Electricity Usage:
Helping Users Understand Energy Bills

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Background: The Electricity Grid

- Increase in renewables, leading to cleaner sources of electricity.
  - 24.76% in July 2018 to 32% in July 2022 (CAISO Monthly Renewables Performance report)

July 2018

24.76%
Jul Average Renewable Serving Load

10439MW
Jul Max Solar Production

4389MW
Jul Max Wind Production

July 2022

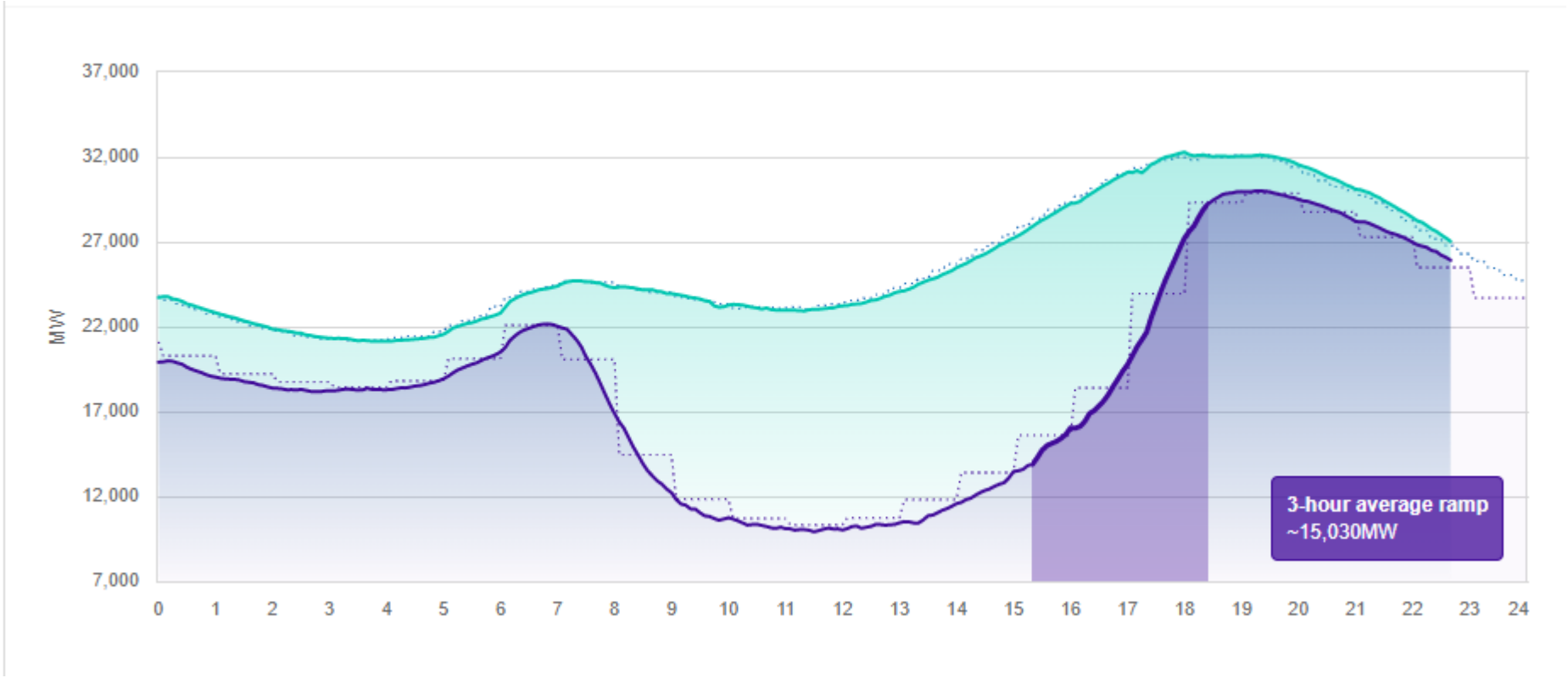
32.28%
Jul Average Renewable Serving Load

