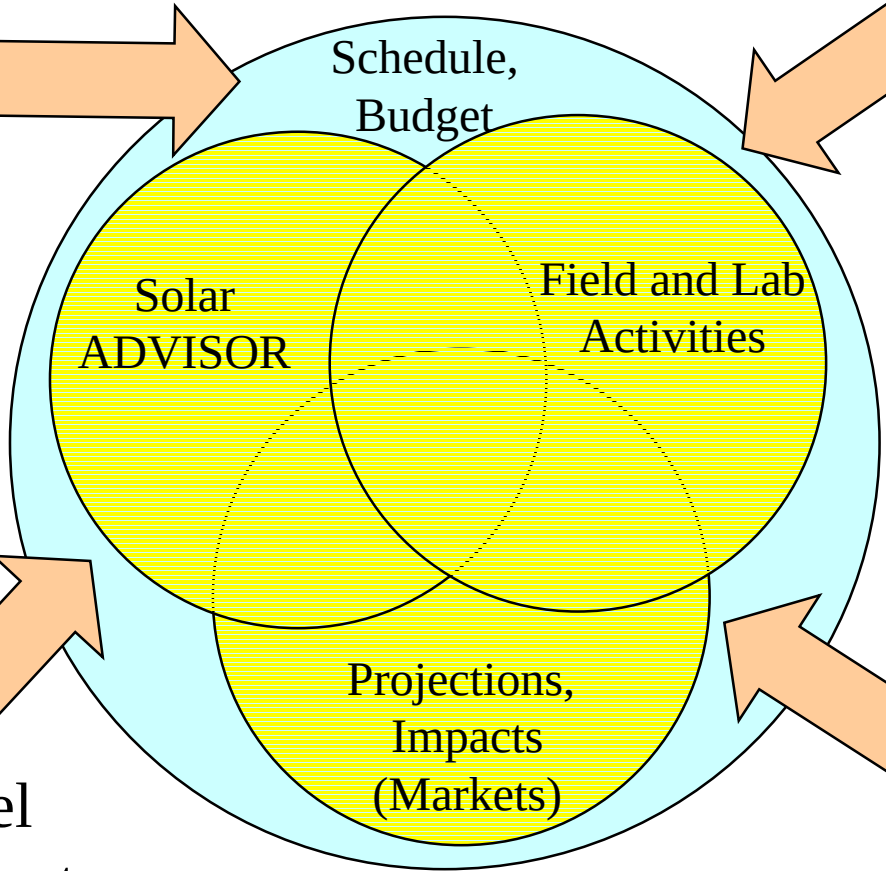
Systems Driven Approach



Team Approach

Team 1: Core

Team 4: Benchmarking



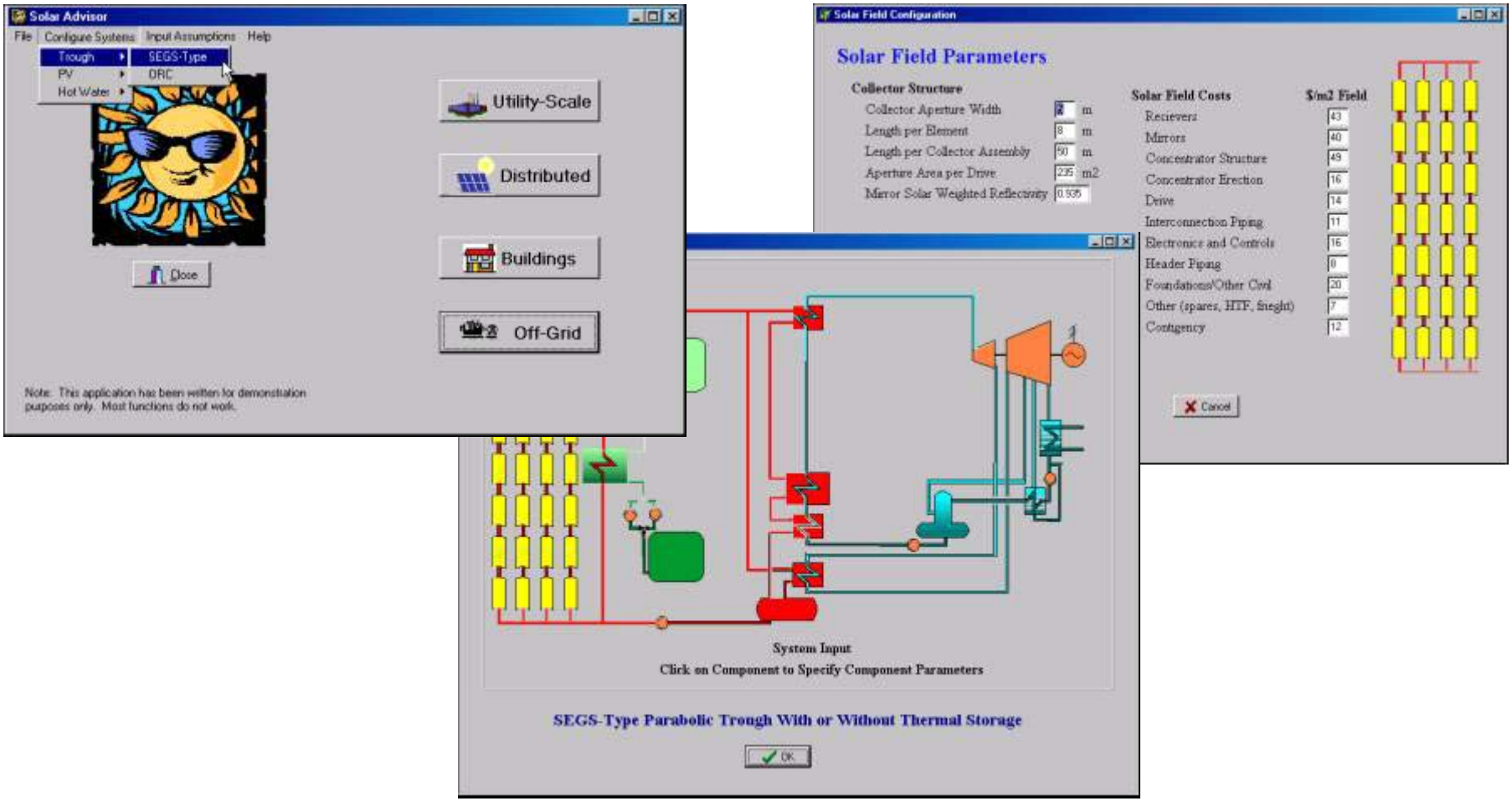
Team 2: Model Code Development

Team 3: Analysis

Proposed Modeling and Analysis Activities

- Program Management Level
  - Standardization of assumptions and market requirements used in programs
  - Identify current analysis capabilities and gaps
  - Develop solar ADVISOR model
- Research Level
  - Develop tools to model performance of new technologies
  - Analyze integrated components to optimize system designs
  - Perform trade-off studies to determine R&D directions

Solar ADVISOR Model Concept



Proposed Technical Target Setting Activity

- Program Management Level
  - Project costs and market penetration levels
  - Develop long-term program goals and estimates of technology impacts
  - Develop market-based technical/economic targets for key market sectors
- Research Level
  - Develop near- and long-term R&D targets at system component level
  - Track progress toward system component targets in relation to program goals

Proposed Benchmarking, Validation and Analysis Updates

- Program Management Level
  - Define parameters for cost, performance, and reliability data
  - Updates to performance/cost analyses
  - Resource assessment activities
- Research Level
  - Fielding of systems, components and collection of data
  - Conduct performance, reliability assessments
  - Lab testing and validation of specific technologies

Steps

- Workshop in Baltimore, December 2002
- Strong Systems Driven Approach component in Multiyear Program Plan, April 2003
- Inverter workshop in April 2003 to follow systems driven approach
- Seek broader industry review and collaboration as tools and models develop
- Start development of Solar ADVISOR model

Workshop Highlights – Existing Models

