R.12-03-014: LTPP Track II Workshop – Operating Flexibility Modeling Results

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California Public Utilities Commission

August 26, 2013

Remote Access

WebEx:

Meeting Number: 748 742 472
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Agenda

Time	Item
9:30 – 9:40	Introduction, Schedule
9:40 – 11:00	Deterministic Model Study Results Presented by Shucheng Liu, Ph.D., CAISO
11:00 – 11:15	Break
11:15 – 12:30	Deterministic Model Study Results (cont.)
12:30 – 1:30	Lunch Break
1:30 – 3:30	Stochastic Model Study Results Presented by Energy and Environmental Economics (E3)

Workshop Logistics

Restrooms are out the Auditorium doors and down the far end of the hallway

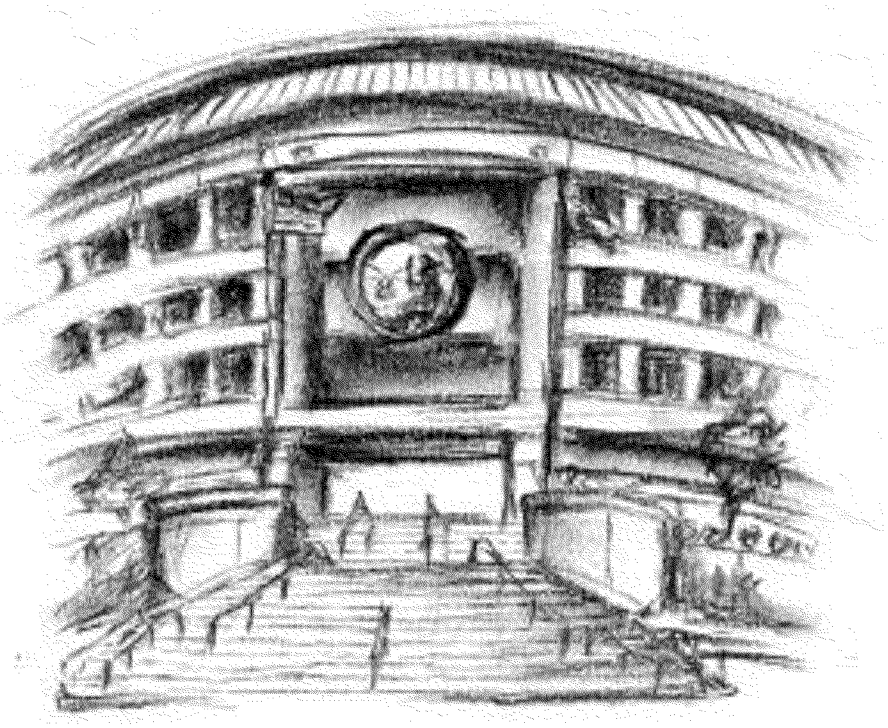
In the event of an emergency evacuation, please go to the Opera House courtyard, across from City Hall

LTPP Schedule

August	
26	Track II Workshop: ISO Operational Flexibility modeling results Track IV Opening Testimony due: SCE LCR modeling results
September	
4	Prehearing Conference: Track II and Track IV procedural issues
18	Track II Workshop: SCE Operational Flexibility modeling results
20	Track II Opening Testimony due: ISO and SCE
23	Track IV Opening Testimony due: All other Parties
October	
7	Track IV Rebuttal Testimony due: All Parties Track IV: Last day to request evidentiary hearings
Late Oct.	Track IV: Evidentiary hearings if necessary
November	
1	Track II Opening Testimony due: All other Parties
15	Track II Rebuttal Testimony due: All Parties

Thank you!
For Additional Information:

http://www.cpuc.ca.gov/PUC/energy/Procurement/LTPP/ltpp_history.htm



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Review of Scenario Assumptions and Deterministic Results

CPUC LTPP Track 2 Workshop
August 26, 2013

Shucheng Liu, Ph.D.
Principal, Market Development

About 2012 Long-Term Procurement Plan (LTPP) Track 2 system operational flexibility study

- CPUC requested the ISO conduct a system operational flexibility modeling study using the Standardized Planning Assumptions and Scenarios as determined in the CPUC Dec 24, 2012 decision (12-03-014).

- ISO conducts the operational flexibility study using a Plexos production cost simulation model.

- ISO studies: 1) Base scenario, 2) Replicating TPP scenario, 3) High DG-DSM scenario, and 4) Base scenario with SONGS.

* SONGS is retired in the first three scenarios. Assessment of local reliability needs without SONGs is address by separate studies.

Agenda

- Model data sources
- Scenario assumption comparison
- Preliminary deterministic simulation results

Model Data Sources

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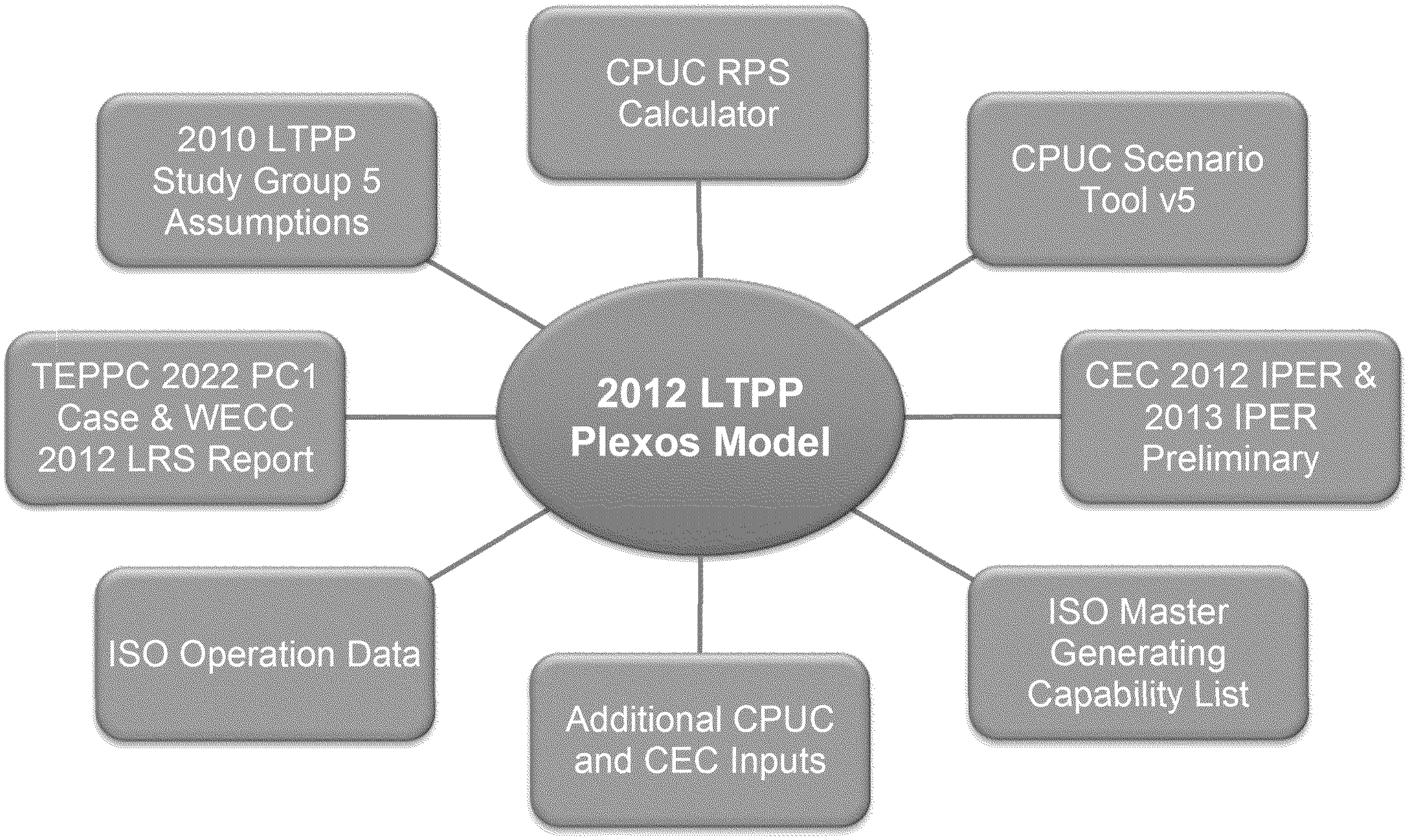
The Plexos production cost simulation model uses data from multiple sources.



