Similarly, for the Early & No Biofuel 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 a third of that of Moderate Load.
- This is largely from reduction in transportation but also in building sectors. Power sector emissions increase slightly.

Annual GHG Emission by Sector for Early & No Biofuel Moderate and High Load (2020-2045)

Annual GHG Emissions for All Sectors

- There are low cost GHG reduction options in the non-power sectors.
  - GHG emission from the power sector stalls after 2030/2035.
  - The charts below compares the renewable PPA costs (roughly representing the total load including electrified load) and natural gas consumptions for buildings (residential and commercial).

Sources: Data from NREL study website, [https://maps.nrel.gov/la100/data-viewer?Theme=electricity-demand&SubTheme=annual-gas-demand&Resolution=lc&LoadScenario=moderate&LayerId=electricity-demand.annual-gas-demand&Year=2045&Variable=btu](https://maps.nrel.gov/la100/data-viewer?Theme=electricity-demand&SubTheme=annual-gas-demand&Resolution=lc&LoadScenario=moderate&LayerId=electricity-demand.annual-gas-demand&Year=2045&Variable=btu)
Summary of Observations from Cost Estimates

Common observations across all pathways include:

- Costs grow exponentially in the second half of the study period.
  - Costs through 2030 do not vary much by pathways and are about a quarter of total cumulative costs.
  - Costs double between 2030 and 2035, then grow exponentially thereafter.
  - Costs growth after 2035 is more than half of total cumulative cost.

- Other cost related observations include:
  - Transmission CapEx do not vary by pathway (other than Transmission Focus Scenarios).
  - Transmission enables more diverse generation options (both short- and long-term) that benefits all customers, rather than a select group, contributing to environmental justice.
  - H2- and RE-CT CapEx are quite high while their OpEx is miniscule.

- Significant benefits of GHG reduction is achieved through the first half of the study period (through 2030/2035) at much lower costs.
  - Incremental cost per reduction in GHG becomes much higher (more than doubles) after 2035.

- Electrification of other sectors (transportation and buildings) are as important as the power sector is for decarbonizing.
  - By 2045, high load pathways with higher load electrification produces 1/3 to 1/2 of GHG compared to moderate load pathways with less electrification.
  - Cost of decarbonizing these other sectors, while varying by pathways, is around $20 to $30/T, or 15% to 20% of the average cost of ~$150/T for the power sector.
  - Health benefits are correlated to load electrification, rather than any specific pathway.
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Estimated Power Prices by Pathway - 1/2

Rate Estimates

- All pathways show modest increase in estimated rates.
  - Similar to costs, rates do not vary much through 2030.
  - Unlike costs, rate grows in early years (through 2030), then generally becomes flatter after 2030.
  - Estimated rates growth through 2045 are below that of inflation (2.5%).
  - Within a scenario, high load pathways result in lower rates (by 10% to 15%) compared to moderate load pathways.

Sources and notes: SLTPR 2017 Modified extends only through 2036. The average 2020 rate is 19.1 cents/kWh (baseline year). Data provided by LADWP FSO.

Discussion Draft
**Estimated Power Prices by Pathway - 2/2**

- All pathways show modest increase in estimated rates.
  - Unlike costs, rate grows in early years (through 2030), then generally becomes flatter after 2030.
  - Within a scenario, high load pathways typically result in lower rate increase (by ~0.5% per year) compared to moderate load pathways.

