WHITE PAPER

California—the Coming Retirement Wave and the Return of Capacity Pricing

By Adil C. Sener

Executive Summary

- *Resource adequacy (capacity) prices at current levels are likely to result in mass retirements in the mid term. Much of the existing dispatchable capacity is being paid too little for reliable performance.*
- *California is engaging in numerous unprecedented experiments simultaneously—ambitious demand side management programs, distributed generation, storage, renewables, especially intermittent renewables, and CO_2 regulations. Investment in existing generation will remain a contrarian play for the next five years. The contrarian play arises in part because changes in capacity pricing can occur quickly and with little or no warning (as New England capacity markets recently experienced).*
- *ICF International notes that the symptoms of these potential issues could first surface in or around load pockets. Therefore, generation assets strategically located in or around these load pockets might be undervalued.*

Capacity Procurement in California

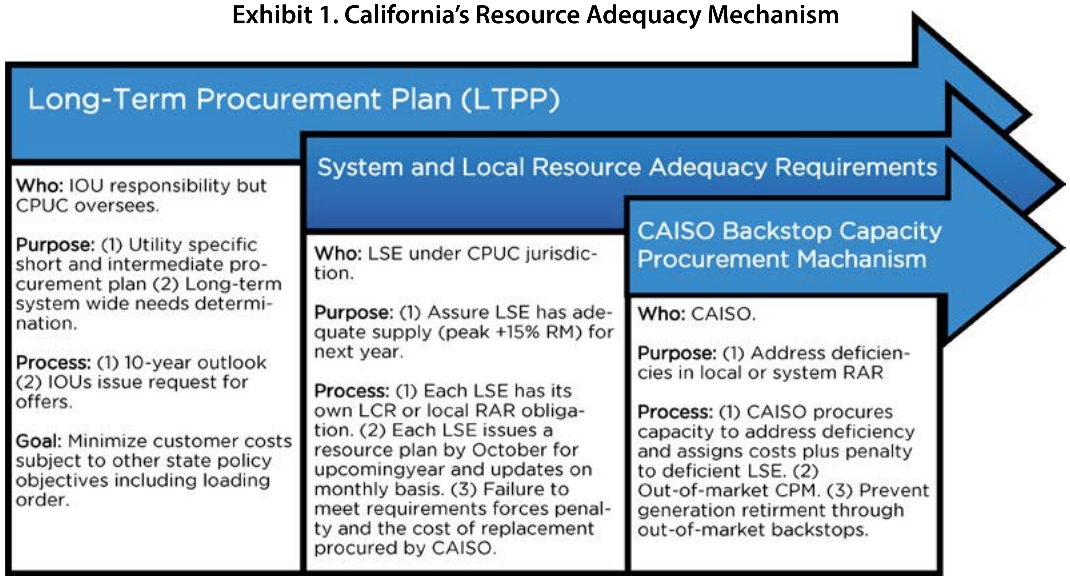
California relies on three key resource adequacy procurement mechanisms: the long-term procurement plan (LTPP), local and system resource adequacy requirements (RARs), and the backstop capacity procurement mechanism (CPM) (Exhibit 1). Under the current compensation mechanism, existing and new generation receive different payments. Every two years, the California Public Utility Commission (CPUC) reviews and adopts each investor-owned utility's (IOU) 10-year procurement plan in the LTPP docket. Under LTPP, new resources are contracted for typically 5 to 10 years. The RAR mechanism takes place annually and mandates a 15 percent planning reserve margin requirement on load-serving entities, effectively functioning as a short-term bilateral capacity market. The CPM is a backstop mechanism for procuring capacity in case LTPP and resource adequacy programs fail to meet regional transmission organization (RTO) wide and local reliability needs. In addition to these three mechanisms, approximately 3.5 GW of generation capacity is contracted as qualified facilities (QFs) under the Public Utility Regulatory Policies Act, which receive fixed capacity payments under long-term contracts.

California's power sector is likely to experience a number of resource adequacy-related challenges that may force higher resource adequacy payments in the mid term, despite currently high statewide reserve margins (~25 percent).