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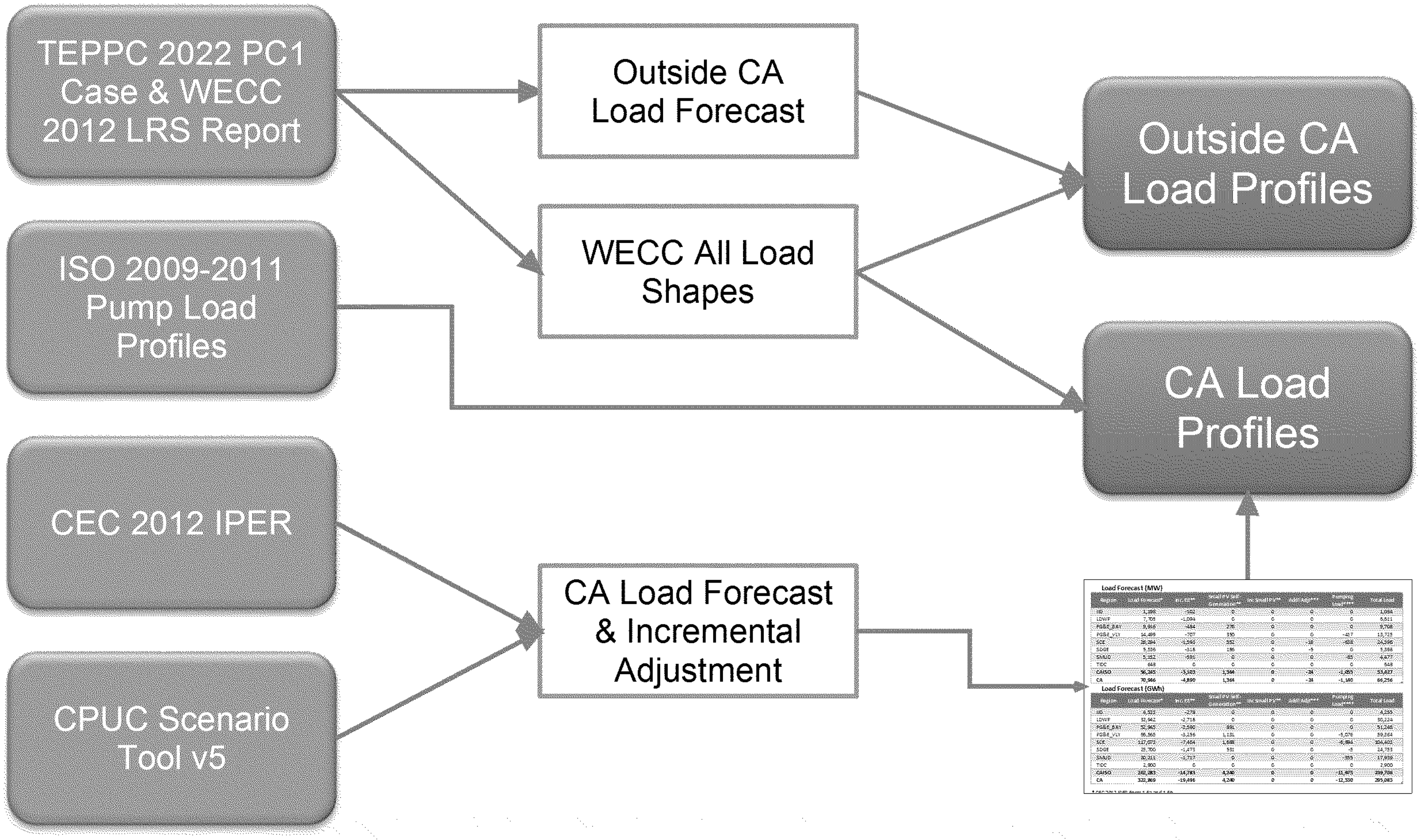
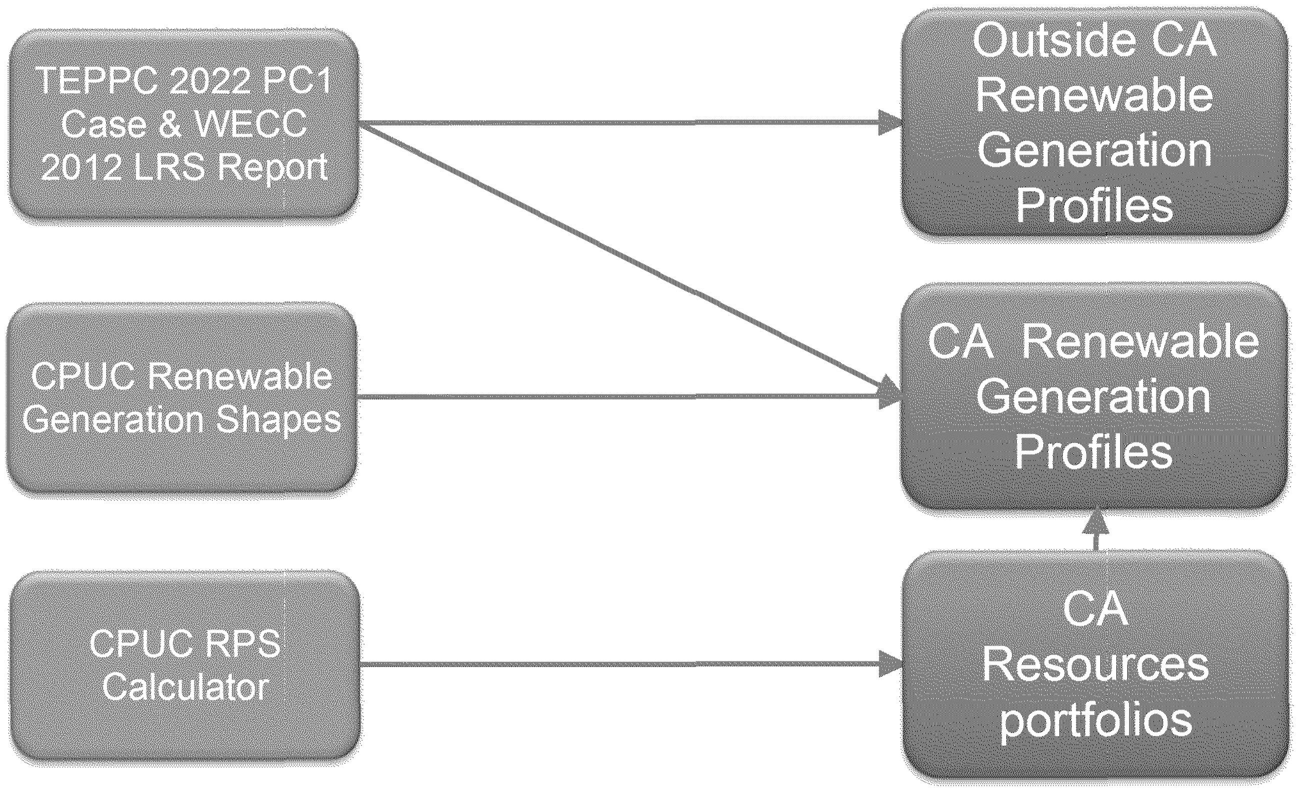
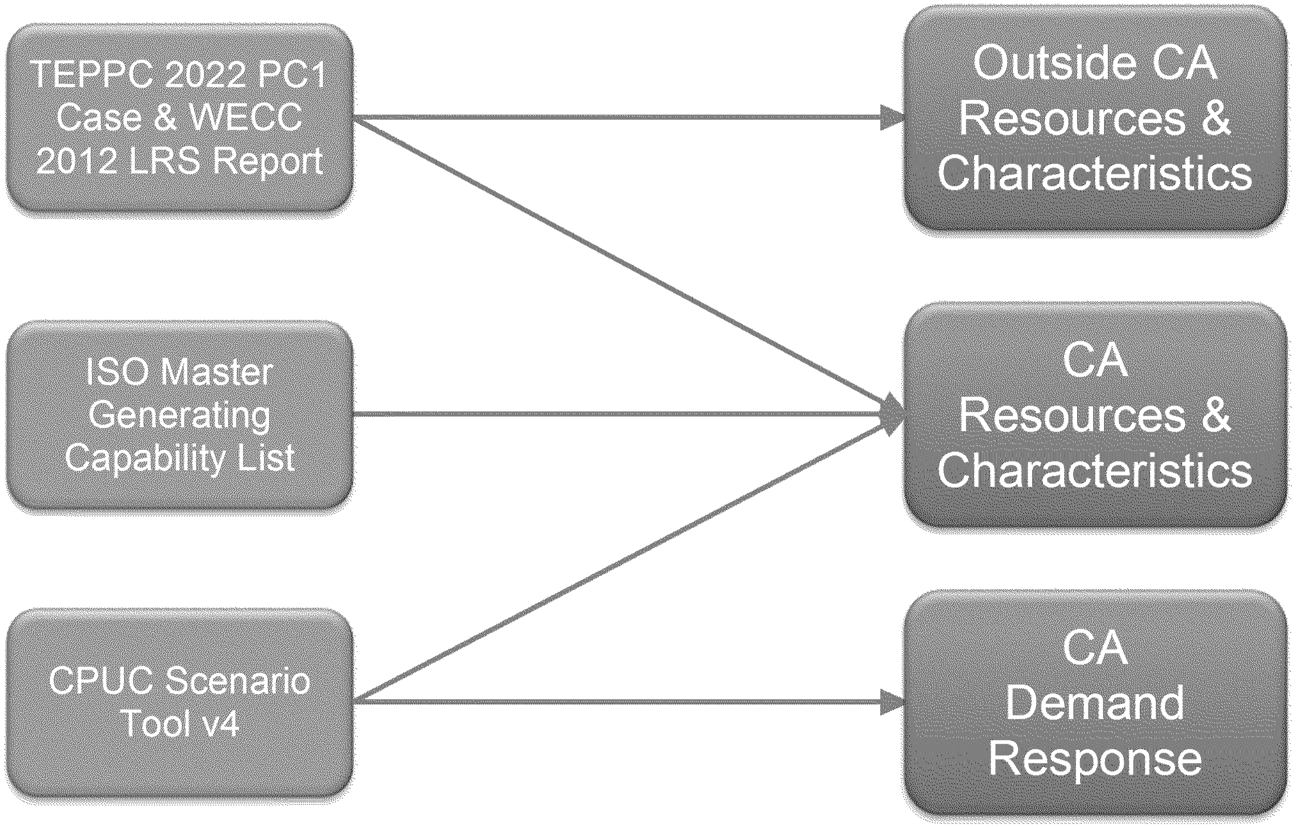
Load forecasts and load shapes are drawn from several data sources.



California renewable generation portfolios follow the CPUC scenario definitions.



Generation resource information is primarily taken from TEPPC 2022 PC1 Case.



CEC provided staff forecast of natural gas prices.

- Comparison of natural gas price forecasts for 2012 and 2010 LTPP studies

Natural Gas Prices (2010 $/MMBTU)

CEC Forecast			2010 LTPP Model		
	PG&E BB	PG&E LT		PG&E BB	PG&E LT
Jan-22	4.23	4.39	Jan-20	6.07	6.23
Feb-22	3.99	4.14	Feb-20	6.04	6.20
Mar-22	3.90	4.06	Mar-20	5.87	6.03
Apr-22	4.02	4.17	Apr-20	5.43	5.59
May-22	4.15	4.30	May-20	5.41	5.57
Jun-22	4.21	4.37	Jun-20	5.46	5.62
Jul-22	4.28	4.43	Jul-20	5.53	5.69
Aug-22	3.96	4.11	Aug-20	5.57	5.73
Sep-22	3.92	4.07	Sep-20	5.59	5.75
Oct-22	4.07	4.23	Oct-20	5.66	5.82
Nov-22	4.40	4.55	Nov-20	5.92	6.08
Dec-22	4.45	4.60	Dec-20	6.17	6.33

Scenario Assumption Comparison

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Aggregated demand and supply assumptions

CAISO - 2022	Base	Base + SONGS	Replic. TPP + DR	High DG-DSM
Demand (MW) *				
Counterfactual Load	58,178	58,178	60,755	58,178
IEPR Self Gen PV	1,364	1,364	1,364	1,364
IEPR Self Gen Non PV	1,850	1,850	1,850	1,850
IEPR Non Event Based DR	93	93	93	93
IEPR Net Load	54,871	54,871	57,448	54,871
Inc. EE	3,103	3,103	1,926	5,312
Inc. Small PV	710	710	0	1,803
Inc. D-CHP	0	0	0	649
Managed Demand Net Load	51,058	51,058	55,522	47,107
Supply (MW)				
Existing Resources	50,442	50,442	50,442	50,442
Resource Additions	10,360	10,360	10,259	9,453
Non-RPS	4,867	4,867	4,867	4,867
RPS	5,492	5,492	5,391	4,586
Authorized Procurement	0	0	0	0
Imports	13,308	13,308	13,308	13,308
Inc. S-CHP	0	0	0	548
Event-Based DR	2,595	2,595	2,336	2,595
Resource Retirements	17,263	15,017	15,392	17,263
OTC	13,146	13,146	13,146	13,146
Nuclear	2,246		2,246	2,246
Solar + Wind	0	0	0	0
Other Renewables	0	0	0	0
All Hydro	0	0	0	0
Other Non Renewables	1,871	1,871	0	1,871
Net Supply	59,442	61,688	60,953	59,083

SONG is retired in three of the four scenarios.

Source: CPUC Scenario Tool v5

* Peak demand on the CAISO system assuming 1-in-2 weather year except the Replicating TPP scenario, which has 1-in-5 weather year.

Base scenario load forecast and adjustments

Base Scenario	Load Forecast*	Inc. EE**	Embedded Small PV**	Inc CHP**	Addl Adjt***	Pumping Load****	Total Load
Load Forecast (MW)							
IID	1,196	-102	0	0	0	0	1,094
LDWP	7,705	-1,094	0	0	0	0	6,611
PG&E_BAY	9,916	-484	276	0	0	0	9,708
PG&E_VLY	14,499	-707	350	0	0	-417	13,725
SCE	26,294	-1,593	552	0	-19	-638	24,596
SDGE	5,536	-318	186	0	-5	0	5,398
SMUD	5,152	-591	0	0	0	-85	4,477
TIDC	648	0	0	0	0	0	648
CAISO	**56,245**	**-3,103**	**1,364**	**0**	**-24**	**-1,055**	**53,427**
CA	**70,946**	**-4,890**	**1,364**	**0**	**-24**	**-1,140**	**66,256**
Load Forecast (GWh)							
IID	4,533	-278	0	0	0	0	4,255
LDWP	32,942	-2,718	0	0	0	0	30,224
PG&E_BAY	52,945	-2,590	891	0	0	0	51,246
PG&E_VLY	66,565	-3,256	1,131	0	0	-5,076	59,364
SCE	117,073	-7,464	1,688	0	0	-6,894	104,403
SDGE	25,700	-1,473	531	0	0	-5	24,753
SMUD	20,211	-1,717	0	0	0	-555	17,939
TIDC	2,900	0	0	0	0	0	2,900
CAISO	**262,283**	**-14,783**	**4,240**	**0**	**0**	**-11,975**	**239,766**
CA	**322,869**	**-19,496**	**4,240**	**0**	**0**	**-12,530**	**295,083**

* CEC 2012 IPER Form 1.5a and 1.5b. Base and High DG-DSM scenarios have 1-in-2 weather year while Replicating TPP scenario has 1-in-5 weahter year

** CPUC Scenario Tool V5 and CEC IPER 2013 Preliminary, and Inc CHP is peak load impact at 70% capacity factor

*** CPUC Dec 24, 2012 decision

**** CPUC Scenario Tool V5 and 2009-2011 average of ISO operation data. MW values are pump loads at peak load hours of the regions.