### Compound Annual Growth Rate (CAGR) by Pathways*1

<table>
<thead>
<tr>
<th>Pathways</th>
<th>5 Year CAGR</th>
<th>10 Year CAGR</th>
<th>Average CAGR</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2025</td>
<td>2030</td>
<td>2035</td>
</tr>
<tr>
<td>SLTRP 2017 Modified</td>
<td>0.9%</td>
<td>4.2%</td>
<td>0.6%</td>
</tr>
<tr>
<td>SB100 Moderate</td>
<td>4.0%</td>
<td>1.7%</td>
<td>0.6%</td>
</tr>
<tr>
<td>Early &amp; No Biofuels Moderate</td>
<td>5.4%</td>
<td>3.7%</td>
<td>2.5%</td>
</tr>
<tr>
<td>Transmission Focus Moderate</td>
<td>4.3%</td>
<td>2.5%</td>
<td>0.6%</td>
</tr>
<tr>
<td>Limited New Transmission Moderate</td>
<td>4.7%</td>
<td>2.7%</td>
<td>0.9%</td>
</tr>
<tr>
<td>SB100 High</td>
<td>4.0%</td>
<td>1.5%</td>
<td>0.1%</td>
</tr>
<tr>
<td>Early &amp; No Biofuels High</td>
<td>5.2%</td>
<td>3.3%</td>
<td>1.1%</td>
</tr>
<tr>
<td>Transmission Focus High</td>
<td>4.4%</td>
<td>2.1%</td>
<td>-0.2%</td>
</tr>
<tr>
<td>Limited New Transmission High</td>
<td>4.8%</td>
<td>2.3%</td>
<td>-0.3%</td>
</tr>
<tr>
<td>SB100 Stress</td>
<td>3.6%</td>
<td>1.6%</td>
<td>0.3%</td>
</tr>
</tbody>
</table>

Sources and notes: *1 The average 2020 rate is 19.1 cents/kWh (baseline year). Data provided by LADWP FSO.
*2 CAGR for SLTPR 2017 Modified extends only through 2036.
Load projections by themselves are a source of uncertainty.

- Rate variation caused by load projection by 2045 (3.5 cents) is about half of that caused by Scenario (7 cents).
- Variation of both types grows largely after 2030.

Sources and notes: Differences between prices by scenario are rounded to the nearest quarter of a cent. Data provided by LADWP FSO.
Load realization is another source of uncertainty.
- Rate variation caused by expected load not showing up under the SB100 Scenarios (e.g., investments made for high load projection but actual load turned out to be at moderate load level) shows rates impacted by nearly 6 cents.
- This is nearly double the rate variations caused by load projections (3.5 cents) and similar to that caused by the difference in scenarios (7 cents).
- Variation grows after 2030.
Summary of Observations from Rate Estimates

Common observations across all pathways include:

- Average rates will grow at a rate that is less than 2.5% of assumed future inflation.
  - Similar to costs, average rates through 2030 do not vary much by pathways.
  - Unlike costs, rate growth is much steeper in the earlier years (in the 25 cents to 30 cents range by 2030), and tend to flatten out in the later years (in the 25 cents to 35 cents range by 2045).
  - This difference is likely caused by existing debt.
  - Within a given scenario, high load pathways typically result in lower rates (by 10% to 15%) compared to moderate load pathways.

- Difference in scenarios and uncertainty in load drive rates. Assuming the different pathways estimates:
  - Difference in scenarios for the same load can lead to a 7 cents difference (nearly 40% of today’s average rate).
  - Difference in load projection for the same scenario can lead to a 3.5 cents difference (~20% of today’s average rate).
  - Difference in realized load (e.g., only moderate level of load showing up after investing under high load projection) can lead to a 6 cents difference.
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Load Projection - Within the LA100 Study

- Load projections by themselves are a source of uncertainty.
  - Variation of both types grows largely after 2030.
  - Energy consumption and peak load projections both vary by 25% (over 10,000 GWh/2,000 MW by 2045).
  - Demand response through 2030 grows by nearly 5x in all pathways.

Sources and notes: Data from NREL Study website, https://maps.nrel.gov/la100/data-viewer?theme=electricity-demand&subtheme=electricity-demand&resolution=lc&loadscenario=moderate&layerid=electricity-demand_peak_demand&year=2045&variable=kwh&temporalresolution=annual&timeperiod=peak. NEL reported an annual consumption of 24,095 GWh (9% lower than NREL projection of 26,457 GWh) and annual peak load of 6,110 MW (3.5% higher than NREL forecast of 5,909 MW). While underestimate the peak load and overestimate of the annual consumption will both lead to increase in average rates (~14%).
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.

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](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).
LA100 Study assumes an optimistic prediction of a growing load factor, in contrast to the historical trend.

- Less peaky (i.e. flat) load estimated for future years.
- Flatter load will require less flexibility and may underestimate renewable curtailments (both will underestimate costs).

**Load Factor by Year (2008-2045)**

LA100 Study shows higher load factors through 2045

The average load factors for 2017-2019 is lower than other historical years.

