Incorporating DER into Planning Assessments

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Presentation Outline

- Types of Distributed Energy Resources (DER)
  - DER forecast for CAISO Balancing Authority Area
- Incorporating DER in load forecast
- Incorporating DER in study scenario development
- Behind-the-meter PV modeling

Types of Distributed Energy Resources – *Distributed Generation (DG)*

- Demand-side DG (Behind-the-meter Generation)
  - Photovoltaic (PV) / Non-photovoltaic
  - Source: California Energy Commission (CEC) demand forecast and Participating Transmission Owner (PTO) Distribution Resource Plan (DRP).
  - Modeled at Transmission/Distribution (T/D) interface as aggregated resource (PV only at this time).

- Supply-side DG
  - Resources connected in front of the customer meter.
  - Source: PTO Wholesale Distribution Access Tariff (WDAT) and California Public Utilities Commission (CPUC) RPS portfolio.
  - Modeled at T/D interface as individual resource.

Types of Distributed Energy Resources – *Energy Efficiency*

- Committed energy efficiency
  - Embedded in the CEC baseline forecast

- Uncommitted energy efficiency - Additional Achievable Energy Efficiency (AAEE)
  - Used as load modifier
  - Source: CEC demand forecast
  - Modeled at T/D interface as aggregated negative load

Types of Distributed Energy Resources – *Demand Response*

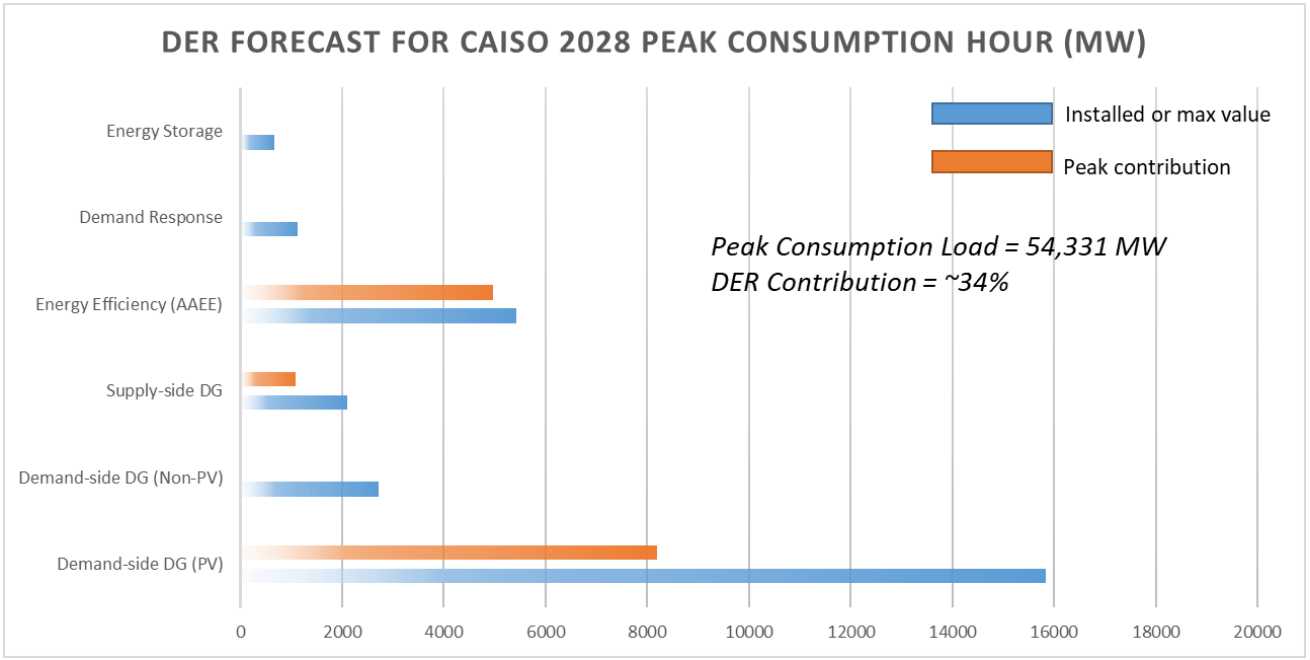
- Demand-side (Load-modifying) demand response
  - Embedded in CEC demand forecast
  - Non-event based

- Supply-side demand response
  - Event based, price-responsive and reliability programs
  - Source – PTOs and CPUC
  - Modeled at T/D interface as aggregated negative load. Initially modeled offline and used as potential mitigation.

