Update on CPUC staff LOLE and ELCC Modeling Results

Thursday, July 30, 2015

Presented by Donald Brooks
Senior Analyst, Energy Division

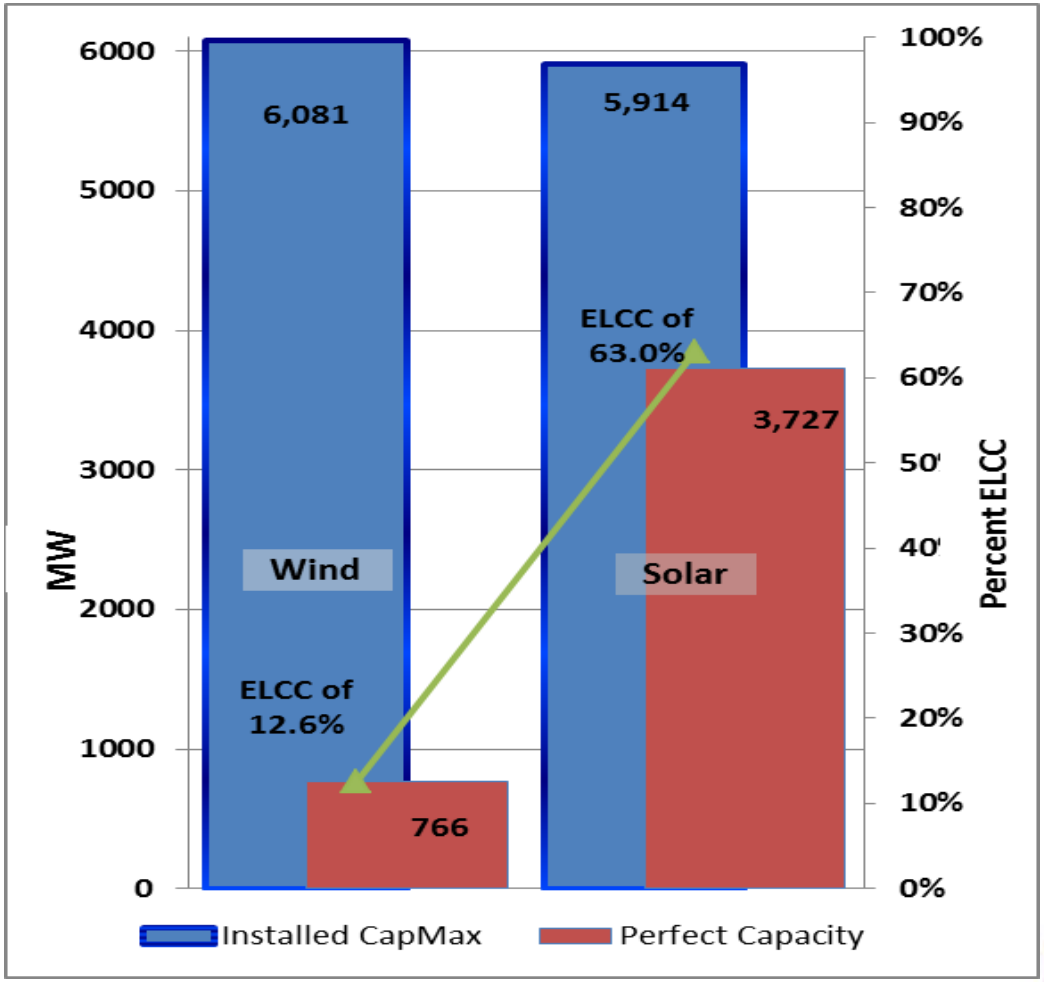
California Public Utilities Commission

Overview

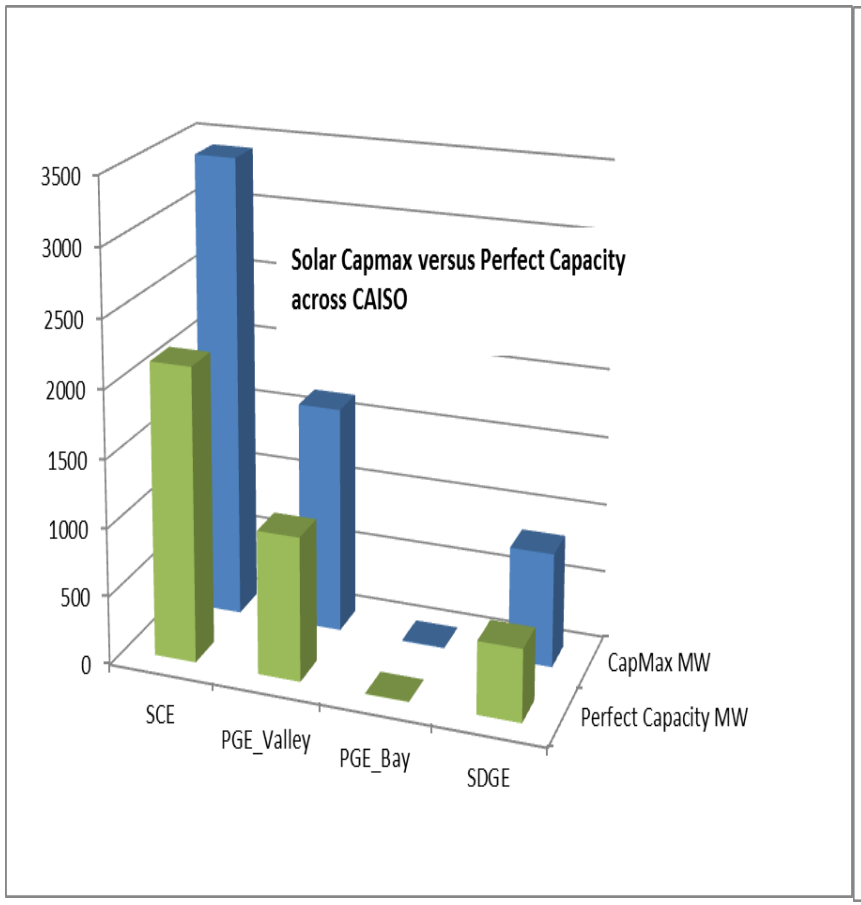
- Summary of ELCC results
- Some questions about best practices
- Preview of future work

