OPA Review of LADWP 2022 SLTRP, Issued July 2023

Frederick H. Pickel, Ph.D.
Office of Public Accountability / Ratepayer Advocate
City of Los Angeles
opa@LAcity.org
tel. 213-978-0220

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OPA/RPA Review of LADWP's 2022 Strategic Long-Term Resource Plan (SLTRP)

- The OPA commissioned The Brattle Group to assist in monitoring and developing a review of LADWP's 2022 SLTRP, which was released in July 2023.
  - The following slides are primarily based on the attached Brattle review, which focused on rate impacts.
- The 2022 SLTRP focused on 3 paths to 100% GHG-free power generation by 2035.
  - The California SB100 case of GHG-free retail sales to customers by 2045 is a reference (roughly 90% GHG-free power generation).

Cost, Rates, and Bill Impacts

- The 100% 2035 case with the least cost (Case 1) is $20 billion (net present value) more than the SB100 case (~90% clean by 2045). The SB100 case defines the industry standard in California.
  - Case 1 is $20 billion for the last 10% GHG reduction.
  - The $20 billion difference is about 4x larger than LADWP's FY21/22 budget of $4.9 billion.
  - The impact on rates (average, compounded) for 2022-2035 from:
    - ✓ a modest 4.8% per year for the SB100 case
      - 2.3% above LADWP's rate modeling long-term inflation assumption of 2.5%/yr, to
    - ✓ a larger 7.7% per year for Case 1 or 2, and 8.3% for Case 3
      - 5.2% to 5.8% above LADWP's rate modeling long-term inflation assumption of 2.5%/yr.
  - This means 2035 bills will increase 1.4x to 2.4x for SB100, and 2.1x to 3.5x for Case 1 or 2. Case 3 is up to 3.8x. (See Brattle p. 5.)
- The sustained escalation in Cases 1-3 rates and bills is *not reasonable*.
  - Better goal attainment, at lower cost, is likely achievable.

Don't Over-Focus on Decarbonizing Power Sector

- How does the incremental $20 billion cost of making the last 10% reduction in power sector GHG compare to making investments in other sectors, like transportation or building electrification? The Brattle analysis says $400 to nearly $1000 per metric tonne for Case 1 versus SB100, a factor of at least 10x higher than current valuations of GHG savings.
- There are key common risks for rate impacts from uncertain load forecasts and new technologies. Timing will strongly affect costs.
  - Conservation and residential PV adoption (less load) versus building electrification and EV adoption (more load) have offsetting load and rate impacts, which are difficult to forecast beyond three to four years.
  - Do we want to make large investments earlier in GHG reduction using current technologies?
  - Do we want to make large investments earlier in long duration (seasonal) storage? New technologies now in demonstration stage will mature 2028-2032. California's focus is creating larger scale opportunities for innovation and partnership now.
  - When faced with high technology uncertainty, which directly affects load growth or shrinkage, history tells us we are poor predicters of leading technologies and adoption rates.
- A huge ferment of innovation exists worldwide on GHG reduction technology in all sectors.
  - Before making very large-scale commitments on GHG that crowd-out lower costs for 30 years to come, DWP should regularly assess and step into new technology at lower cost and better efficiency. Publish cost per tonne of carbon reduced in plans.
  - Racing to go 100% GHG free in the power sector means foregoing the benefits of this innovation effort.

*"Plans are Worthless, But Planning is Essential"**

- Stay flexible. Stay agile. Getting to our GHG goals requires:
  - Making core investments in areas that are likely to have the least regrets, like key transmission and distribution opportunities.
  - Partnering to spread the risk of new major projects like transmission projects in new corridors, or long duration/seasonal storage, will reduce transmission stress for goals of 90% to 100% clean after 2030.
  - Adapting to uncertainties in loads, technology adoption, and new technology cost and performance. The pace of change is very hard to predict beyond even 2028.
  - Thinking more "out of the box" on opportunities as well as risks.
- LADWP is doing well through its evolving, annual, planning efforts along with existing and potential partnering ventures and industry innovation.

*President Eisenhower cited this Army aphorism, in similar form, multiple times. https://quoteinvestigator.com/2017/11/18/planning/

OPA Conclusions

- LADWP's next big step for GHG reduction is the IPP construction now underway, which will eliminate LADWP's last coal generation by the end of 2025.
  - Remember, LADWP generation was almost 50% coal and 26% oil & gas in the late 1980's and expects to be 0% coal by the end of 2025, with GHG dropping from 17.9 in 1990 to 2 to 4 million metric tonnes per year after 2025.
  - LADWP, from 2013 to 2018, reduced the expected GHG incremental cost of coal elimination from over $100 to under $50 per metric tonne.

- Between 2025 and 2030, LADWP's system needs to be strengthened to manage:
  - Ever higher levels of clean resources,
  - Evolving levels of electricity use and utility sales, and
  - Avoiding early, large-scale investments in GHG reducing or storage technologies whose costs may drop, and performance may improve after 2030.
  - Moving too fast can accelerate and increase rate impacts, which would result in rate impacts that are *not reasonable*.

- The most important keys to success are largely outside LADWP's control, in transportation and building electrification. Substantial GHG savings are possible for GHG reduction investments below $50 per metric tonne.

Review of the LADWP 2022 Strategic Long-Term Resource Plan

PRESENTED BY

T. Bruce Tsuchida

Sylvia Tang

PRESENTED TO

City of Los Angeles
Office of Public Accountability / Ratepayer Advocate

APRIL 10, 2024

Brattle

Disclaimer

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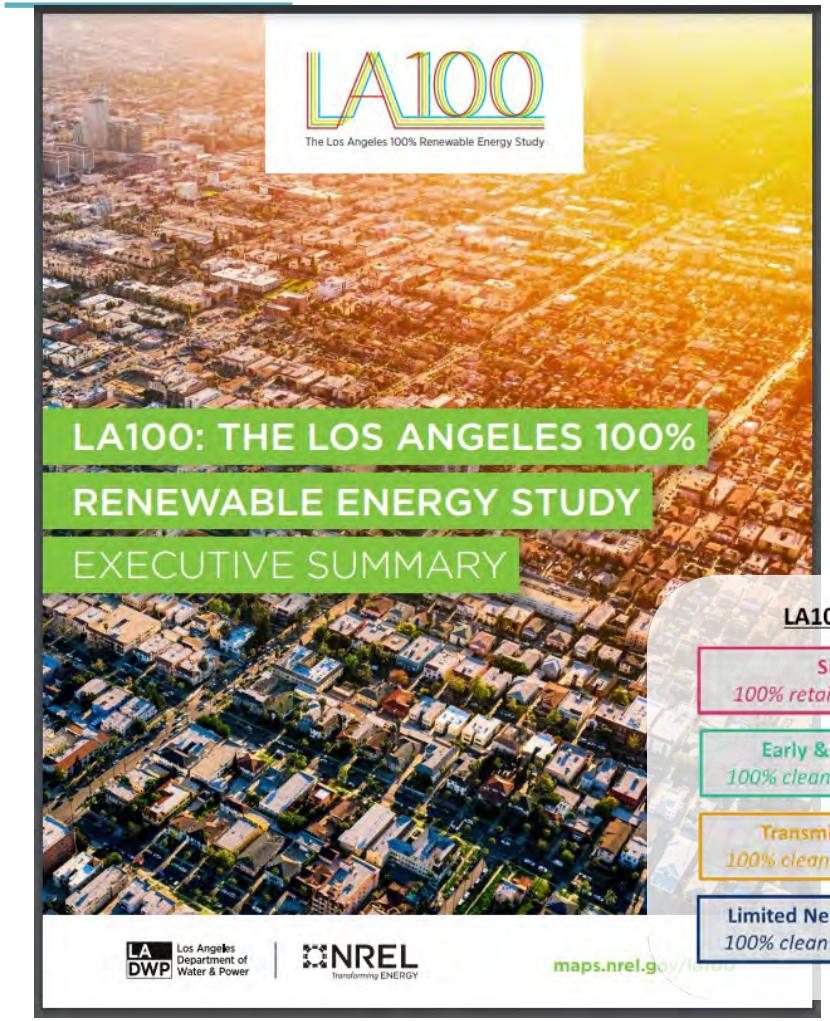
- The analyses that we provide here are necessarily based on assumptions with respect to conditions that may exist or events that may occur in the future. Brattle and OPA/RPA are aware that there is no guarantee that the assumptions and methodologies used will prove to be correct or that the forecasts will match actual results of operations. Our analysis, and the assumptions used, are also dependent upon future events that are not within our control or the control of any other person, and do not account for certain regulatory uncertainties. Actual future results may differ, perhaps materially, from those indicated. Brattle does not make, nor intends to make, nor should anyone infer, any representation with respect to the likelihood of any future outcome, can not, and does not, accept liability for losses suffered, whether direct or consequential, arising out of any reliance on our analysis. While the analysis that Brattle is providing may assist OPA/RPA and others in rendering informed views of how LA can advance towards a 100% clean energy system, it is not meant to be a substitute for the exercise of their own business judgments.

Table of Contents

2022 Strategic Long-Term Resource Plan (SLTRP)

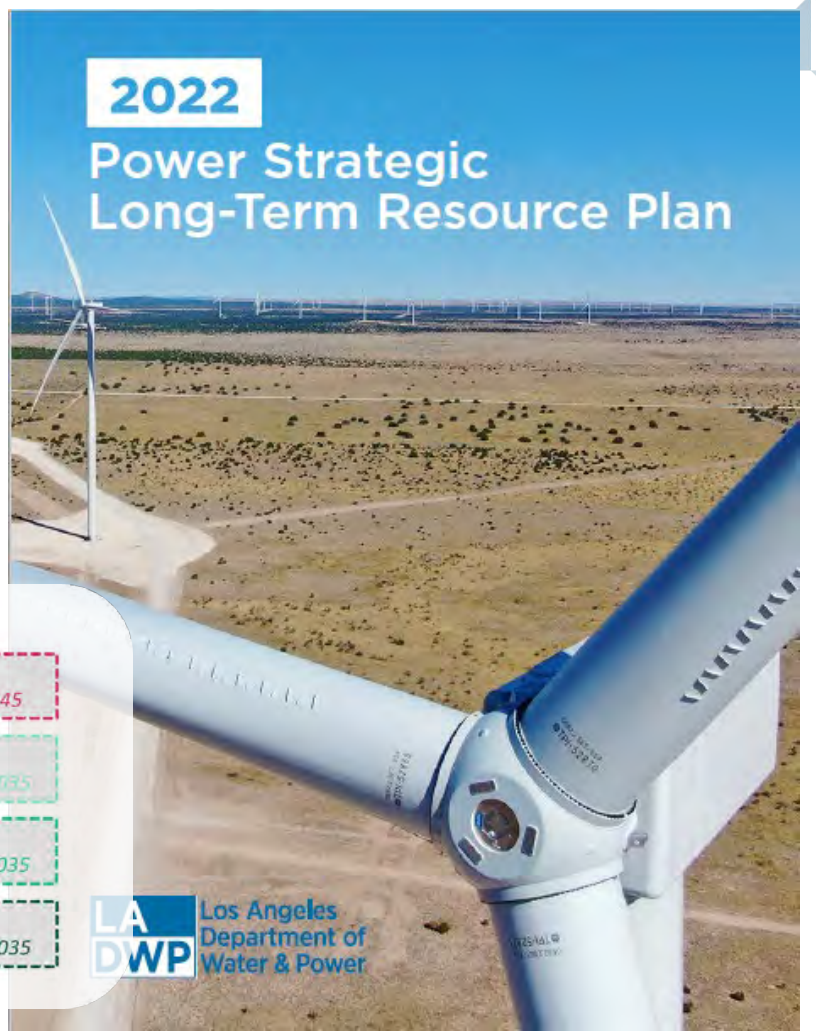


LA100 Study

- SB 100 — *100% retail sales by 2045*
- Early & No Biofuels — *100% clean energy by 2035*
- Transmission Focus — *100% clean energy by 2045*
- Limited New Transmission — *100% clean energy by 2035*

2022 SLTRP

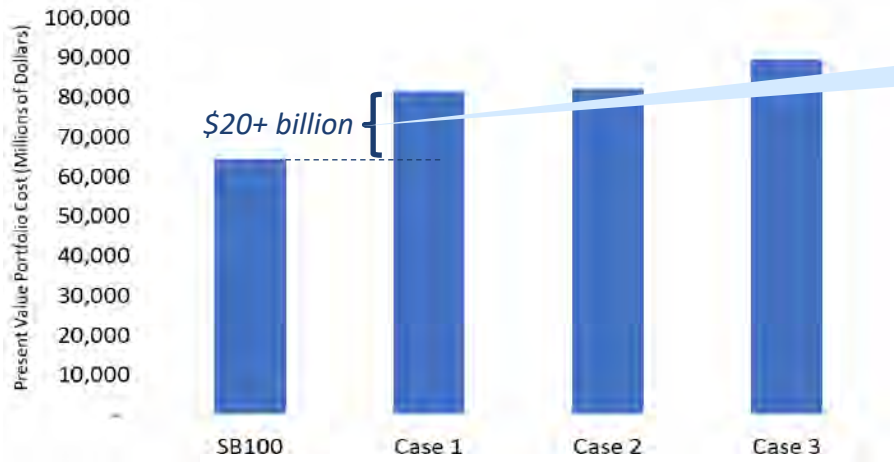
- SB 100 — *100% retail sales by 2045*
- Case 1 — *100% clean energy by 2035*
- Case 2 — *100% clean energy by 2035*
- Case 3 — *100% clean energy by 2035*



Bill Impact Analysis: Sneak Peek

Brattle analyzed rate and bill impacts for the four SLTRP Cases (LADWP recommended Case 1 to the Board).

Net Present Value of Total Costs by SLTRP Case ($ millions)



	SB100	Case 1	Case 2	Case 3
2030 RPS	60%	80%	90%	90%
Clean Energy Penetration 2035	80%	100%	100%	100%
Clean Energy Penetration 2045	90%*1	100%	100%	100%
Average Annual Rate Increase (%)*2	4.8%	7.7%	7.7%	8.3%

$20+ billion is more than 4x of LADWP's Power System fiscal year budget ($4.9 million for FY 2021-22). The average burden per LADWP customer (~1.6 million customers) would be over $12,500.

Estimated Range for Monthly Bill in 2035 (Single Family Home Customers Average)*3,4

Current Bill	2035 Bill Range		
	SB100	Cases 1 & 2	Case 3
$144	$200 – $350	$300 – $500	$300 – $550
Ratio*5	1.4x – 2.4x	2.1x – 3.5x	2.1x – 3.8x

2035 bill estimate range rounded to the nearest $50.

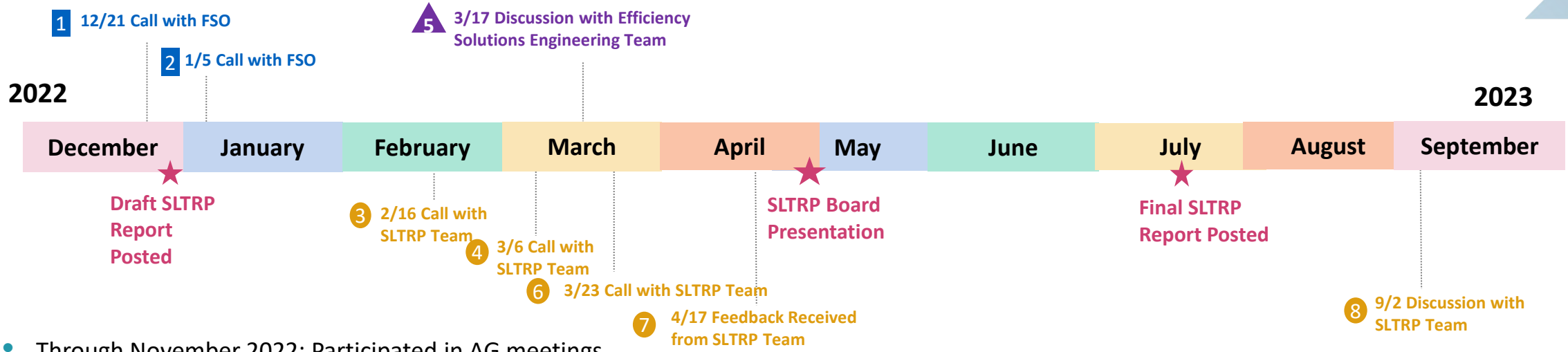
LADWP's GHG emission from power plants today is ~7 MMT. A 10% difference of GHG emission in 2045 is about 0.7 MMT, or 0.2% of the 2020 California economy-wide emission (~370 MMT).