- Increasing need for flexible capacity—The state's ambitious renewable targets will require flexible (fast ramp-up and ramp-down) capacity to address renewable power's intermittency issues, thus increasing the need for generation capacity.
- Once–through-cooling (OTC)—Regulations already have pushed roughly 5 GW capacity to retirement; an additional 15 GW remains at risk. In the Los Angeles (LA) Basin and San Diego, where OTC retirements are significant, utilities are trying to replace retiring capacity by using the LTPP mechanism. Southern California Edison (SCE) and San Diego Gas & Electric® (SDG&E) are in the process of procuring approximately 3 GW of new capacity.
- Decreasing energy margins for thermal generation—Increasing penetration of renewables, distributed generation (DG), and demand side management (DSM) are further squeezing energy margins of existing generation. This squeezing further exacerbates the potential for mass retirement of merchant generation capacity.

- Sustained drought—Further extension of drought conditions could limit contributions from hydroelectric plants.
- QF contract expiration—A large portion of the contracted QF capacity consists of relatively small (<50 MW) generators, which in turn requires high-capacity payments for continued operations. Expiration of legacy QF contracts may put some of this capacity at risk of retirement.

Exhibit 1. California's Resource Adequacy Mechanism



Source: California Public Utility Commission (CPUC)

Market Outlook: Slow Demand Growth and Diversifying Supply

The California Independent System Operator's (CAISO's) supply and demand outlook, based on CPUC's LTPP scenario analysis, suggests slow demand growth and less thermal generation capacity in the near future (Exhibit 2).

Exhibit 2. California Supply and Demand Balance (Source: CPUC LTPP Scenario Analysis—Baseline)

	2014	2016	2018	2020	2022	2024
Net Peak Demand	49,444	50,996	52,310	53,725	54,995	56,044
Additional Energy Efficiency (EE)	85	1,083	2,071	2,980	3,945	5,042
Managed Demand Load	49,359	49,913	50,239	50,745	51,049	51,003
Existing generation	51,878	51,878	51,878	51,878	51,878	51,878
Imports[2]	10,350	10,350	10,350	10,350	10,350	10,350
Renewable Portfolio Standard (RPS) Builds[1]	1,255	4,109	4,386	6,099	6,218	6,299
New Thermal Builds[1]	15	329	329	1,529	1,529	1,529
Dispatchable Demand Response[1]	2,116	2,162	2,166	2,171	2,174	2,176
Storage[1]	0	0	228	456	684	913
Retirements[1]	(1,742)	(2,121)	(7,583)	(7,682)	(13,620)	(13,708)
Net Installed Capacity	63,872	66,706	61,754	64,800	59,213	59,437
Reserve Margin	29%	34%	23%	28%	16%	17%

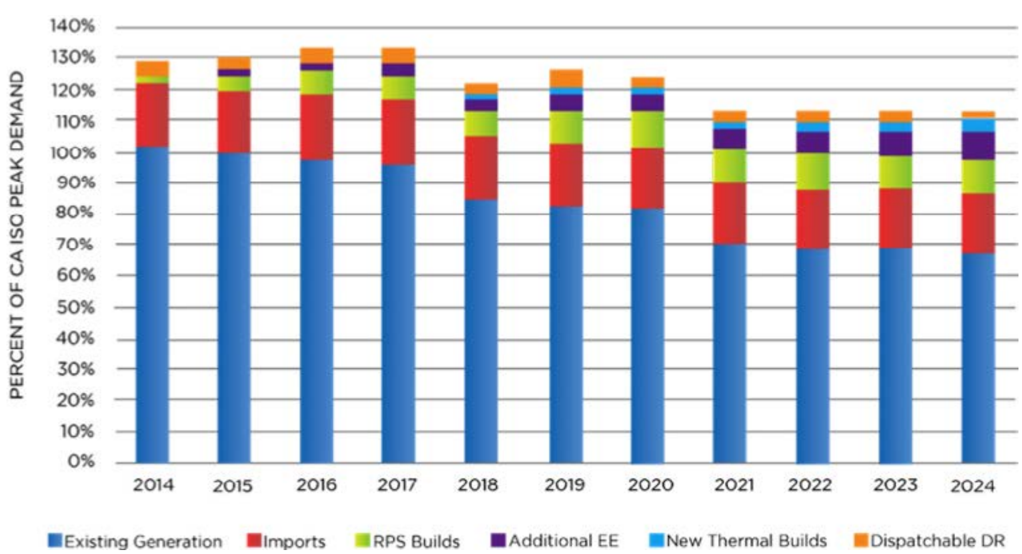
Source: CPUC, 2014. 1. Cumulative. 2. Assumes CEC net interchange of 10,350 MW for imports.