High DG-DSM scenario load forecast and adjustments

High DG-DSM Scenario	Load Forecast*	Inc. EE**	Embedded Small PV**	Inc CHP**	Addl Adjt***	Pumping Load****	Total Load
Load Forecast (MW)							
IID	1,196	-126	0	-11	0	0	1,059
LDWP	7,705	-1,351	0	-81	0	0	6,274
PG&E_BAY	9,916	-915	276	-114	0	0	9,163
PG&E_VLY	14,499	-1,150	350	-167	0	-417	13,114
SCE	26,294	-2,711	552	-303	-19	-638	23,175
SDGE	5,536	-535	186	-64	-5	0	5,117
SMUD	5,152	-714	0	-49	0	-85	4,304
TIDC	648	0	0	-7	0	0	641
CAISO	**56,245**	**-5,312**	**1,364**	**-649**	**-24**	**-1,055**	**50,569**
CA	**70,946**	**-7,502**	**1,364**	**-797**	**-24**	**-1,140**	**62,847**
Load Forecast (GWh)							
IID	4,533	-334	0	-104	0	0	4,095
LDWP	32,942	-3,298	0	-756	0	0	28,888
PG&E_BAY	52,945	-3,855	891	-1,231	0	0	48,751
PG&E_VLY	66,565	-4,847	1,131	-1,547	0	-5,076	56,226
SCE	117,073	-11,040	1,688	-2,721	0	-6,894	98,106
SDGE	25,700	-2,039	531	-597	0	-5	23,589
SMUD	20,211	-2,043	0	-464	0	-555	17,149
TIDC	2,900	0	0	-67	0	0	2,833
CAISO	**262,283**	**-21,781**	**4,240**	**-6,096**	**0**	**-11,975**	**226,672**
CA	**322,869**	**-27,456**	**4,240**	**-7,486**	**0**	**-12,530**	**279,637**

* CEC 2012 IPER Form 1.5a and 1.5b. Base and High DG-DSM scenarios have 1-in-2 weather year while Replicating TPP scenario has 1-in-5 weahter year

** CPUC Scenario Tool V5 and CEC IPER 2013 Preliminary, and Inc CHP is peak load impact at 70% capacity factor

*** CPUC Dec 24, 2012 decision

**** CPUC Scenario Tool V5 and 2009-2011 average of ISO operation data. MW values are pump loads at peak load hours of the regions.

Replicating TPP scenario load forecast and adjustments

Replicating TPP Scenario	Load Forecast*	Inc. EE**	Embedded Small PV**	Inc CHP**	Addl Adjt***	Pumping Load****	Total Load
Load Forecast (MW)							
IID	1,269	-73	0	0	0	0	1,196
LDWP	8,032	-910	0	0	0	0	7,122
PG&E_BAY	10,277	-309	276	0	0	0	10,244
PG&E_VLY	15,225	-457	350	0	0	-417	14,701
SCE	27,461	-973	552	0	-19	-638	26,383
SDGE	5,922	-187	186	0	-5	0	5,916
SMUD	5,330	-482	0	0	0	-85	4,763
TIDC	677	0	0	0	0	0	677
CAISO	**58,885**	**-1,926**	**1,364**	**0**	**-24**	**-1,055**	**57,244**
CA	**74,193**	**-3,391**	**1,364**	**0**	**-24**	**-1,140**	**71,002**
Load Forecast (GWh)							
IID	4,533	-195	0	0	0	0	4,338
LDWP	32,941	-2,005	0	0	0	0	30,936
PG&E_BAY	52,945	-1,633	891	0	0	0	52,203
PG&E_VLY	66,565	-2,419	1,131	0	0	-5,076	60,201
SCE	117,073	-4,222	1,688	0	0	-6,894	107,645
SDGE	25,700	-807	531	0	0	-5	25,419
SMUD	20,211	-1,300	0	0	0	-555	18,355
TIDC	2,900	0	0	0	0	0	2,900
CAISO	**262,283**	**-9,081**	**4,240**	**0**	**0**	**-11,975**	**245,468**
CA	**322,868**	**-12,581**	**4,240**	**0**	**0**	**-12,530**	**301,997**

* CEC 2012 IPER Form 1.5a and 1.5b. Base and High DG-DSM scenarios have 1-in-2 weather year while Replicating TPP scenario has 1-in-5 weahter year

** CPUC Scenario Tool V5 and CEC IPER 2013 Preliminary, and Inc CHP is peak load impact at 70% capacity factor

*** CPUC Dec 24, 2012 decision

**** CPUC Scenario Tool V5 and 2009-2011 average of ISO operation data. MW values are pump loads at peak load hours of the regions.

California RPS net short calculation

	All Values in GWh for the Year 2022	Formula	Base Scenario	High DG-DSM Scenario	Replicating TPP Scenario
1	Statewide Retail Sales - June 2012 IEPR12 Final		301,384	301,384	301,384
2	Non RPS Deliveries (CDWR, WAPA, MWD)		12,530	12,530	12,530
3	Retail Sales for RPS	3=1-2	288,854	288,854	288,854
4	Additional Energy Efficiency		19,543	27,457	19,543
5	Additional Rooftop PV		2,159	5,480	2,159
6	Additional Combined Heat and Power		0	7,486	0
7	Adjusted Statewide Retail Sales for RPS	7=3-4-5-6	267,152	248,431	267,152
8	**Total Renewable Energy Needed For RPS**	8=7*33%	**88,160**	**81,982**	**88,160**
	Existing and Expected Renewable Generation				
9	Total In-State Renewable Generation		40,305	40,305	40,305
10	Total Out-of-State Renewable Generation		13,950	13,950	12,600
11	Procured DG (not handled in Calculator)		1,110	1,110	1,319
12	SB 1122 (250 MW of Biogas)				1,753
13	**Total Existing Renewable Generation for CA RPS**	13=9+10+11+12	**55,364**	**55,364**	**55,976**
14	**Total RE Net Short to meet 33% RPS In 2022 (GWh)**	14=8-13	**32,796**	**26,618**	**32,184**

Source: CPUC Scenario Tool v5

California RPS renewable portfolios

	Biomass	Geothermal	Small Hydro	Solar PV	Large Solar PV	Small Solar PV	Solar Thermal	Wind	Total
Base Scenario									
Capacity (MW)	1,321	3,636	1,530	1,503	5,728	2,183	2,140	9,766	27,805
Energy (GWh)	9,418	21,555	7,228	2,329	13,111	4,384	4,813	25,323	88,161
In-State Energy	7,815	18,468	7,189	1,507	11,284	4,384	4,813	14,422	69,881
Out-State Energy	1,604	3,087	40	822	1,827	0	0	10,901	18,280
High DG-DSM Scenario									
Capacity (MW)	1,318	3,159	1,530	1,503	3,966	3,961	1,525	9,467	26,428
Energy (GWh)	9,397	18,114	7,228	2,329	9,167	7,869	3,375	24,502	81,983
In-State Energy	7,794	15,027	7,189	1,507	7,341	7,869	3,375	13,601	63,703
Out-State Energy	1,604	3,087	40	822	1,827	0	0	10,901	18,280
Replicating TPP Scenario									
Capacity (MW)	1,571	3,596	1,530	1,713	5,685	2,082	2,140	9,759	28,075
Energy (GWh)	11,016	21,084	7,224	2,635	12,817	4,179	4,813	24,392	88,160
In-State Energy	9,568	18,180	7,188	1,718	11,184	4,179	4,813	14,402	71,232
Out-State Energy	1,448	2,904	36	918	1,633	0	0	9,990	16,928

70% of out-state RPS renewable generation is imported into California in all scenarios.

Study	Dynamic Schedule	Intra-Hour (15-min) Schedule	Hourly Schedule	Unbundled RECs
2010 LTPP	15%	15%	40%	30%
2012 LTPP	15%	35%	20%	30%

- The shift from Hourly Schedule to Intra-Hour Schedule reflect combination of FERC Order 764 and Energy Imbalance Market
- The scheduling assumptions affect Regulation and Load-Following requirements calculated in Step 1

Step 1 regulation and load following requirement calculation uses t-30 minute forecast errors.

Solar and Wind Forecast Errors (as percentage of installed capacity)

Scenario	Type	Persistent	Hour	0<=CI<0.2	0.2<=CI<0.5	0.5<=CI<0.8	0.8<=CI<=1
Base	DG PV	t-30 min	H12-16	1.4%	2.7%	2.4%	1.2%
Base	Small PV	t-30 min	H12-16	1.6%	4.1%	4.9%	1.5%
Base	Large PV	t-30 min	H12-16	3.0%	4.3%	3.7%	1.6%
Base	Solar Thermal	t-30 min	H12-16	4.1%	7.4%	5.7%	1.9%
Base	Wind	t-30 min	All	2.3%	2.2%	1.9%	2.1%
High DG-DSM	DG PV	t-30 min	H12-16	0.0%	3.0%	2.8%	1.8%
High DG-DSM	Small PV	t-30 min	H12-16	3.3%	3.3%	2.8%	1.2%
High DG-DSM	Large PV	t-30 min	H12-16	3.7%	7.5%	10.4%	3.0%
High DG-DSM	Solar Thermal	t-30 min	H12-16	5.2%	9.0%	6.6%	2.1%
High DG-DSM	Wind	t-30 min	All	2.4%	2.3%	2.0%	2.2%
Replicating TPP	DG PV	t-30 min	H12-16	0.0%	2.9%	3.8%	2.2%
Replicating TPP	Small PV	t-30 min	H12-16	3.4%	2.7%	2.5%	1.0%
Replicating TPP	Large PV	t-30 min	H12-16	2.4%	5.7%	4.8%	2.4%
Replicating TPP	Solar Thermal	t-30 min	H12-16	4.1%	7.4%	5.7%	1.9%
Replicating TPP	Wind	t-30 min	All	2.2%	2.1%	1.8%	2.1%

Load Forecast Errors (standard deviation, MW)*

Scenario	Load	Time	Hour	Spring	Summer	Fall	Winter
All	RTPD	t-30 min	All	228	333	410	252
All	RTD	t-5 min	All	103	189	258	118

* Calculated based on the ISO 2012 operation data

Using t-30 min forecast errors resulted in slightly lower load-following requirements.