*1: SB100 achieves 100% clean energy by 2045 based on retail sales, or approximately 90% generation.
*2: Compound Annual Rate through 2035.
*3: Range based on four different calculation methods (Methods) for estimating the bill. See appendix for further details.
*4: Single family home customers assumes 700 kWh of monthly consumption.
*5: Ratio = 2035 Bill / Current Bill ($144) and will be the same for Apartment customers (which assumes 300 kWh of monthly consumption).

Source: 2022 Power Strategic Long-term Resource Plan (SLTRP).

The assumed cost and rate/bill impact may warrant further discussion.

OPA/RPA SLTRP Reviews and Discussions



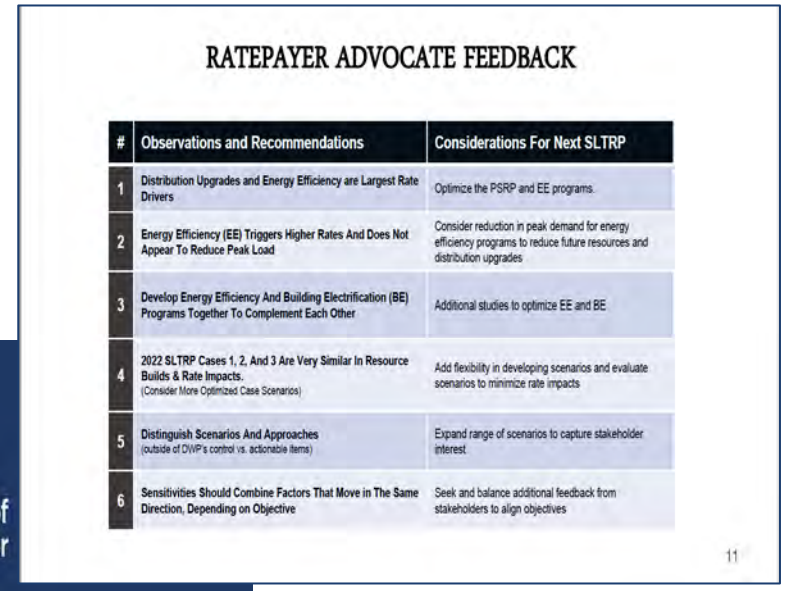
- Through November 2022: Participated in AG meetings.
- December 2022: Reviewed rate analysis performed by the Financial Services Office (FSO) ("Review Summary"). 1
- December 2022 – January 2023: Shared Review Summary with FSO and clarified observations (e.g., different gas prices used). 2
- January 2023: Reviewed draft SLTRP report and updated Review Summary. 3
- February 2023 – March 2023: Shared Review Summary and recommendations for future improvements with SLTRP team. 4
- March 2023: Shared Review Summary with Efficiency Solutions Engineering group to discuss Energy Efficiency specifics. 5
- April 2023: Received feedback from SLTRP team. 6
- April 2023: Confirmed that suggested recommendations for future improvements are aligned with SLTRP team, including the need for better coordination among groups and processes. 7
- May – June 2023: Finalized Review Summary (final SLTRP has not been released yet).
- August 2023: Reviewed Final SLTRP report and shared feedback with SLTRP team.
- September 2023: Discussed feedback with SLTRP team. 8

Key OPA/RPA Recommendations for Future SLTRP

Recommendations for future SLTRP (accepted by SLTRP Team, to be incorporated in the next SLTRP cycle).

- Distinguish Scenarios (Future World*) and Approaches (Actionable Items).
  - Distinction will allow LADWP to decide on actions as the future world reveals itself. Otherwise, its difficult to make good use of insights gained from the SLTRP.
- Clarify purpose and design of Scenarios and Sensitivities.
  - Sensitivities should combine factors that move in the same direction, depending on the objective (including drivers of renewables, carbon emission (or reduction) per MWh, or rate impacts) to see the combined impact (as bookends of probable outcomes).
- Clarify underlying assumptions, their purpose, and model behavior.
  - Range of assumptions could help define bookends of probable outcomes.
- Improve future process and involve LADWP subject matter experts (SMEs) from outside the SLTRP team.
  - For example, SMEs focused on PSRP, or energy efficiency and demand-side resources.

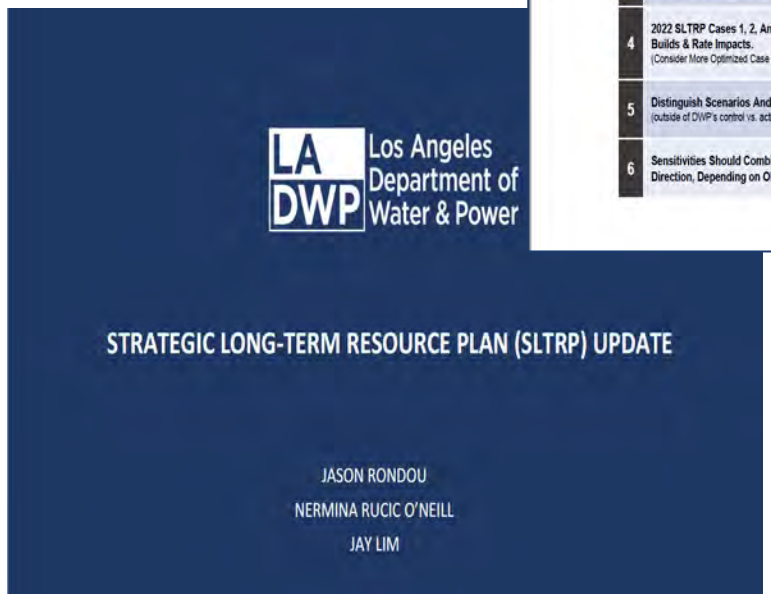
SLTRP Board Presentation Excerpt



RATEPAYER ADVOCATE FEEDBACK

#	Observations and Recommendations	Considerations For Next SLTRP
1	Distribution Upgrades and Energy Efficiency are Largest Rate Drivers	Optimize the PSRP and EE programs.
2	Energy Efficiency (EE) Triggers Higher Rates And Does Not Appear To Reduce Peak Load	Consider reduction in peak demand for energy efficiency programs to reduce future resources and distribution upgrades
3	Develop Energy Efficiency And Building Electrification (BE) Programs Together To Complement Each Other	Additional studies to optimize EE and BE
4	2022 SLTRP Cases 1, 2, And 3 Are Very Similar In Resource Builds & Rate Impacts. (Consider More Optimized Case Scenarios)	Add flexibility in developing scenarios and evaluate scenarios to minimize rate impacts
5	Distinguish Scenarios And Approaches (outside of DWP's control vs. actionable items)	Expand range of scenarios to capture stakeholder interest
6	Sensitivities Should Combine Factors That Move in The Same Direction, Depending on Objective	Seek and balance additional feedback from stakeholders to align objectives

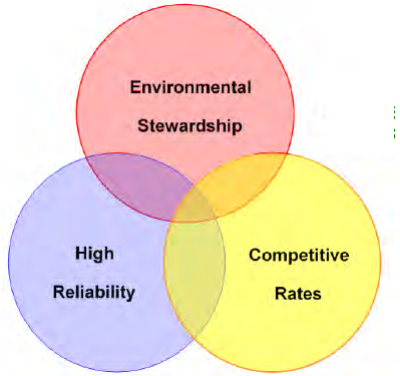
11



*Notes: *The Scenarios ("Future World") is defined as the varying states of the future world that is outside of LADWP's control.*

Four Cases Studied

2022 SLTRP Objectives



The 2022 SLTRP studies four Cases (i.e. SB100, Case 1, Case 2 and Case 3, as shown in the table below).

- SLTRP compares Cases 1, 2, and 3 against SB100 (the baseline case).
- FSO analyzes the rate drivers for each of these four cases.

LADWP recommended Case 1 to the Board

SLTRP Cases

		SB100	Case 1	Case 2	Case 3
Clean Energy Target	Total Renewable Portfolio Standard 2030	60%	80%	90%	90%
	Total Clean Energy Penetration Achieved 2035	80%	100%	100%	100%
	Total Clean Energy Penetration Achieved 2045	90%*1	100%	100%	100%
Distributed Energy Resource (DER)	Local Solar	1,500 MW	2,240 MW	2,240 MW	2,900 MW
	Local Energy Storage	Reference	High*2	High	Highest (Max DERs)
	Energy Efficiency	3,210 GWh	4,350 GWh	4,350 GWh	4,770 GWh
	Demand Response	576 MW	576 MW	576 MW	633 MW
	Building Electrification	Reference	High	High	High
Transmission	New or Upgraded Transmission	Moderate	High	High	High

Notes: **1: SB100 achieves 100% clean energy by 2045 based on retail sales.*
**2: The high level of local energy storage refers to over 1,300 MW in total cumulative storage adoption.*

Estimated Load by Case

Forecast retail load sales vary by Case.

- The variation is largely caused by difference in assumed Local solar and storage, Energy Efficiency (EE), Demand Response (DR) and Building Electrification (BE).
- The variation (up to 9% of the average retail load sales projected for the four Cases) is of similar magnitude to LADWP's variation between recent vintages of load projections, and future projection boundaries (see table and figure below).
- Baseline projection appears to reflect load growth. *(see Appendix C)*

Retail Load Sales Projections by SLTRP Cases (GWh)

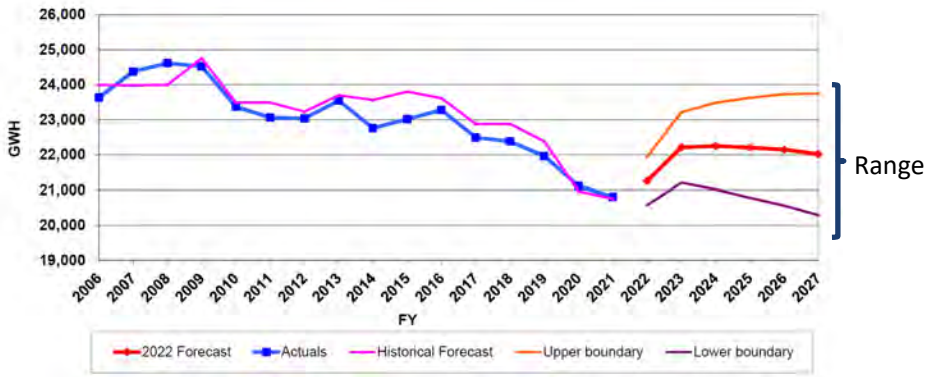
	2022	2025	2030	2035	2040	2045	2050
SB100	21,041	21,376	22,638	24,118	25,896	27,624	29,352
Case 1	21,024	21,245	22,027	23,139	25,107	27,884	30,662
Case 2	21,024	21,245	22,027	23,139	25,107	27,884	30,662
Case 3	21,002	20,714	21,125	21,951	23,780	26,510	29,241
Average	21,023	21,145	21,954	23,087	24,972	27,476	29,979
Max Difference	39	661	1,513	2,167	2,116	1,374	1,420
Max Diff/Avg	0%	3%	7%	9%	8%	5%	5%

LADWP Retail Sales Projection Comparison (GWh)

Projection Comparison	2021	2022	2023	2024	2025	2026	2027
2022 Projection [A]	20,811	21,255	22,211	22,521	22,204	22,147	22,019
2021 Projection [B]	20,754	20,926	20,610	20,671	20,834	20,874	21,017
% Difference [C] = [A] / [B] - 1	0%	2%	8%	9%	7%	6%	5%

Source: LADWP 2022 Retail Electricity Sales and Demand Forecast (Preliminary).

LADWP Retail Sales 2022 Forecast (GWh)

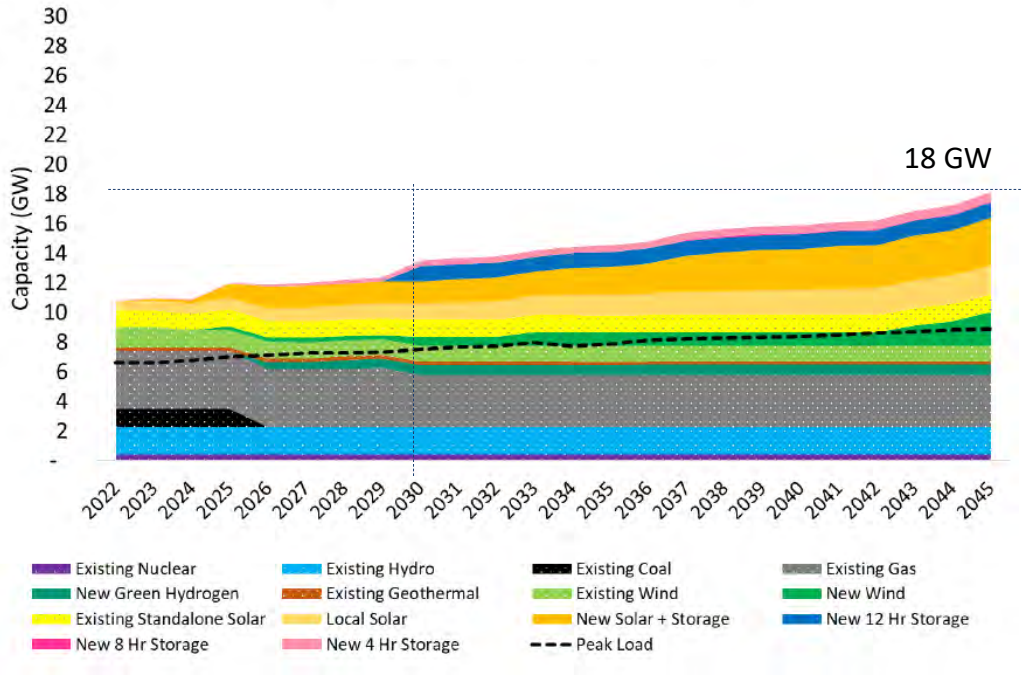


Resource Mix by Case: SB100 and Case 1

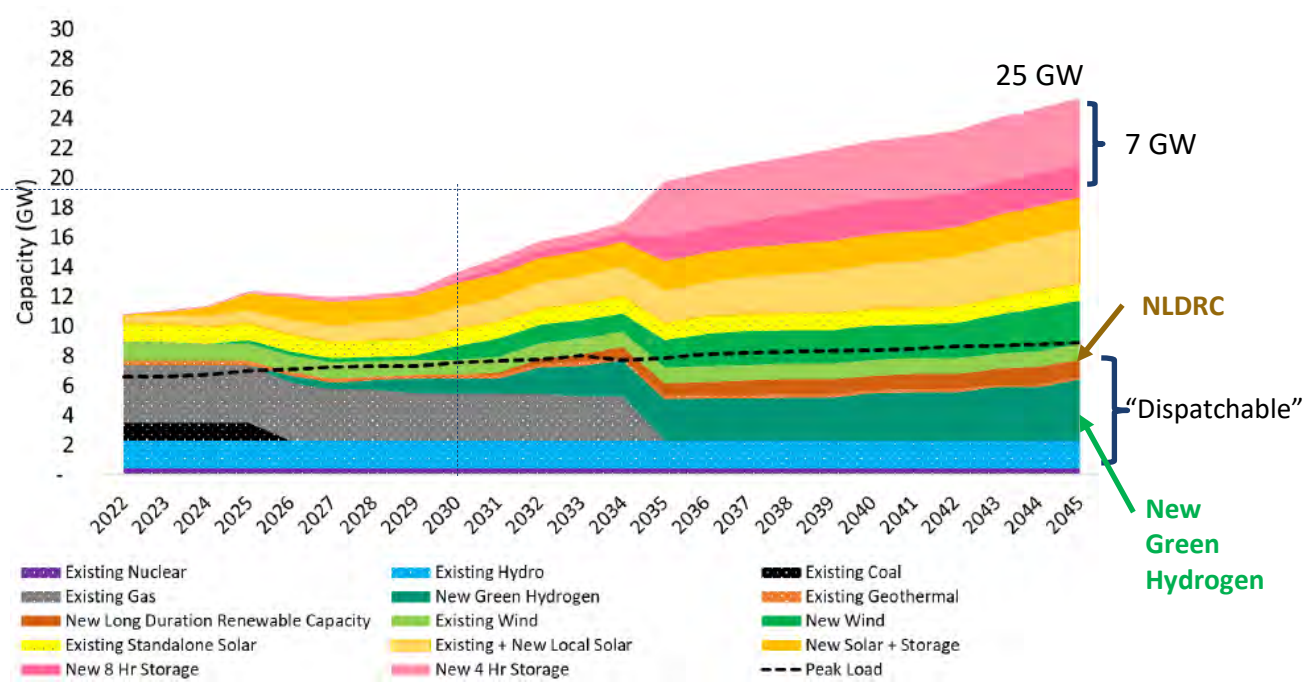
Varying clean energy targets lead to different resource portfolios for each Case.