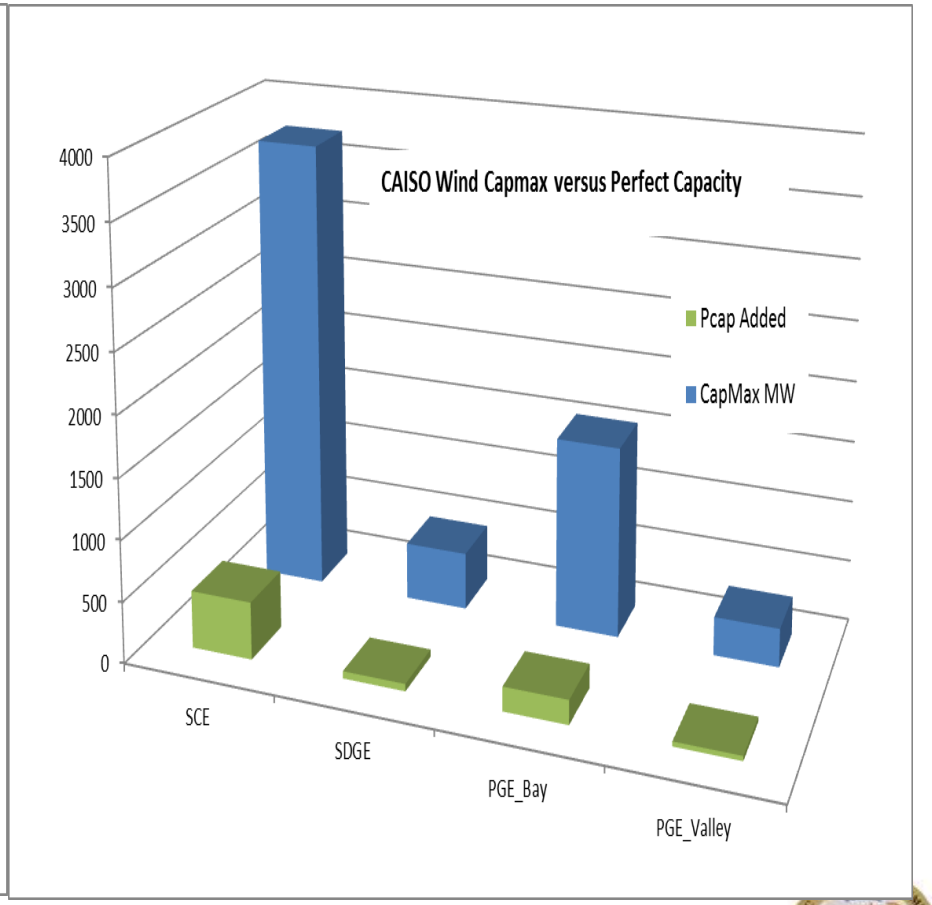
Summary of ELCC Results

- CPUC staff completed ELCC modeling for wind and solar resources in CAISO BAA
- Added perfect capacity to replace wind/solar removed



Most Solar/Wind in SCE Area





Monthly and Locational Impacts at 0.1 LOLE

Month	1	2	3	4	5	6	7	8	9	10	11	12
CAISO	0.000	0.000	0.000	0.000	0.000	0.000	0.025	0.073	0.003	0.000	0.000	0.000
SCE	0.000	0.000	0.000	0.000	0.000	0.000	0.025	0.072	0.003	0.000	0.000	0.000
SDGE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
PGE_Bay	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
PGE_Valley	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Calibrated Base Case at 0.1 LOLE

	1	2	3	4	5	6	7	8	9	10	11	12
CAISO	0.000	0.000	0.000	0.000	0.000	0.000	0.024	0.061	0.006	0.000	0.000	0.000
SCE	0.000	0.000	0.000	0.000	0.000	0.000	0.024	0.061	0.006	0.000	0.000	0.000
SDGE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.000	0.000	0.000
PGE_Bay	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000
PGE_Valley	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Wind ELCC

	1	2	3	4	5	6	7	8	9	10	11	12
CAISO	0.000	0.000	0.000	0.000	0.000	0.000	0.027	0.068	0.005	0.000	0.000	0.000
SCE	0.000	0.000	0.000	0.000	0.000	0.000	0.027	0.067	0.004	0.000	0.000	0.000
SDGE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
PGE_Bay	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
PGE_Valley	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Solar ELCC

Future work

Request for best practices

CPUC staff faced two challenges

- Monthly LOLE and ELCC - shaping annual values to monthly needs
- Calibration and benchmarking to other studies of CAISO and CA system

Next Phases of Study

- Further refine study case