In Exhibit 3, the breakdown of available supply is presented as a percentage of peak demand. We note several key assumptions in this outlook.

1. LTPP scenario planning assumes almost all OTC generation capacity would retire, except for Diablo Canyon. In addition, the LTPP scenario planning assumes approximately 2.0 GW of additional thermal retirements.
2. The amount of imports available to CAISO was assumed to remain constant at 10.3 GW. This level is higher than the 9 GW assumed by the CAISO summer assessment study.
3. Additional EE reaches up to approximately 5.0 GW by 2024, corresponding to roughly 10 percent of the peak demand. During the 2014–2024 period, the following incremental assumptions are included in the Net Peak Demand forecast: 1) approximately 6 GW of committed energy efficiency[1], 2) 1.0 GW of distributed solar, and 3) 0.2 GW of non-solar distributed generation. In sum, approximately 14.5 GW of demand side measures are accounted for in the supply and demand balance, which is approximately 25 percent of the peak demand in 2024.
4. By 2024, approximately 6.0 GW of new renewable resources contribute to resource adequacy. We note this calculation likely assumes 70 to 80 percent capacity contribution from solar resources based on CAISO's resource adequacy listings.

The share of dispatchable generation capacity is expected to decrease continuously in the next decade (Exhibit 3), as California plans to rely more on a mix of DSM and renewable supply for resource adequacy. By 2024, roughly 50 percent of the available capacity in California would come from demand side measures, imports, and renewables. The trend is expected to continue; California Governor Jerry Brown recently proposed a 50 percent renewables target by 2030 and a goal of doubling the energy efficiency of existing buildings. Although this step is significant toward transitioning to an emissions free power industry, any deviation from these targets could result in higher demand for thermal generation.

Exhibit 3. 2014 LTPP Planning Baseline Outlook



1 Committed energy efficiency refers to the savings from already budgeted energy efficiency initiatives.

Once–Through-Cooling Could Lead to 12 GW of Additional Retirements

Overall, our view is that current pricing level does not support investing in existing generation, and the high OTC-related retirement assumption in the LTPP planning is plausible. The baseline LTPP planning assumed approximately 12 GW of additional OTC-related retirements, contradicting owner-proposed schedules for compliance as shown in Exhibit 4. California's State Water Resources Control Board (SWRCB) adopted the "Policy on the Use of Coastal and Estuarine Waters for Power Plant Cooling" in May 2010.

Exhibit 4. Official Owner Proposals for OTC

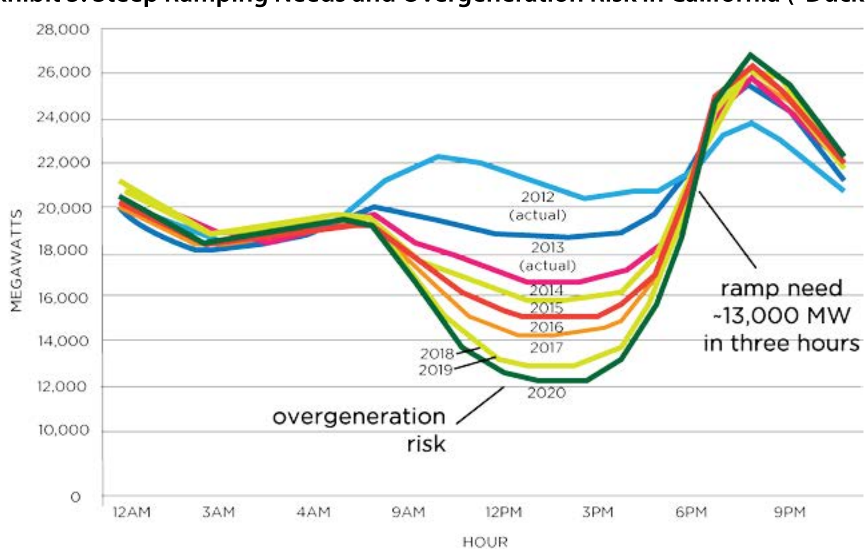
OTC Status	Combined MW
Already retired	4,659
Plans to retire	989
Retrofitted to comply	1,320
Plans to comply and repower by the deadline	12,266
Request pending for delay	1,470
Total	**20,704**

