

Renewable Energy Update

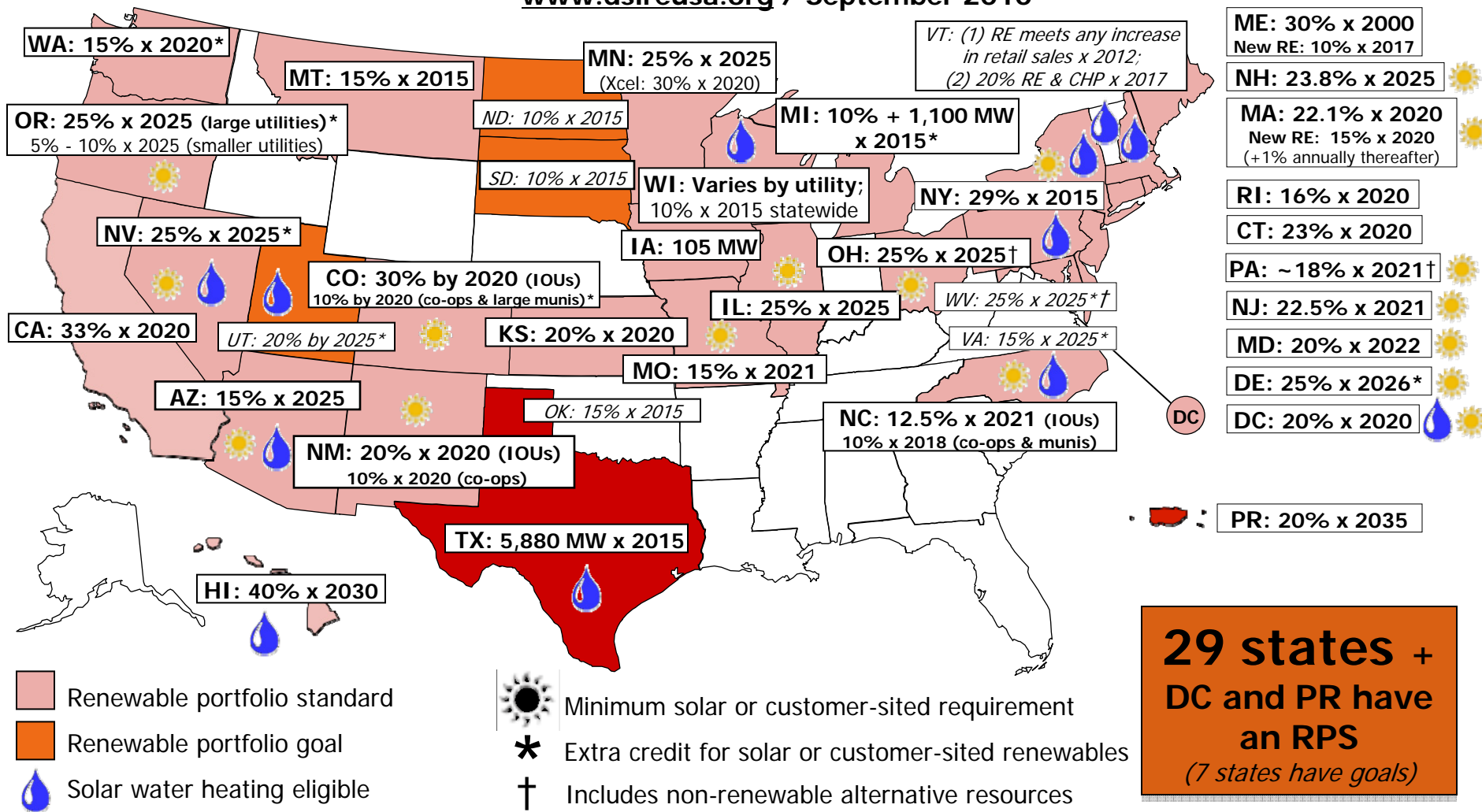
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Principal
Emerging Clean Technologies