- 2045 capacity is ~18 GW for SB100 (~90% clean generation) and ~25 GW for Case 1 (100% clean generation).
  This suggests going from 90%* to 100% clean energy generation requires ~7 GW of additional capacity (while maintain similar levels of "dispatchable" capacity).

SB100



Case 1



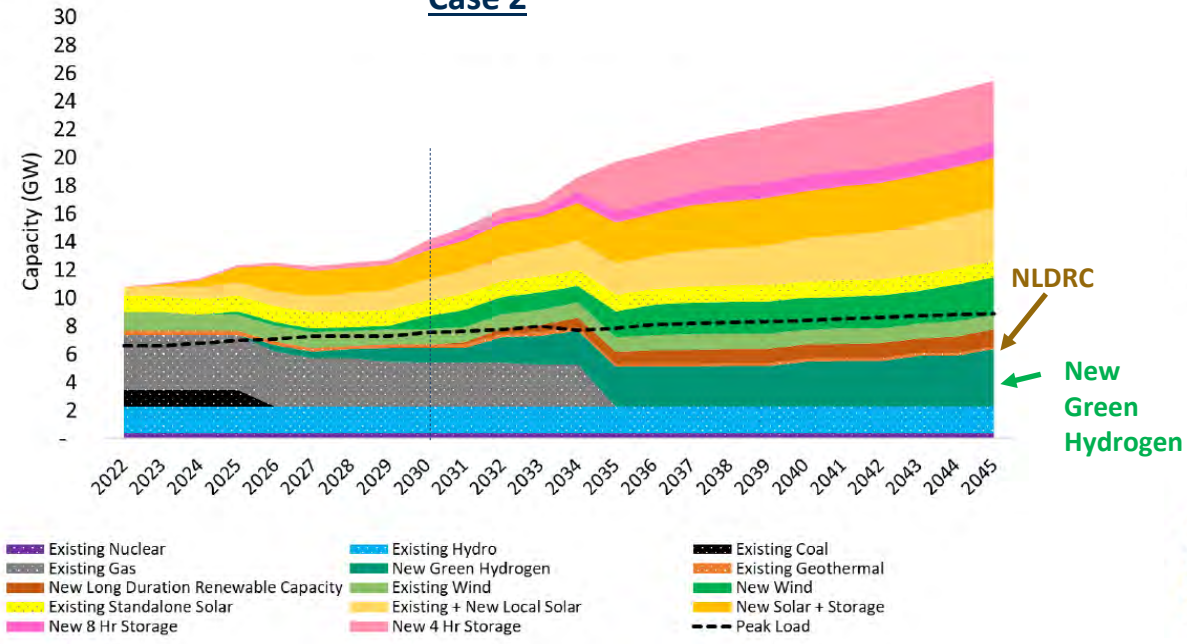
Source: 2022 Power Strategic Long-term Resource Plan (SLTRP). SB100 achieves 100% clean energy by 2045 based on retail sales.

Resource Mix by Case: Case 2 and Case 3

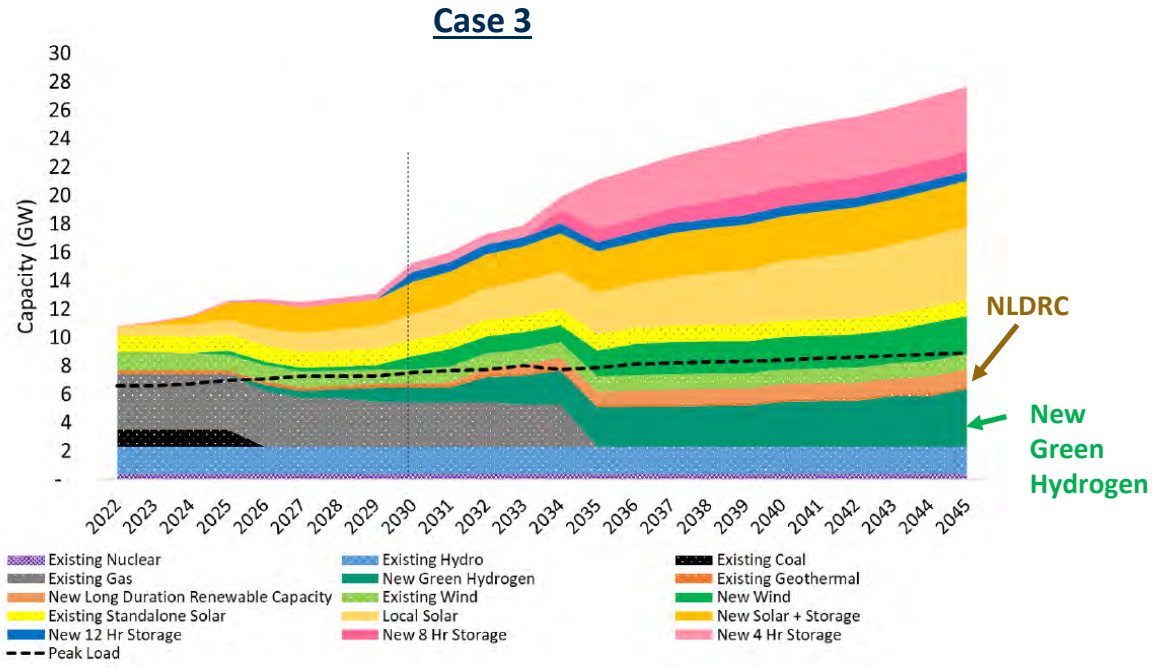
Case 2 and Case 3 have similar buildouts as Case 1.

- Cases 1, 2, and 3 all include New Long Duration Renewable Capacity (NLDRC, *a generic term that encompasses geothermal as well as other renewables that provide a greater effective load carrying capacity such as concentrating solar-thermal power with storage*), indicated by **brown arrows** in figures below and previous slide, that does not appear in SB100.
- Cases 1, 2, and 3 also include **New Green Hydrogen** that effectively replaces existing fossil resources as dispatchable resources.

Case 2

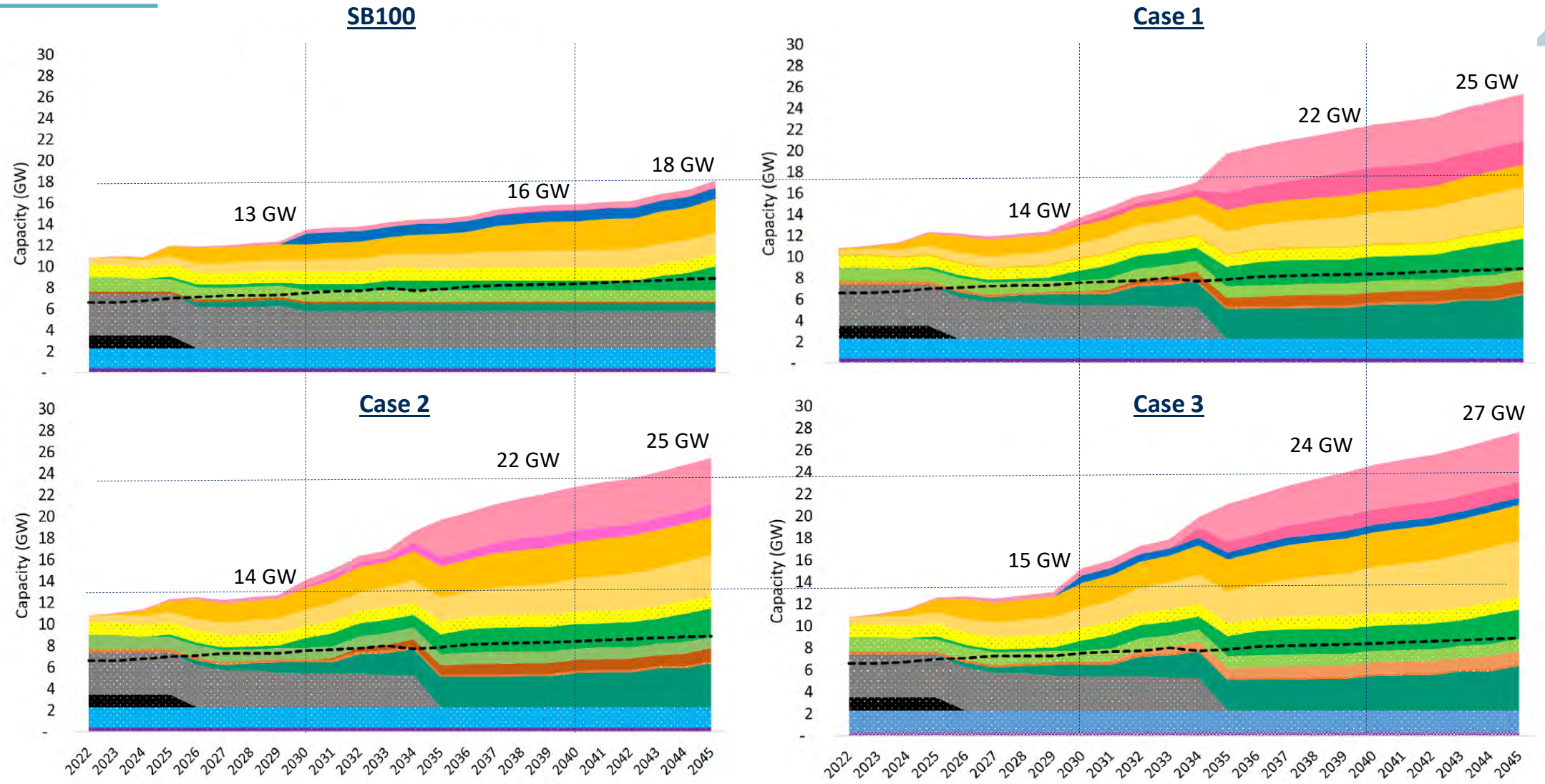


Case 3



Source: 2022 Power Strategic Long-term Resource Plan (SLTRP).

Resource Mix by Case: All Four Cases

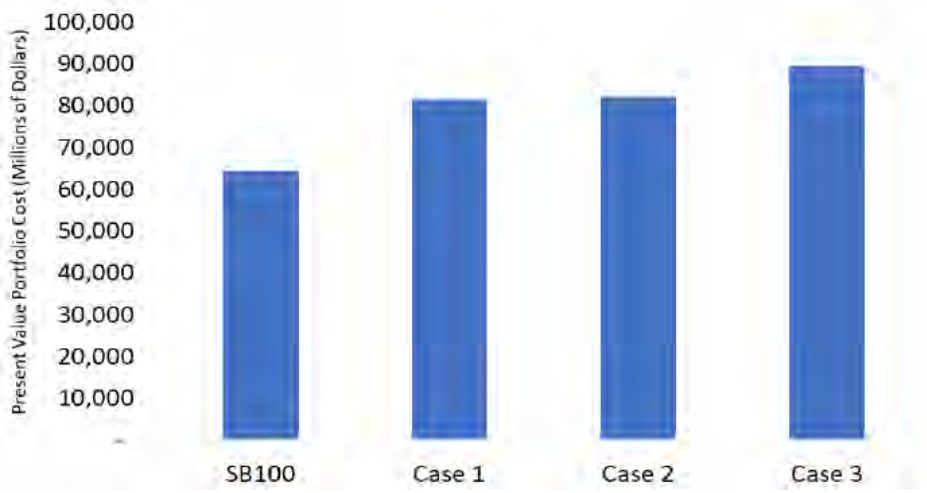


Source: 2022 Power Strategic Long-term Resource Plan (SLTRP).

LADWP Recommendation to Board (Case 1)

- 2022 SLTRP shows three pathways for LADWP to achieve 100% clean energy by 2035. LADWP recommended Case 1 to the Board.
  - Case 1 achieves 80% RPS by 2030 and 100% clean energy by 2035.
  - Case 1 builds over 15,500 MW of clean energy resources (12,823 MW of bulk and 2,694 MW of distributed resources). This indicates ~1,108 MW per year (on average), which is more than 5x of historically (2018-2021) observed build rate of ~200 MW a year.
  - LADWP recognizes the need for firm resources, while expecting to minimize the usage of in-basin green hydrogen resources (such as for providing back-up power during contingencies).
  - The Net Present Value (NPV) of the estimated cost for Case 1 is $80+ billion.* (NPV for Case 2 is higher than Case 1, and NPV for Case 3 is higher than Case 2).
  - By comparison, the NPV estimated for SB 100 is $60 billion.
  - $80+ billion will trigger a rate increase of 7.7% annually (compound average rate increase from 2022 through 2035).
  - Estimated costs (and associated rate increase) will be even higher without successful electrification (transportation and buildings, see slides 15 through 17).

Net Present Value of Total Costs by SLTRP Cases



Source: 2022 Power Strategic Long-term Resource Plan (SLTRP).

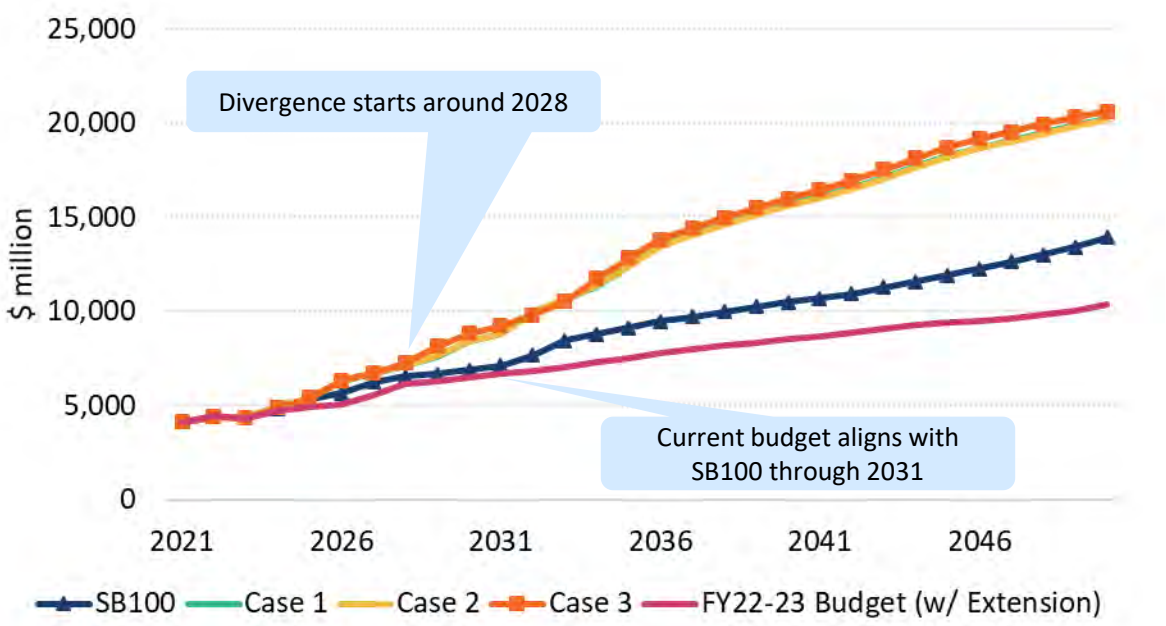
* LADWP assumes a 5.5% discount rate.