- High interest in developing a modeling capability as strong and flexible as ADVISOR
- There are extensive modeling efforts in solar program, but focused on specific objectives and needs
- Little cross-comparison among models to document and rationalize assumptions, inputs
- Modeling and analysis capability needs industry input and validation to be effective

Highlights – Questions

- Strong element of program management questions – what are the energy potentials, environmental impacts, security implications, economic benefits of solar technologies
- Market questions – what does it take to be competitive, to have market penetration, how will competing technologies evolve…
- Technology tradeoff questions – what is the research priority of different activities, what advances in components/processes have biggest impact on objectives
- Risks/probability questions on research pathways

Highlights – Key Factors, Markets and Applications

- Cost/Value indicators – levelized, Internal Rate of Return, first cost, payback period
- Other value characteristics – peak impacts, green value
- Incentives, regulations, consumer interests
- System performance requirements in applications
- Market penetration factors

Key Factors – Systems and Subsystems

- Cost/performance tradeoffs
- Performance impacts – climate, design, failure modes
- Service and distribution networks
- Field experience
- Interactions with grid, with building elements, with components

Key Factors – Components, Materials and Processes

- Manufacturing inputs/processes
- Lifetime, failure modes
- Form factor – dimension, weight, other factors that impact shipping/installation/end-use
- Material properties/physics
- Thin-film deposition, process controls

Highlights – Data Needs

- Validated, real-world data on performance, reliability, cost…
- Resource, weather
- Demographics
- Consumer preferences
- Housing and other market characterization information