September 28, 2010



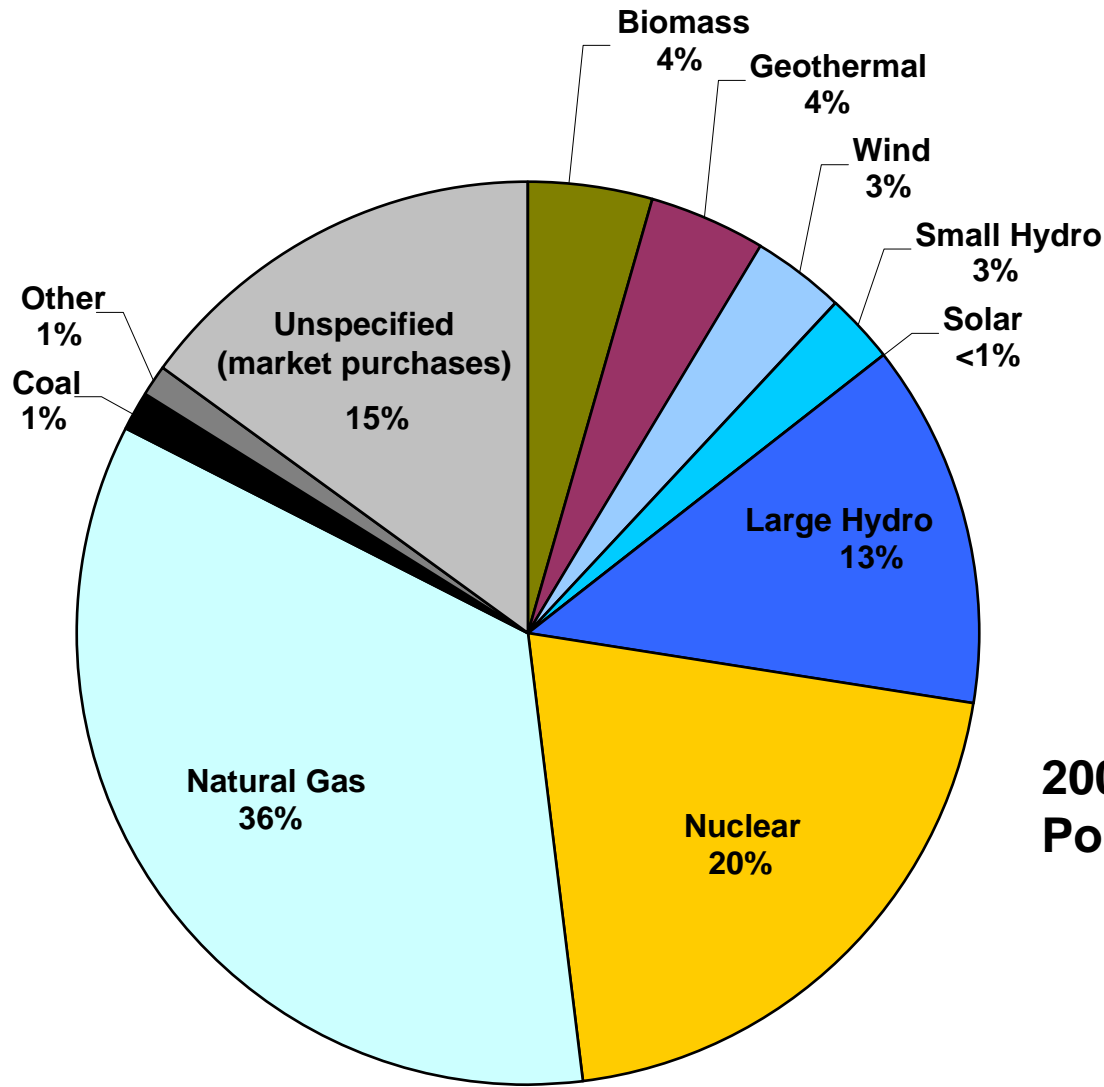
RPS Policies

www.dsireusa.org / September 2010





PG&E Provides Some of the Cleanest Energy in the Nation



2009 Electric Generation Portfolio Mix



California has Aggressive Renewables Targets

History of California's Renewable Portfolio Standard (RPS) requirement:

- Established in 2002 under SB 1078 (20% by 2017)
- Accelerated in 2006 under SB 107 (20% by 2010)

PG&E's **current** obligation:

- RPS “requires electric corporations to increase procurement from eligible renewable energy resources by at least 1% of their retail sales annually, until they reach 20% by 2010.”

Potential **future** obligations:

- Gov. Schwarzenegger vetoed a bill for 33% by 2020 in Aug. 2009
- Governor passed Executive Order in Sep 2009 directing CA Air Resources Board (CARB) to adopt regulation to support 33% RPS by 2020
- SB 722 to make 33% RPS state law did not come up for vote by 8/31/10 deadline
- 10/23/10 CARB approves 33% renewable electricity standard (RES) **regulation**



Most Green and/or Emissions-free Technologies Count Towards RPS

What are “eligible renewable energy resources”?

- Biomass
- Fuel cells: using renewable fuels
- Geothermal
- Hydro: small facilities <30 MW
- Ocean: ocean wave, ocean thermal, or tidal current
- Solar: solar thermal & photovoltaic
- Waste: digester gas, municipal solid waste conversion, landfill gas
- Wind

RPS requirement to generate within or deliver to California

- If unbundled, Renewable Energy Certificate (REC)
- Amount of RECs allowed to meet 20% target unknown
- CARB RES allows RECs to meet 33% target



Renewable Energy Technologies

Traditional



Biomass



Small Hydro



Geothermal



Wind

Emerging



Concentrating
Solar Thermal



Photovoltaic



BioGas



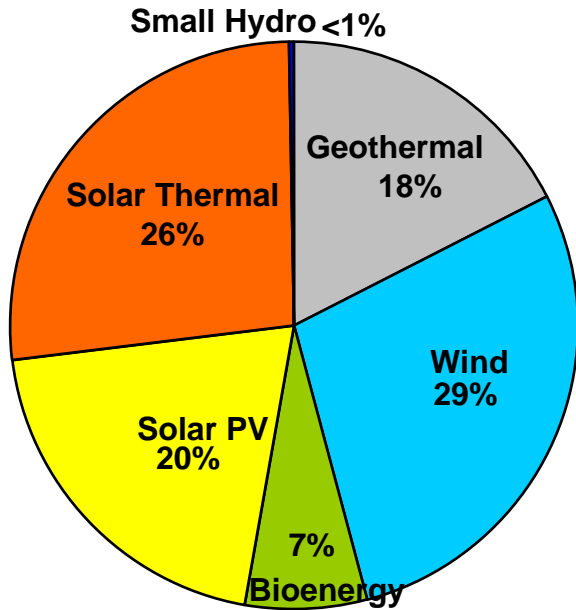
Wave Power

Airborne Wind, Deepwater Offshore Wind?



