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Energy Commission Renewable Energy RD&D

Presentation to California Energy Commission
Staff Workshop: Emerging Technologies for the Integration of Renewables
July 31, 2008
Sacramento, CA

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Outline

- Renewable Energy Technologies
- California Renewable Energy Resources
- Renewable Energy (RE) Integration
- Energy Commission RE R&D Programs
  - Collaborative Research
  - Utility Scale Renewables
  - RE Secure Communities
  - RE Secure Buildings

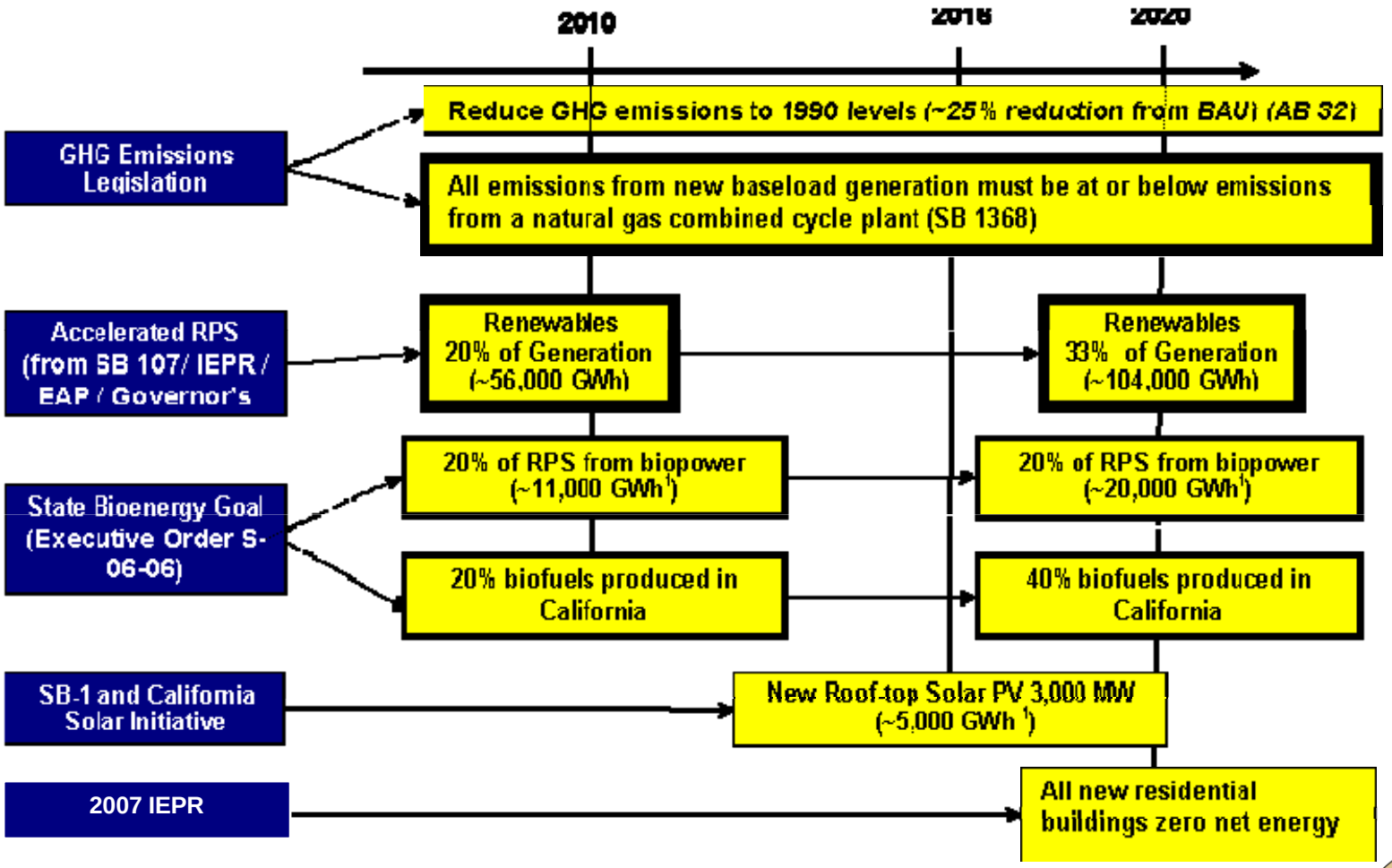
Renewable Energy Technology Menu

√ = primary application	Deployment Venues		
√ = secondary application	Utility-Scale Renewables	RE Secure Communities	RE Secure Buildings
Technology/ Resource	Utility-scale power plants and bio-refineries	Smaller energy plants exploiting high-quality local resources	Modular systems for building and industrial power, heat, cooling and lighting
Wind Power Plants	√	√	
Geothermal Power	√	√	
Hi Temp Solar Thermal	√	√	√
Biomass Power	√	√	√
Ocean/Wave	√	√	
Solar PV	√	√	√
DG Wind		√	√
Solar Heat & Cooling		√	√
Direct Geothermal		√	√
Geothermal Heat Pumps		√	√
Biofuels	√	√	√