Types of Distributed Energy Resources – *Energy Storage*

- Demand-side or supply-side energy storage
- Source – PTOs and CPUC
- Modeled at T/D interface as aggregated resource, only those that are procured by LSEs.

DER forecast for CAISO Balancing Authority Area –
Year 2028 based on 2018-2019 TPP



Incorporating DER in Load Forecast

- The CAISO uses load forecast provided by the CEC as part of it's Integrated Energy Policy Report (IEPR). The CEC adopts an IEPR every two years and an update every other year.
- CEC provides hourly load forecast that includes hourly consumption load and hourly load modifiers such as PV generation (committed and Additional Achievable PV) and Additional Achievable Energy Efficiency (AAEE).
  - Hourly load forecast allows for selecting snapshot for base case modeling such as hour of maximum managed peak which represents shifted peak hour due to increased PV penetration.
  - CEC also provides installed capacity of behind-the-meter PV generation by planning area and bus level allocation for AAEE.
  - BTM-PV bus level allocation is done by PTOs using information from Distribution Resource Plan (DRP).

Link to 2018 IEPR: https://efiling.energy.ca.gov/getdocument.aspx?tn=224934
Link to 2018 Hourly Forecast: https://www.energy.ca.gov/2018_energypolicy/documents/2018-12-06_workshop/2018-12-06_demandforecast.php

Incorporating DER in Load Forecast

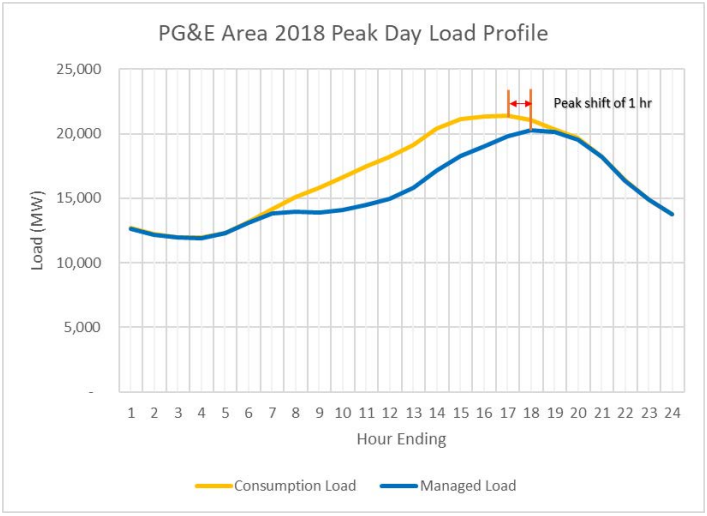
Behind-the-meter PV installed capacity and AAEE peak impact provided by CEC as part of 2017 IEPR. Used in the CAISO 2018-2019 Transmission Planning Process.