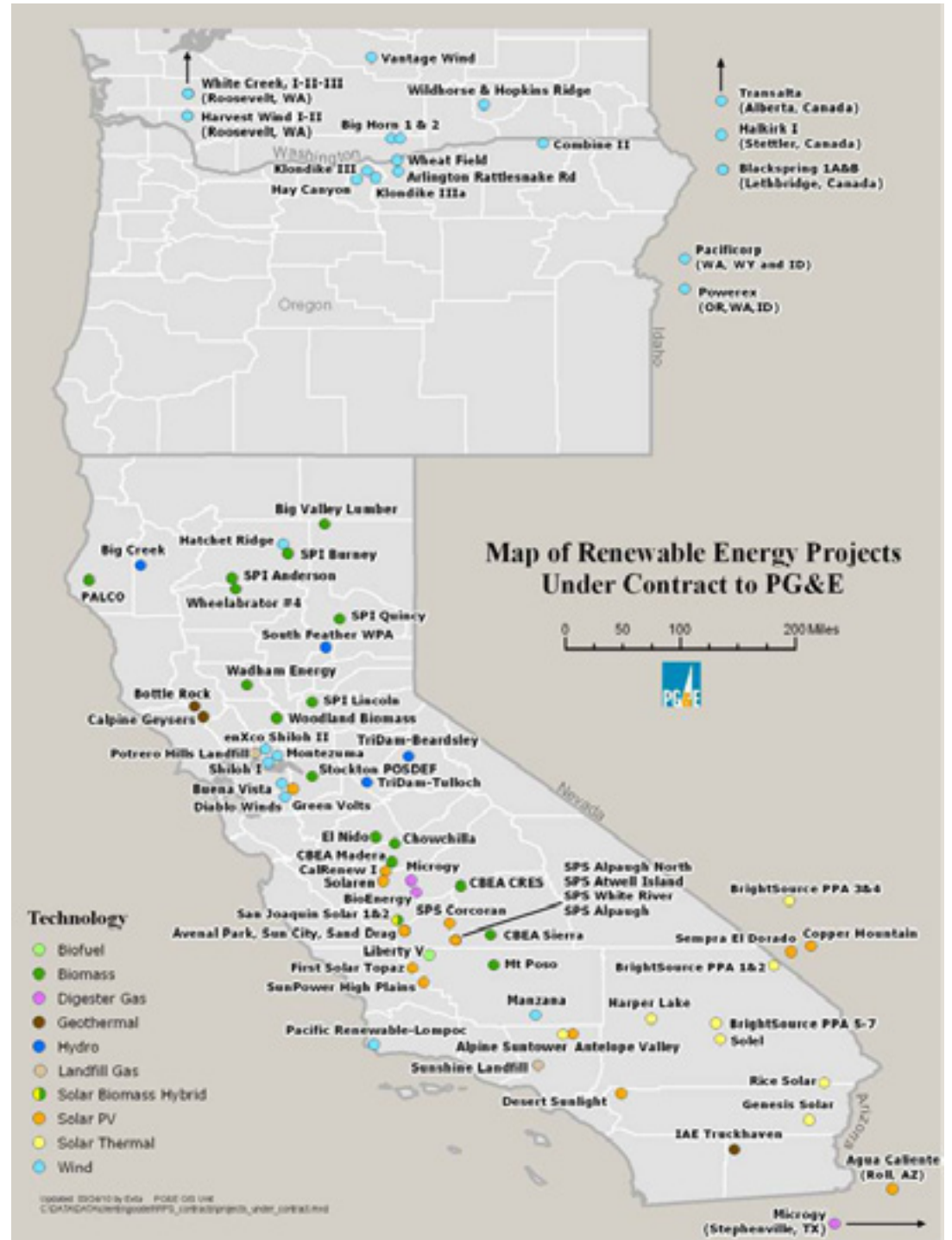
Diverse Mix of RPS Contracts

(% of MWh contracted)



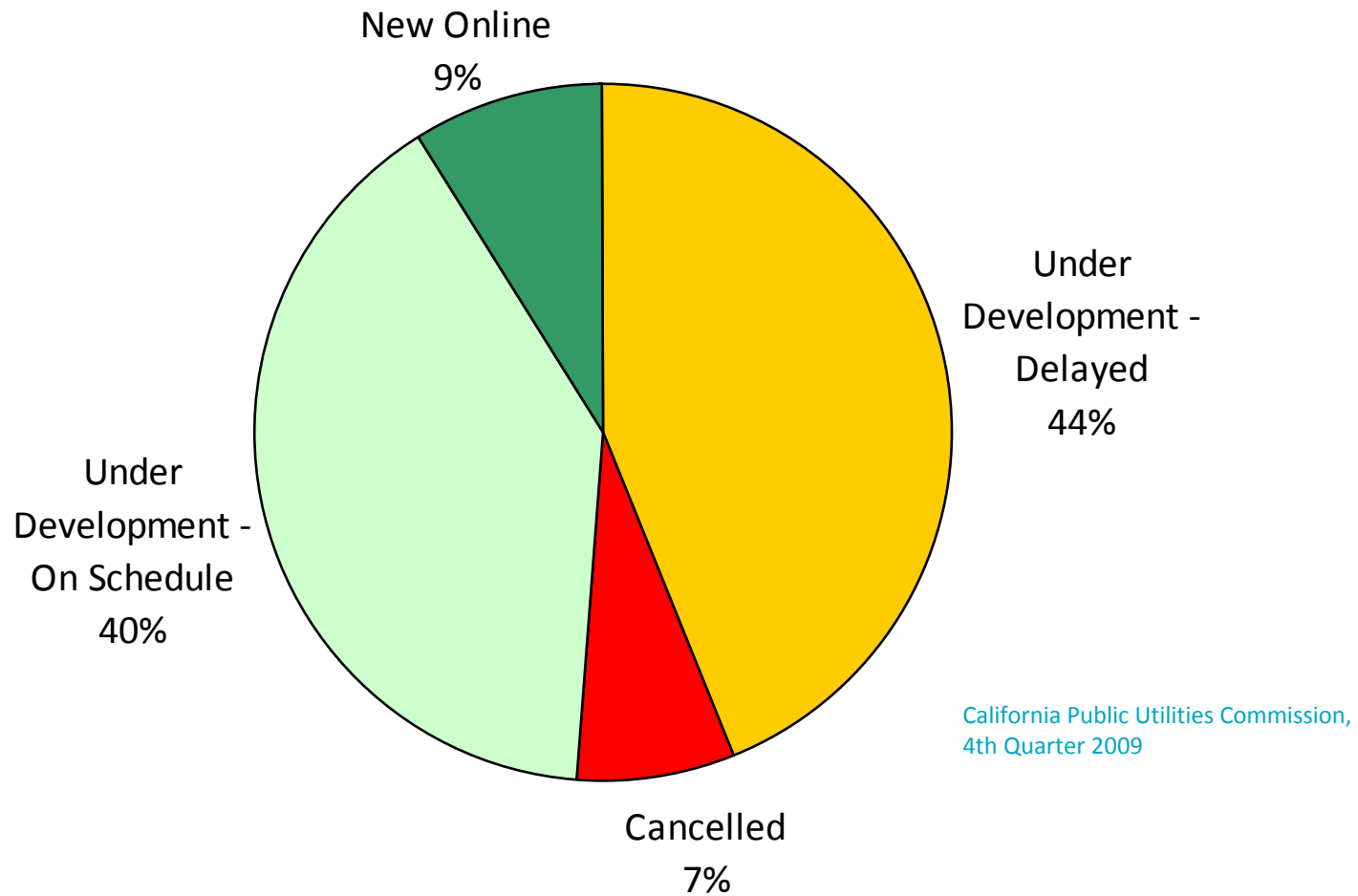
	#	MWs
Geothermal	8	635
Wind	33	2,778
Bioenergy	23	285
Solar PV	20	2,106
Solar Thermal	13	2,797
Small Hydro	5	49
Wave	1	2
Total	103	8,590

(as of 6/30/10)