Future Load Profiles

- The LA100 Study load profile suggests opportunities for demand side resources.
  - Top 20 hours reduce peak load by 5% and top 100 hours reduce peak load by 15%.
  - Top 100 hours are concentrated in early August, suggesting a targeted demand side resource program may be worth evaluating.

- Future load profile (and growth) will vary by rate and pace of electrification—a large source of uncertainty.
  - LA100 Study shows shift in daily peak hours depending on pathways.
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.

Price of Electricity from New Power Plants

<table>
<thead>
<tr>
<th>Power Type</th>
<th>2009 Price</th>
<th>2019 Price</th>
<th>% Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solar Photovoltaic</td>
<td>$359</td>
<td>$275</td>
<td>-24%</td>
</tr>
<tr>
<td>Gas Peaker (-37%)</td>
<td>$175</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nuclear (+26%)</td>
<td>$155</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Solar Thermal Tower (-16%)</td>
<td>$141</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coal (-2%)</td>
<td>$109</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Geothermal (+20%)</td>
<td>$91</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gas - combined cycle (-32%)</td>
<td>$56</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Onshore Wind (-70%)</td>
<td>$41</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Solar Photovoltaic</td>
<td>$40</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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.
NREL’s Annual Technology Baseline (ATB)\(^{1}\) shows modest future cost reduction for solar.
- NREL’s historical analysis\(^{2}\) shows a significantly higher drop in renewable costs (~80% for solar PV installations, and ~40% for onshore wind over the past five years).

**Drop in PV LCOE (Historical)**

Sources: 
Future Economics of Distributed Solar - 1/5

- LA100 assumes significant amounts of customer PV installations across all pathways.
  - In all pathways, they add up to around 3 to 4 GW by 2045 with about half of that installed in the last ten years (2036-2045).
  - PV capacity expands by 8x to 10x through 2045. 3x to 5x of this growth is within the next ten years (through 2030).

Sources: Data from NREL Study website, [https://maps.nrel.gov/la100/data-viewer?Theme=distribution-grid&SubTheme=rooftop&Resolution=rs_dist&LoadScenario=moderate&RpmScenario=sb100&LayerId=distribution.local-solar-rooftop-deployment-potential&Year=2045&Variable=pv_kw](https://maps.nrel.gov/la100/data-viewer?Theme=distribution-grid&SubTheme=rooftop&Resolution=rs_dist&LoadScenario=moderate&RpmScenario=sb100&LayerId=distribution.local-solar-rooftop-deployment-potential&Year=2045&Variable=pv_kw)
LA100 assumes significant amounts of renewable PPAs to be signed across all pathways.
- More than half of the PPAs (over 80% for the Early and No Biofuel Scenarios) are executed by 2030 (2x to 3x of today).
LA100 assumes significant amounts of renewable PPAs to be signed across all pathways.
- Renewable curtailment increases significantly after 2030 except for Early & No Biofuel Scenarios (e.g., SB100 Moderate jumps by nearly 14x from ~134 GWh in 2030 to ~1,864 GWh in 2035).

Sources and notes: SLTRP 2017 Modified extends only through 2036. Data from NREL Study website, https://maps.nrel.gov/la100/data-viewer?theme=xmission&resolution=rs&loadscenario=moderate&rpmscenario=sb100&layerid=xmission.generation-capacity&year=2045&variable=mw.
Future Economics of Distributed Solar - 4/5

- Higher renewables will likely have dramatic consequences for power market prices.
  - Ontario, with 90% clean energy fleet, shows ~2,500 hours of zero or negative priced hours.
  - California duck also shows negative prices in mid-day.
  - Will LA follow a similar track where renewables crowd out each other, and if so, will there be incentives for customers to install their own PVs?

**Clean Energy and Energy Market Prices (Ontario)**

- Energy prices have fallen 79% with low gas prices and de-carbonization
- ~2500 of zero or negative price hours

Sources: [http://www.ieso.ca/en/Corporate-IESO/Media/Year-End-Data](http://www.ieso.ca/en/Corporate-IESO/Media/Year-End-Data)

**SP15 Day-Ahead Market Prices for the Second Sunday in April**

**SP15 Day-Ahead Market Prices and Wind and Solar Generation for the Second Sunday in April 2020**

Sources: S&P Market Intelligence and EIA, data as of 1/11/2021
A wide estimation range of adoption rates and pace has been observed. In general, the adoption rate, once accepted, are very steep, making the prediction even harder.