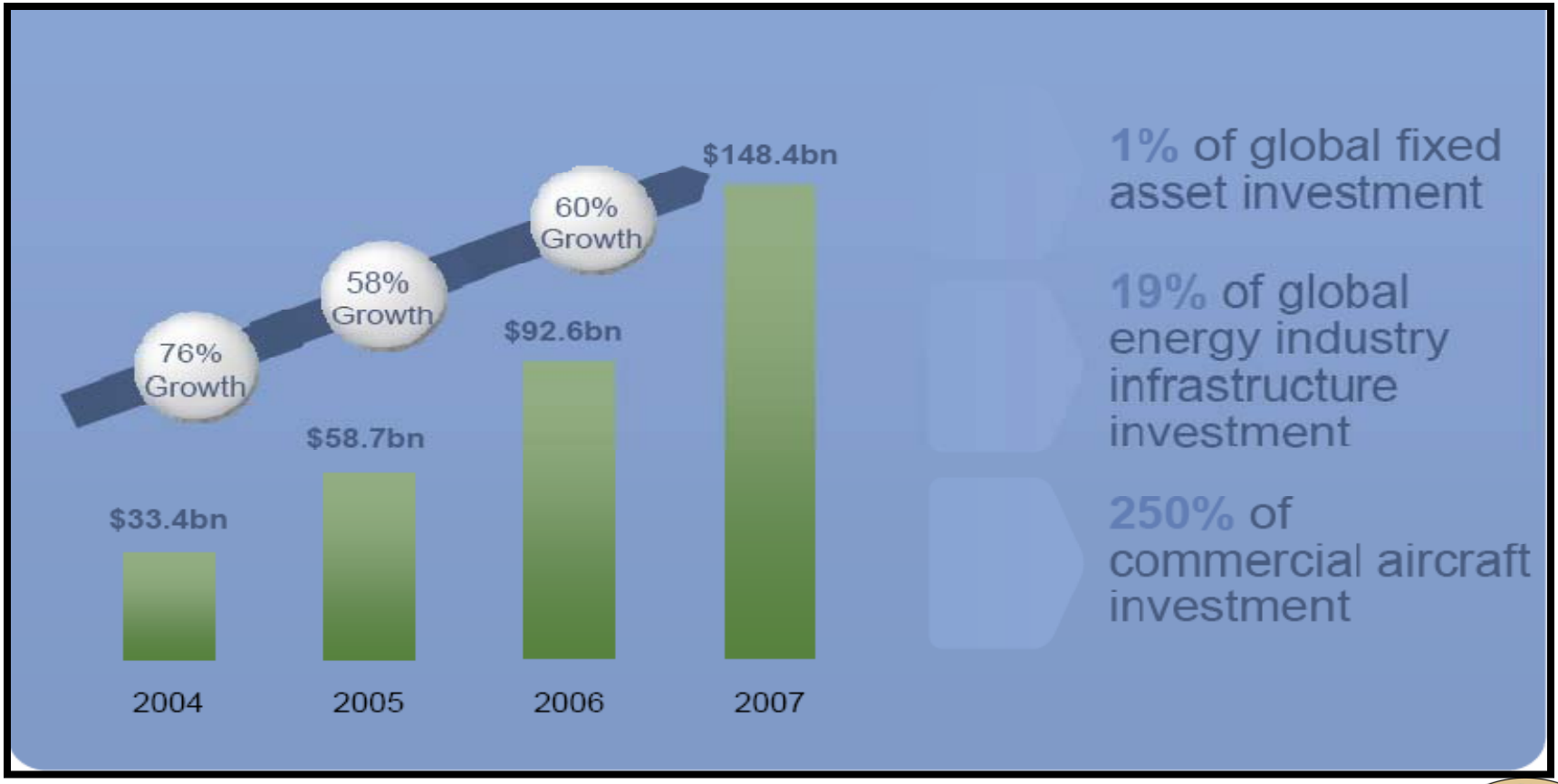
California RE Context

- Launch pad of modern global RE industries
- RE “resource rich”:
  - Best direct and total solar radiation
  - Best geothermal
  - Major wind hot spots
  - Substantial agricultural and forestry waste streams
- RE R&D rich:
  - Source of one third of all clean energy venture capital
  - Legacy of ratepayer funded RE RD&D
- RE incentives and mandates:
  - $1/W buy-down for solar PV averaged over 3 GW
  - 33% RPS for 2020