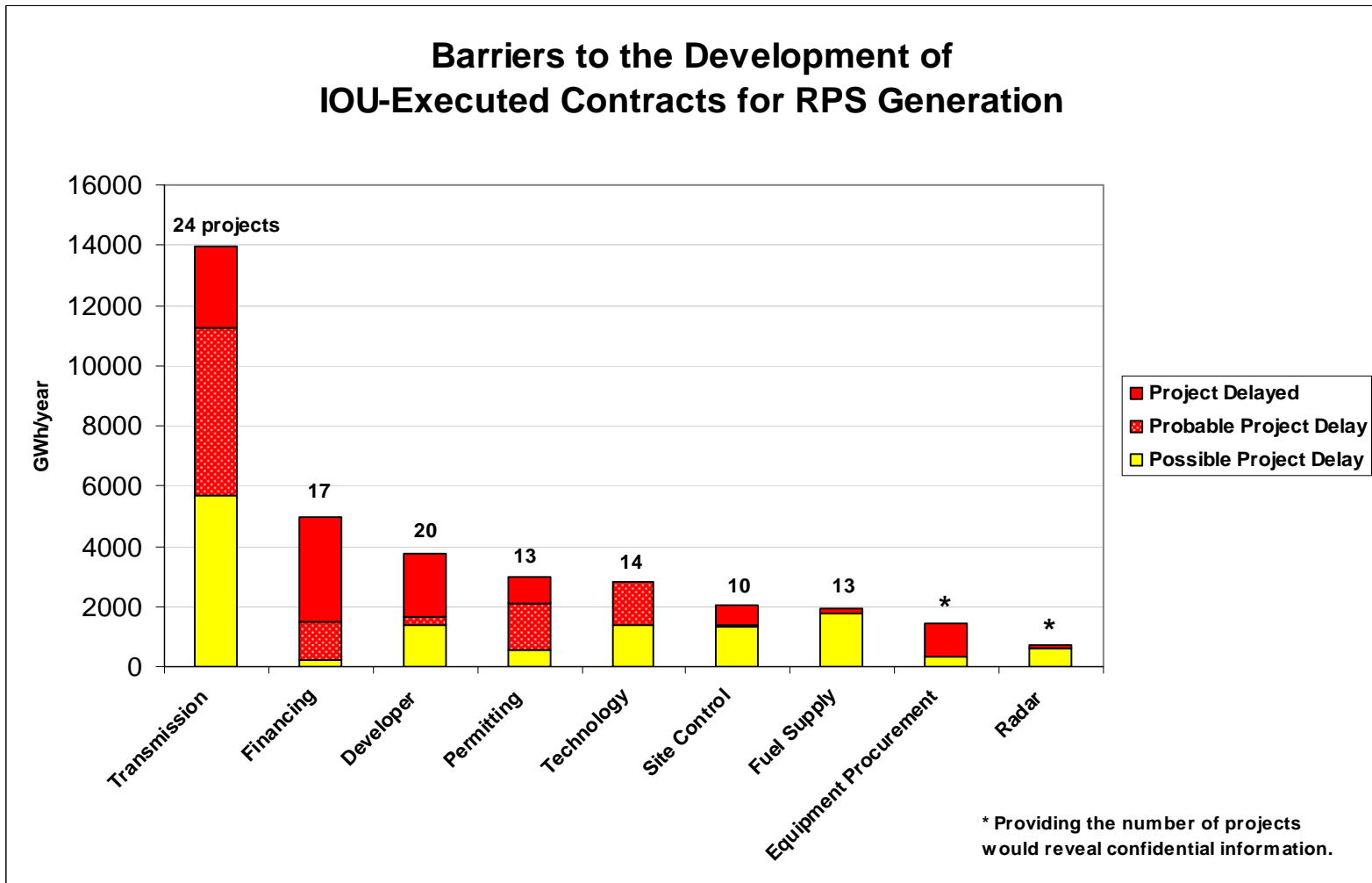


Only Half of CA Renewables Projects Are Online or On Schedule





Various Obstacles to Renewable Development Exist



Source: CPUC RPS Quarterly Report, January 2009
Barriers associated with approximately 50 CPUC approved, but not yet operational contracts
Data are outdated, but indicative of areas that remain problematic for renewable resources



Challenges to Meeting Current & Future RPS Goals

Project-level Challenges

Financial crisis

- Project financing difficulties
- Appetite for tax credits

Technology risk

Developer performance

Transmission upgrades

- Need upgrades that can be identified, approved and developed by contract online date

Project permitting

- Need expedited permitting approvals for contracted projects

Portfolio-level Challenges

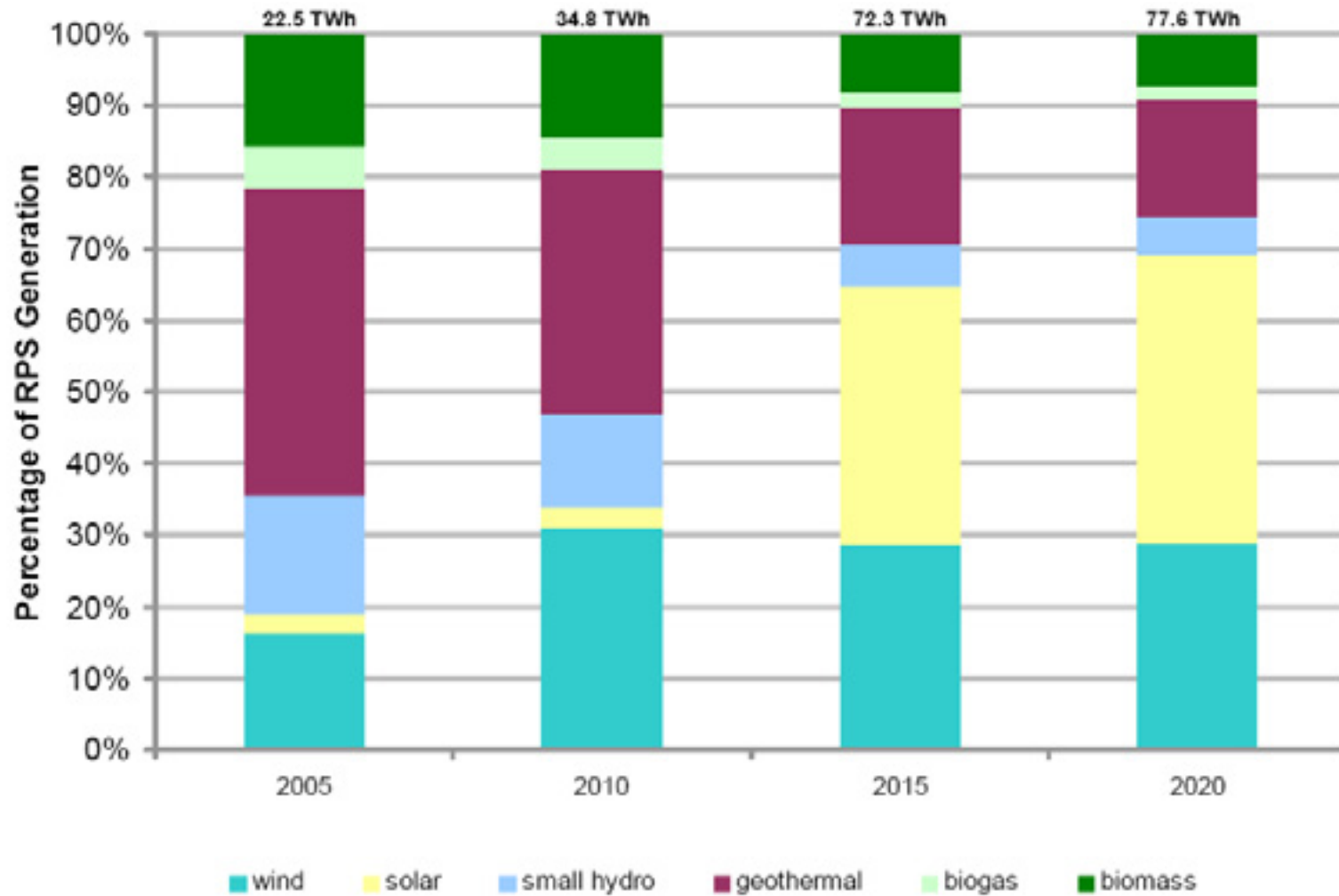
Large-scale transmission lines needed to reach remote areas