Annual Maximum Regulation and Load-Following Requirements (MW)

Study	Case	Regulation Up	Regulation Down	Load Following Up	Load Following Down
2012 LTPP	33Base	1,319	1,390	3,554	3,776
2012 LTPP	33High DG	1,307	1,288	3,454	3,976
2012 LTPP	33TPP	1,213	1,305	4,483	4,653
2010 LTPP	Trajectory	1,219	991	3,564	4,122

SCIT and California import limits

(MW)	Summer Peak	Summer Off-Peak	Non-Summer Peak	Non-Summer Off-Peak
Base Scenario				
SCIT Limit	13,665	10,260	11,295	8,447
CA Import Limit	13,865	10,460	11,495	8,647
High DG-DSM Scenario				
SCIT Limit	13,853	10,896	11,635	8,804
CA Import Limit	14,053	11,096	11,835	9,004
Replicating TPP Scenario				
SCIT Limit	13,692	10,575	11,356	8,505
CA Import Limit	13,892	10,775	11,556	8,705

Demand response resource capacity, triggering prices, and availabilities

Category	Price ($/MWh)	Max Capacity (MW)	Available Hour	Daily Energy Limit (GWh)	Monthly Energy Limit (GWh)
Base and High DG-DSM Scenario					
Low Cost	137	939	H12-18	3.85	
Mid Cost	600	939	H12-18		19.06
High Cost	1,000	717	All		
Total		**2,595**		**3.85**	**19.06**
Replicating TPP Scenario					
Low Cost	137	845	H12-18	3.47	
Mid Cost	600	845	H12-18		17.16
High Cost	1,000	646	All		
Total		**2,336**		**3.47**	**17.16**

Note: The demand response assumptions were made in 2010 LTPP study and scaled proportionally to match the total capacity in the 2012 LTPP Track 2 study scenarios.

Preliminary Deterministic Simulation Results

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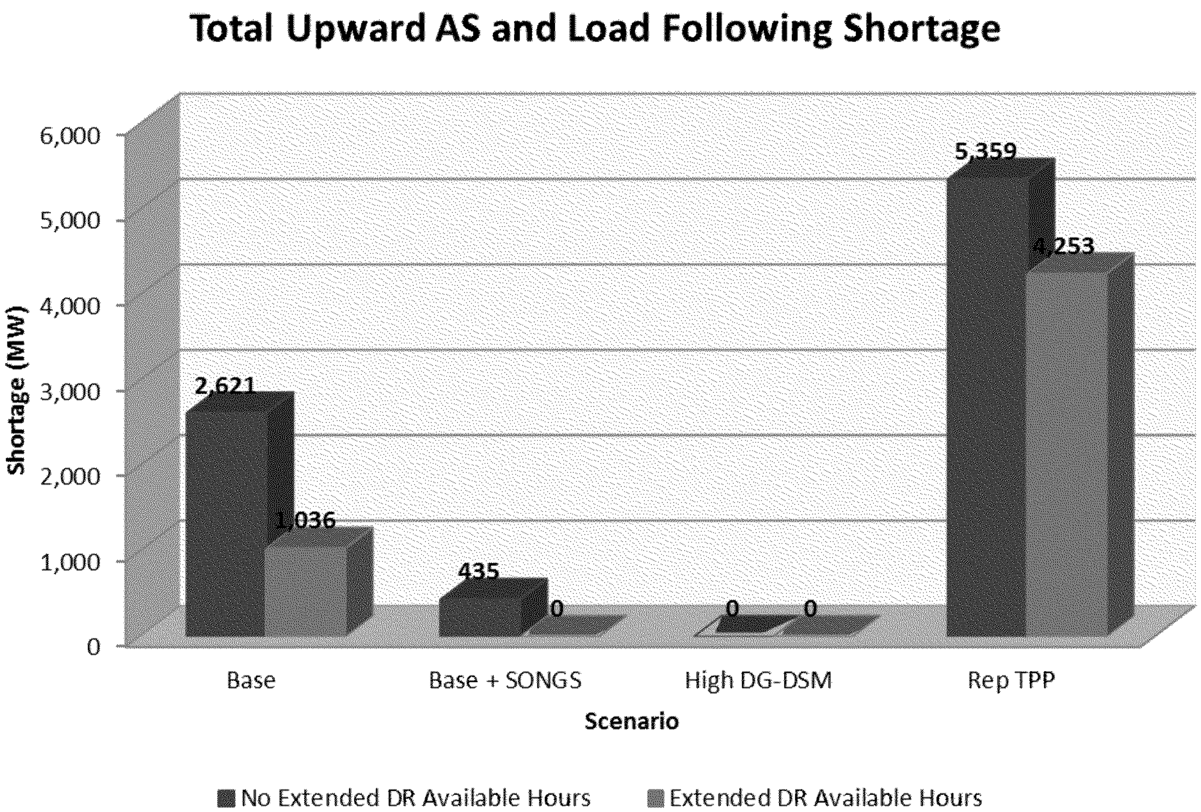
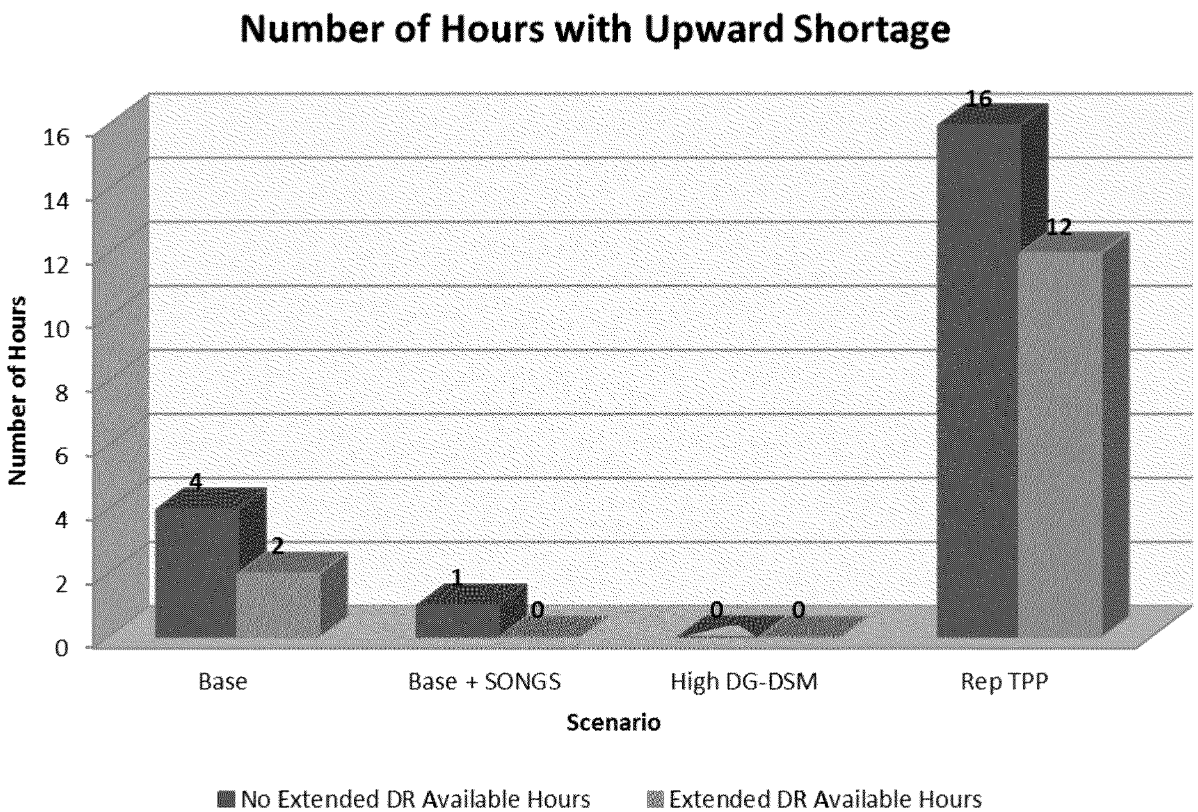
Upward ancillary services and load-following shortages



Note: Rep TPP scenario 5,359 MW shortage includes 359 MW Unserved Energy

Number of hours with upward ancillary services and load-following shortages



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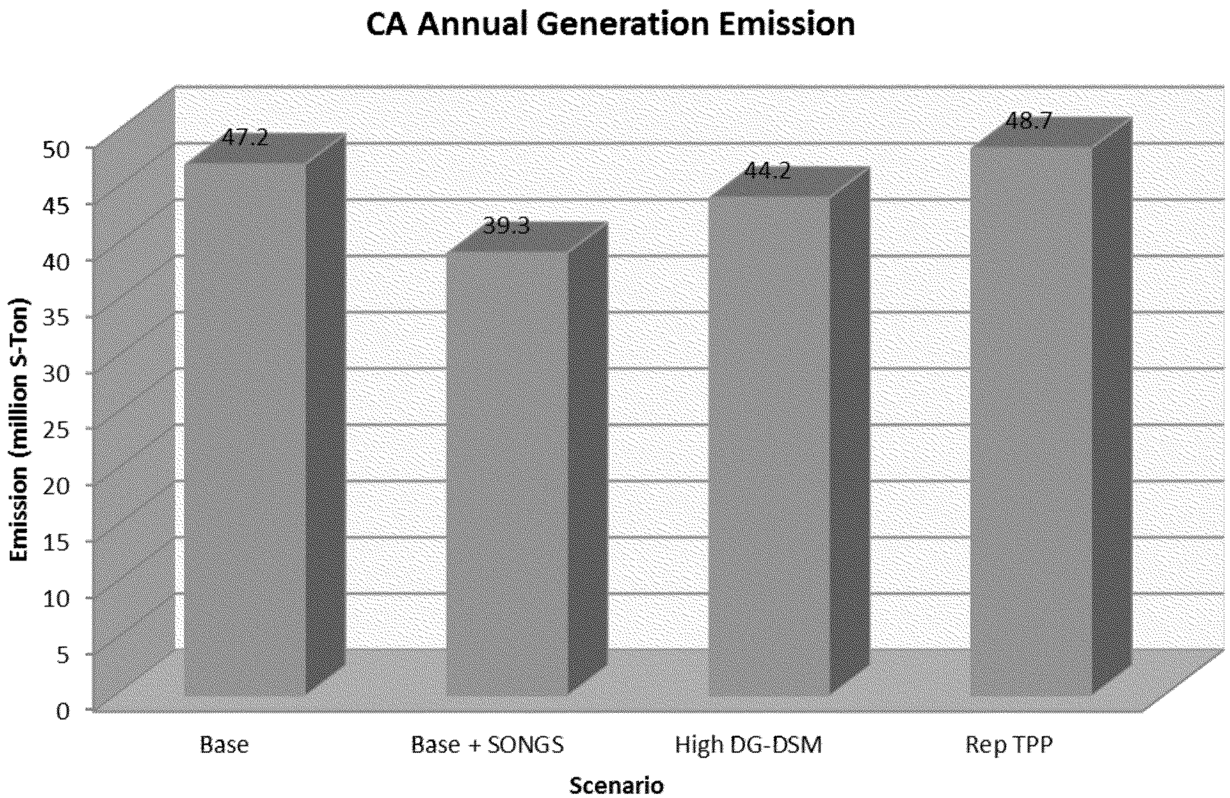
Annual CO_2 emission by California generation