California Policies Impacting Renewable Energy



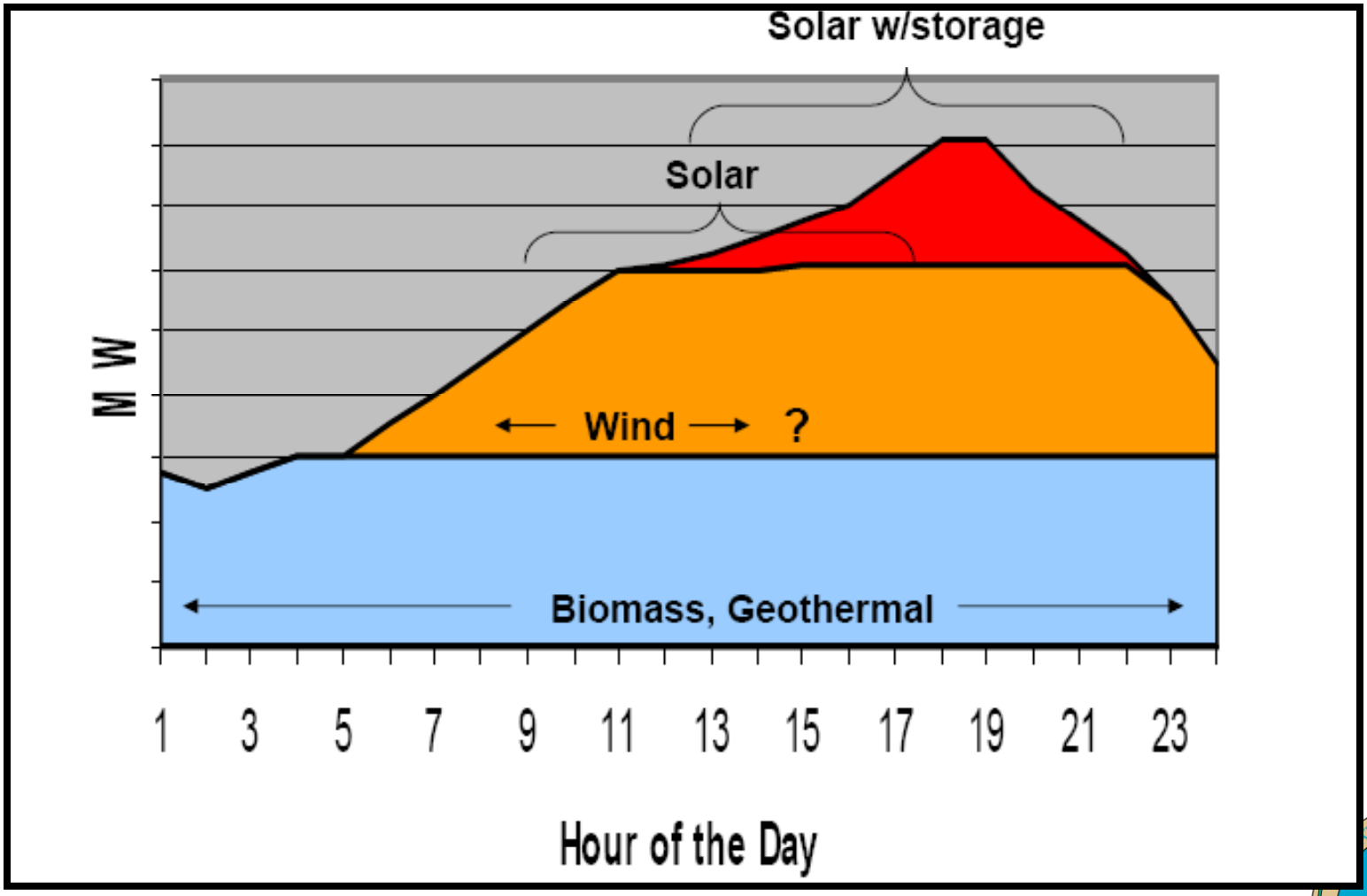
Total Global Investment in Clean Energy (2004-2007)



Some Dimensions of RE Integration

- Supply and end use - RE and efficiency
- Supply and delivery – RE and T&D
- Mix - Baseload, intermittent and peaking
- Siting – Remote, local, on-site
- Scale – Utility, community, building
- Technology - commercial and emerging
- Technology - primary and enabling (e.g. storage)