System integration of intermittent resources

Competition for renewables projects from other utilities/states/countries



Solar Expected to Increase Contribution

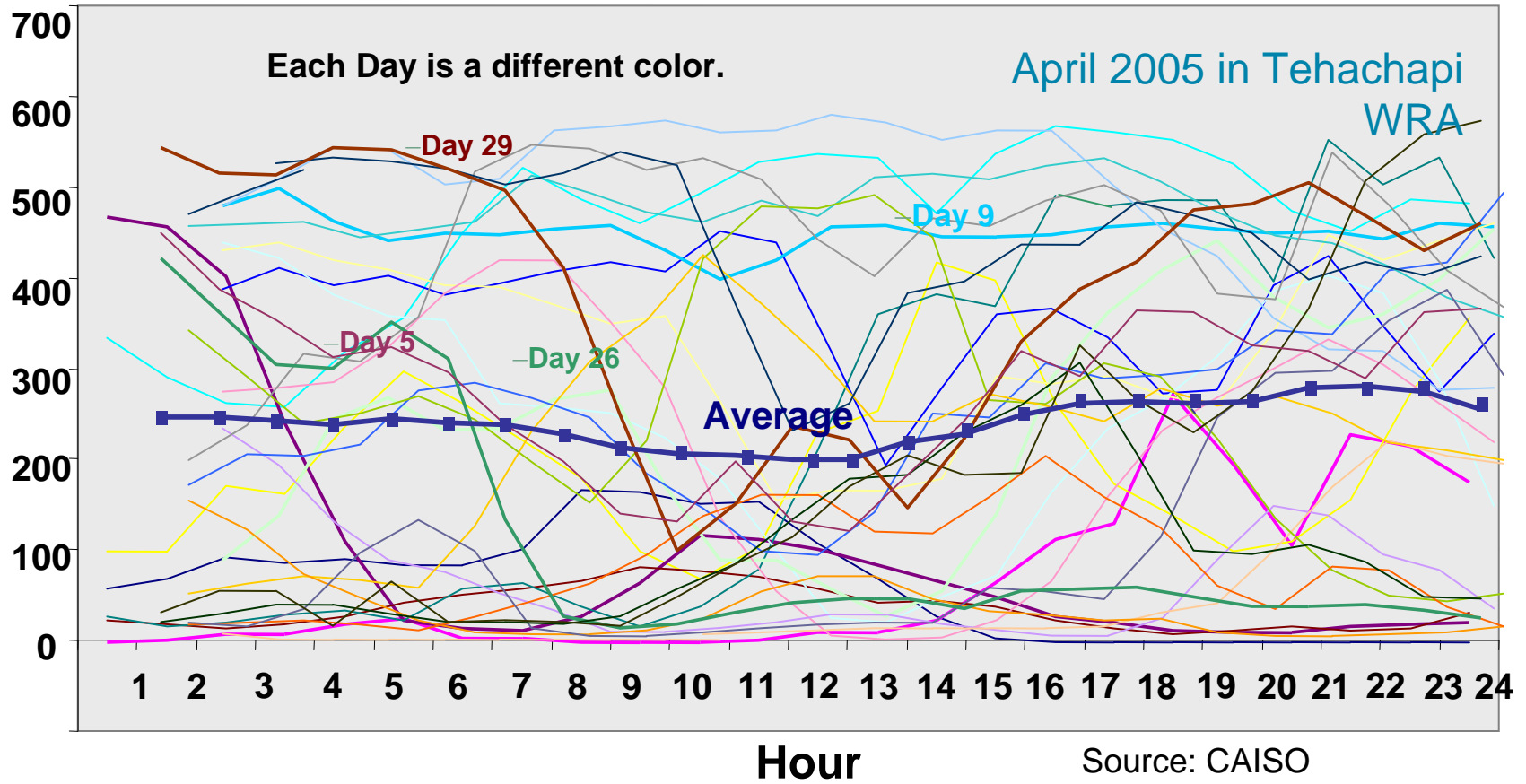


Source: California Public Utilities Commission, July 2009



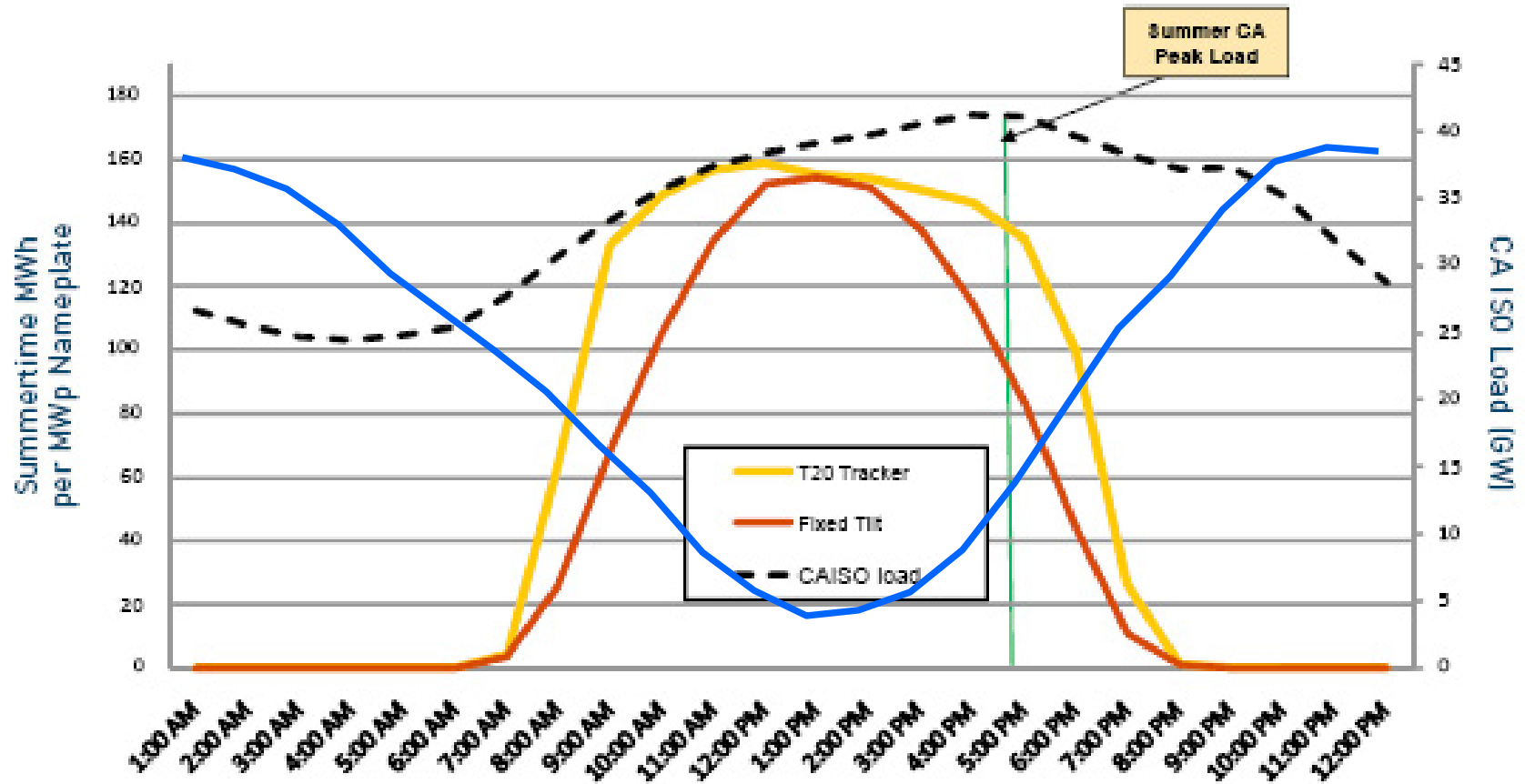
Wind Generation Varies Widely

MW *The average is smooth, but day-to-day variability is great*





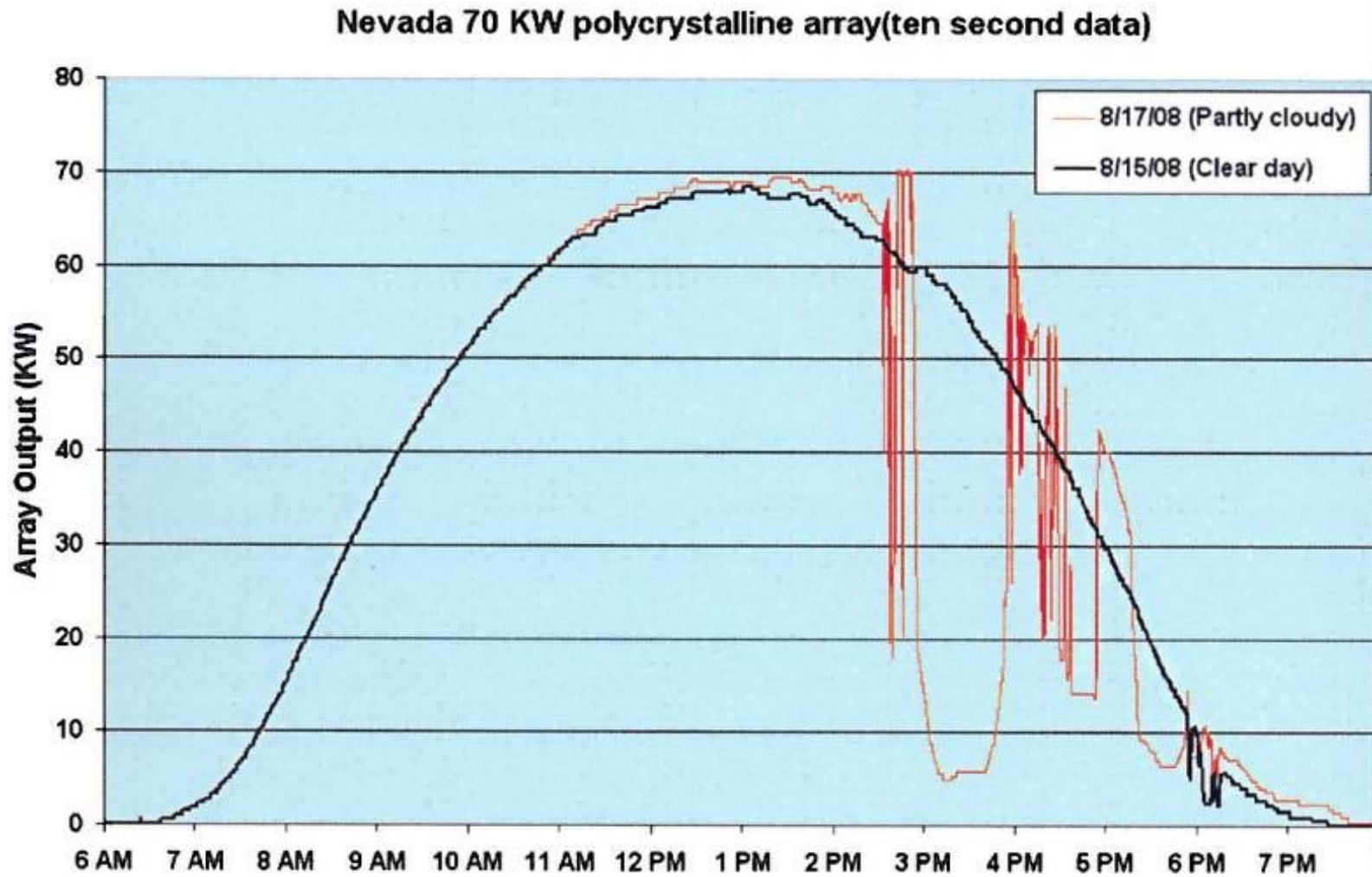
Solar and Wind Production Fit



Source: solar chart from SunPower; wind curve from CEC

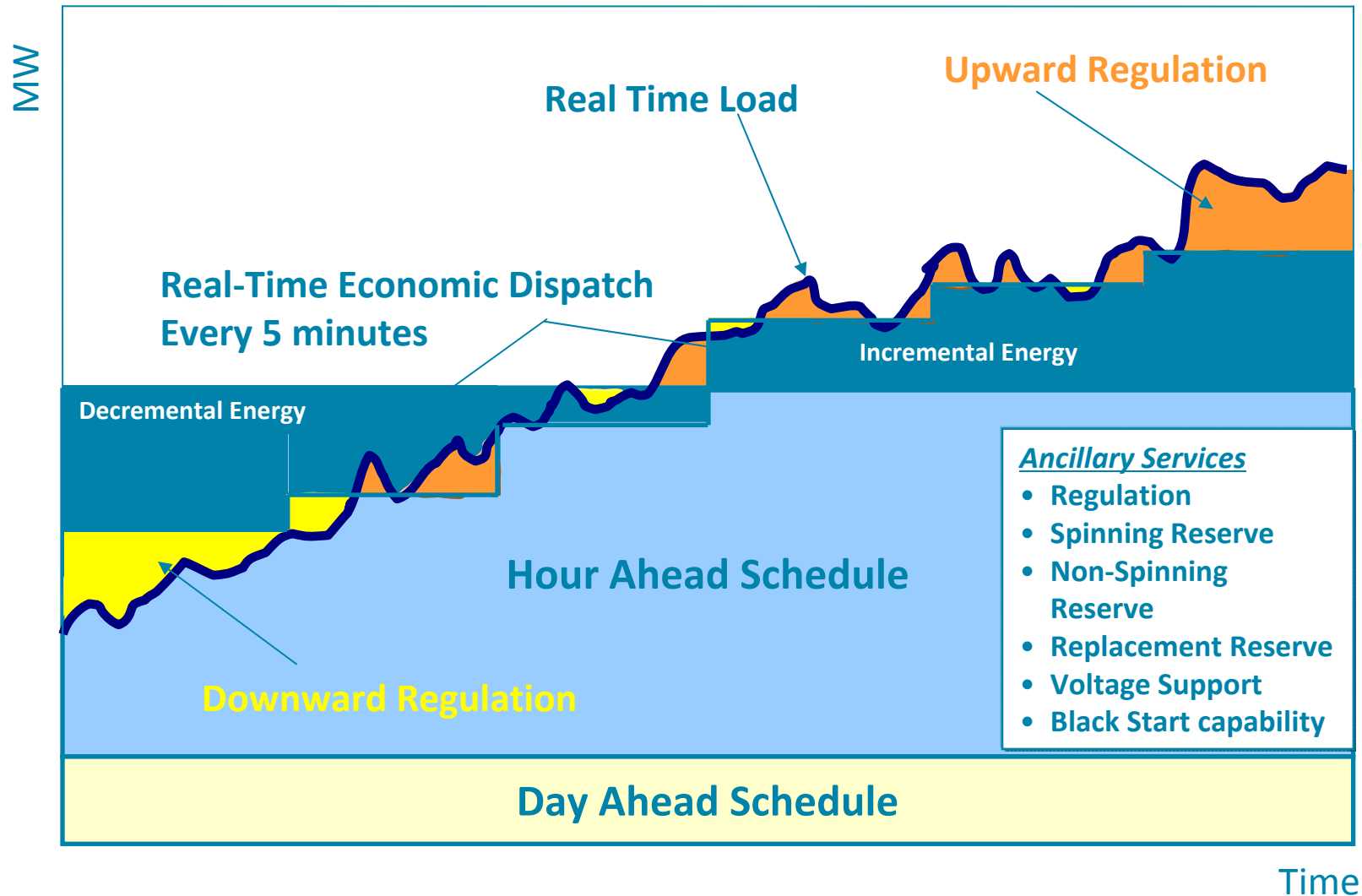