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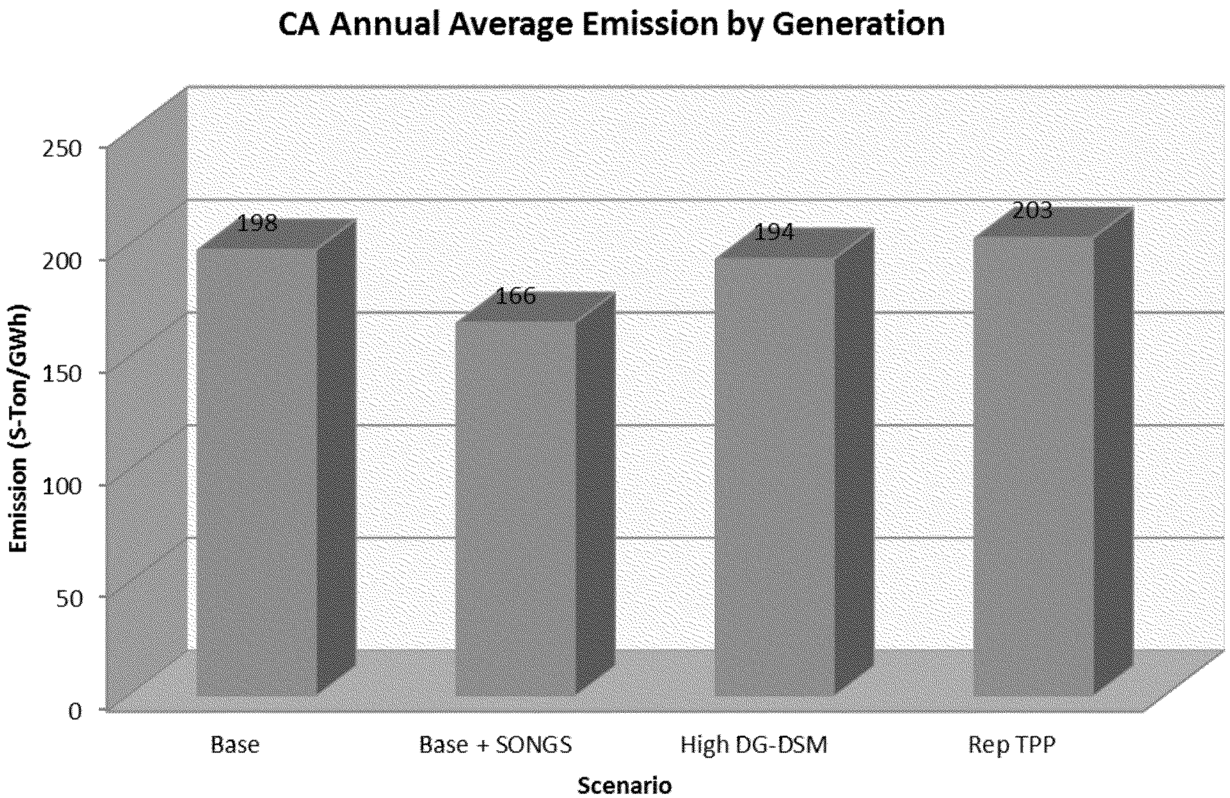
Average CO_2 emission from California generation



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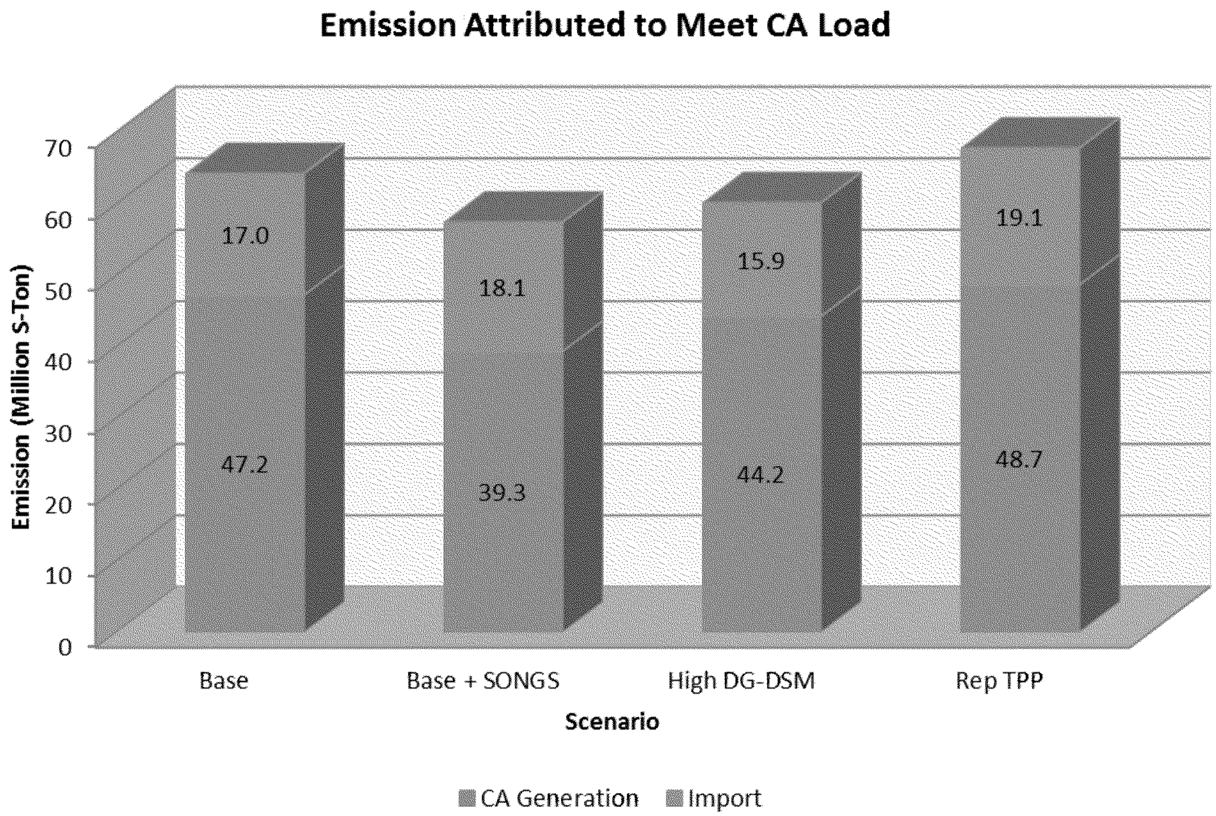
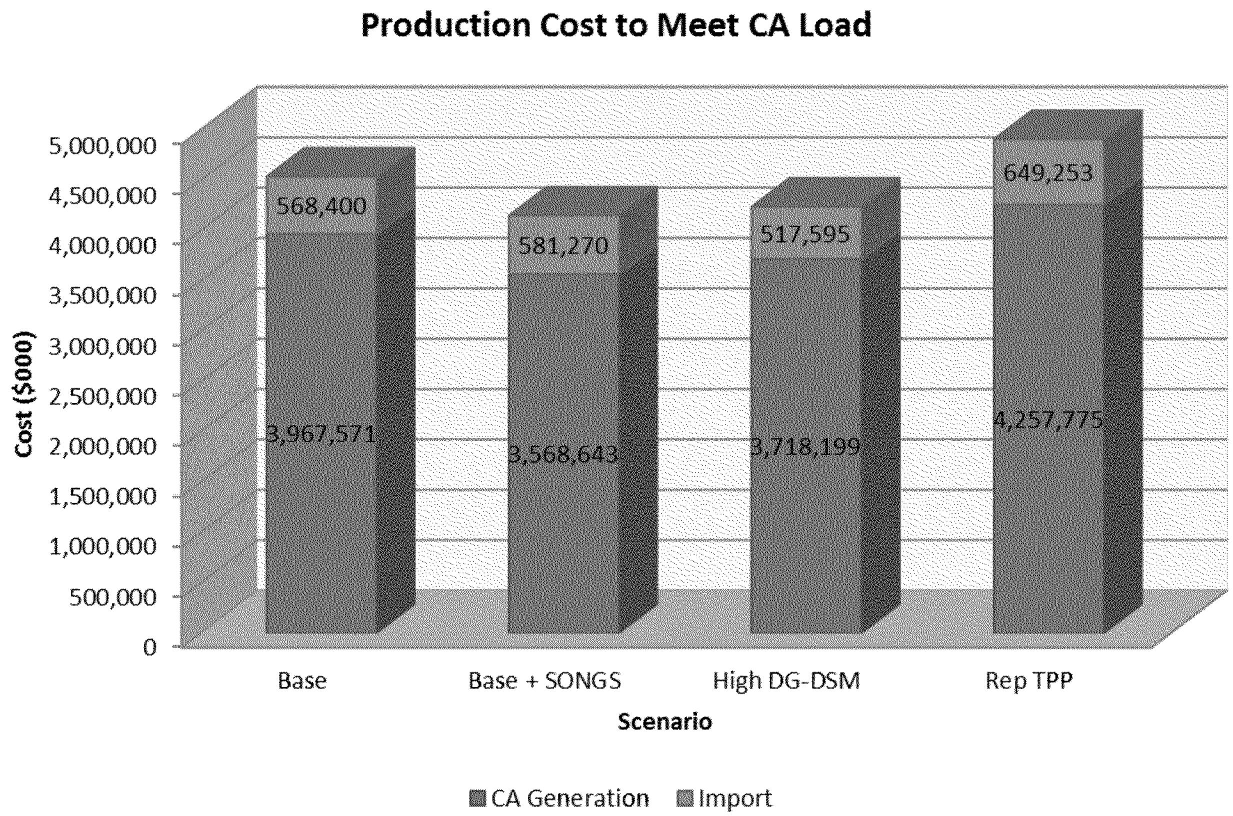
Annual CO_2 emission to meet California load