While the end-point is defined, the timing and pace of change is uncertain.
- Market dynamics and responses vary and evolve over time.
- Impact to rates will depend largely on the timing.

Market Dynamics and Temporal Responses

+ : reinforcement effects
  (e.g., higher fuel prices lead to higher electrification)
- : balancing effects
  (e.g., higher electrification leads to lower fuel prices)
 +/- : both effects
  (e.g., higher loads can increase rates (pushing up the demand curve against short-term supply curve) or lower rates (split the fixed cost with more parties))
Summary of Observations on Uncertainties

Common observations across all pathways include:

- **Load Uncertainties**
  - Load projections define development needs. While LA100 models different load levels, the historical variation appears much larger, and also change over time.
  - Realized loads are a risk in themselves. The mismatch between load projections that drives investments and actually realized load can swing the rates significantly.
  - Future load factors assumed in LA100 may be optimistic, and potentially leading to lower flexibility needs and lower renewable curtailments—both which would underestimate investment costs.

- **Cost Uncertainties**
  - Generation costs have changed much more than what LA100 assumes. This variable is in addition to the cost variation estimated to occur after 2030.

- **Market Dynamics and Response Timing Uncertainties**
  - More than half of all renewable PPAs (2x to 3x of today’s level) signed by 2030.
  - Customer PV adoption timing and magnitude also coincides with this timing (3x to 5x of customer PV built by 2030).
  - Market dynamics (including prices) may not support customer investment decisions.
  - Various projections and historical observations suggests a steep adoption rate after a technology is widely accepted—that timing and pace is very difficult to estimate.

See slide 54, See slide 59, See slide 63
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Summary of Observations - 1/3

All LA100 pathways are shown to achieve 100% Clean Energy by 2045.

- The LA100 pathways show that a significant portion of the Clean Energy Goals are achieved by around 2030/2035.
  - Retirement of coal reduces over 70% of direct combustion emission.
  - Non-combustion emissions are not easily controlled by anyone and generally do not change over years.
  - Average unit cost of GHG reduction ($/T) increases after 2030/2035.
- Electrification of other sectors (transportation and buildings) are as important as the power sector is for decarbonizing.
  - By 2045, high load pathways with higher load electrification produces 1/3 to 1/2 of GHG compared to moderate load pathways with less electrification.
  - Cost of decarbonizing other sectors, while varying by pathways, is around $20 to $30/T, or 15% to 20% of the average cost of ~$150/T for the power sector.
  - Health benefits do not vary by the power sector pathways—rather, they are correlated more with the level of load electrification.

Recommendations for GHG reduction

- Focus on avoidable GHG—trying to reduce non-combustion GHG may be difficult and expensive with very little gain.
- Weigh the cost and benefits of decarbonizing the power sector vs other sectors (transportation and buildings), including electrification of the other sectors.

All LA100 pathways are shown to achieve 100% Clean Energy by 2045.

- Costs deviate among pathways after 2035. Costs also increase significantly after 2035.
  - Cumulative costs through 2030 are about a quarter of total cumulative costs and do not vary by pathway.
  - Cumulative costs through 2035 are more than double the amount of that through 2030.
  - Incremental costs for the last ten years (2035-2045) exceeds that of the first 15 years (2021-2035).
  - In addition to the above, empirical evidence suggests a much larger range of cost uncertainty exists in the post 2030/35 timeframe.

- Other cost related observations include:
  - Load assumptions will drive investment needs. Uncertainty associated with load forecasts and profiles is material and can impact the rates more than the pathways modeled in LA100. How realistic is the load conditions assumed for 2035 and after?
  - Technology improvements and changes to future costs are another source of uncertainty. The combination of cost and technology risks may lead to stranded assets. Such risk should be evaluated with care, especially if early GHG reduction is important.
  - Transmission CapEx does not vary by pathway (other than Transmission Focus Scenarios). Note: transmission projects require long lead times.
  - H2- and RE-CT CapEx is quite high while their OpEx is miniscule.

Recommendation for investment options

- Focus on the near-term (through 2030 or 2035 at most) when costs are relatively lower and there is more certainty.
- Focus on proven technology with known costs rather than those that show higher investment costs and lower utilization.
  - Transmission investments do not vary by pathways and may be a “no-regrets” option. It also enables more diverse generation options (for both the short- and long-term) that benefits all customers, rather than a select group, contributing to environmental justice.
All LA100 pathways are shown to achieve 100% Clean Energy by 2045.