Conceptual California RE Resource Mix



Source: F. Morse, Abengoa

Commercial vs. Emerging – Technology Perspective

C = Commercial	Deployment Venues		
E = Emerging	Utility-Scale Renewables	RE Secure Communities	RE Secure Buildings
Technology/ Resource	Utility-scale power plants and bio-refineries	Smaller energy plants exploiting high-quality local resources	Modular systems for building and industrial power, heat, cooling and lighting
Wind Power Plants	C	C	
Geothermal Power	C	C	
Hi Temp Solar Thermal	C/E	C/E	E
Biomass Power/CHP	C	C	C
Ocean/Wave	E	E	
Solar PV	E	C/E	C
DG Wind		C/E	C/E
Solar Heat & Cooling		C/E	C/E
Direct Geothermal		C	C
Geothermal Heat Pumps		C	C
Cellulosic Biofuels	E	E	E

Commercial vs. Emerging – Industry Capability Perspective

C = Capable	Deployment Venues		
D = Developing	Utility-Scale Renewables	RE Secure Communities	RE Secure Buildings
Technology/ Resource	Utility-scale power plants and bio-refineries	Smaller energy plants exploiting high-quality local resources	Modular systems for building and industrial power, heat, cooling and lighting
Wind Power Plants	C	D	
Geothermal Power	C	D	
Hi Temp Solar Thermal	C/D	D	D
Biomass Power/CHP	D	C/D	D
Ocean/Wave	D	D	
Solar PV	D	C	C
DG Wind		D	D
Solar Heat & Cooling		D	D
Direct Geothermal		D	D
Geothermal Heat Pumps		D	D
Cellulosic Biofuels	D	D	D

California RE Collaboratives

- Statewide networks of government, industry, environmental groups, and educational institutions.
- Sponsored by the Energy Commission
- Technical staffs execute collaborative research addressing program and stakeholder priorities.

- A fourth collaborative (solar) is in the formation stage.
- All four are being brought together under a single two year contract.
- Promotes continuity, administrative efficiency and joint efforts on integration issues.

Collaborative Research

- Technical Issues:
  - Cost and performance forecasts for commercial RE options and improvements
  - Assessment of next generation RE technologies under development in California
  - Technically validated supply curves for all major RE sources
  - Optimum scenarios to achieve 50% RPS
- Recommended Steps:
  - Two year (on-going research) funding for four RE collaboratives
  - Initiate collaborative research (co-funded by) industry, utility and Federal stakeholders

Development and Demonstration

- Potential Strategies:
  - Create new options
  - Improve existing options
  - Enable deployment
- In the RPS context:
  - Enable deployment
  - Emphasize RE integration
- RD&D can help:
  - Fill technology gaps
  - Optimize economic value of RE supply
  - Optimize T&D around increasing levels of RE supply

RD&D program: Utility Scale Renewables

- Technical issues:
  - Proliferation of solar thermal power technical solutions
  - Integration of thermal storage and natural gas
  - Integration of renewable sources
  - Real time resource forecasts
- Recommended RD&D solicitation targets:
  - Enabling technologies and tools, e.g. thermal storage and solar and wind forecasting
  - High value integrated solutions, e.g. solar/storage/NG hybrids