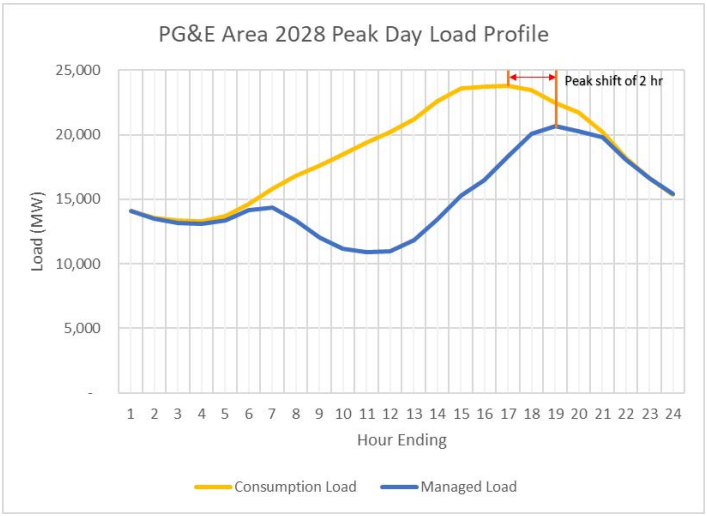
Behind-the-meter PV installed capacity

PTO	Forecast Climate Zone	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
PG&E	Central Coast	232	274	305	337	368	397	425	451	477	501	525	549
	Central Valley	715	862	972	1083	1194	1300	1402	1501	1594	1684	1771	1857
	Greater Bay Area	881	1060	1203	1353	1510	1665	1820	1969	2110	2241	2363	2476
	North Coast	249	289	319	350	382	412	441	467	490	511	528	543
	North Valley	161	189	210	231	251	271	289	306	321	336	349	361
	Southern Valley	854	1024	1153	1279	1403	1520	1634	1744	1851	1957	2063	2169
	PG&E Total	3091	3698	4163	4632	5109	5565	6009	6437	6844	7230	7599	7955
SCE	Big Creek East	224	270	310	350	392	432	473	513	553	593	633	674
	Big Creek West	150	174	193	213	234	254	273	292	309	325	340	355
	Eastern	524	625	709	793	878	961	1044	1126	1208	1291	1376	1466
	LA Metro	867	1043	1196	1362	1543	1728	1915	2100	2276	2439	2588	2724
	Northeast	366	431	485	541	601	660	720	779	835	889	939	987
	SCE Total	2131	2542	2892	3259	3647	4035	4426	4810	5182	5537	5877	6206
SDG&	SDGE	797	905	1010	1108	1198	1277	1349	1417	1482	1545	1608	1673
	CAISO Total	6019	7145	8065	8999	9955	10876	11784	12664	13507	14312	15084	15834

AAEE peak impact

Year	PG&E		SCE		SDG&E	
	Mid-Low	Mid-Mid	Mid-Low	Mid-Mid	Mid-Low	Mid-Mid
2019	-	-	-	-	-	-
2020	66	75	63	72	11	13
2021	131	150	127	146	23	26
2022	197	226	193	221	34	39
2023	263	301	258	295	46	53
2024	329	376	324	370	58	66
2025	395	452	390	445	70	80
2026	462	528	456	521	82	93
2027	528	603	520	595	93	107
2028	592	677	585	669	105	120





Link to CAISO 2018-2019 TPP Study Plan: http://www.caiso.com/Documents/Final2018-2019StudyPlan.pdf

Incorporating DER in Study Scenario Development

Different baseline and sensitivity scenarios are selected that represent seasons and hours with different levels of DER contribution.

Baseline scenarios and DER contributions

Scenario	Day/Time			BTM-PV			AAEE			Driver
	2020	2023	2028	2020	2023	2028	2020	2023	2028	
Summer Peak	8/10 HE 18	8/14 HE 19	8/14 HE 19	18%	3%	3%	90%	81%	76%	Hour of maximum managed load
Spring Off Peak	4/5 HE 12	4/6 HE 13	4/16 HE 13	79%	84%	85%	58%	56%	49%	Hour of minimum managed load
Winter Off peak			2/13 HE 4			0%			28%	Hour of minimum consumption
Winter peak	10/15 HE 19	10/3 HE 18	10/3 HE 19	0%	1%	0%	77%	76%	72%	Hour of maximum managed load in winter

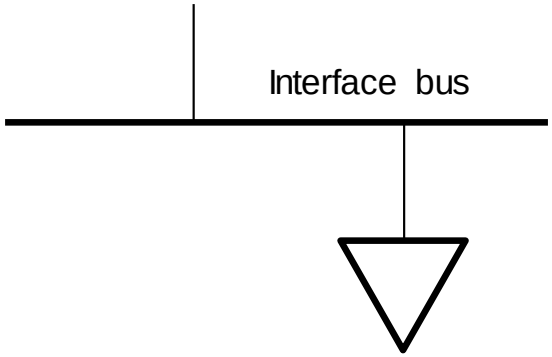
Sensitivity scenarios and DER contributions

Scenario	Starting Baseline Case	BTM-PV		AAEE	
		Baseline	Sensitivity	Baseline	Sensitivity
Summer Peak with high CEC forecasted load	2023 Summer Peak	3%	3%	81%	0%
Off peak with heavy renewable output and minimum gas generation commitment	2023 Offpeak	84%	99%	56%	56%
Summer Peak with heavy renewable output and minimum gas generation commitment	2020 Summer Peak	18%	99%	81%	81%

Link to CAISO 2018-2019 TPP Study Plan: http://www.caiso.com/Documents/Final2018-2019StudyPlan.pdf

Behind-The-Meter PV (BTM-PV) Modeling –
PSLF Power Flow Base Case for Steady State Study

- Aggregated amounts of BTM-PV modeled at each bus by specifying the P and Q values of the PV as separate entries in the power flow load data, including the following values:
  - Pdg - MW output of distributed generation
  - Qdg - MVAr of distributed generation (sign convention same as generators)
  - Stdg - DG status
  - DGmax – Installed capacity of distributed generation



Load = Gross load
(Load before PV)

Distributed Generation PV Modeling –
For Transient Stability Study

Composite load model with DG (CMPLDWG) with DER_A