Revenue Requirements by Case

Comparing the revenue requirement between Cases:

- Case 3 has the highest revenue requirement while SB100 has the lowest.
- Cases 1 and 2 have similar levels of revenue requirements.
- Revenue requirement for Case 1 is ~1.4x of SB100 in 2035, ~1.5x in 2040, and ~1.3x in 2045.

Revenue Requirements by Case ($ Million)



Summary of Revenue Requirements by Year ($ million)

	2025	2030	2035	2040	2045
SB100	5,338	6,863	9,115	10,479	13,915
Case 1	5,394	8,363	12,418	15,677	18,234
Case 2	5,395	8,392	12,429	15,622	18,178
Case 3	5,415	8,793	12,804	15,983	18,695

Difference between Case 1 and SB100

	2025	2030	2035	2040	2045
Delta	56	1,500	3,303	5,198	4,319
Ratio*	1%	22%	36%	50%	31%

** Ratio = Case 1/SB100 - 1.*

Rate Increase by Decade

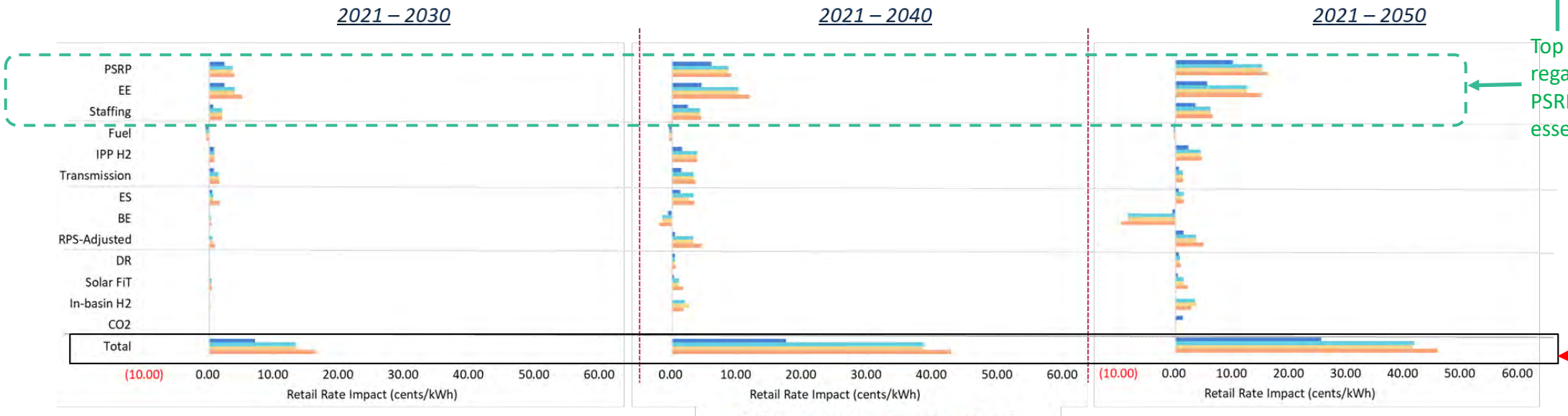
Summary Review started with FSO's analysis of the SLTRP rate drivers.

- SLTRP analyzed four future cases (SB100, Case 1, Case 2 and Case 3).
- FSO analyzed SLTRP's rate impacts by for each of the future cases through 2050 drivers (13 drivers identified, see table to the right).
- FSO's analysis shows rates could almost triple between 2021 and 2045 (from ~20 cents per kWh to ~66 cents per kWh).
- A 3% inflation alone would double the rate between 2021 and 2045 (from ~20 cents per kWh to ~40 cents per kWh).

FSO Rate Drivers

Driver Items as Described in FSO Analysis	Abbreviation
PSRP > FY22-23 Budgeted Level	PSRP
Energy Efficiency	EE
Staffing Requirement	Staffing
Fuel Price Increase	Fuel
IPP hydrogen conversion	IPP H2
Transmission	Transmission
Energy Storage	ES
Building Electrification	BE
RPS (without hydrogen generation and without Energy Storage and with FiT)	RPS-Adjusted
Demand Response	DR
Solar Feed-in-Tariff	Solar FiT
In-basin hydrogen	In-basin H2
CO2 Expense beyond Allocation	CO2

Summary of Rate Impact (2021 – 2050)



Top 3 are the same, regardless of the Cases. PSRP and Staffing are essential needs.

Addition to the current rate of ~20 cents/kWh

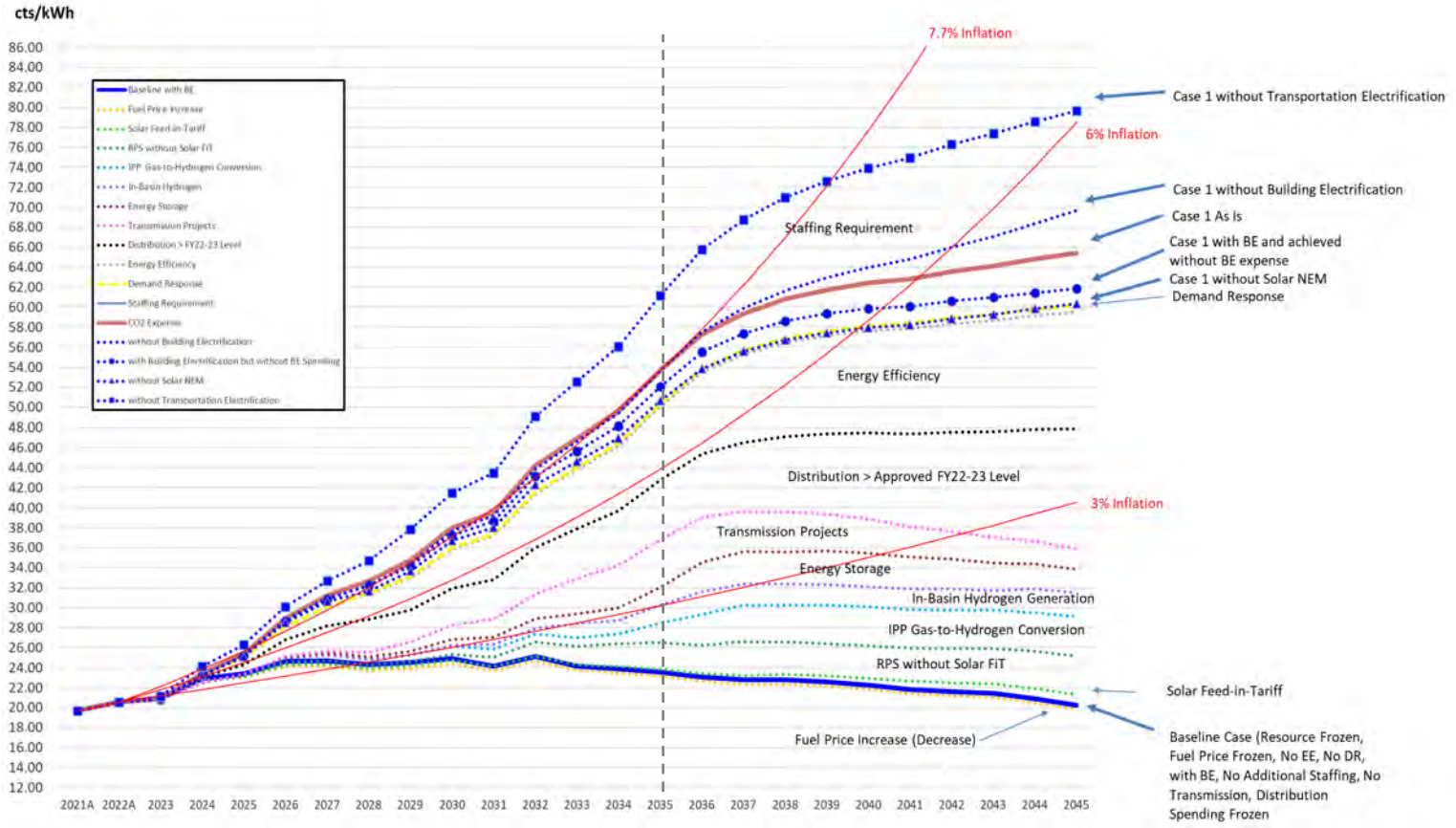
Notes: Offsets from Transportation Electrification are discussed on slides 16 and 17.

Rate Increase (Case 1)

Brattle reviewed FSO's analysis of the SLTRP rate drivers.

- FSO analyzed SLTRP's rate impacts by drivers (13 rate drivers identified) through 2050.
- FSO's analysis shows rates could more than triple between 2021 and 2045 (from ~20 cents per kWh to ~66 cents per kWh).

Major Program FSO Rate Drivers (Case 1)



13 rate drivers

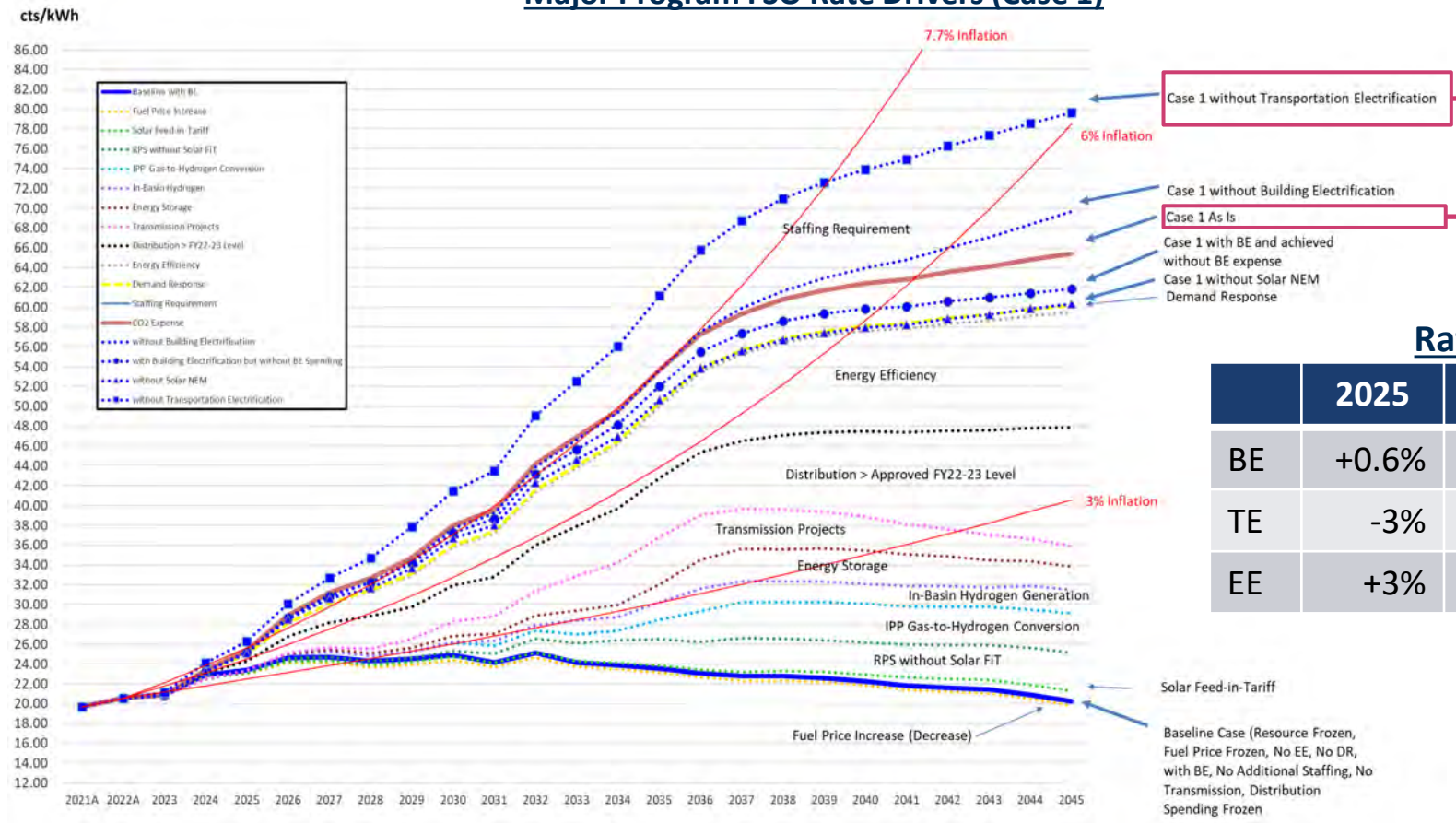
Average Rate Increase % (2022-2035, Compound)	
SB100	4.8%
Case 1	7.7%
Case 2	7.7%
Case 3	8.3%

Impact of Load Electrification and Energy Efficiency

Brattle reviewed FSO's analysis of the SLTRP rate drivers.

- Electrification of transportation (TE) and buildings (BE) decreases rates by increasing the divisor. *(see Appendix B)*
- EE increases rates by reducing the divisor. *(see Appendix B)*

Major Program FSO Rate Drivers (Case 1)



Rate Impact (% Change)

	2025	2030	2035	2040	2045
BE	+0.6%	+0.8%	+0.04%	-2.4%	-6%
TE	-3%	-8%	-12%	-16%	-18%
EE	+3%	+11%	+16%	+18%	+19%

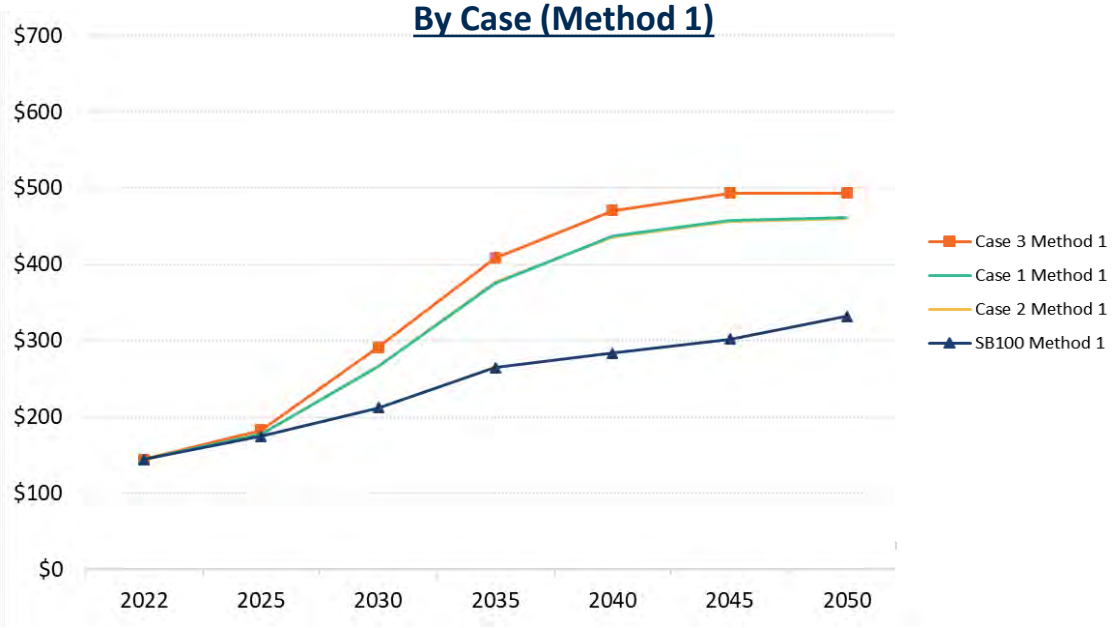
Single Family Home - 1/2

Brattle developed four calculation methods (Methods) per SLTRP Case for monthly bill impact analysis (see appendix).