Source: California Energy Commission, Once-Through Cooling Phase-Out; retrieved from http://www.energy.ca.gov/renewables/tracking_progress/documents/once_through_cooling.pdf

Flexible Capacity Procurement Mechanism

California's target of 33 percent renewable generation by 2020 requires significant reliance on flexible supply resources that can ramp up and down in response to the intermittency of renewables. The "duck chart" in Exhibit 5 demonstrates the magnitude of the challenge caused by increased penetration of renewables and their variable average hourly generation profiles. Although alternative resources, such as storage and demand side management are expected to meet some of the demand for flexible resources, gas turbines are expected to remain the primary supplier of flexible capacity.

Exhibit 5. Steep Ramping Needs and Overgeneration Risk in California ("Duck Chart")



Source: CAISO, https://www.caiso.com/Documents/FlexibleResourcesHelpRenewables_FastFacts.pdf

Systemwide flexible capacity needs for 2015 range between 7 GW and 11 GW. CAISO and CPUC have developed[2] flexible capacity requirements for three categories of capacity:

- Category 1: Base Flexibility (must offer from 5 a.m. to 10 p.m. daily, year around)
- Category 2: Peak Flexibility (must offer five hours per day, defined seasonally, with at least one start per day)
- Category 3: Super-Peak Flexibility (must offer five hours per day, defined seasonally, with the obligation complete after five starts per month)

Exhibit 6 provides the supply and demand balance for all three categories in 2015. Note, base resources also could be procured as peak or super-peak resources. Furthermore, peak resources could count as super-peak resources. California, therefore, appears to have sufficient amount of flexibility capacity product; however, retirements may tighten the supply and demand balance further. ICF believes that the flexible capacity framework could ultimately serve as another revenue source for at least some of the existing generation capacity but does not address the overall inadequate capacity pricing for existing generation in California.

Exhibit 6. Flexible Capacity Supply and Demand Balance for 2015

	Flexible Capacity Demand (MW)			Flexible Capacity Supply (MW)		
	Base Flexibility	Peak Flexibility	Super-Peak Flexibility	Base Flexibility	Peak Flexibility	Super-Peak Flexibility
Jan	6,639	1,884	449	30,852	3,223	390
Feb	7,473	2,121	505	30,688	3,210	390
Mar	6,679	1,895	451	30,890	3,223	390
Apr	5,924	1,681	400	31,057	3,271	380
May	4,851	1,926	357	31,254	3,272	360
Jun	5,921	2,351	435	31,450	3,277	340
Jul	5,232	2,077	385	31,327	3,279	330
Aug	5,076	2,015	373	31,129	3,268	330
Sep	5,526	2,194	406	30,934	3,231	340
Oct	7,265	2,062	491	30,851	3,202	360
Nov	7,740	2,197	523	31,023	3,197	380
Dec	8,166	2,317	552	30,835	3,216	390

Source: CAISO, https://www.caiso.com/informed/Pages/StakeholderProcesses/FlexibleCapacityProcurement.aspx

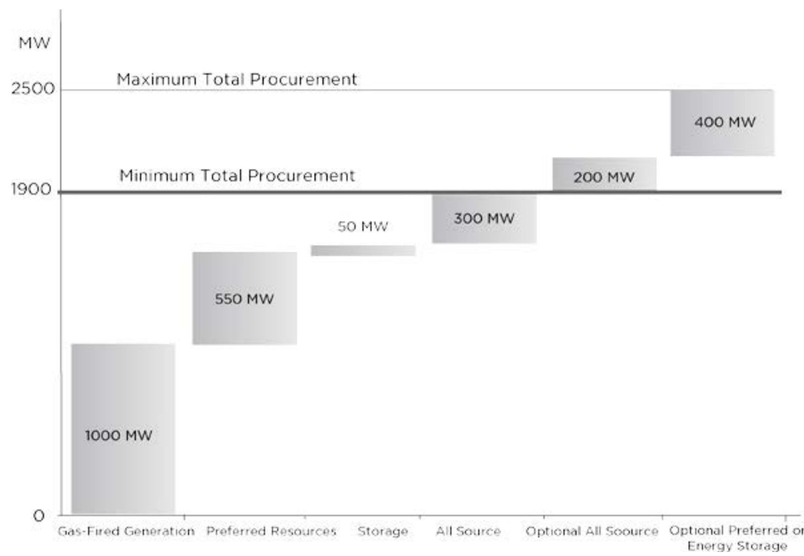
Recent LTPP Procurements—Making Up for Some of the Lost Capacity