RD&D Program: RE Secure Communities

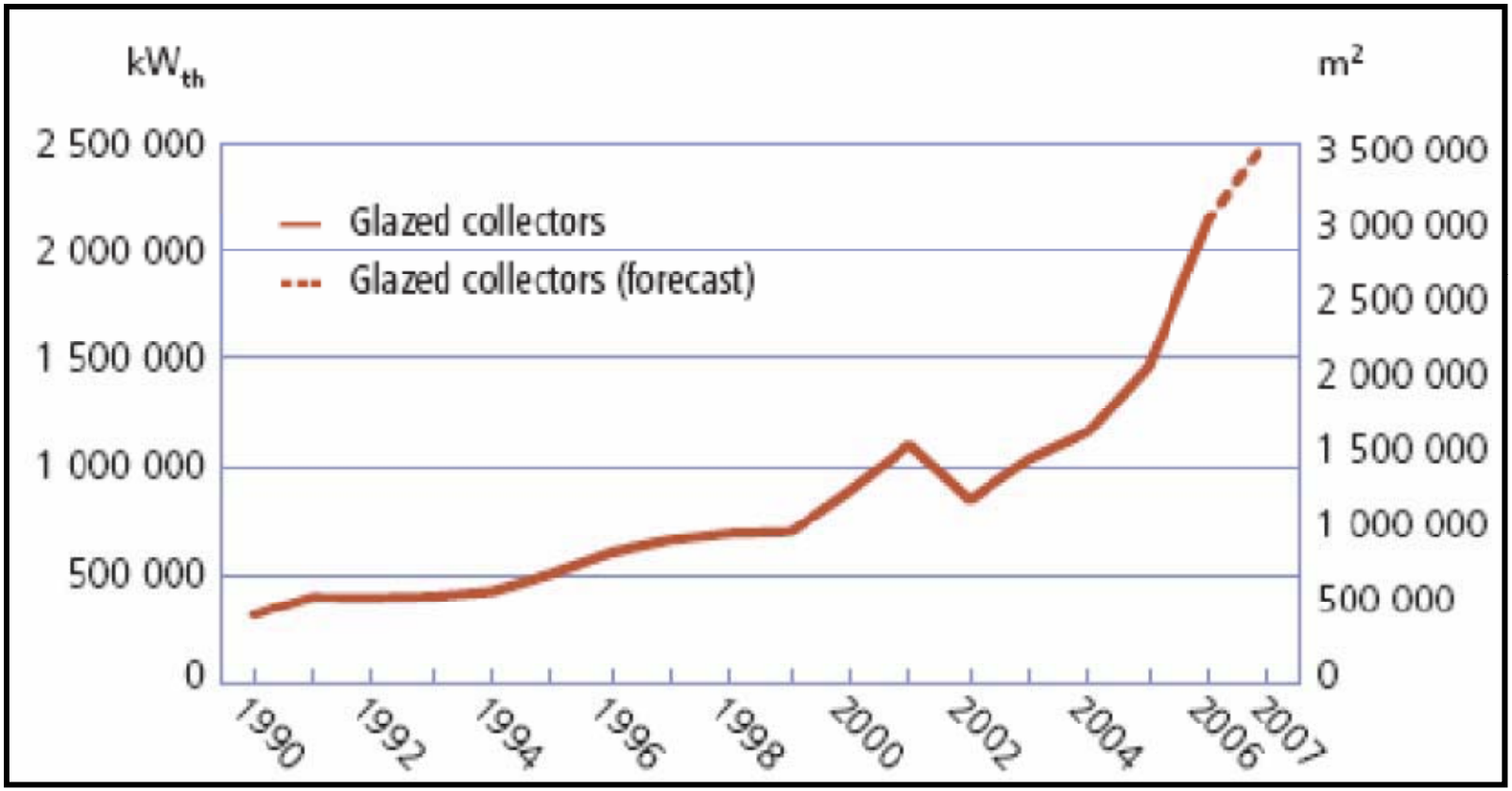
- Technical Issues:
  - Strategy to exploit local RE resources to achieve RE security, i.e.:
    - Stable, favorable energy supply economics
    - Stable local RE workforce
    - Complementary efficiency and demand response capacity
  - Manage risks scaling from existing base
- Recommended RD&D Solicitation Targets:
  - Address scale-up risks and innovative integration opportunities
  - Expand RE technical infrastructure, e.g. via RE Secure Campus Communities

Up-coming Workshops

RE-based Secure Communities

- **WEDNESDAY, AUGUST 6, 2008** at 1:00 to 5:00 p.m.
  CALIFORNIA ENERGY COMMISSION
  1516 Ninth Street, Sacramento, California 95814
- **FRIDAY, AUGUST 8, 2008** at 1:00 to 5:00 p.m.
  SOUTHERN CALIFORNIA GAS COMPANY
  9240 Firestone Blvd., Downey, California, 90241
- **TUESDAY, AUGUST 12, 2008** at 1:00 to 5:00 p.m.
  PACIFIC GAS AND ELECTRIC COMPANY
  77 Beale Street, Room 323, San Francisco, California 94105

Solar Thermal Market in EU27 + CH



RD&D Solicitation: RE Secure Buildings

- Technical Gaps:
  - In state laboratory testing, evaluation and rating capability
  - Product innovation
  - Field test and demonstration of emerging technologies
  - Codes and standards support
  - Technical assistance to architects and builders
- Recommended RD&D Solicitation Targets:
  - Outdoor testing of next generation PV technology
  - Transfer of emerging and commercial RE heating and cooling technology to California market
  - Market support, e.g. California RE product technology center

Summary

- Global RE deployment globally drives incremental innovation and cost reduction.
- California - the world's best venue for RE integration.
- Must address all dimensions of RE integration
- Need scenarios for an RE-based energy economy.
- Uneven RE industry capability limits RE deployment
- Energy Commission RE RD&D priorities:
  - Research driven by vision of RE-based economy
  - Development and demonstration of high value integrated solutions