Annual production cost to meet California load



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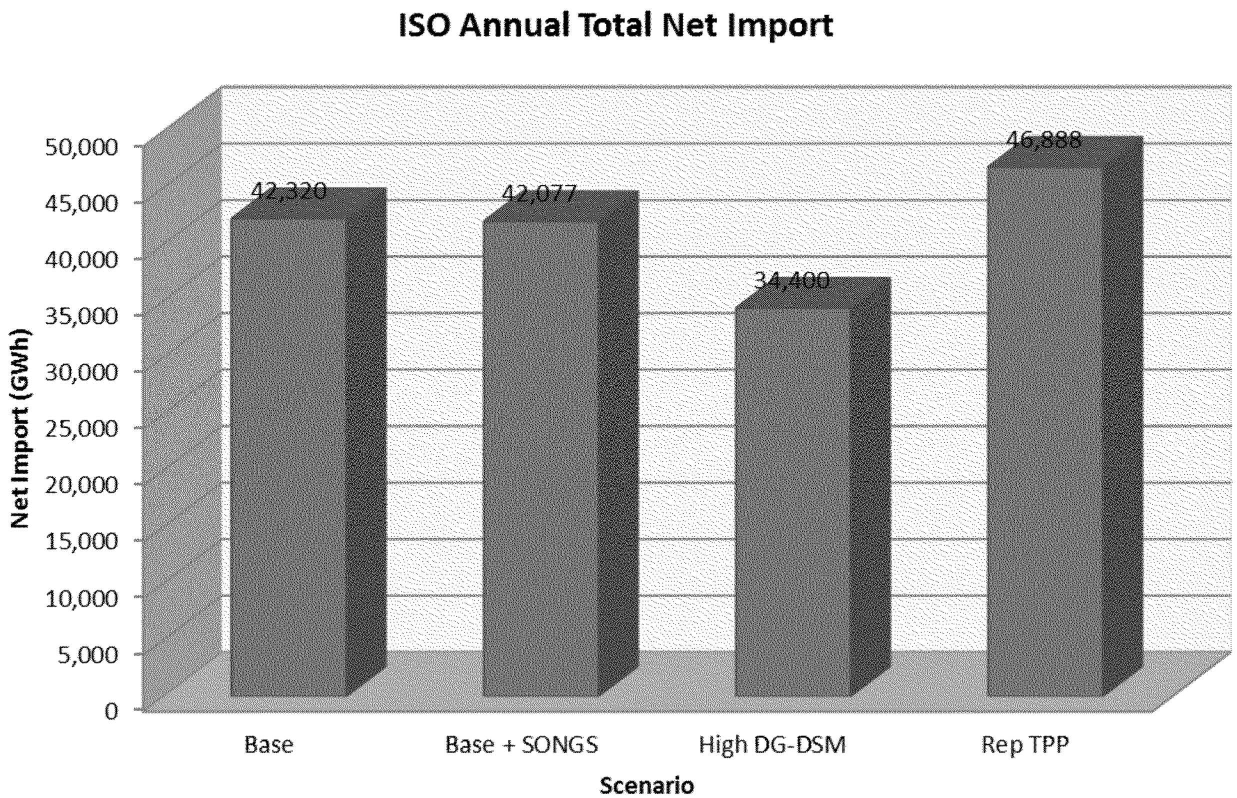
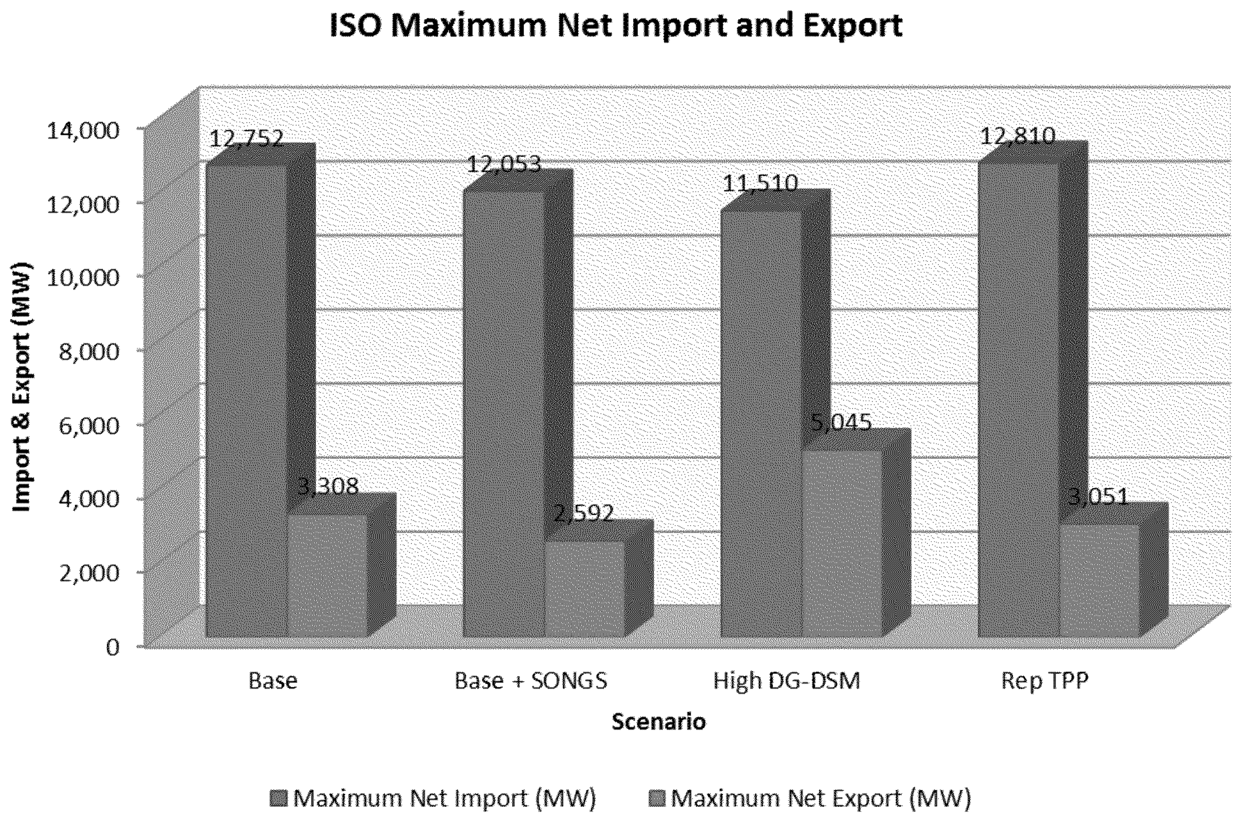
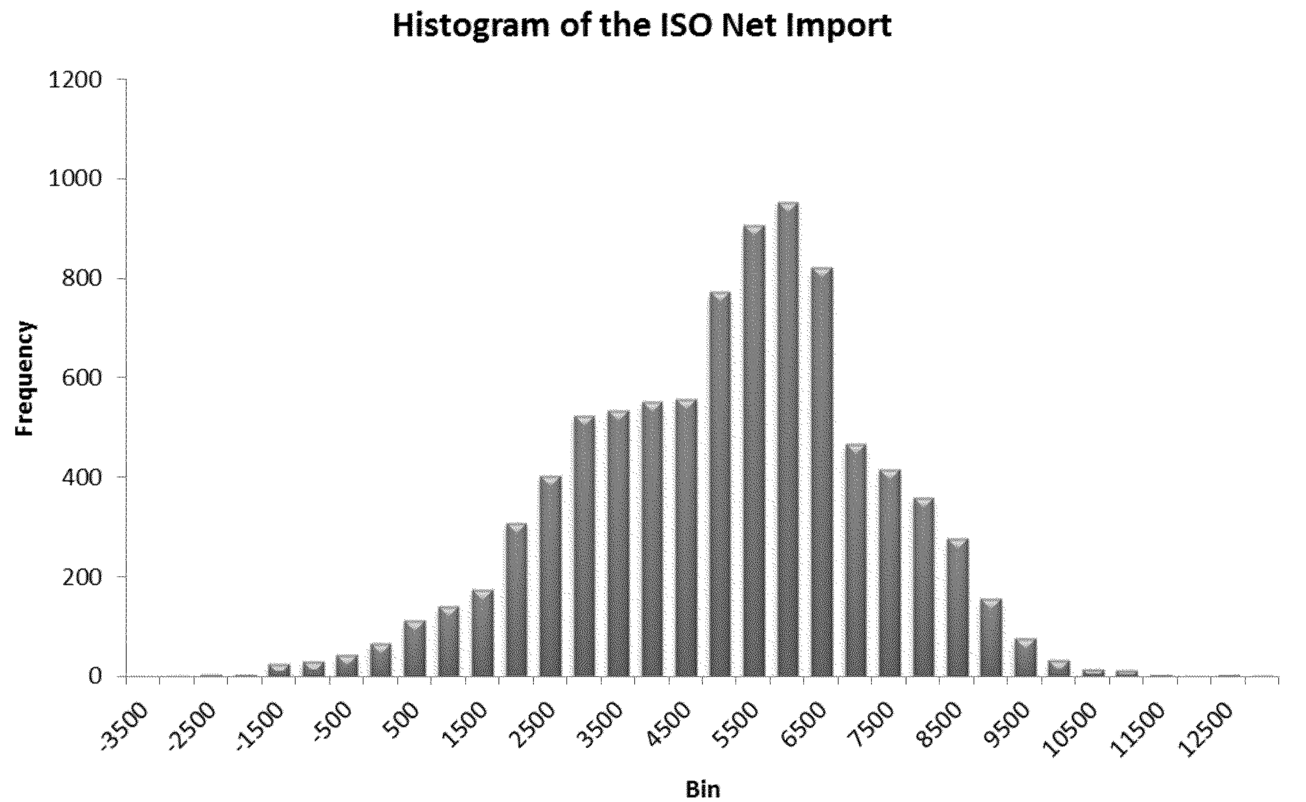
The ISO annual total net import