In early 2014, CPUC authorized SCE and SDG&E to procure between 2,700 MW and 3,600 MW of capacity under the 2012 LTPP process to compensate for the retirement of the San Onofre nuclear plant and OTC retirements in the LA Basin and San Diego areas. Under CPUC rules, roughly 20 to 25 percent of the procurement target must be met by the preferred resources (energy efficiency, demand response, renewables, and distributed generation). In addition, CPUC capped the amount of natural gas-fired

2 CPUC defines the Flexible Capacity framework in the Local and Flexible Resource Adequacy (RA) Compliance Filings guide for 2015. The still-evolving framework is complex and introduces yet another dimension to California's complex resource adequacy compensation structure. The principal platform for procurement of flexible capacity will be the RA market where resource owners can sell different combinations of their capacity as either a standard or flexible capacity product.

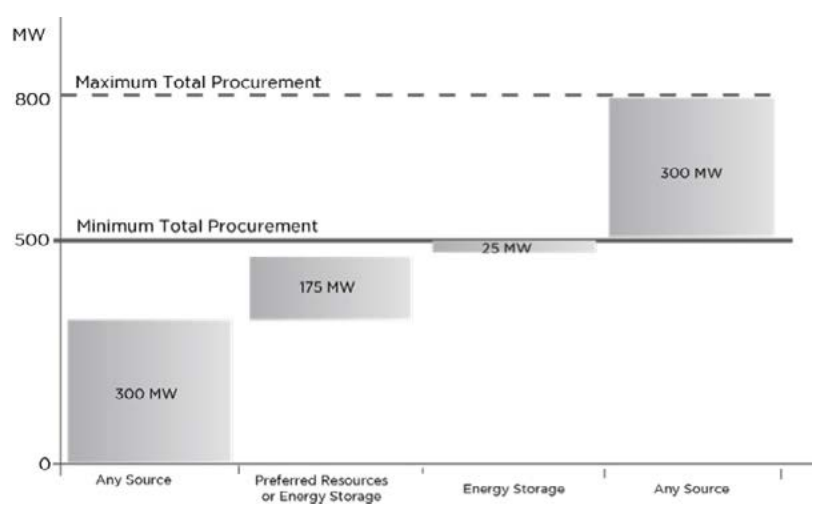
generation capacity at 1,500, therefore guaranteeing that the total amount of preferred resources procured would be more than 550 MW. The breakdown of SCE's and SDG&E's long-term procurement plans are presented in Exhibits 7 and 8. In November 2014, SCE filed for approval of the results of the procurement process for Western Los Angeles Basin. In its application, SCE requests approval of procurement of 500 MW of preferred resources (DSM, storage, and renewables) and approximately 1,400 MW thermal generation (from Alamitos, Huntington Beach, and the Stanton Reliability Center).

Exhibit 7. Breakdown of SCE's Capacity Procurement Targets for LTPP 2012



Source: CPUC.

Exhibit 8. Breakdown of SDG&E's Capacity Procurement Targets for LTPP 2012



Source: CPUC.

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Resource Adequacy Program Pricing Does Not Justify Investment in Reliability

As discussed earlier, the RAR mechanism creates a bilateral capacity market for existing units. Exhibit 9 shows the ranges of RA contract prices, which vary significantly. For example, CAISO System Northern California prices range from \$16/kW-mo to \$0.10/kW-mo with an average of \$2.7/kW-mo. RA payments are significantly below LTPP payments, ranging between \$10/kW-mo and \$25/kW-mo. A significant portion of generators are only able to secure these monthly contracts for peak periods (three to five months). These payments are not sufficient for many generators to keep up with fixed operating expenses. Consequently, plant operators opt to minimize maintenance expenses, an action likely to result in higher forced outage rates and reliability issues.

