



# Photovoltaics and Energy Storage



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# Early Solar Projects

AQMD has long history of promoting solar technology as alternative means of electricity generation

In 1993, 20 kW crystalline silicon solar PV installation over carport to charge EVs in AQMD demo fleet



# Early Solar PV Projects

In 2005, 80 kW crystalline silicon solar PV installation to provide electricity for H<sub>2</sub> station electrolyzer for H<sub>2</sub> vehicles (130 kWh of electricity with cost savings of \$24,000/year)



# Solar PV Tech Comparison

In 2009, demonstration of two 40 kW crystalline silicon PV and BIPV (amorphous Si) to compare performance

- System output
- Cost effectiveness
- 5 year study



ST-42 Inverter Tree  
Used by Both Systems



BIPV by Solar Integrated



Crystalline silicon PV by PermaCity



# Solar PV Research

- Major solar PV technologies include crystalline silicon, thin film, concentrated solar
- Thin film advantages: better performance in low light, easier installation, lightweight, lower manufacturing cost, less PV material
- Crystalline silicon advantages: higher conversion efficiency, less surface area, more durable

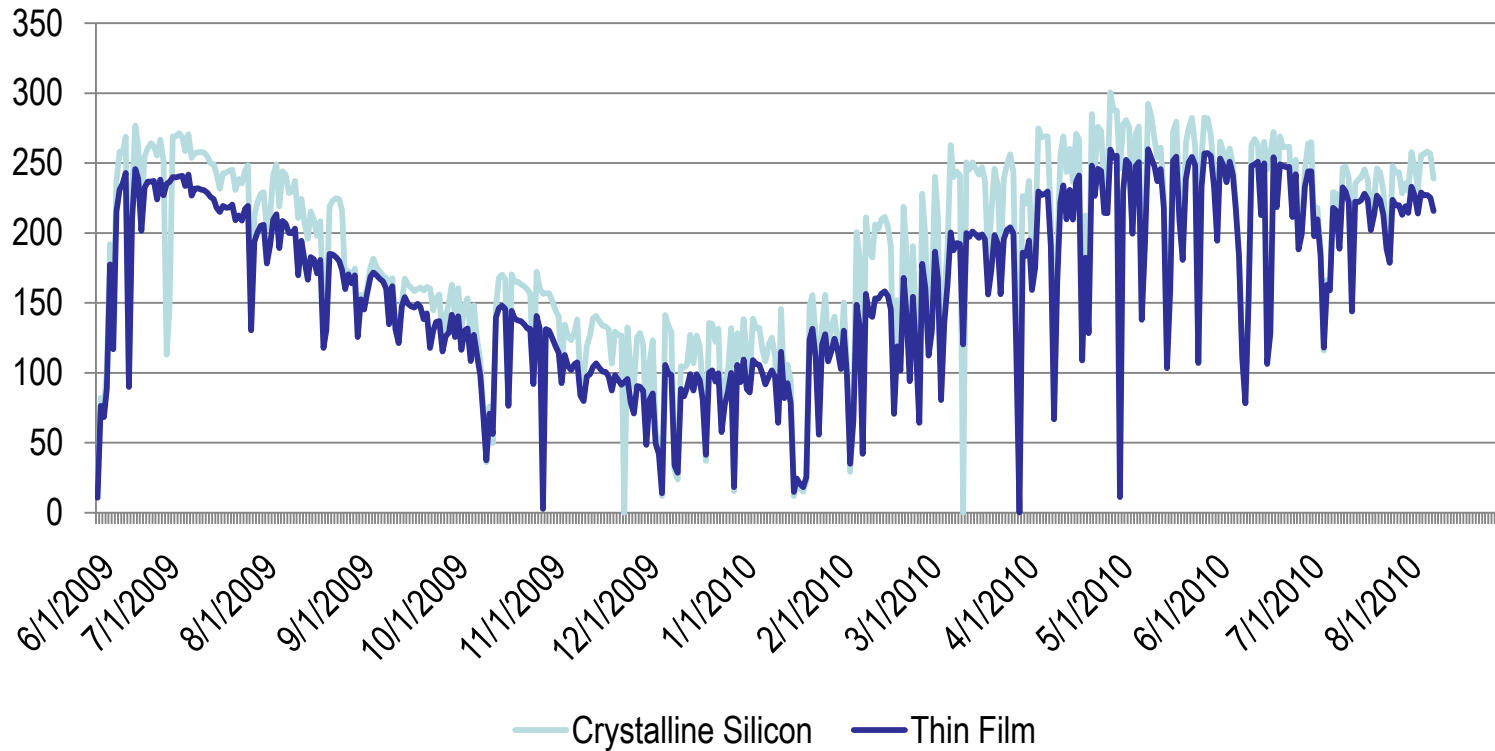


Kiosk in AQMD lobby monitoring AQMD solar PV installations

# Comparison of Solar Technologies

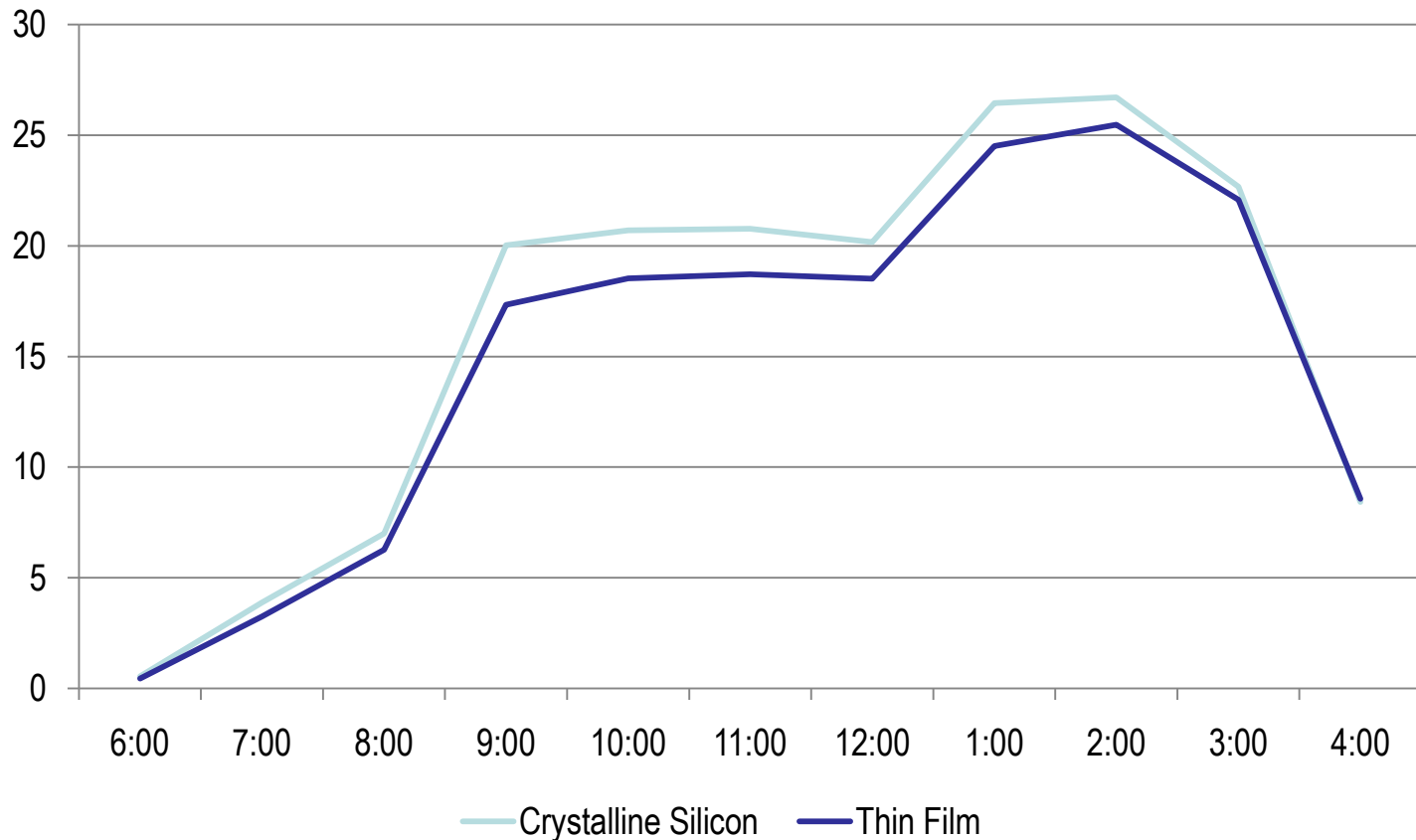
Characteristic	Crystalline Silicon	BIPV
Installed Cost (residential 1-3 kW)	\$8.50/watt	\$9.40/watt
Equipment Life	25-30 yrs	20-25 yrs
Conversion Efficiency	13%	7%