The ISO maximum net import and export

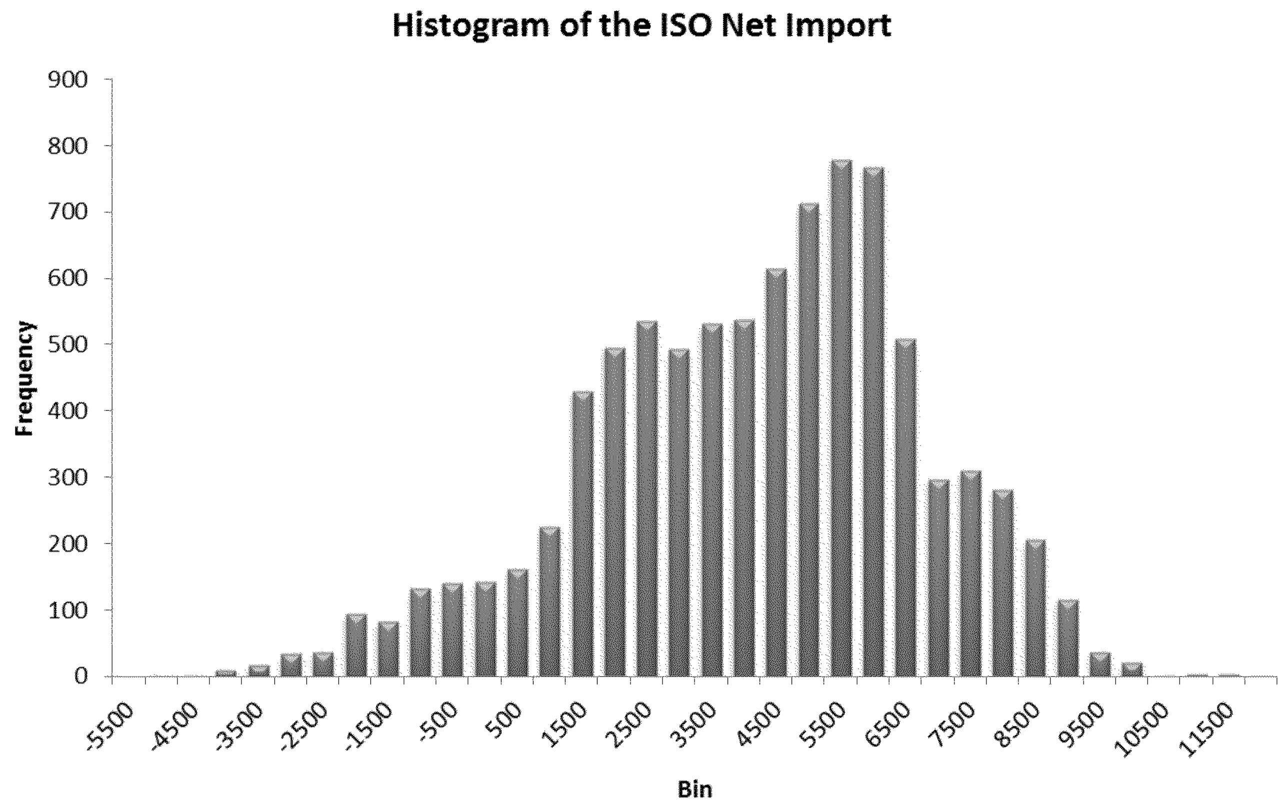


Net import distribution of the Base scenario



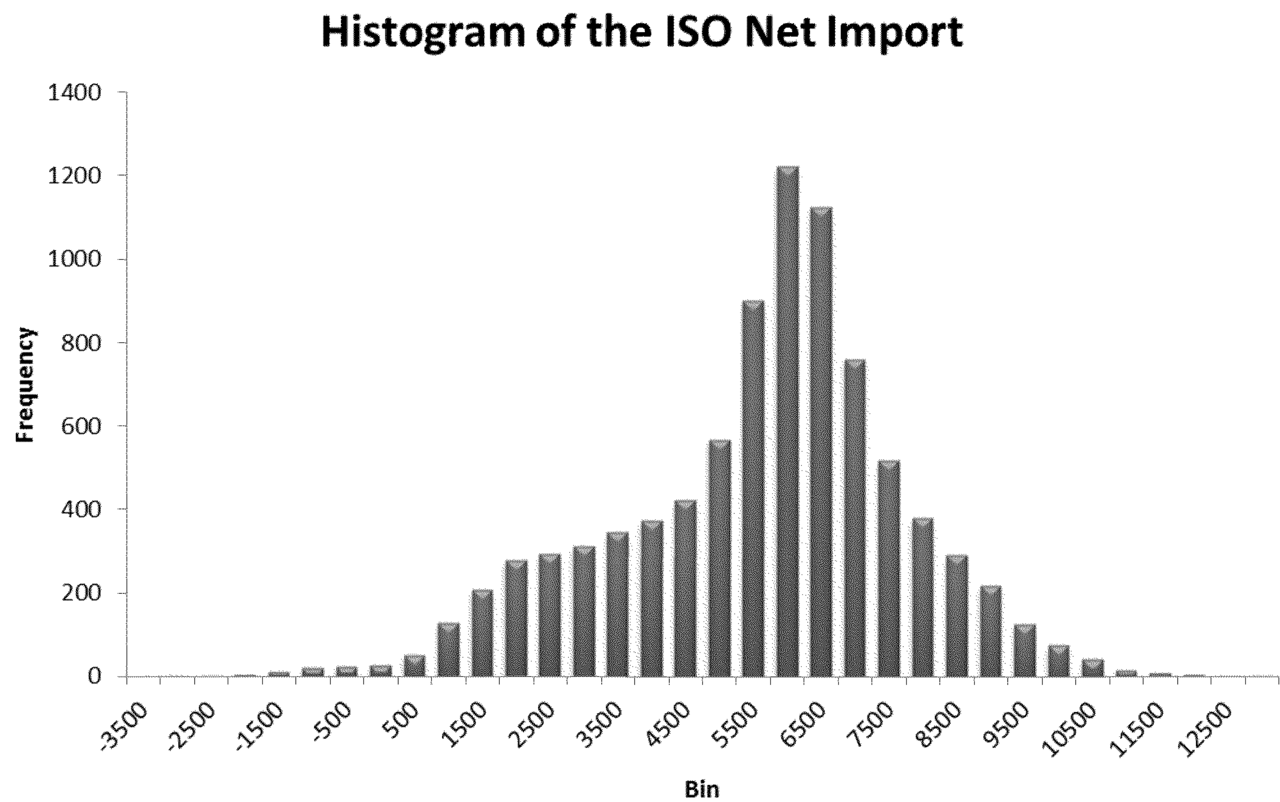
Note: there are 179 hours with net export

Net import distribution of the High DG-DSM scenario



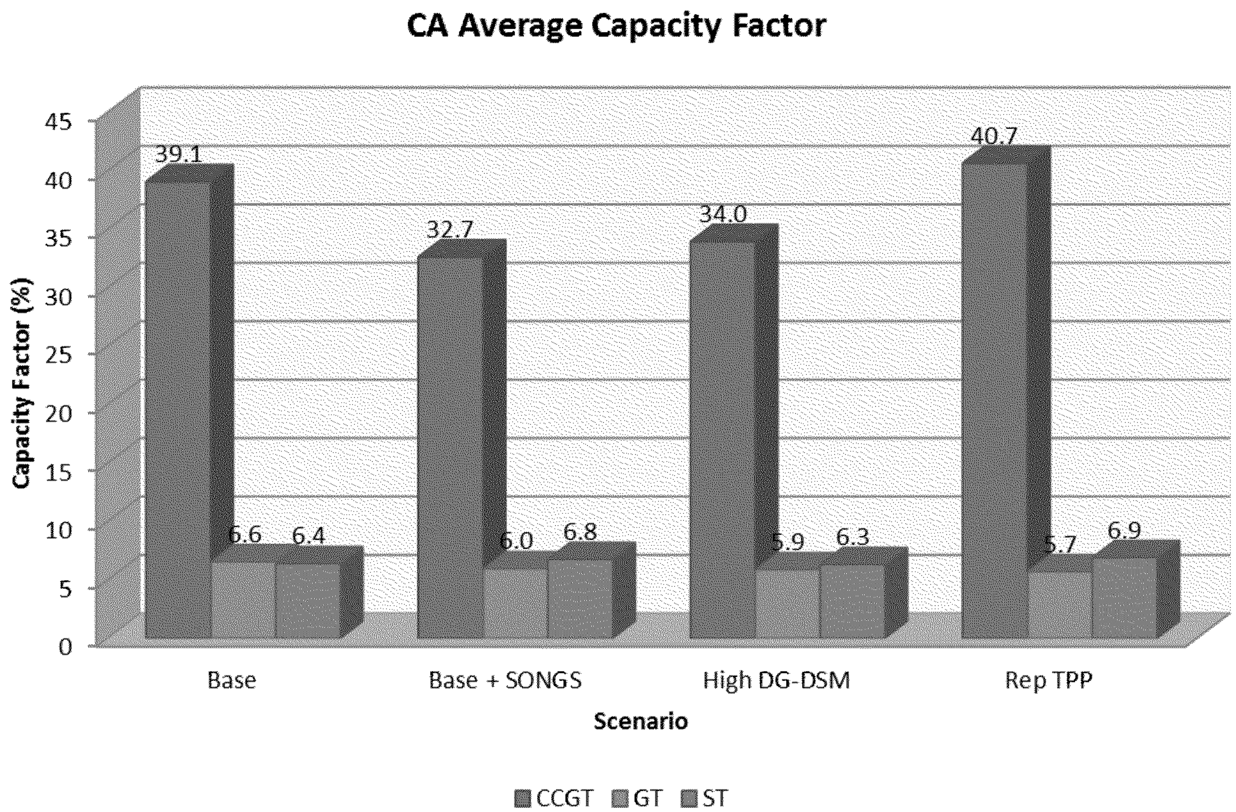
Note: there are 691 hours with net export

Net import distribution of the Replicating TPP scenario

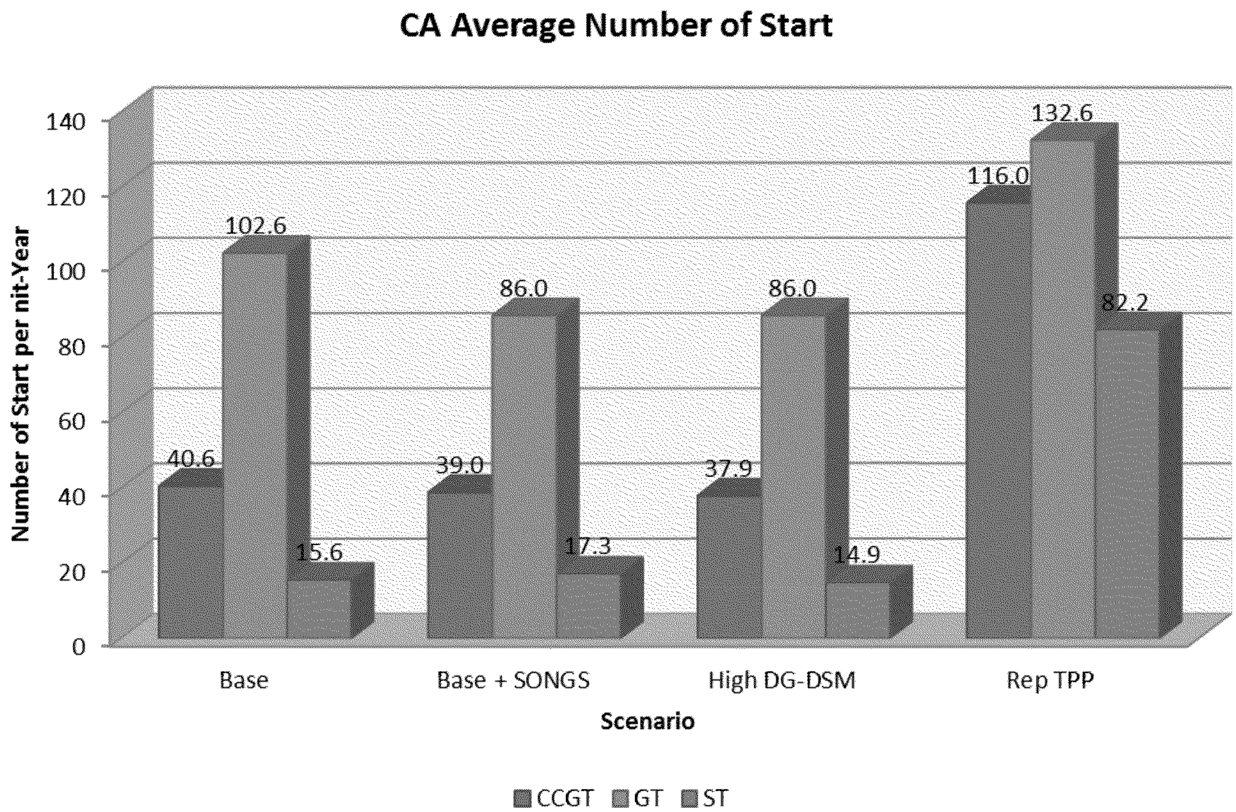


Note: there are 92 hours with net export

California annual average capacity factors of selected types of units



California annual average starts of selected types of units



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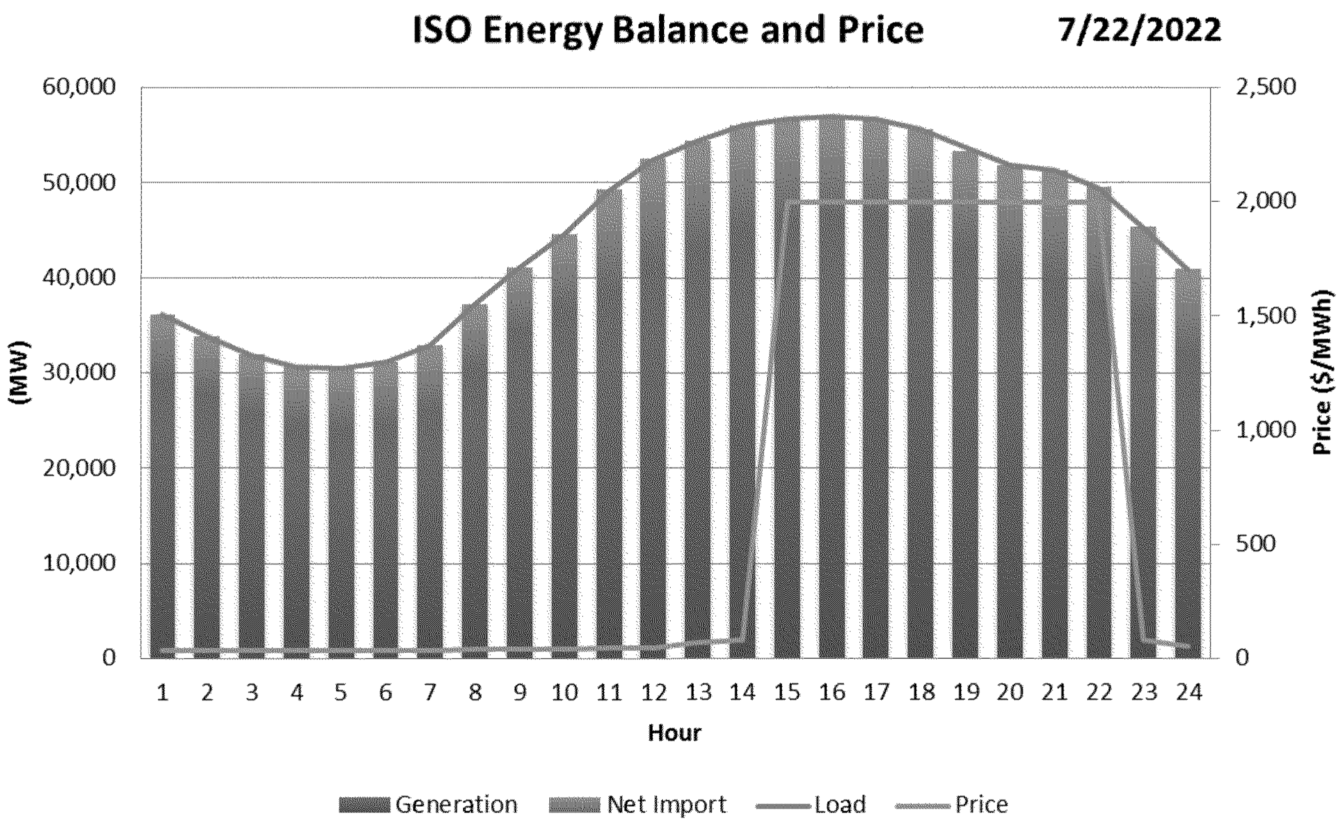
ISO energy balance on peak-load day in the Replicating TPP scenario