- A huge amount of renewables are added through 2030. Is this feasible?
  - More than half of all renewable PPAs (2x to 3x of today’s level) are signed by 2030.
  - Customer PV adoption timing and magnitude also coincides with this timing (3x to 5x of customer PV built by 2030).
  - Market dynamics (including prices) may not support customer investment decisions.
  - Renewable curtailment increases significantly after 2030 except for Early & No Biofuel Scenarios (e.g., SB100 Moderate jumps by nearly 14x from ~134 GWh in 2030 to ~1,864 GWh in 2035).
  - Observations from other markets indicate the difficulty of adding such amounts of renewables within the next 10 to 15 years.

Recommendation for cross-industry planning.

- Re-develop a plan for increasing renewables at the preferred pace for the next 10 to 15 years.
  - Revisit goal. What does 100% mean? Is it more important than the economy-wide GHG reduction or estimated health benefits? Do non-combustion emissions matter?

- Incorporate other recommendations listed in this section into this plan.
  - Weigh the cost and benefits of electrifying and decarbonizing other sectors.
  - Identify no-regret investments and those with longer lead time.
  - Observe changes in load (projection, profiles etc.) as they can impact investment decisions, particularly timing.
  - Identify areas where additional incentives are needed. This is not limited to economic benefits and includes social equity.
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LA100 Study Financial Assumptions

LA100 Study relies on 2019 ATB Assumptions:

**Financial Data Used in Resource Planning Model (RPM)**

<table>
<thead>
<tr>
<th>Name</th>
<th>Value</th>
<th>Information</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inflation Rate</td>
<td>2.50%</td>
<td></td>
<td>ATB2019</td>
</tr>
<tr>
<td>Capital Recovery Period</td>
<td>30 years</td>
<td></td>
<td>ATB2019</td>
</tr>
<tr>
<td>Interest Rate (real)</td>
<td>1.2% - 3.5%</td>
<td>Varies by technology</td>
<td>ATB2019</td>
</tr>
<tr>
<td>Interest During Construction [nominal]</td>
<td>3.9% - 8%</td>
<td>Varies by technology</td>
<td>ATB2019</td>
</tr>
<tr>
<td>Rate of Return on Equity (real)</td>
<td>2.45% - 12.45%</td>
<td>Varies by technology</td>
<td>ATB2019</td>
</tr>
<tr>
<td>Debt Fraction (real)</td>
<td>40% - 100%</td>
<td>Varies by technology</td>
<td>ATB2019</td>
</tr>
<tr>
<td>Tax Rate</td>
<td>25%</td>
<td>Includes federal and states.</td>
<td>ATB2019</td>
</tr>
<tr>
<td>Present Value of Depreciation</td>
<td>0.5 - 0.8</td>
<td>Varies by technology</td>
<td>ATB2019</td>
</tr>
<tr>
<td>WACC (real)</td>
<td>Calculated using other assumptions</td>
<td></td>
<td>ATB2019</td>
</tr>
</tbody>
</table>

- Key data points include:
  - Cost of debt during the construction and operation of the asset (the cost of equity during construction is NOT included).
  - Amount of debt provided during construction.
  - Required debt service coverage ratio (DSCR) debt providers used to determine the amount of debt (i.e., leverage) they would provide to a project during the operation of the asset.

A. Economic Growth -> G. Fuel Prices
   - Increase in economic growth leading to higher fuel consumption.

A. Economic Growth -> H. Load
   - Increase in economic growth leading to higher consumption and load growth.

B. Electrification -> G. Fuel Price
   - Higher electrification leading to lower fuel consumption.

B. Electrification -> H. Load
   - Higher electrification leading to higher load.

C. Clean Energy Policy -> B. Electrification
   - Stronger clean energy policies leading to increased electrification (either directly or indirectly).

C. Clean Energy Policy -> D. Renewables Deployment
   - Stronger clean energy policies leading to increased renewables (either directly or indirectly).

C. Clean Energy Policy -> F. Thermal Generation
   - Stronger clean energy policies leading to increased retirements of thermal generation.
   - Clean energy policies favoring nuclear (and providing subsidies), or favoring gas over coal.