Exhibit 9. Aggregated RA Contract Prices, 2012–2016

	All RA Capacity			Local RA Capacity			CAISO System RA Capacity		
	Total	NP-26	SP-26	Subtotal	NP-26	SP-26	Subtotal	NP-26	SP-26
Weighted Average Price (\$/kW-month)	\$ 3.28	\$ 2.74	\$ 3.57	\$ 3.45	\$ 2.82	\$ 3.55	\$ 2.90	\$ 2.71	\$ 3.68
Average Price (\$/kW-month)	\$ 3.37	\$ 2.87	\$ 3.65	\$ 3.55	\$ 3.26	\$ 3.64	\$ 2.74	\$ 2.41	\$ 3.68
Minimum Price (\$/kW-month)	\$ 0.08	\$ 0.10	\$ 0.08	\$ 0.08	\$ 0.18	\$ 0.08	\$ 0.10	\$ 0.10	\$ 0.14
Maximum Price (\$/kW-month)	\$ 26.54	\$ 23.62	\$ 26.54	\$ 6.54	\$ 23.62	\$ 6.54	\$ 18.99	\$ 15.93	\$ 18.99
85th Percentile (\$/kW-month)	\$ 6.46	\$ 4.00	\$ 9.80	\$ 8.10	\$ 3.92	\$ 9.84	\$ 4.79	\$ 4.20	\$ 8.34
Contracted Capacity (MW)	423,318	144,655	278,663	295,736	41,747	253,989	127,582	102,908	24,674
Percentage of Total Capacity in Data Set	100%	34%	66%	70%	10%	60%	30%	24%	6%
Number of Monthly Values	3,463	1,227	2,236	2,719	677	2,042	744	550	194

Source: CPUC, http://www.cpuc.ca.gov/NR/rdonlyres/94E0D083-C122-4C43-A2D2-B122D7D48DDD/0/2012RAReportFinal.pdf

CAISO Capacity Procurement Mechanism

The CAISO board recently approved a revised CPM procurement mechanism that allows generators to bid competitively without being subject to cost justifications up to a soft cap of \$75.68/kW-yr. The CPM has a one-year horizon for procurement and two-year horizon for facilities designated as "capacity at risk of retirement." Although historically CPM has not played a major role in procuring capacity, it will remain an important emergency tool for CAISO. Its recently increased soft cap will be an important benchmark metric to monitor.

Conclusion

In ICF's view, resource adequacy prices at these current levels (see Exhibit 9) are not sustainable in the long term. Recent developments in New England may be a harbinger of the future for California; i.e. nearly a decade of low-capacity pricing followed by retirements resulting in a sudden spike in capacityprices, which in the case of New England remain strong for the second auction in a row. We note that despite efforts to mitigate volatility, in many markets the nature of capacity payments remain binary. For example, retirement of one or two large generators can shift the region from excess to deficiency, thereby spiking the capacity payments from low levels to near net cost of new entry level.

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Although the consensus indicates that market equilibrium and recovery of capacity pricing will not occur until after 2020, ongoing developments may drive an earlier market recovery. Imports are expected to contribute 20 percent of peak demand in the next decade, exposing the market to volatility around import levels and dynamics in neighboring markets. For example, a 10 percent decrease in the amount of available imports would result in a 2 percent decrease in California reserve margin capacity. Similarly, any decrease to the solar reserve margin contribution or additional energy efficiency targets would result in lower reserve margins that could easily accelerate supply and demand equilibrium before 2020. Going forward, we flag the decreasing share of thermal generation in California's supply mix as a potential reliability concern. We expect that existing power plant valuations will increase as the current disconnect between required investments for reliable operation of existing fleet and resource adequacy payments is not sustainable in the mid term.

About the Author

Dr. Sener joined ICF International in 2006. His transactional experience includes acquisition support for potential bidders, largely private equity and independent power producers (IPPs), and sellers of generation assets and portfolios. He provides energy markets advisory services in bankruptcy and restructuring processes, financing and development due diligence support for various IPPs and utilities, litigation and regulatory support to utilities, and advisory support to power companies in contracting and asset optimization for new and existing power plants.

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