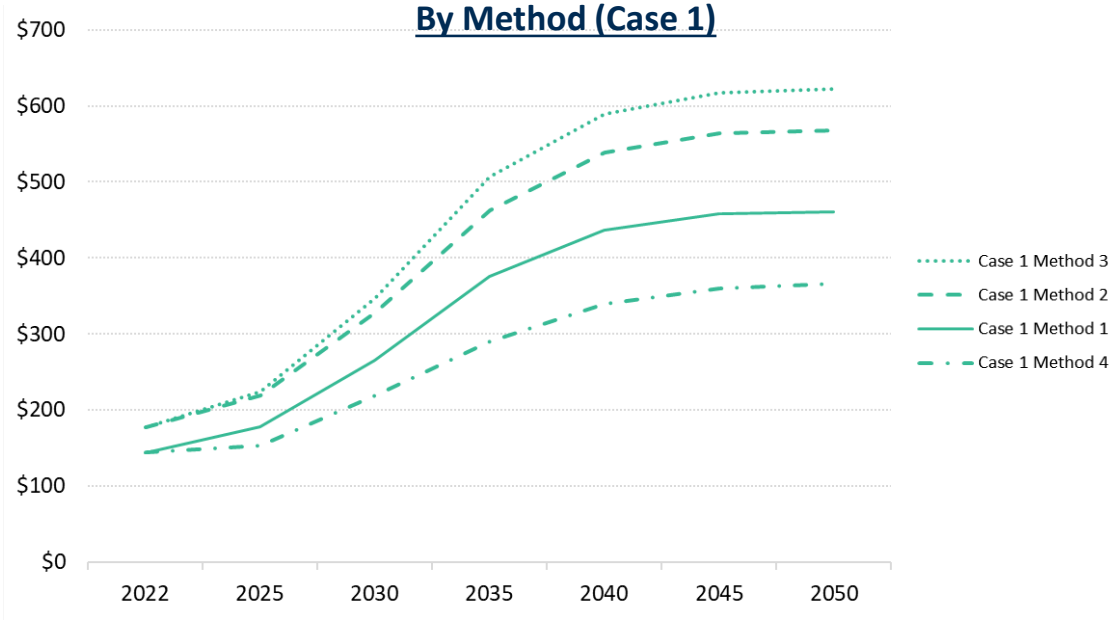
- Within a Method (for all four Methods):
  - Case 3 leads to the highest bill while SB100 has the lowest.
  - Bills for Cases 1 and 2 are higher than SB100 by ~40% in 2035 and by over 50% in 2045.
- Within a Case (for all four Cases), Method 3 leads to the highest bill while Method 4 shows the lowest.

Monthly Bill Estimates for Single Family Home Customers

By Case (Method 1)



By Method (Case 1)

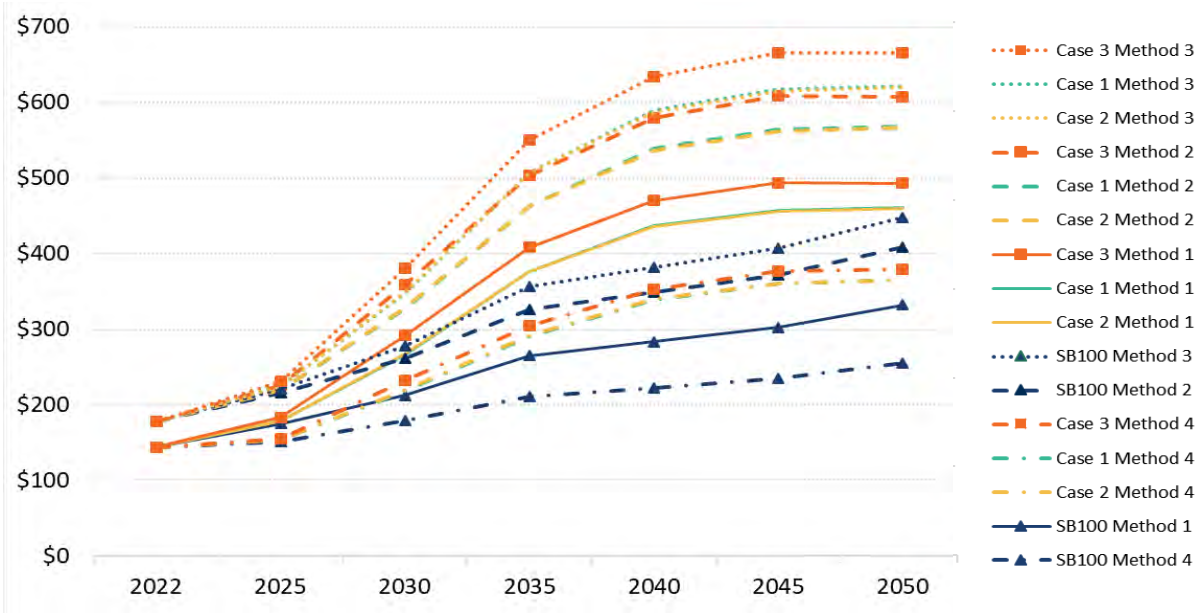


Notes: Single family home customers are assumed to consume 700 kWh per month.

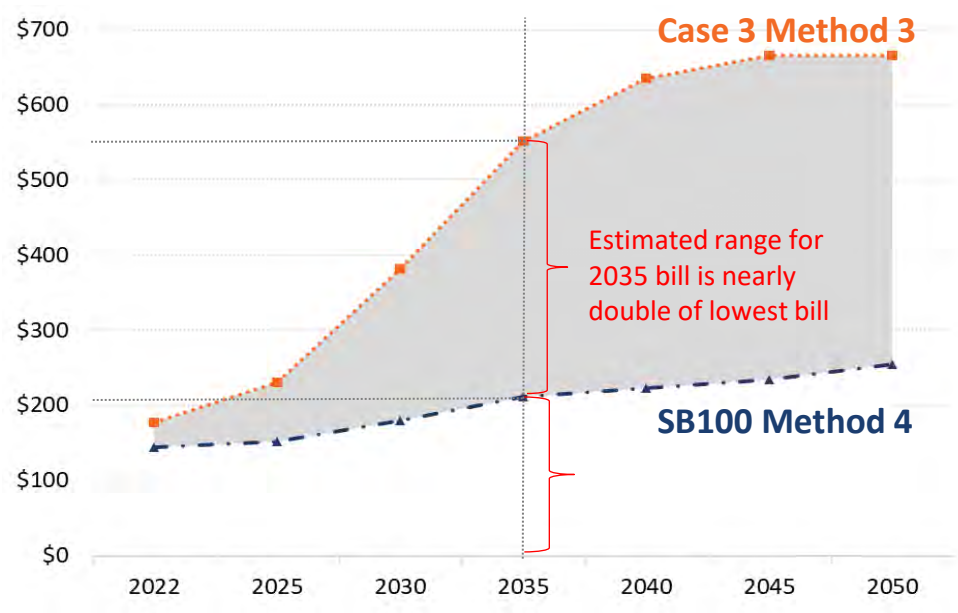
Single Family Home - 2/2

- Monthly bills by Case and by Method have a wide uncertainty band.
  - Case 3 Method 3 leads to the highest bill while SB100 Method 4 has the lowest.
- The uncertainty band (grey area) is larger than the actual bill.

Monthly Bill Estimates for Single Family Home Customers (All Methods and Cases)



Monthly Bill Estimates for Single Family Home Customers (Range)



Notes: Single family home customers are assumed to consume 700 kWh per month.

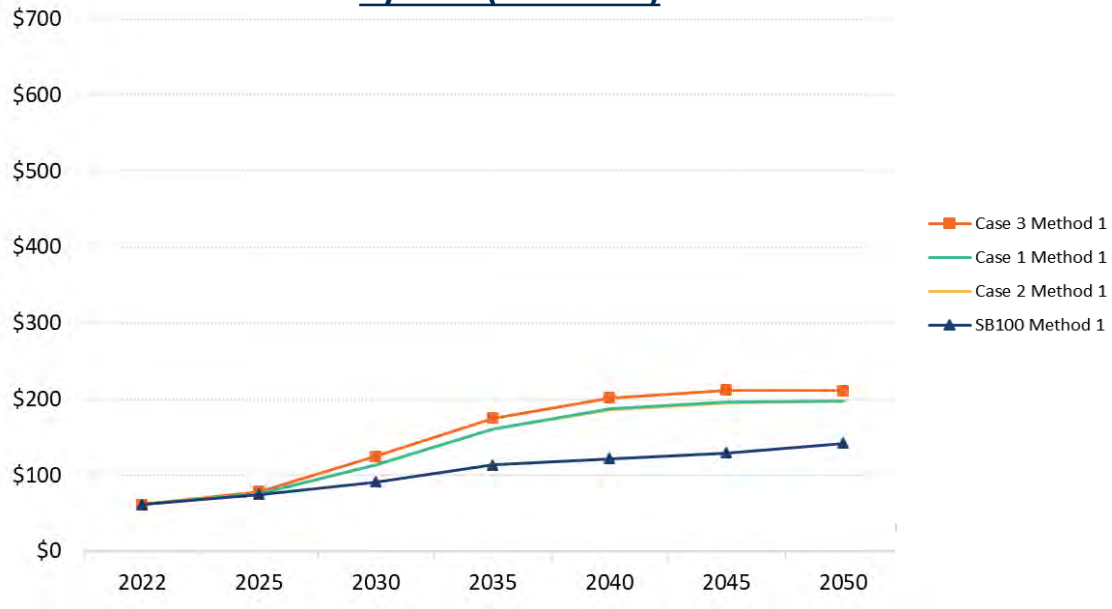
Apartments - 1/2

Patterns observed for apartment customers are the same as those observed for single family home customers:

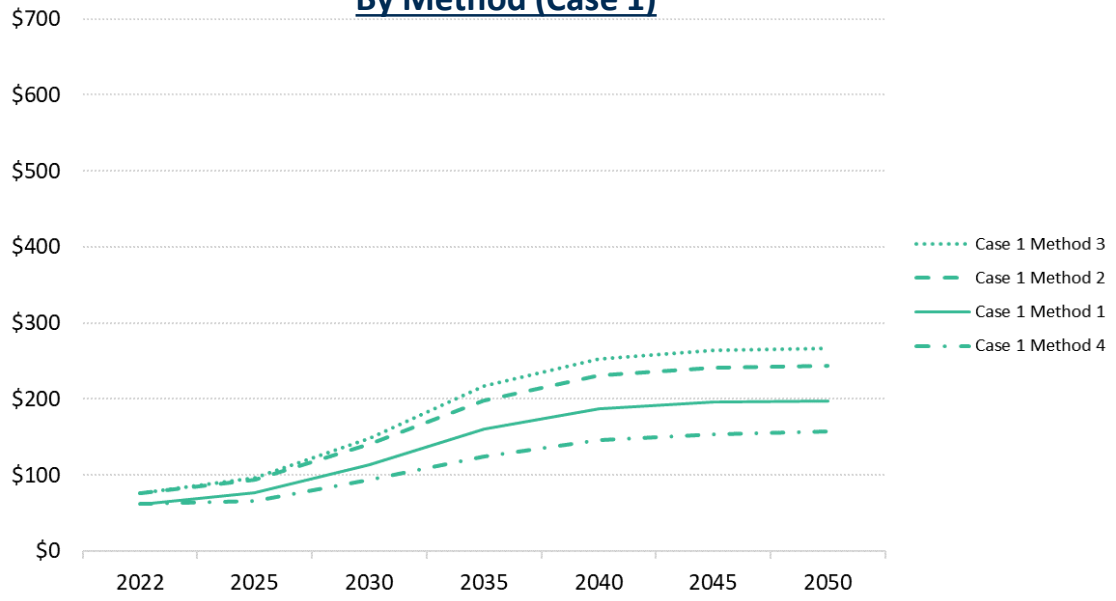
- Within a Method (for all four Methods):
  - Case 3 leads to the highest bill while SB100 has the lowest.
  - Case 1 bills are higher than SB100 bills by ~ 40% in 2035 and by over 50% in 2045.
- Within a Case (for all four Cases), Method 3 leads to the highest bill while Method 4 has the lowest.

Monthly Bill Estimates for Apartment Customers

By Case (Method 1)



By Method (Case 1)

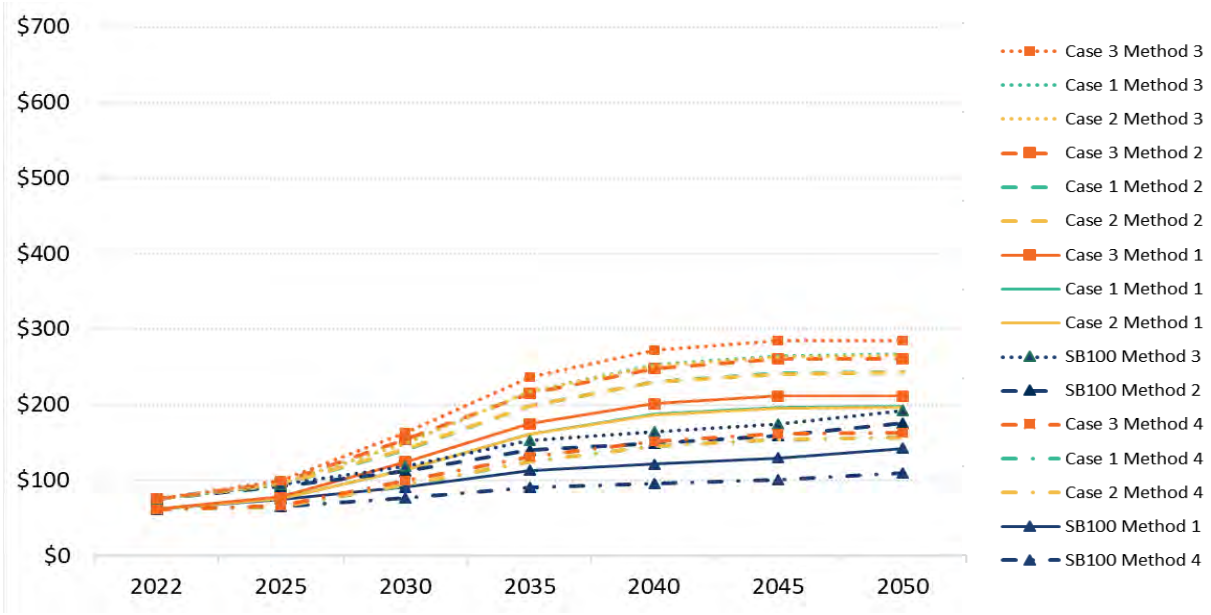


Notes: Apartment customers are assumed to consume 300 kWh per month.

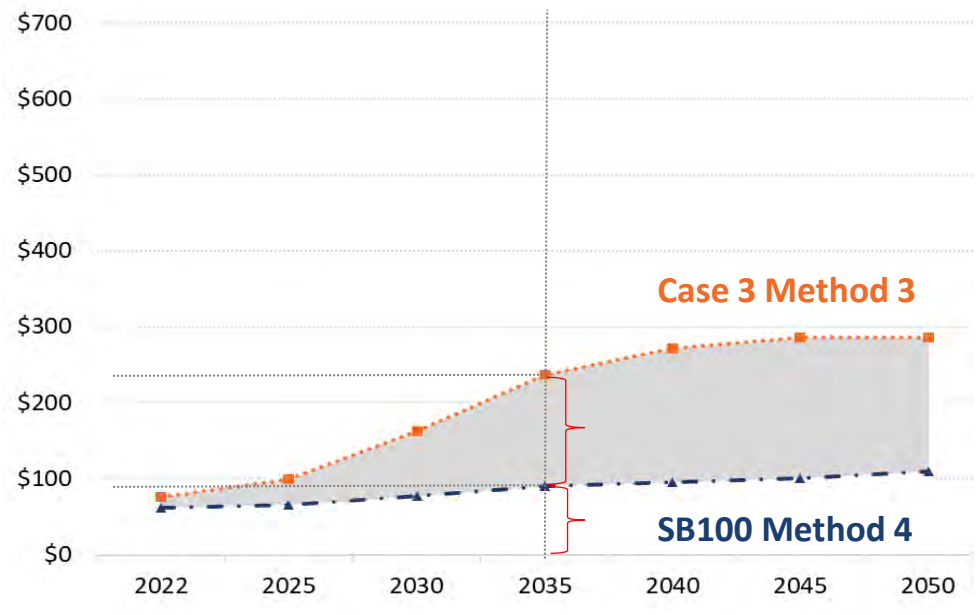
Apartments - 2/2

- Monthly bill estimates for apartment customers are less than a half of that for single family home customers.
  - The observed trend (e.g., 2035 range is nearly double of the lowest bill estimates) is the same.

Monthly Bill Estimates for Apartment Customers (All Methods and Cases)



Monthly Bill Estimates for Apartment Customers (Range)



Notes: Apartment customers are assumed to consume 300 kWh per month.

Summary of Bill Analysis

Bill impacts show a much larger range than the Cases and associated Rates by themselves do.