- Establish overall RA obligations
- Disaggregate solar/wind ELCC into location and technology groups
- Calculate ELCC of other technologies like DR

CPUC staff LOLE and EFC Modeling Development of Best Practices

Friday, July 31, 2015

Presented by Donald Brooks
Senior Analyst, Energy Division

California Public Utilities Commission

Outline of presentation

- Status update – Where we are so far
- Further modeling planned
- CPUC staff encountered barriers, and seek best practices to develop solutions
  - Monthly LOLE and EFC - shaping annual values to monthly needs
  - Calibration and benchmarking to ensure realistic representation of electric system
  - Load shape analysis

Where are we so far

- Completed LOLE study covering 2016 study year
- Developed EFC values that correspond to an annual average EFC covering two categories of resources
  - All solar facilities received an EFC of 63%
  - No differentiation for location or technology groups (solar thermal, PV, tracking, fixed)
  - Wind facilities received EFC of 12.6%
  - No differentiation for location or technology groups

Capacity Balance in Base Case

Region	SDGE	PGE_Bay	PGE_Valley	SCE	CAISO
Study Year	2016	2016	2016	2016	2016
Peak Load (all figures in MW)	4,421	8,233	13,408	22,789	47,038
Total Nameplate Resources	6,015	8,979	24,195	26,045	65,235
Nuclear Resources	0	0	2,300	0	2,300
Fossil Resources	4,030	5,617	9,600	13,523	32,770
Peaking Resources	600	1,621	2,438	2,808	7,467
Run of River Hydro Resources	0	0	374	132	505
Scheduled Hydro Resources	0	0	5,586	972	6,558
Emergency Hydro Resources	0	0	0	200	200
Pumped Storage Resources	40	0	1,218	200	1,458
Demand Response Resources	43	169	703	1,268	2,182
Total Wind and Solar Resources	1,302	1,572	1,976	6,943	11,794