C. Clean Energy Policy -> I. Rates
   - Clean energy policies reducing energy prices in the short-run.
   - Clean energy policies requiring additional investments, leading to higher fixed costs.
D. Renewable Deployments -> B. Electrification
  • + Increased renewables deployment lowering energy prices and increasing electrification.

D. Renewable Deployments -> F. Thermal Generation
  • + Increased renewables deployment requiring more ramping capabilities and leading to higher capacity prices.
  • - Increased renewables reducing generation from thermal resources and further lowering energy prices, leading to earlier retirements.

D. Renewable Deployments -> G. Fuel Price
  • - Increased renewables deployment reducing fuel demand for power generation.

D. Renewable Deployments -> H. Load
  • - Increased distributed renewables reducing net load.

D. Renewable Deployments -> I. Rates
  • + Renewables deployment requiring more investments.
  • - Increased renewables deployment lowering energy prices.

E. Falling Renewable & Storage Costs -> D. Renewable Deployments
  • + Lower prices will increase renewables deployments.

F. Thermal Generation -> G. Fuel Price
  • + More thermal generation needs putting upward pressure on fuel prices.

F. Thermal Generation -> I. Rates
  • + More thermal generation increasing short-run energy costs.
  • - More generation from depreciated thermal assets lowering fixed costs.
G. Fuel Price -> B. Electrification
  + Higher fuel prices encouraging electrification.

G. Fuel Price -> D. Renewable Deployments
  + Higher fuel prices increasing thermal generation cost and encouraging renewable deployment.

G. Fuel Price -> F. Thermal Generation
  + Higher fuel prices increasing energy prices and net revenues for thermal generation.
  - Higher fuel prices decreasing generation from thermal generation and net revenue.

G. Fuel Price -> I. Rates
  + Higher fuel prices increasing short-run energy costs.
  - Higher fuel price reducing generation from thermal resources, leading to lower rates.

H. Load -> G. Fuel Price
  + Higher load increasing fuel needs for generation, putting upward pressure on prices.

H. Load -> I. Rates
  + Higher load will increase needs for generation, pushing the demand curve up the supply curve.
  - Higher load may result in lower share of fixed costs.
Glossary

ATB: Annual Technology Baseline
CapEx: Capital Expenses
CO2e: Carbon Dioxide Equivalents
CT: Combustion Turbine
DSCR: Debt Service Coverage Ratio
DR: Demand Response
EE: Energy Efficiency
EV: Electric Vehicles
FERC: Federal Energy Regulatory Commission
FSO: Financial Services Office
GHG: Greenhouse Gas
GW: Gigawatt
GWh: Gigawatt hour
H2: Hydrogen
IRP: Integrated Resource Plan
LA: Los Angeles
LADWP: Los Angeles Department of Water and Power
LCOE: Levelized Cost of Energy
MW: Megawatt
MWh: Megawatt hour
MMT: Millions Metric Ton
NEL: Net Energy for Load
NOx: Nitrogen Oxides
NREL: National Renewable Energy Laboratory
O3: Ozone
OPA/RPA: Office of Public Accountability/Ratepayer Advocate
OpEx: Operating Expenses
PM2.5: Fine Particulate Matters
PPA: Power Purchase Agreement
PV: Photovoltaic
RE: Renewable
SB100: Senate Bill 100
SF6: Sulfur Hexafluoride
SLTRP: Strategic Long-Term Resource Plan
SP15: the South of Path 15 Zone of the California ISO Control Area
T: Tonne, metric ton
WACC: Weighted Average Cost of Capital
Unit price per peak load and unit price per energy consumption show a similar trend with the total expenditure (slide 14).


Cost do not include debt payments on asset installed prior to 2021, distribution maintenance costs, or costs associated with energy efficiency or demand response program. Unit price per peak load is calculated as expenditure in million dollars on slide 14 divided by energy peak load of MW on slide 51. Unit price per energy consumption is calculated as expenditure in million dollars on slide 14 divided by energy consumption in GWh on slide 52.
Unit price per peak load and unit price per energy consumption show a similar trend with the total CapEx (slide 18).