- Monthly bills are estimated for customers in single family homes (monthly consumption of 700 kWh) and apartments (monthly consumption of 300 kWh).
  - Four methods (referred to as Methods 1 through 4, see appendix) were applied for estimating bills.
- As total cost and rate estimates from SLTRP indicate, Case 3 shows the highest bill, and SB100 the lowest.
  - Estimated 2035 bill shows highest estimate to be ~3x of lowest estimate (i.e., estimated range is ~2x of lowest estimate).

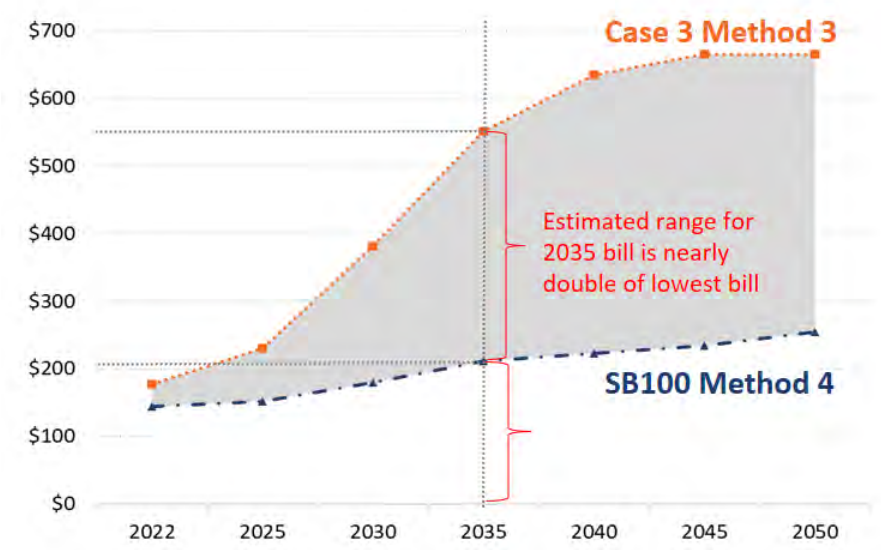
Estimated Range for Monthly Bill (Single Family Home)

2035 Bill Range*	SB100	Cases 1 and 2	Case 3
Highest	$350	$500	$550
Lowest	$200	$300	$300

*: Rounded to the nearest $50.

- The bill difference between Case 1 (recommended case) and SB100 grows further (~40% in 2035 to over 50% in 2045).
  - The bill increase for SB100 from 2035 to 2045 is 14%.
  - The bill increase for Case 1 from 2035 to 2045 is 22%.

Estimated Range for Monthly Bill (Single Family Home Customers)



Notes: Single Family Home customers are assumed to consume 700 kWh per month.

Price of Power

Price of power was the most common feedback topic from stakeholders.

- Estimated cost difference between Case 1 (recommended case) and SB100 are quite significant.
  - NPV of total cost for Case 1 ($81.4 billion) is 30% higher than SB100 ($60 billion) (see slide 13).
  - The difference of $20+ billion is more than 4x of the LADWP Power System fiscal year budget (FY 2021-22 budget was $4.9 million).
  - With ~1.6 million customers, the average burden per LADWP customer for this $20 billion calculates to be $12,500.
  - Average annual rate increase for Case 1 (7.7% per year) is 60% higher than SB100 (4.8% per year).
- Impact to customers' bills are equally significant (see slides 17 through 21).
  - LADWP estimates monthly bills for single family home customers increase by 82% (from the current $144 to $262) under SB100, by 162% (to $373) under Case 1, and by 184% (to $404) under Case 3.
  - Estimated monthly bills for apartment customers grows at the same rate from the current $62 to $112 under SB100, $160 under Case 1, and $173 under Case 3.

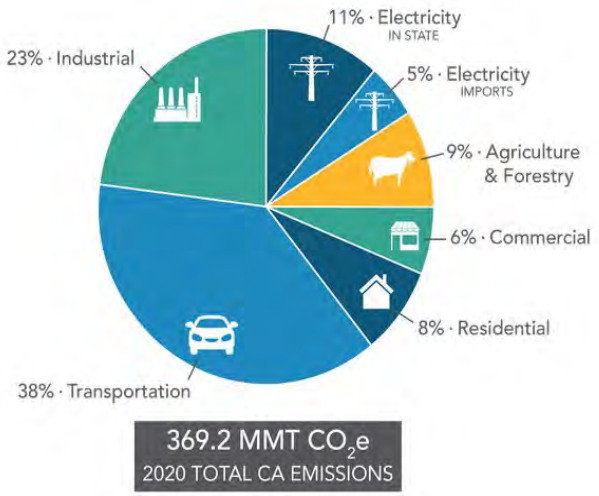
The assumed cost and rate/bill impact may warrant further discussion.

Air Quality and GHG Emissions

Air quality and GHG emission reduction were key policies driving the SLTRP.

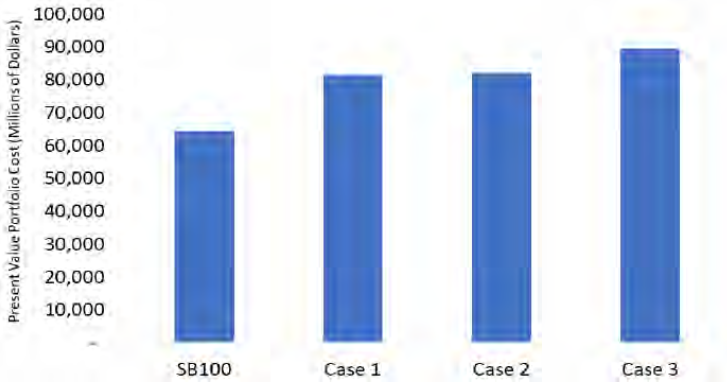
- The difference in greenhouse gas (GHG) emission between Case 1 and SB100 is 20% to 30% in 2035 and ~10% in 2045.
  - SB100 assumes 100% clean energy for retail sales (approximately 90% clean generation) by 2045 while achieving clean energy for retail sales 80% by 2035. Case 1 assumes 100% clean generation by 2035.
  - LADWP's GHG emissions for 2021 were approximately 7.0 million metric tons (MMT), which is less than 2% of the 2020 California economy-wide emission (~370 MMT).
  - 10% difference (in 2045) of the 7 MMT (0.7 MMT) is less than 0.2% of the 2020 California economy-wide emission (~370 MMT).
- The difference of Net Present Value (NPV) of the estimated cost between Case 1 (recommended case) and SB100 are quite significant.
  - Total cost for Case 1 ($81.4 billion) is 30% higher than SB100 ($60 billion).
- Is $20+ billion dollars (in NPV) worth reducing the California economy-wide GHG emission by 0.2%? *(see Appendix D)*
  - Are there alternative lower-cost options to reduce GHG emission from other sectors? *(see Appendix B)*

California 2020 GHG Emission by Sector



Source: https://ww2.arb.ca.gov/ghg-inventory-data

Net Present Value of Total Costs by SLTRP Case



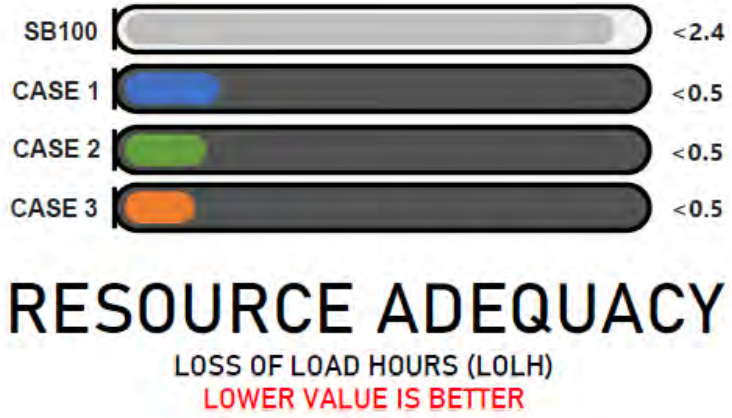
Source: 2022 Power Strategic Long-term Resource Plan (SLTRP).

Reliability (LOLH)

Reliability & Resiliency is one of the three guiding principles for the SLTRP (in addition to Environmental Benefits & Equity, and Affordability & Rate).

- LADWP uses Loss of Load Hour (LOLH, when generation cannot meet demand) as a measure of reliability.
  - The industry standard is at or below 2.4 LOLH per year. SB100 is at that level.
  - LADWP's current LOLH is about 0.22.
  - Cases 1, 2, and 3 show high reliability levels of LOLH below 0.5.
- LOLH typically looks at the bulk power system and not the distribution network.
  - Distribution networks are typically responsible for 90% or more of service interruptions. In other words, failure on the bulk power system contributes to less than 10% of all service interruptions.
  - LADWP's System Average Interruption Duration Index (SAIDI) shows the average outage duration in minutes per customer during a year to be 139 minutes (or ~2.3 hours). Comparing this to LADWP's LOLH of 0.22 indicates that failure in the bulk system is only responsible for less than 10% of all service interruptions.
- Improving the LOLH from 2.4 hours to 0.5 hours will only reduce system disturbance by ~8%.
  - Is $20+ billion dollars (in NPV), or the associated rate increase, worth this reduction (improvement in reliability), even after accounting for the environmental benefits (see previous slide)?

LOLH by SLTRP Case



Source: 2022 SLTRP Board Presentation Final 09-26-22.

Options to Consider: 1/3

Common risks across all Cases include:

- Load Projection (and associated investment needs) uncertainties
  - Load projections define development needs. Historical variation appears much larger than the range covered by Cases.
  - Realized loads can be a risk in themselves. The mismatch between load projections that drives investments and actually realized load can swing the rates and bills significantly. Effects of load electrification is part of this uncertainty.
- Technology and Cost uncertainties
  - Generation technology (e.g., efficiency) and costs have changed significantly over the past few years and will likely continue to do so. Investing early in future technologies may lead to uneconomic asset.
  - Various projections and historical observations suggests a steep adoption rate (after a technology is widely accepted) leads to lower prices—that timing and pace is very difficult to estimate.

Are there alternative options to balance the three guiding principles (SLTRP Objectives)?

1. Consider incremental investments (less committal) rather than lump sum.
2. Consider investment from least-regrets options.
3. Share investments with external partners.
4. Distinguish quantifiable benefits from monetizable benefits.

2022 SLTRP Objectives

Options to Consider: 2/3

Consider incremental investments (less committal) rather than lump sum.

- Cases 1, 2, and 3 (but not SB100) include **New Green Hydrogen** plants that effectively replace existing fossil resources (largely replacing existing in-basin thermal power plants) as dispatchable resources.
  - SLTRP assumes (with transmission upgrade in place) in-basin green hydrogen to operate at low capacity factors, averaging <2%.
  - SLTRP assumes these green hydrogen turbines to serve as backup resources to maintain reliability during periods of low renewable energy output, and to bolster grid resiliency to ride through and recover from grid outages that can be caused by extreme events such as wildfires, earthquakes, heatwaves, and other types of unplanned events.
  - Conversely, if the transmission upgrade is not completed, SLTRP assumes LADWP must rely on in-basin hydrogen resources to replace the lost energy, with a capacity factor averaging approximately 18% between 2028 and 2045.
- Can Reciprocal Internal Combustion Engines (RICE) be considered as an alternative option?
  - Both gas turbines (GTs) and RICE can accommodate multiple fuel types, including natural gas, fuel oil, and hydrogen (currently being developed for both types).
  - Heat rates and emission rates are comparable between the two technologies.
  - Both technologies provide flexibility with fast responses and wide operating ranges (some RICE more than GTs).
  - Compared to GTs, RICE have lower start-up costs and lower water consumption.
  - RICE come in 10 MW - 20 MW size, and can be built incrementally as needed, easing financial commitment and locational flexibility. The portability of RICE units (can be moved around on a trailer, if needed) also provides locational flexibility.
  - GTs command replacements of hot gas path components (e.g., turbine blades) after several years of operations. RICE do not.

Options to Consider: 3/3

Consider least-regrets investments.

- Transmission may be a "no-regrets" option.
  - Transmission is a "proven technology" with known costs.
  - Transmission projects discussed in SLTRP do not vary by Case.
  - Transmission enables more diverse generation options for both the short-term for energy imports and long-term for resource planning.
  - Transmission benefits all customers, rather than a select group (e.g., rooftop PV holders), contributing to environmental justice.
  - The Cap-Ex extensive **New Green Hydrogen** (discussed in previous slide) could potentially be avoided with transmission. On the other hand, failure to build transmission could increase the overall costs by approximately $7 billion (net present value) between 2028 and 2045.
- Can LADWP co-develop transmission with other utilities to hedge the risk of no or negative load growth while maintaining optionality?
  - The key policies driving the SLTRP are state policies so other utilities within the state are facing similar challenges.
  - Monetizable benefits need to be quantified for cost sharing.

Excerpts from the 2022 SLTRP Final Report

"As a result of the LA100 Study, LADWP was able to identify near-term actions that can and should be taken irrespective of the carbon-free pathway that we elect to follow. At least ten critical in-basin transmission projects were identified as necessary to maintain reliability in light of the once-through cooling (OTC) retirements and to bring renewable power to load centers within the City." (Page 2-13)

"If the anticipated transmission line upgrade is not completed, the energy that would have been imported via this transmission corridor must be replaced with other sources. Such energy is likely to come from LADWP's generation resources situated within the Los Angeles Basin, and will mainly consist of energy produced from green hydrogen generation resources. …… such resources tend to be costlier to operate than renewable resources, owing to the elevated cost of the green hydrogen fuel….., the net effect would be in increase in overall costs of approximately $7 billion between 2028 and 2045 on a net present value basis." (Page 4-28, partially omitted)

Appendices

- Appendix A: Cost of Service and Bill Impact Analysis Methodology

  Shows methodology of bill impact analysis and observations from the analyses. Slides are new.
  - *Four Calculation Methods for Bill Analysis*
  - *Need for More Frequent Cost of Service Studies*
- Appendix B: Electrification in Other Sectors

  Shows how electrification of other sectors will help mitigate rate increases while achieving higher levels of decarbonization. Slides are from previous presentations (shown in the right figure).
  - Slide *"Energy Efficiency (EE) and Building Electrification (BE) - 5/5"* from "Review of SLTRP Drivers."
  - Slide *"Annual GHG Emissions for All Sectors"* from "Review of the LA100 Study."
- Appendix C: Projections - Variance Over Time

  Shows how projections can vary over time. The uncertainties in load and cost projections can significantly impact rate making. Slides are from previous presentations (shown in the right figure).
  - Slide "*Load Projection - Variance Over Time*" from "Review of the LA100 Study."
  - Slide "*Cost Estimates for Generation Resources - 1/2*" from "Review of the LA100 Study."
- Appendix D: Incremental Cost of GHG Reduction

  Shows the marginal cost of GHG reductions for Case 1 and Case 3 compared to SB100. Slide is new.

Source Presentations

Originally shared and discussed with OPA/RPA and the SLTRP team on March 6, 2023.

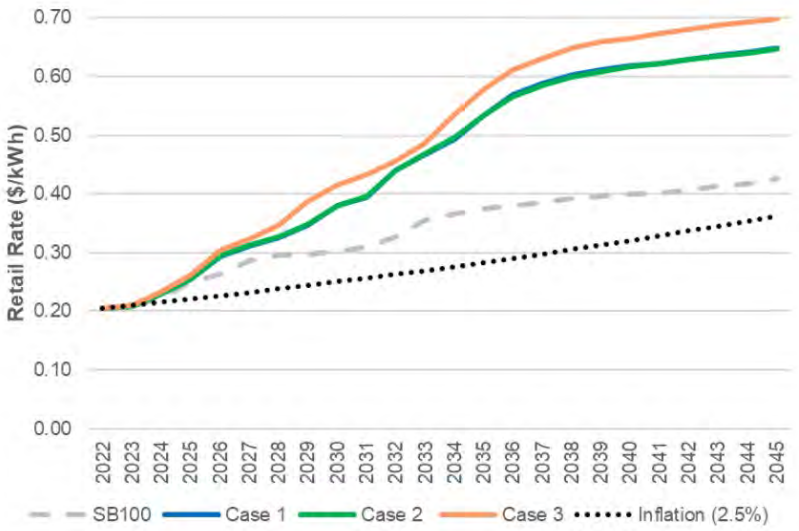
Originally presented to OPA/RPA on August 7, 2021 (available at Review of LA100 (lacity.org)).