Future work

Request for best practices

– Investigation of “best practices” in addressing these two challenges

- Monthly LOLE and EFC - shaping annual values to monthly needs
- Calibration and benchmarking how to “sanity check” values
- Load shape analysis

Next Phases of Study

- Further refine study case
- Establish overall RA obligations
- Disaggregate solar/wind EFC into location and technology groups
- Calculate EFC of other technologies like DR

Development of Best Practices

- CPUC staff struggled with two issues, and request help in developing best practices to resolve these two issues
- CPUC staff appreciates the opportunity to present at the LOLE Best Practices WG today
- Issues particular to CPUC programs and situation
  - Disaggregate annual average LOLE and EFC values into month specific values
  - Benchmark with other studies of CAISO and California system tp ensure realistic dispatch of electric system

Monthly Values Based on Annual Results

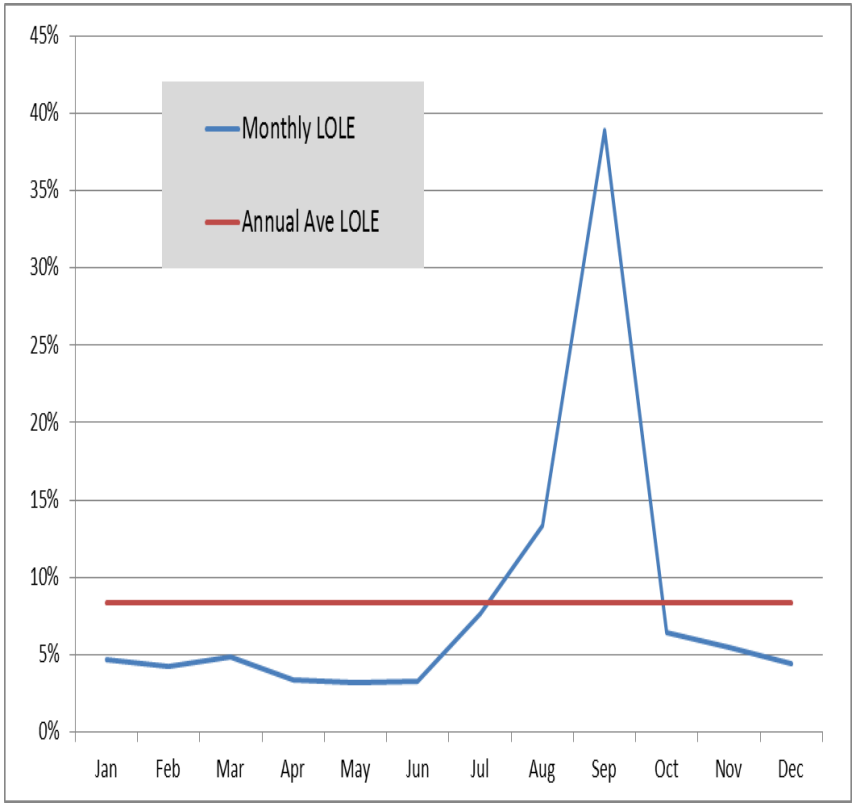
- CPUC sets month-specific RA obligations, where a PRM is added to monthly peak load forecast. LSEs procure capacity to meet monthly RA obligations. Each generator is given monthly qualifying capacity (QC) values.
- Leads to lower procurement and lower resource availability in offpeak months. EFC and LOLE values are annual metrics – difficulty reflecting monthly QC values and RA obligations when modeling shows only risk is at peak month.