Variation of Solar PV System Output



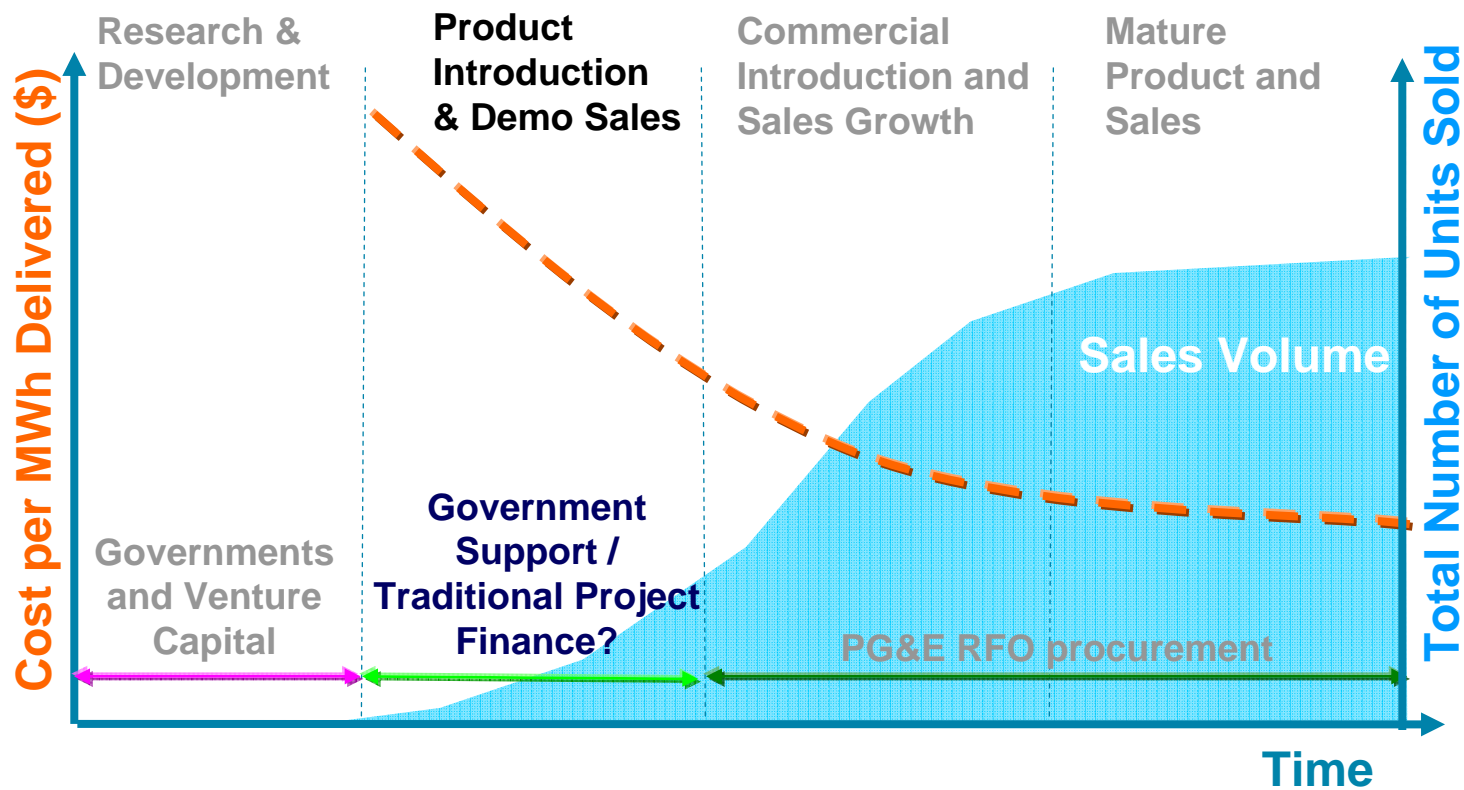


Integrating Renewables Becomes More Complex as Intermittent Sources Increase



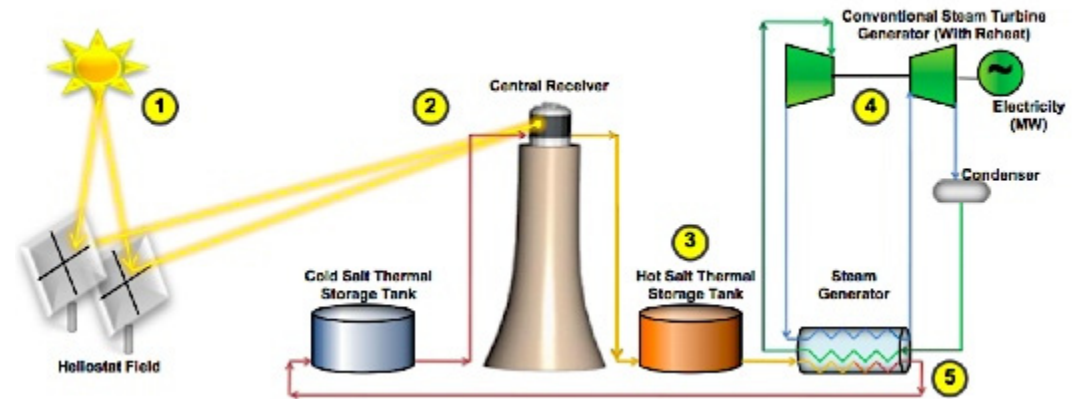


Financing Initial Demonstration Project is Major Hurdle for New Technologies





Solar Thermal Power Tower is Promising



- Opportunity
 - Lower cost components
 - Increased temperatures, increased efficiencies, better economics
 - Technology allows for cost-effective thermal energy storage

- Challenges
 - Standard ones (permitting, transmission, etc.)