Four Calculation Methods for Bill Analysis

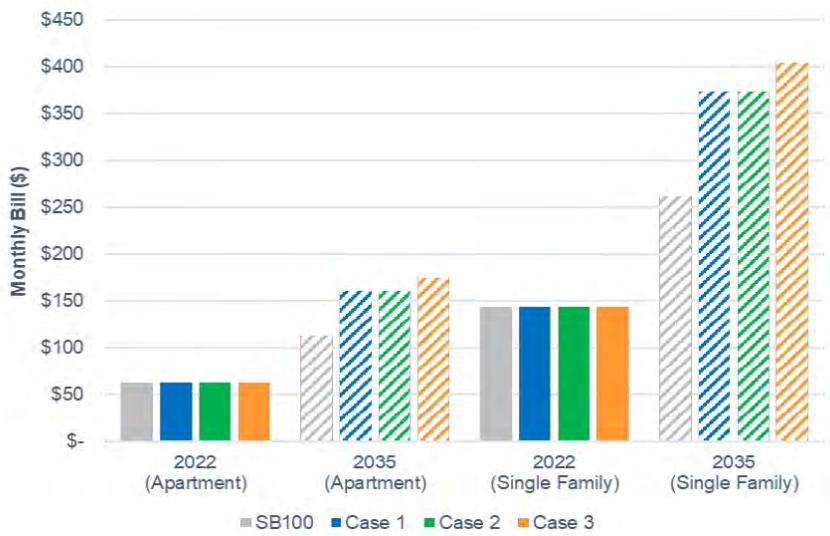
Brattle developed four calculation methods (Methods) per SLTRP case for monthly bill impact analysis:

- Method 1: Average System Rates as reported in SLTRP (see slide 13 for Revenue Requirements).
- Method 2: Residential Rates (R1A) assuming 45% allocation of Revenue Requirements (same as Method 1) to residential customers, and fixed share of retail sales (residential customers' share assumed 37% of all loads for all years).
- Method 3: Residential Rates (R1A) assuming 45% allocation of Revenue Requirements (same as Method 1) to residential customers, and varying share of retail sales (37% in 2022 to 33% in 2050).
- Method 4: Average System Rates assuming higher load (including modified Revenue Requirements).

Nominal Forecasted Electric Retail Rates



Monthly Retail Customer Electricity Bill



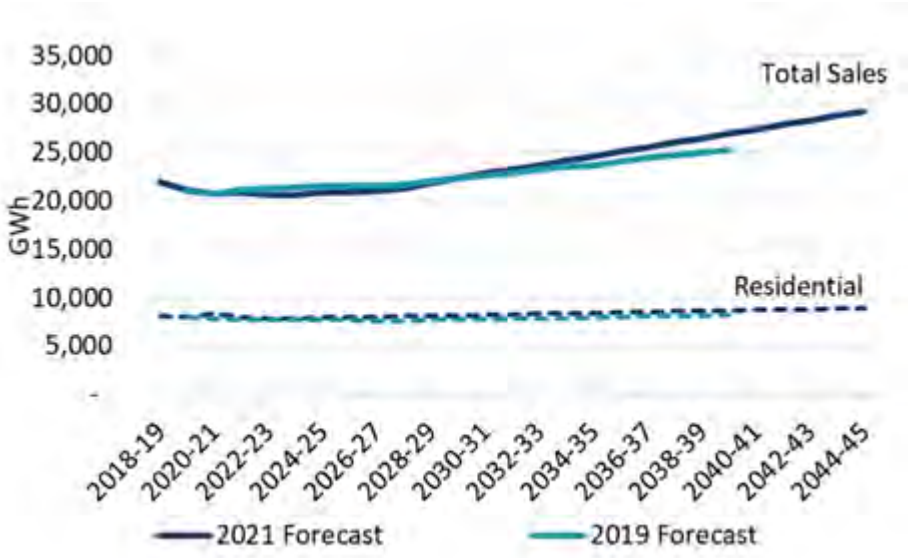
Sources: 2022 Power Strategic Long-term Resource Plan (SLTRP). Figure 15 and Figure 16.
Notes: Apartment customers are assumed to consume 300 kWh per month and single family home customers are assumed to consume 700 kWh per month. Monthly electricity bill is calculated by multiplying the retail rates by assumed consumption.

Need for More Frequent Cost of Service Studies

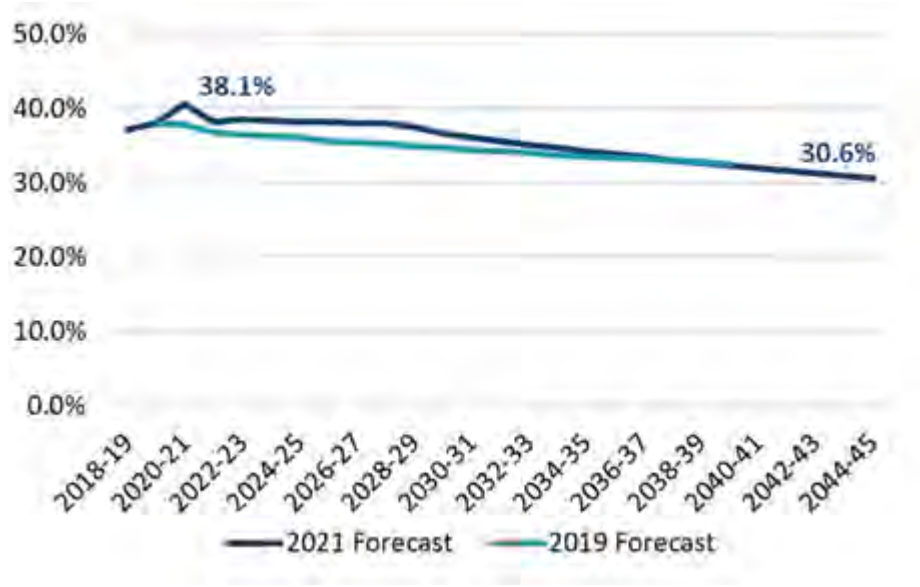
Brattle developed four calculation methods (Methods) per SLTRP case for monthly bill impact analysis:

- The Methods differ by how total costs (revenue requirements) were allocated to residential customers.
  - The current allocation assumes 45% of total costs to be spread among residential customers.
  - Residential customers are about 37% of all loads today. Ideally, the allocation value would roughly equal the share of load.
  - LADWP projects total sales to grow at a higher pace than residential sales (partially due to electrification), indicating the difference between the two values would grow. This suggests a need for a more frequent adjustments of the allocation (derived through cost of service studies).

Residential and Total Sales Projections

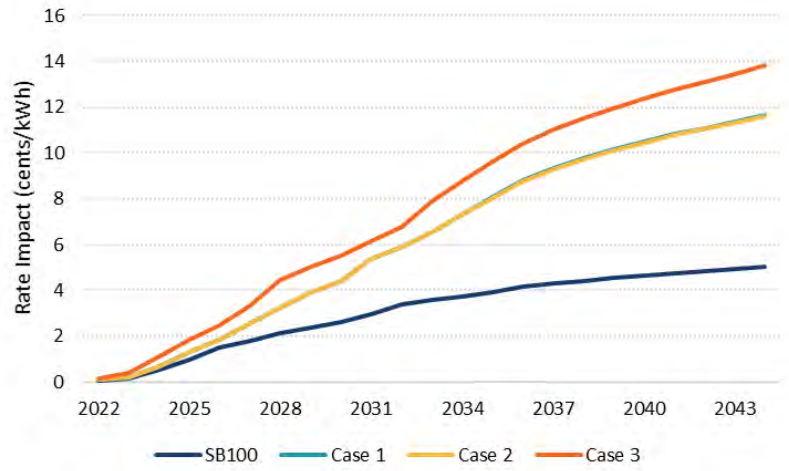


Residential Sales Share Projections

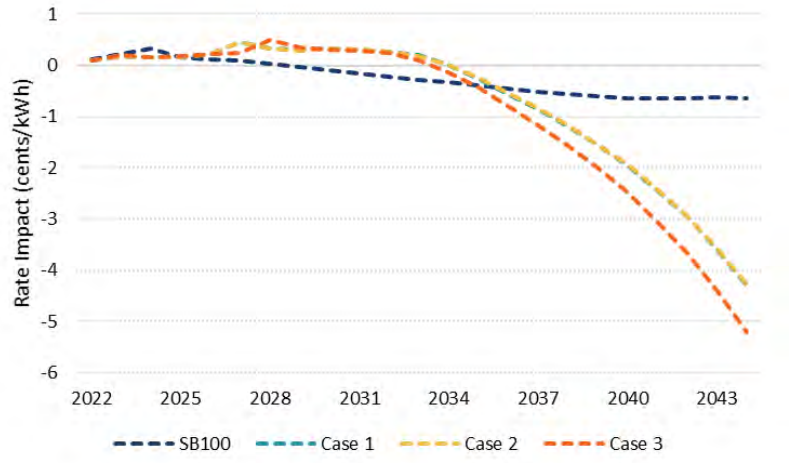


Energy Efficiency (EE) and Building Electrification (BE) - 5/5

EE Rate Impact (cents/kWh)

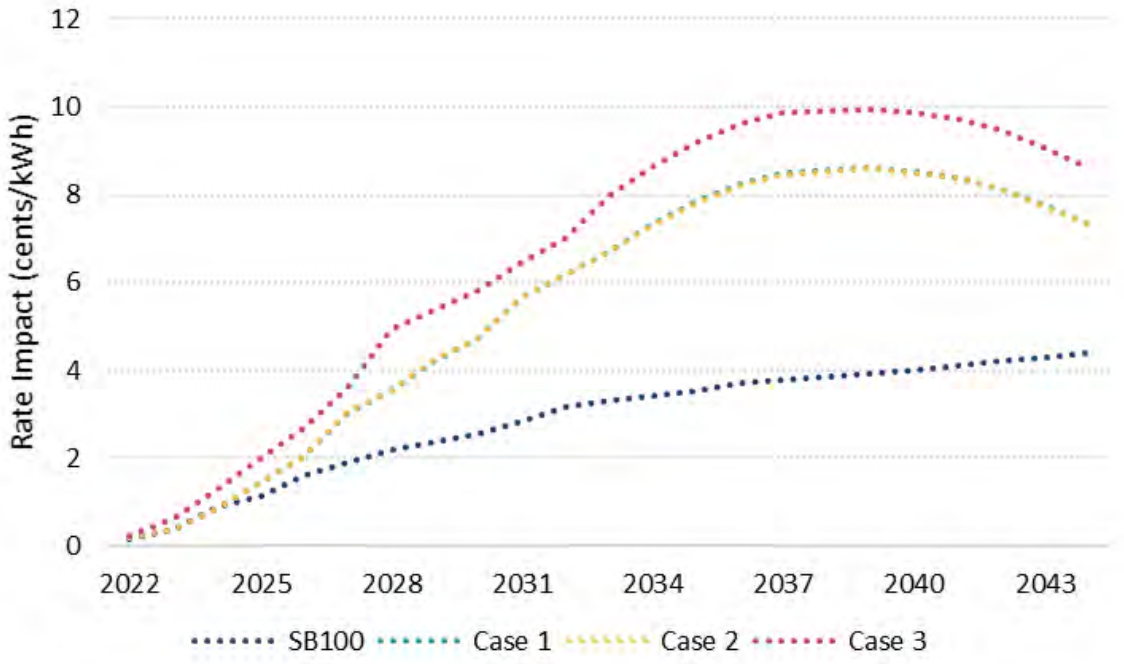


BE Rate Impact (cents/kWh)



EE (which increases rates) and BE (which decreases rates in the long term) can offset each other.

EE and BE Combined Rate Impact (cents/kWh)



Notes: Case 1 and 2 have the same level of EE. Case 1, 2, and 3 have the same level of BE.

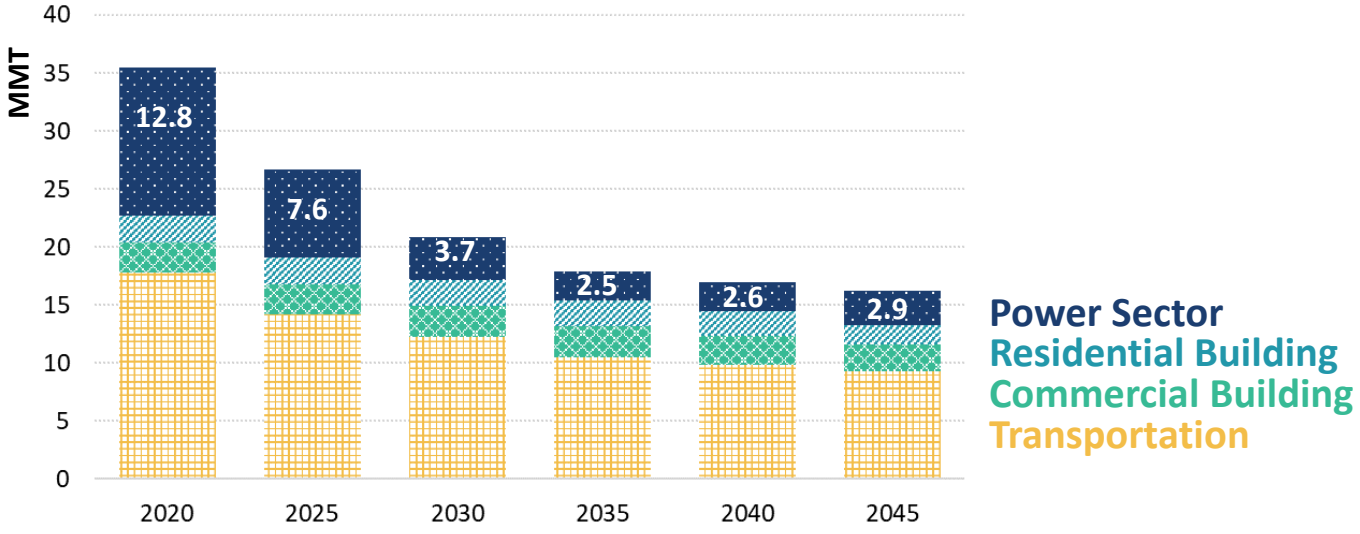
Annual GHG Emissions for All Sectors

- For the SB100 Scenarios, GHG emission from the power sector stalls after 2035.
  - The all-sectors' annual GHG emission for High Load (with higher electrification for transportation and buildings) in 2040 and after is about half of that of Moderate Load.
  - This is largely from reduction in transportation but also in building sectors. Power sector emissions increase slightly.
  - The associated cost is about $20-$30/T, which is about 15% to 20% of the estimated long-run cost.

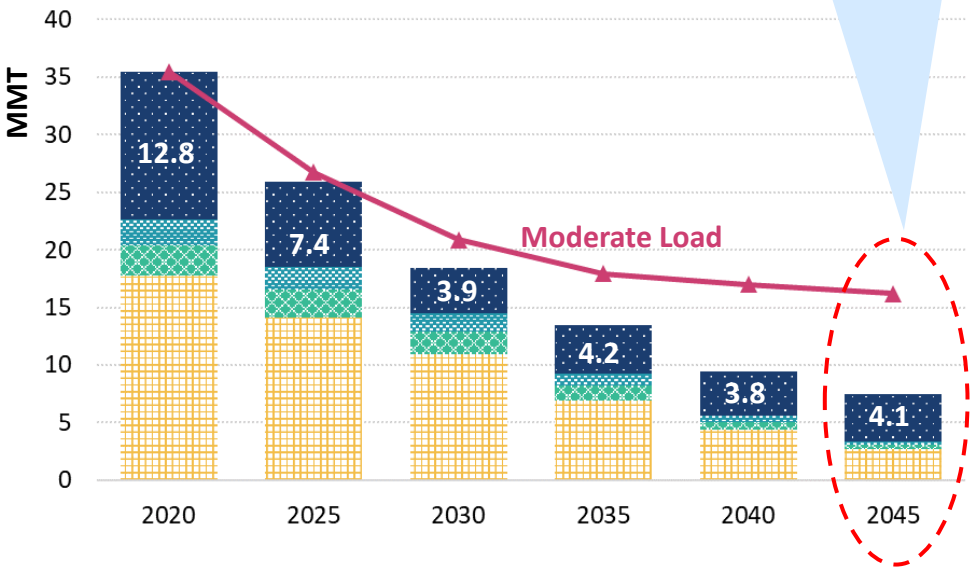
Annual GHG Emission by Sector for SB100 Moderate and High Load (2020-2045)

Electrification of other sectors lead to significantly lower total GHG emission with slight increase in power sector emission.