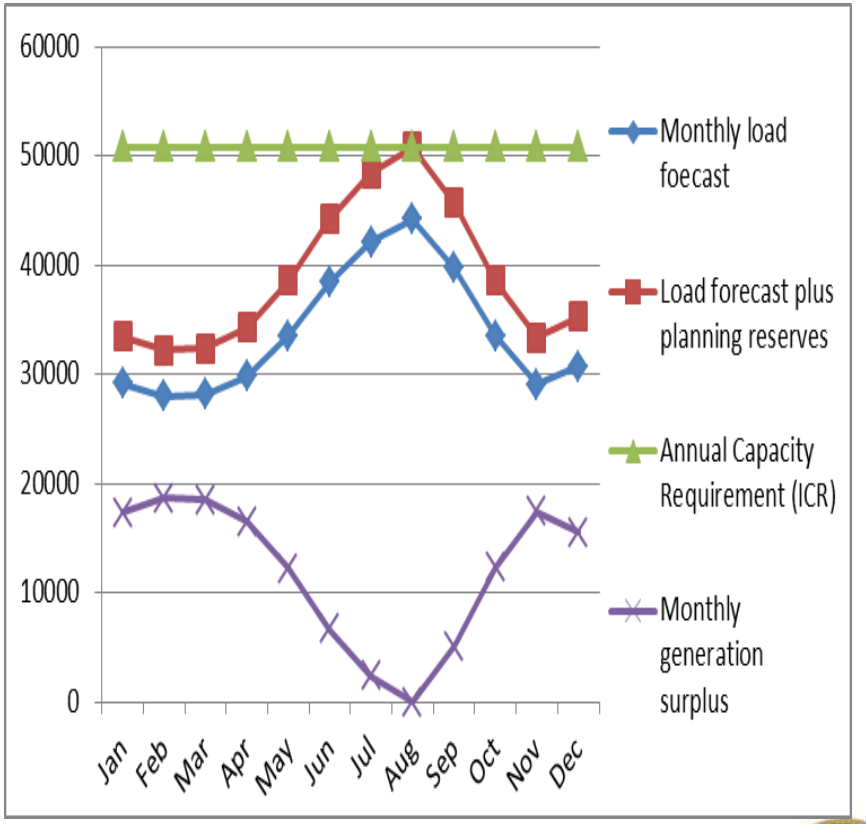
Monthly values based on annual results

- EFC and LOLE are annual metrics
  - LOLE is concentrated in three months in middle of year
  - Surplus in offpeak months suppresses reliability risks

Day/Hour	1	2	3	4	5	6	7	8	9	0	11	12
1	-	-	-	-	-	-	-	0.0%	0.1%	-	-	-
2	-	-	-	-	-	-	-	-	0.1%	-	-	-
3	-	-	-	-	-	-	-	-	0.1%	-	-	-
4	-	-	-	-	-	-	-	-	0.1%	-	-	-
5	-	-	-	-	-	-	-	0.0%	0.1%	0.0%	-	-
6	-	0.0%	0.0%	-	-	-	-	0.0%	0.0%	0.0%	0.0%	-
7	0.0%	0.0%	0.0%	-	-	-	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%
8	0.0%	0.0%	0.0%	-	-	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
9	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
10	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
11	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
12	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.1%	0.0%	0.0%	0.0%	0.0%
13	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.2%	0.1%	0.0%	0.0%	0.0%
14	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%	0.3%	0.1%	0.0%	0.0%	0.0%
15	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%	0.3%	0.1%	0.0%	0.0%	0.0%
16	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%	0.3%	0.1%	0.0%	0.0%	0.0%
17	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%	0.3%	0.1%	0.0%	0.0%	0.0%
18	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.2%	0.1%	0.0%	0.0%	0.0%
19	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.2%	0.1%	0.0%	0.0%	0.0%
20	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.1%	0.0%	0.0%	0.0%	0.0%
21	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
22	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
23	0.0%	0.0%	-	-	-	-	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
24	-	-	-	-	-	-	0.0%	0.0%	0.1%	0.0%	-	0.0%

Reliability Risk is Concentrated





Allocation of LOLE and EFC

- CPUC staff has attempted to spread LOLE and EFC to other months
  - Lower reliability of system to surface more reliability risk
  - Shape EFC to load in offpeak months by weighting EFC to MW of peak load
  - Flat EFC value across variable monthly peak loads distorts RA procurement – too much credit as percent of RA fleet in offpeak, too little in peak