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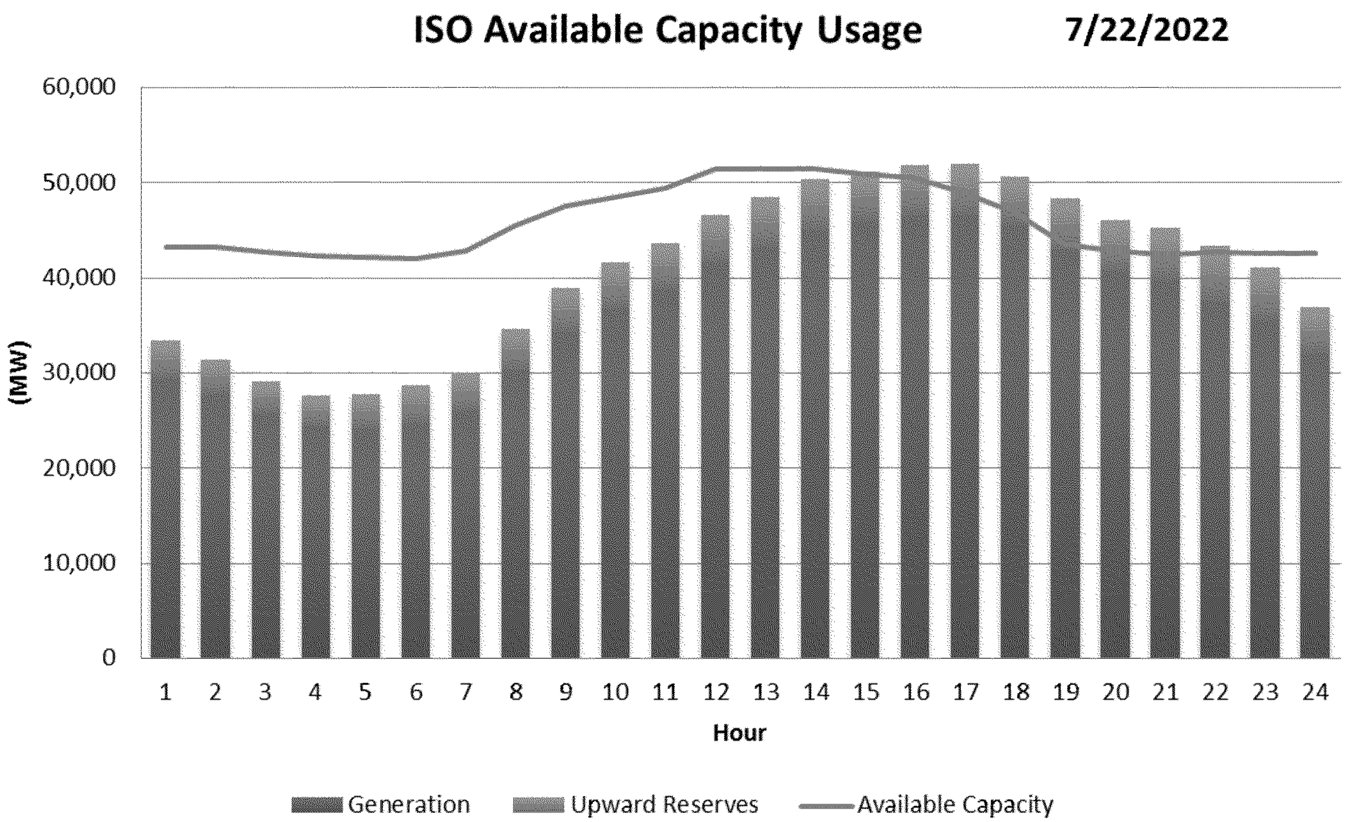
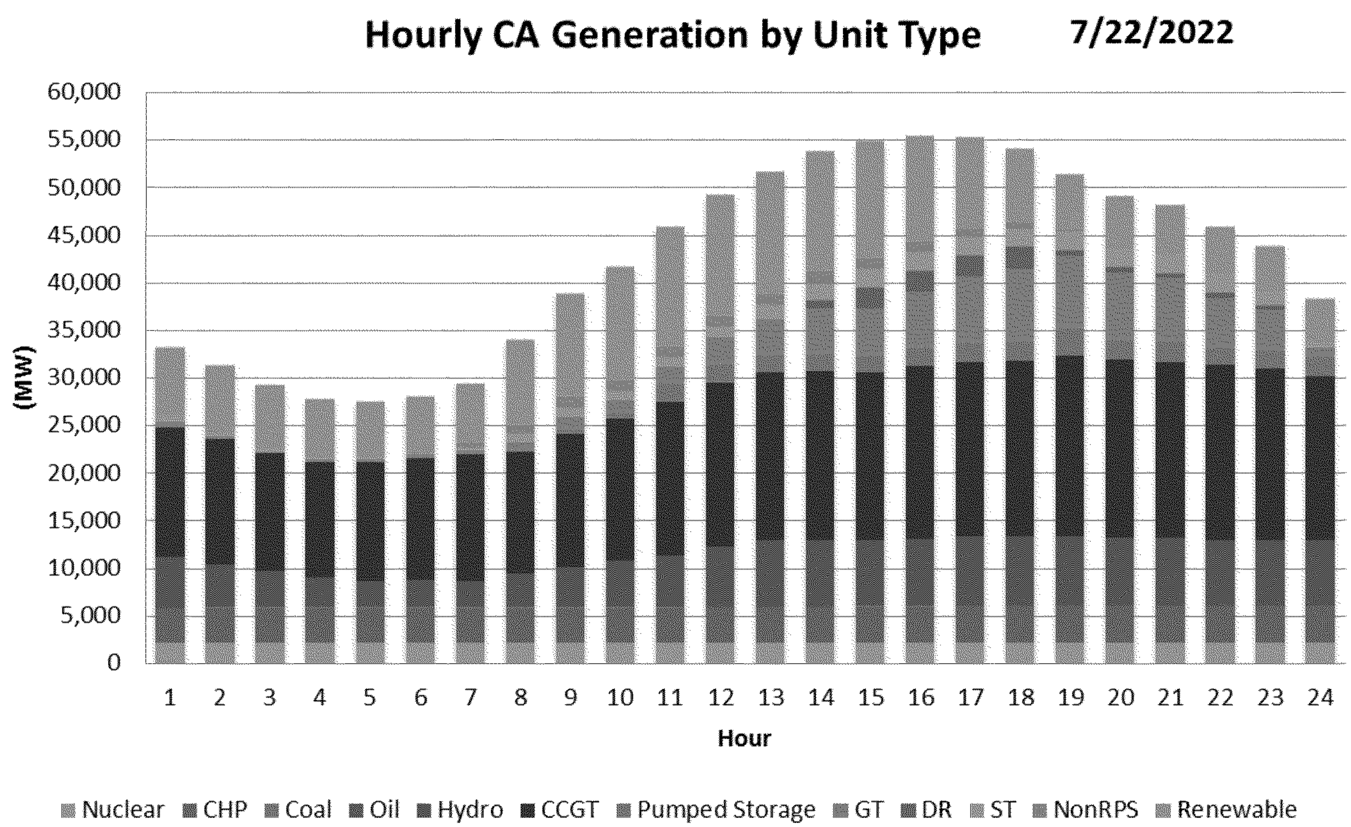
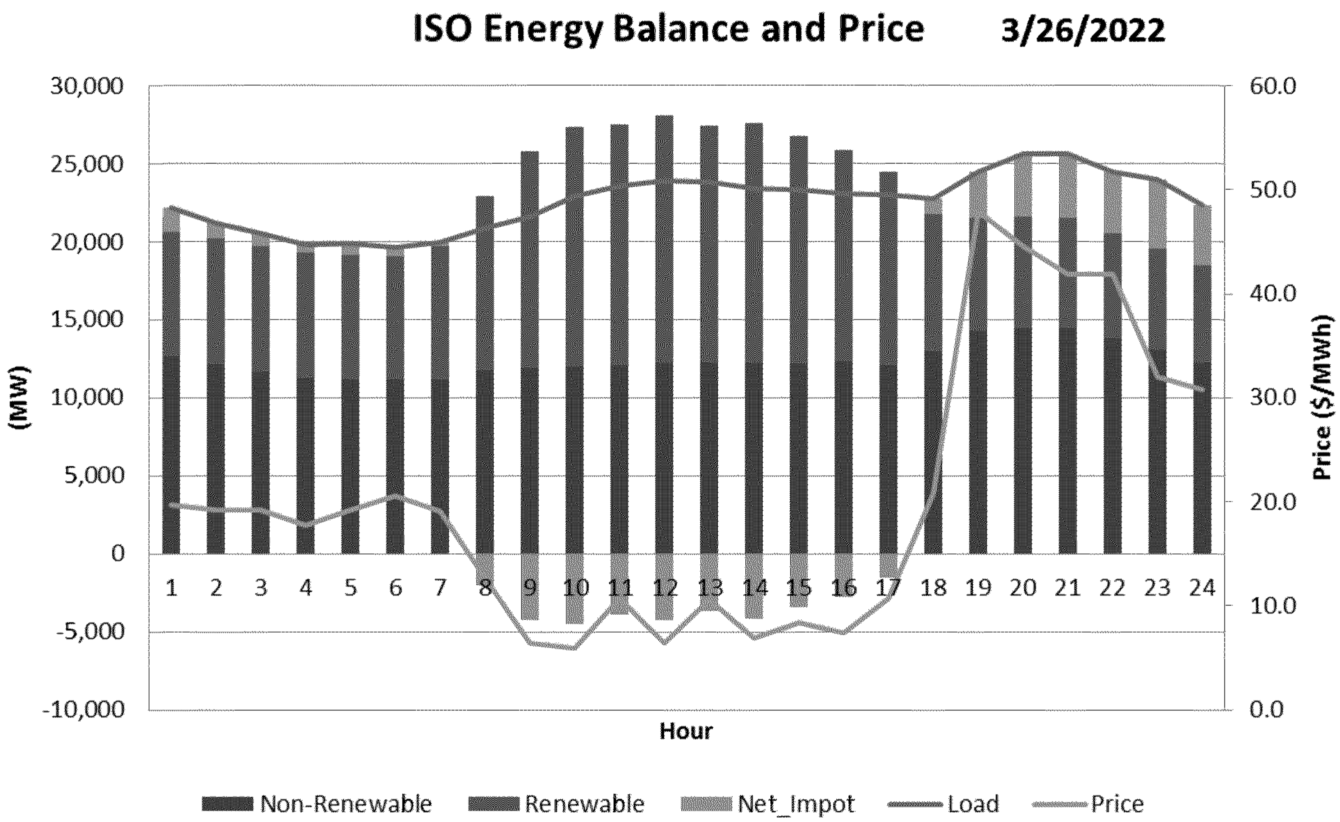
Available capacity is insufficient on peak-load day in the Replicating TPP scenario.



Resource dispatch on peak-load day in the Replicating TPP scenario.



ISO energy balance on a Spring day in the High DG-DSM scenario



Takeaway based on the preliminary results:

- Demand response program should revised to extend and reduce shortage window
- Local capacity requirements without SONGs is a separate assessment but should be considered into residual system shortage results
- Assessment of alternatives needs to be considered

Thank you!

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