SB100 Moderate Load



SB100 High Load

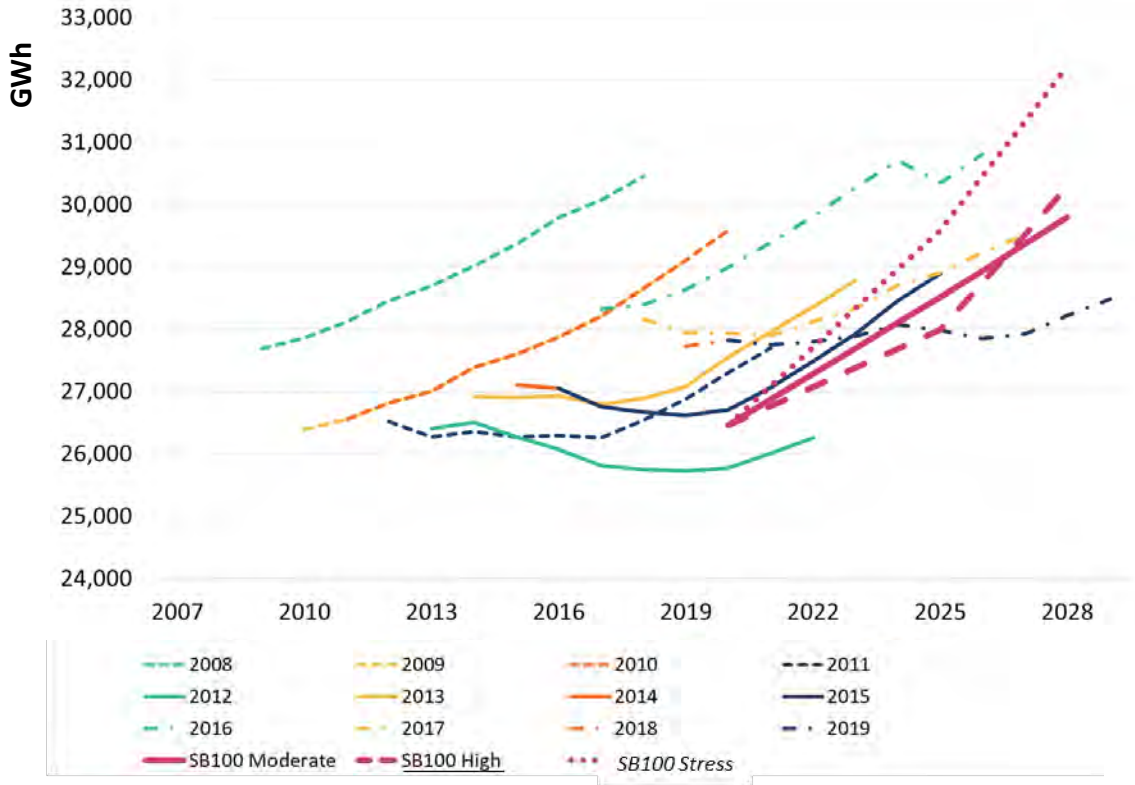


Sources: Data from NREL study report, Chapter 8, Appendix A, https://www.nrel.gov/docs/fy21osti/79444-8.pdf.

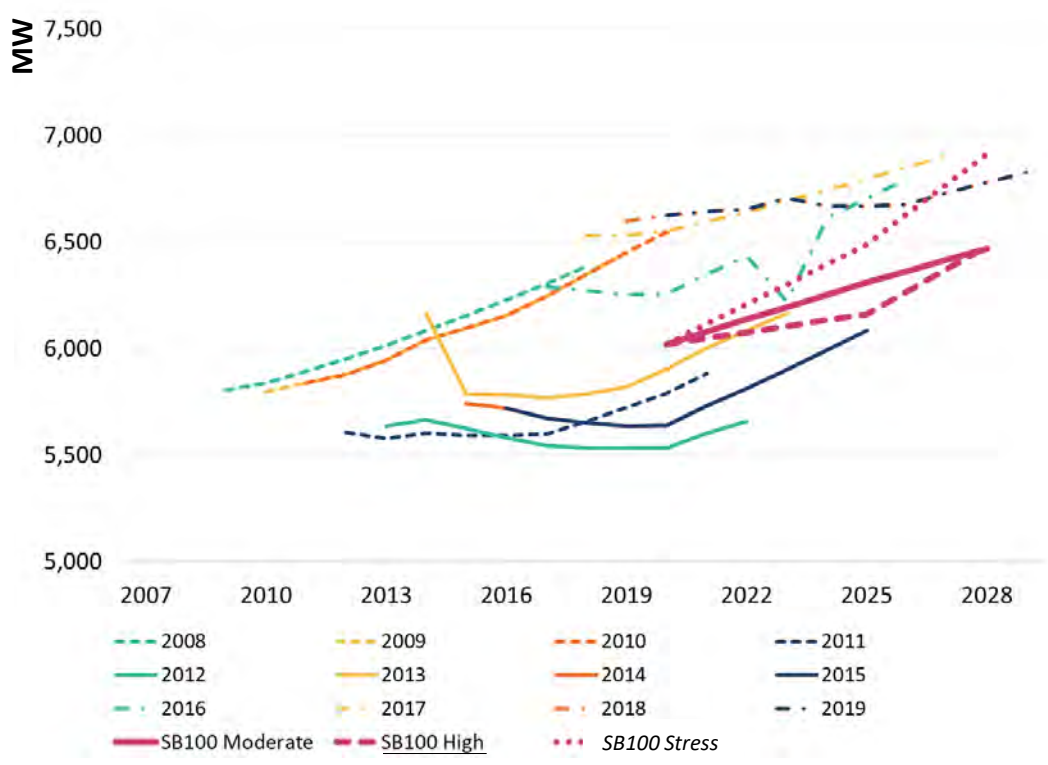
Load Projection - Variance Over Time

- Load projections by themselves are a source of uncertainty.
  - Variation of projections (both energy and peak load) changes over time.
  - Variation assumed in LA100 Study pales compared to historical observations.

Annual Energy Consumption Projections (SB100 Scenario)



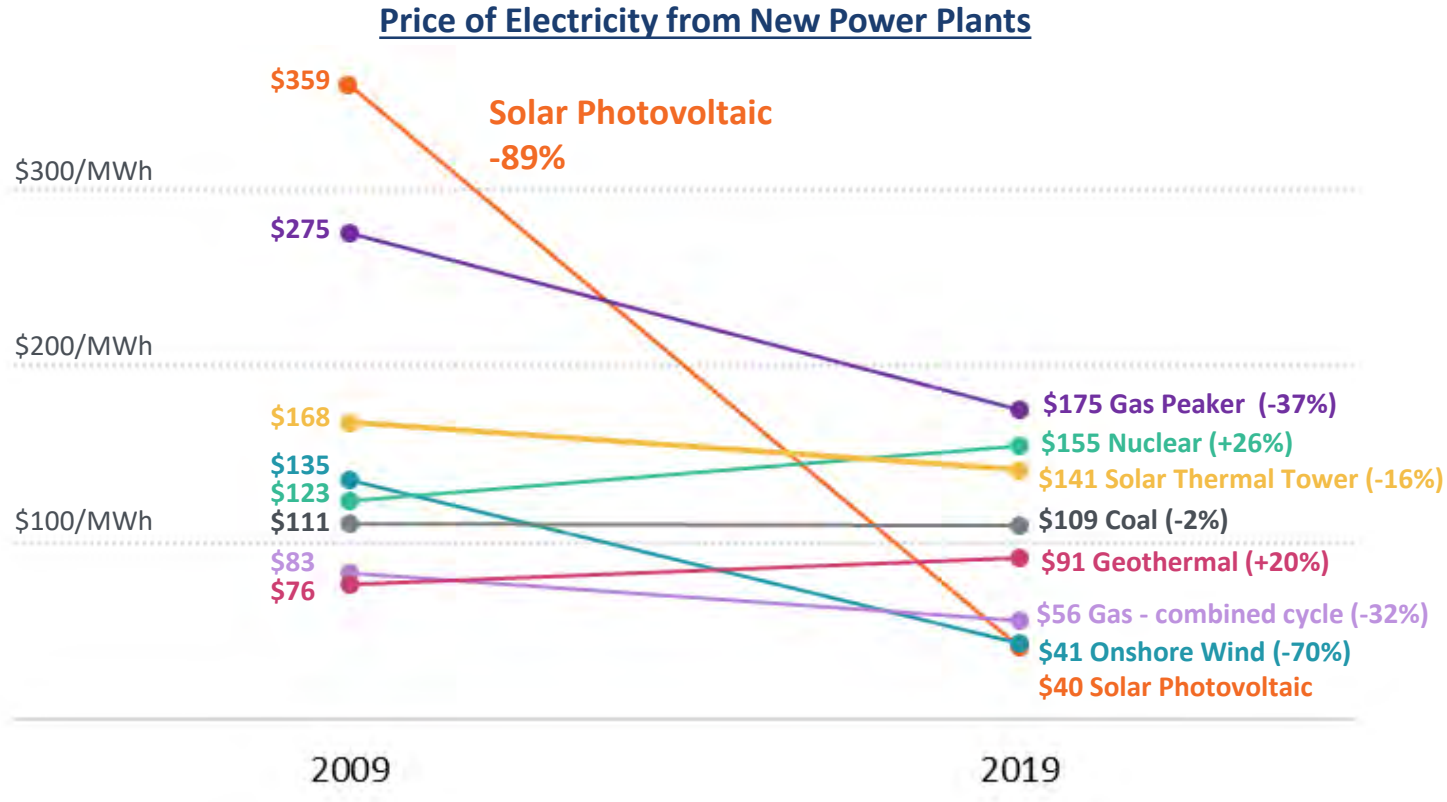
Annual Peak Load Projections (SB100 Scenario)



Sources and notes : Historical load projections from FERC 714 Filings, https://www.ferc.gov/industries-data/electric/general-information/electric-industry-forms/form-no-714-annual-electric/data.
City of Burbank (1,131 GWh and 301 MW, 2019) and City of Glendale (1,462 GWh and 288 MW, 2019) appear to be included in LADWP's FERC 714 Filing (27,718 GWh and 6,598 MW, 2019).

Cost Estimates for Generation Resources - 1/2

- The price of electricity from renewables dropped from 2009 to 2019.
  - The price of electricity from solar declined by 89% in these 10 years.
  - The price of onshore wind electricity declined by 70% in these 10 years.



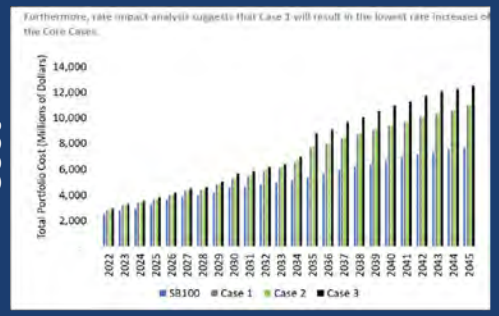
Sources and notes: Electricity prices are expressed in 'levelized costs of energy' (LCOE). LCOE captures the cost of building the power plant itself as well as the ongoing costs for fuel and operating the power plant over its lifetime. Data from Lazard Levelized Cost of Energy Analysis, Version 13.0.

Incremental Cost of GHG Reduction

- The incremental GHG emission reduction cost*1 of the SLTRP Cases (compared to the SB100 Case) are around ***$1,000/Metric Ton.***
  - The costs of SB100 vs Cases 1 to 3 is an order of magnitude or more above current valuations of GHG savings.

SLTRP Data*2

Cost



Total cost difference between SLTRP Core Cases (Cases 1 & 3) and SB100.

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Emissions

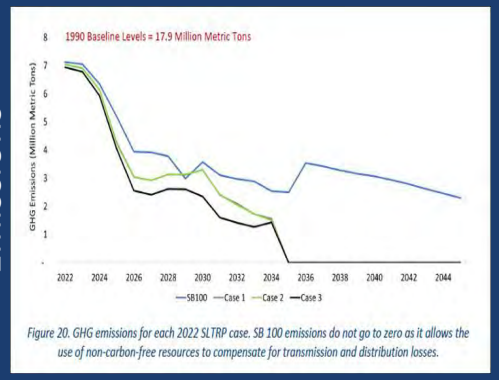
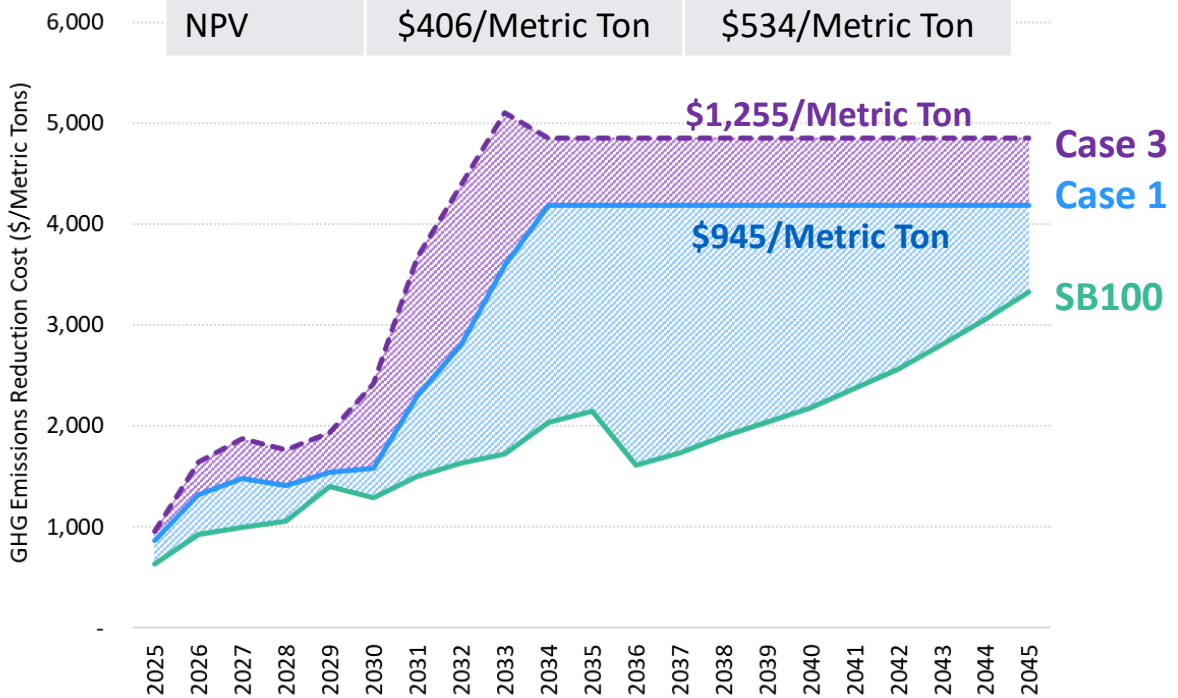


Figure 20. GHG emissions for each 2022 SLTRP case. SB 100 emissions do not go to zero as it allows the use of non-carbon-free resources to compensate for transmission and distribution losses.

Total GHG Emission Reduction difference between SLTRP Core Cases (Cases 1 & 3) and SB100.

Incremental Cost of GHG Reduction (2025-2045)

$/T Delta	Case 1	Case 3
Nominal	$945/Metric Ton	$1,255/Metric Ton
NPV	$406/Metric Ton	$534/Metric Ton



*1: Calculated as the total cost difference (SLTRP Core Case minus SB100) divided by total emission reduction difference (SLTRP Core Case minus SB100) for years 2025 through 2045.
*2: Data taken from Figure 20 and Figure 21 of the 2022 SLTRP Final Report.

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