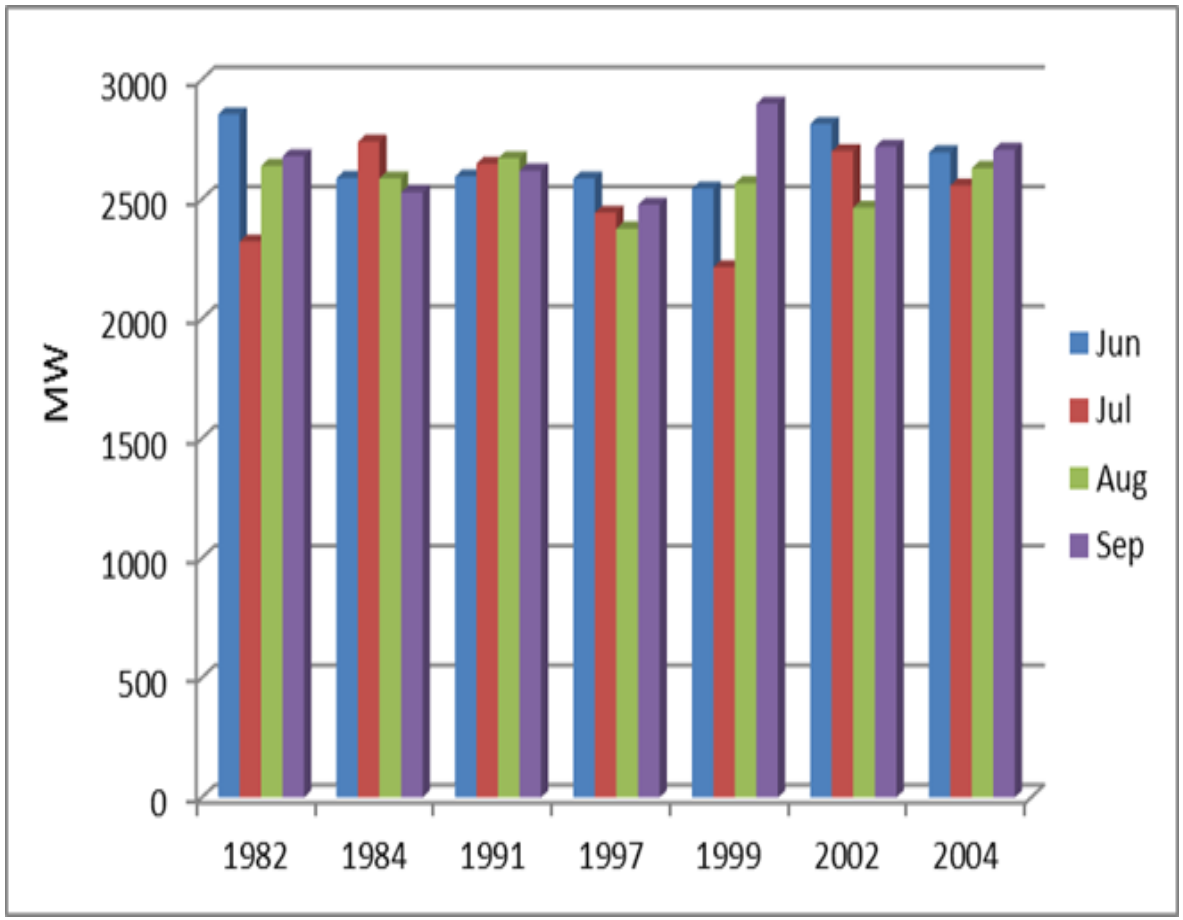
Calibration with other studies of CAISO or CA system

- Calibration and reality checking of study results - several important calibrations to perform
  - Using a production cost model - economic miscalibration leads to distorted reliability effects
  - How to calibrate economic effects to reality?
    - Economic transfers between study areas
    - Dispatch of individual plants or classes of plants
    - Total energy used or fuel generated

