About SEIA

• Founded in 1974

• U.S. National Trade Association for Solar Energy
  • 1,000 member companies from around the world
  • Members from across 50 states
  • Largest companies in the world as well as small installers

• Our Mission: Build a strong solar industry to power America

• Our Goal: 10 gigawatts (GW) of annual installed solar capacity in the U.S. by 2015
Solar Installation Forecast

- Nearly $20\,\text{GW}_{\text{dc}}$ of PV and $2.1\,\text{GW}_{\text{ac}}$ of CSP expected to be online by the end of 2016.
System Prices Continue to Decline

- Typical residential system now about $3.73/W_{dc}$
- Typical commercial system now about $2.53/W_{dc}$
- Utility system now $1.77/W_{dc}$
Solar Generation as Fraction of Total Consumption

Massachusetts
- Resi PV, 0.11%
- Comm PV, 0.53%
- Utility PV, 0.07%
- Other, 99.29%

Georgia
- Resi PV, 0%
- Comm PV, 0.02%
- Utility PV, 0.01%
- Other, 99.97%

California
- Resi PV, 0.52%
- Comm PV, 0.7%
- Utility PV, 0.92%
- CSP, 0.26%
- Other, 97.61%

Colorado
- Resi PV, 0.25%
- Comm PV, 0.35%
- Utility PV, 0.31%
- Other, 99.09%

Arizona
- Resi PV, 0.43%
- Comm PV, 0.47%
- Utility PV, 2.17%
- CSP, 1.26%
- Other, 95.66%

Nevada
- Resi PV, 0.03%
- Comm PV, 0.19%
- Utility PV, 1.51%
- CSP, 0.4%
- Other, 97.87%
California Trends

- Largest State Market by Far

Historical Solar Installations and Prices

SEIA/GTM Research *U.S. Solar Market Insight.* (Utility pricing reflects national average, not state specific)
California Forecast

Annual Installations Forecast

- CSP
- Utility
- Non-Residential
- Residential

SEIA/GTM Research U.S. Solar Market Insight
The CA Duck Curve Issue Incorporates Many Grid IX issues

CAISO Net Demand

Net Demand (MW)

Hour

- 2020 Net Load
- Net_Load_2012
- Net_Load_2013
- Net_load_2014
- Net_load_2015
- Net_load_2016
- Net_load_2017
- Net_load_2018
- Net_load_2019
- Net_load_2020
However, CA “problem” was not as bad as it appeared....

- Ramping issue is less severe than first analysis showed, still an issue in CA and elsewhere.
- Flexible gas dispatch.
- Regional cooperation helps smooth ramping issues.
- Ramps are 100% predictable.
....and There Are Solutions.

- Accurate Forecasting
  - Real-time Forecasting
  - Centralized Forecasting
- Markets
  - CAISO: EIM
  - Centralized Capacity Markets
  - CAISO: FERC Order 764
  - CPUC: Flex RA
  - CAISO: Flexi-Ramp
- Additional Flexible Generation
- Energy Storage
  - CPUC: LTPP
  - CPUC: Energy Storage OIR
Figure 4

Comparison of Pre-Strategies and Post-Strategies Load Profiles

**Pre-Strategy Load**

- Total Load (Blue)
- Load Net of Wind and Solar (Red)

**Post-Strategy Load**

- Total Load (Blue)
- Load Net of Wind and Solar (Green)

MW vs Hours from 1 to 24
10 Strategies from RAP

- Strategy 1: Target energy efficiency to the hours when load ramps up sharply;
- Strategy 2: Orient fixed-axis solar panels to the west;
- Strategy 3: Substitute solar thermal with a few hours storage in place of some projected solar PV generation;
- Strategy 4: Implement service standards allowing the grid operator to manage electric water heating loads to shave peaks and optimize utilization of available resources;
- Strategy 5: Require new large air conditioners to include two hours of thermal storage capacity under grid operator control;
- Strategy 6: Retire inflexible generating plants with high off-peak must-run requirements;
- Strategy 7: Concentrate utility demand charges into the “ramping hours” to enable price induced changes in load;
- Strategy 8: Deploy electrical energy storage in targeted locations, including electric vehicle charging controls;
- Strategy 9: Implement aggressive demand-response programs; and
- Strategy 10: Use inter-regional power transactions to take advantage of diversity in loads and resources.*

Solar Can Be A Solution….
Matching Peak in Texas

4 Days in August 2010

- Sum of Total PV (MW) - WEST
- Sum of Total PV (MW) - SOUTHERN
- Sum of Total PV (MW) - SOUTH_C
- Sum of Total PV (MW) - NORTH_C
- Sum of Total PV (MW) - NORTH
- Sum of Total PV (MW) - FAR_WEST
- Sum of Total PV (MW) - EAST
- Sum of Total PV (MW) - COAST
- Sum of Load Net of PV (MW) - WEST
- Sum of Load Net of PV (MW) - SOUTHERN
- Sum of Load Net of PV (MW) - SOUTH_C
- Sum of Load Net of PV (MW) - NORTH_C
- Sum of Load Net of PV (MW) - NORTH
- Sum of Load Net of PV (MW) - FAR_WEST
- Sum of Load Net of PV (MW) - EAST
- Sum of Load Net of PV (MW) - COAST
SEIA Recommendations to ERCOT

- ERCOT should change how it calculates the capacity value of solar in its resource planning.
- ERCOT should include utility-scale and distributed generation solar in its resource planning.
- ERCOT should establish future ancillary service requirements that will enable solar generation to participate in ERCOT’s ancillary services market.