# Overall Performance



Overall, crystalline silicon PV modules continue to perform 12-14% better on average than BIPV year

# Time of Day Performance



Crystalline silicon has better performance during peak hours but perform similarly with BIPV at beginning and end of the day (8/18/10)

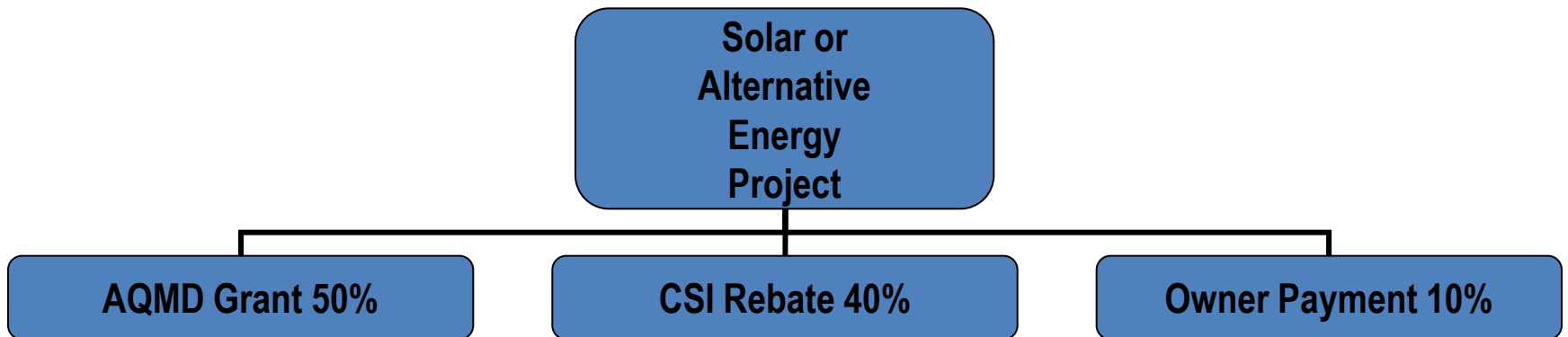


# Conclusions

- Initial results indicate that crystalline silicon (15 degree tilt) perform better overall and at peak hours than BIPV (0 degree tilt) during the summer
- Performance is comparable in early morning and late afternoon hours during the summer
- BIPV may display better performance during low light conditions in winter
- Further study to determine seasonal differences over 5 year period

# Rule 1309.1 Renewable Energy Grant Program

- Rule 1309.1 awarded \$5.2M for renewable energy projects
- 83 projects with 21 contractors near EGFs and EJ areas
- Original projects mostly completed, on backup list