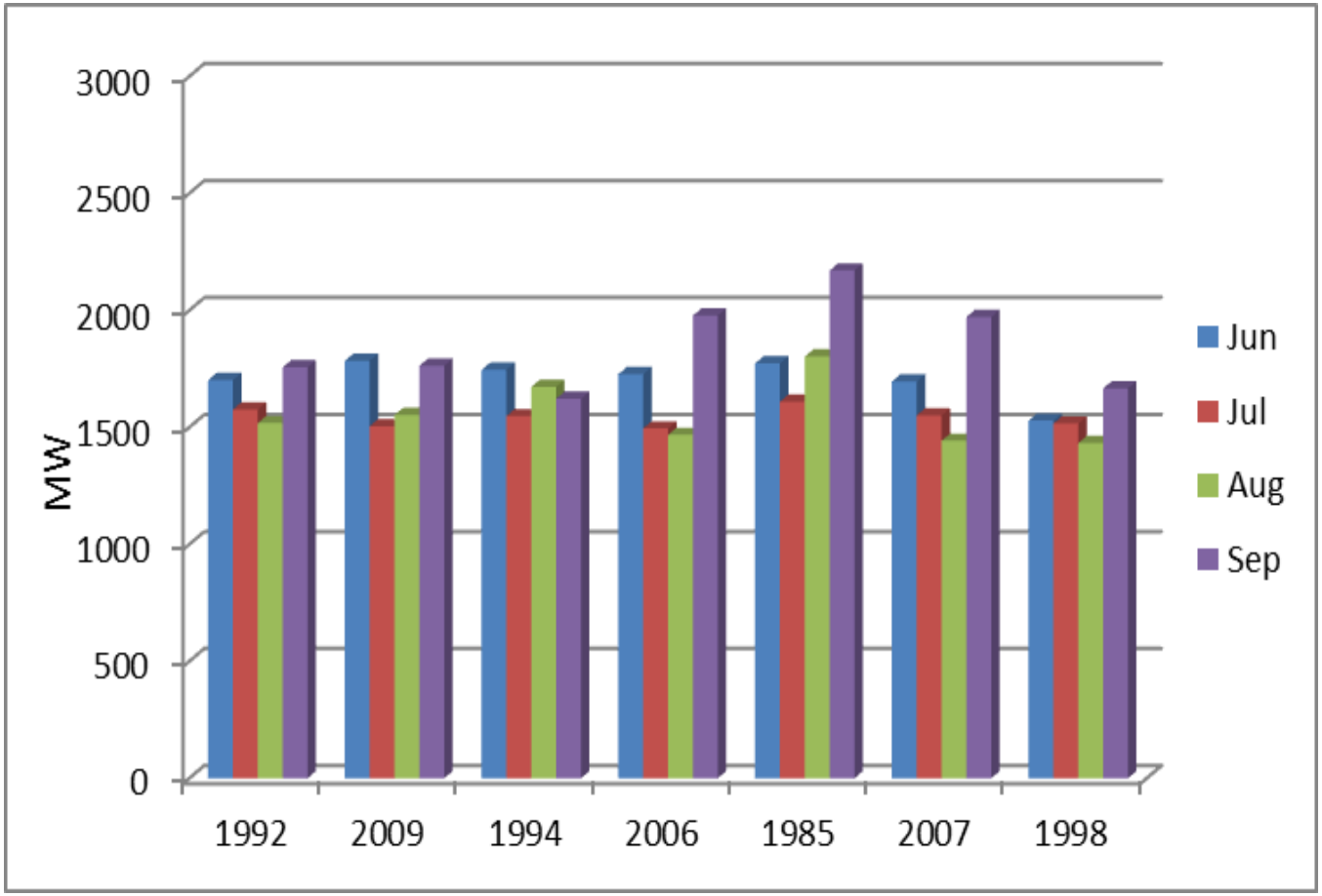
Load shape analysis

- LOLE events are concentrated in very few load shapes
- Analyze load shapes to learn what might be leading to LOLE in the model

Average Median to Peak MW – Lowest LOLE Load Shapes



Average Median to Peak MW - Highest LOLE Load Shapes



Thank you!

For Additional Information:

www.cpuc.ca.gov