Sources and notes: SLTRP 2017 Modified extends only through 2036. Cost and Load data from NREL Study website, https://maps.nrel.gov/ia100/data-viewer?Theme=system-costs&Resolution=lc&LoadScenario=moderate&RomScenario=sb100&LayerId=xmission.cost&Year=2045&Variable=dlrs_millions and Data from NREL Study website, https://maps.nrel.gov/ia100/data-viewer?Theme=electricity-demand&SubTheme=electricity-consumption&Resolution=lc&LoadScenario=moderate&LayerId=electricity-demand_peak-demand&Year=2045&Variable=kwh&TemporalResolution=annual&TimePeriod=peak.

Cost do not include debt payments on asset installed prior to 2021, distribution maintenance costs, or costs associated with energy efficiency or demand response program. Unit price per peak load is calculated as expenditure in million dollars on slide 18 divided by energy peak load of MW on slide 51. Unit price per energy consumption is calculated as expenditure in million dollars on slide 18 divided by energy consumption in GWh on slide 52.
Unit price per peak load and unit price per energy consumption show a similar trend with total OpEx (slide 24).

**Unit Price per Peak Load by Scenario (OpEx)**

- $/kW

**Unit Price per Energy Consumption by Scenario (OpEx)**

- $/kWh


Cost do not include debt payments on asset installed prior to 2021, distribution maintenance costs, or costs associated with energy efficiency or demand response program. Unit price per peak load is calculated as expenditure in million dollars on slide 24 divided by energy peak load of MW on slide 51. Unit price per energy consumption is calculated as expenditure in million dollars on slide 24 divided by energy consumption in GWh on slide 52.
Estimated OpEx by Pathway - 1/2

- Renewable PPAs share the bulk of the OpEx and generally increase over the years.
  - The exception is the Early and No Biofuel Scenarios, which show much higher costs (total, CapEx, and OpEx) over other pathways.

### Renewable PPA Expenditures by Pathways (% of Total OpEx)

<table>
<thead>
<tr>
<th>Pathways</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
</tr>
</thead>
<tbody>
<tr>
<td>SLTRP 2017 Modified</td>
<td>45%</td>
<td>58%</td>
<td>65%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SB100 Moderate</td>
<td>43%</td>
<td>58%</td>
<td>68%</td>
<td>74%</td>
<td>77%</td>
</tr>
<tr>
<td>SB100 High</td>
<td>44%</td>
<td>59%</td>
<td>68%</td>
<td>74%</td>
<td>77%</td>
</tr>
<tr>
<td>SB100 Stress</td>
<td>42%</td>
<td>56%</td>
<td>66%</td>
<td>72%</td>
<td>75%</td>
</tr>
<tr>
<td>Early &amp; No Biofuels Moderate</td>
<td>71%</td>
<td>86%</td>
<td>90%</td>
<td>91%</td>
<td>91%</td>
</tr>
<tr>
<td>Early &amp; No Biofuels High</td>
<td>69%</td>
<td>85%</td>
<td>89%</td>
<td>91%</td>
<td>91%</td>
</tr>
<tr>
<td>Transmission Focus Moderate</td>
<td>60%</td>
<td>74%</td>
<td>80%</td>
<td>82%</td>
<td>83%</td>
</tr>
<tr>
<td>Transmission Focus High</td>
<td>59%</td>
<td>75%</td>
<td>80%</td>
<td>83%</td>
<td>82%</td>
</tr>
<tr>
<td>Limited New Transmission Moderate</td>
<td>60%</td>
<td>75%</td>
<td>81%</td>
<td>83%</td>
<td>84%</td>
</tr>
<tr>
<td>Limited New Transmission High</td>
<td>60%</td>
<td>76%</td>
<td>82%</td>
<td>84%</td>
<td>85%</td>
</tr>
</tbody>
</table>

Sources and notes: SLTPR 2017 Modified extends only through 2036. Other renewables (including wind, solar and geothermal) are assumed to be PPAs. Data from NREL Study website, https://maps.nrel.gov/la100/data-viewer?Theme=system-costs&Resolution=lc&LoadScenario=moderate&RpmScenario=sb100&LayerId=xmission.cost&Year=2045&Variable=dhrs_millions.
While the H2-CT and RE-CT shares of the CapEx (3 to 5 GW of capacity by 2045) is significant (see slides 20 and 21), their share of OpEx is minuscule.
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