# Rule 1309.1 Renewable Energy Grants

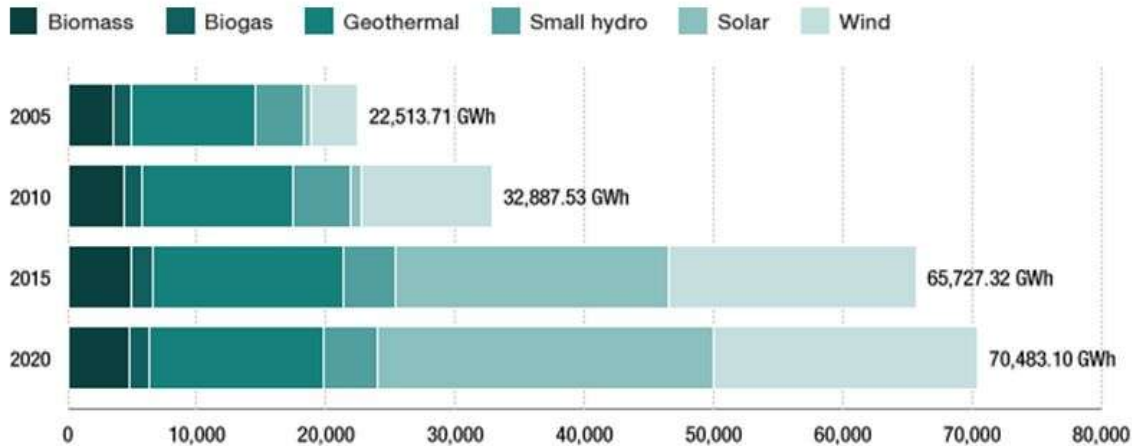
Status	# Projects	Cost (\$)
Projects Completed	59	\$3,318,770
Projects to be Completed	25	1,024,420
Total R1309.1 Funding		5,262,484
Remaining Funds		\$919,294



# CA Renewable Energy Goals

## California Renewable Energy Goals

The state of California wants 33 percent of its electricity to come from renewable sources by 2020. This chart shows how renewable energy sources are expected to be used to help the state meet its goal.



### Notes

Large-scale hydro projects are not counted toward California's renewable goals.

GWh = Gigawatt hour, or 1 million kilowatt hours. GWh is the unit used to measure large-scale electricity generation and usage.

Source: California Public Utilities Commission, Renewables Portfolio Standard Quarterly Report, July 2009

- 33% of electricity from renewable sources by 2020, 20% renewable by 2010 (SB 107 Renewable Portfolio Standard, Exec Order S-14-08)
- AB 2514 requires utilities to create energy storage systems
  - CPUC adopt energy storage targets by 2013, achieve targets by 2015 and 2020
  - Utilities adopt targets by 2014, achieve targets by 2016 and 2021

# Thin Film Cd-Telluride Solar Panels

- GE Research and PrimeStar Solar developed Cd-Telluride panels with 16% efficiency
- First Solar largest producer of thin film panels
- Part of GE's new products incorporating Smart Grid technology
  - WattStation charges 24 kWh EV battery in 4-8 hours
  - Nucleus: collect household data



GE Cd-Te panels

# iCell Home Energy Storage

- Li-ion cells bundled into 1 kWh packs for stationary backup power
- Proprietary welding of cells and software control allowing real-time balancing of pack and load leveling on house-size micro grid

--54 kWh substation  
Anaheim Utilities  
--500 kW-1 MW  
substation Anaheim  
Utilities (pending)





# AES Energy Storage

- A123, Altair Nano Li-ion cells with Smart Grid Stabilization
- 22 MW energy storage systems to date, 44 MW to be delivered by 2011
  - Two 1 MW 250 kw substation Indianapolis (2008)
  - 2 MW substation AES Huntington Beach (2008)
  - 12 MW substation Atacama Desert Chile (2009)
  - 20 MW Johnson City, NY (pending)
- Largest user of lithium ion batteries for ancillary power