 - Technical
 - Financing an ‘unproven’ technology
- **PG&E PPAs**
 - BrightSource
 - eSolar
 - Solar Reserve (molten salt with storage)



PG&E Investigating Wave Power

- Opportunity
 - 600 miles of coastline bordering PG&E's service territory
 - Predictability of wave power
 - Energy density (economics)
- Challenges
 - Permitting (unknown, complex, multiple stakeholders)
 - Infrastructure cost
 - Technology development (nascent)
 - Unforgiving environment
- WaveConnect Project
 - Permitting two sites off CA coast
 - Enable plug-and-play environment
 - \$6M from CPUC and DOE
 - Filed draft license application with FERC



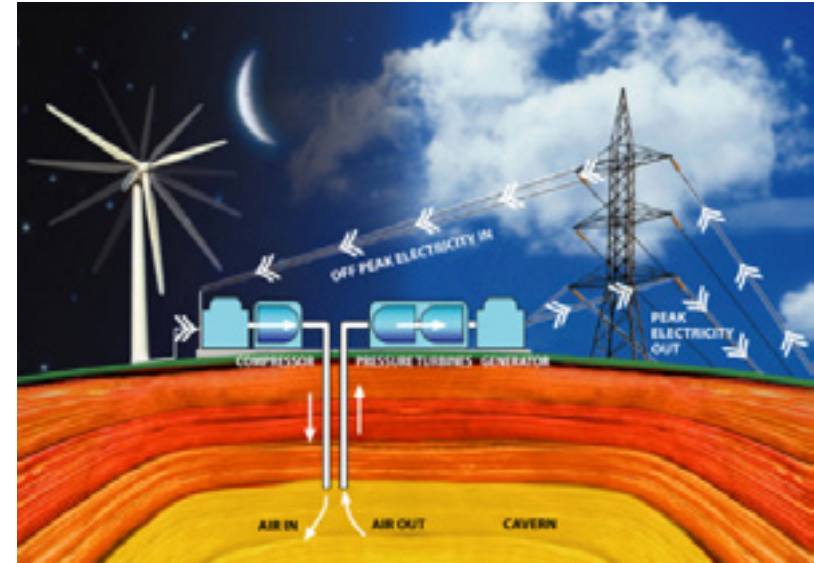


Compressed Air Energy Storage (CAES) Project

300 MW, up to 10 hours storage

3 phases:

1. Permitting, transmission interconnection, plant design (DOE match funding)
2. Plant construction
3. Monitoring



Partners:



Funded by:



- Integrate intermittent renewables
- Store off-peak energy
- Provide ancillary services
- Manage peak demand
- Relieve grid congestion



Questions?

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