14224MW
Jul Max Solar Production

5661MW
Jul Max Wind Production

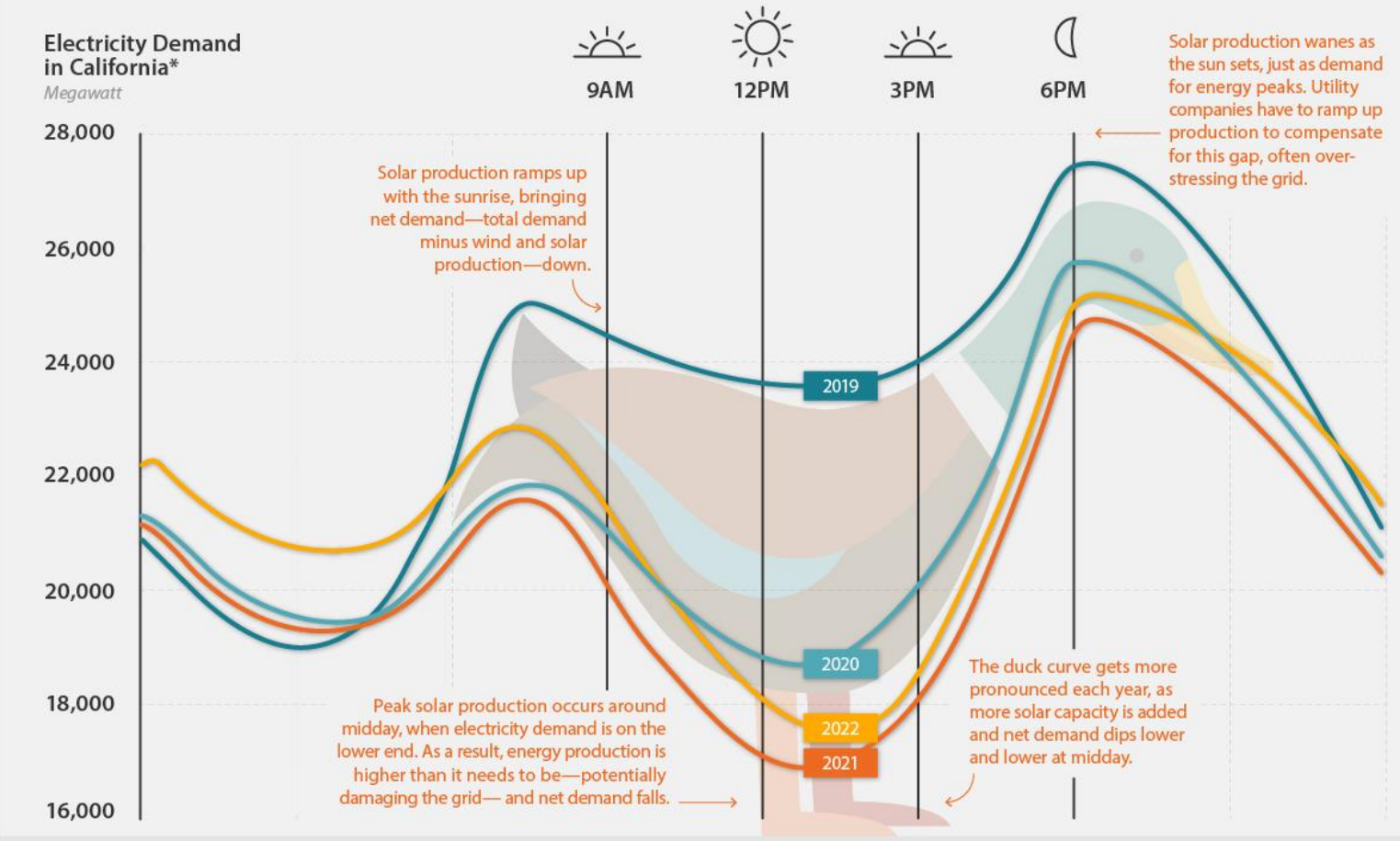
Background: Net Demand Trend

- Example of Demand Trend vs. Net Demand Trend (Demand – Wind – Solar)
  - 9/22/2022 (CAISO)

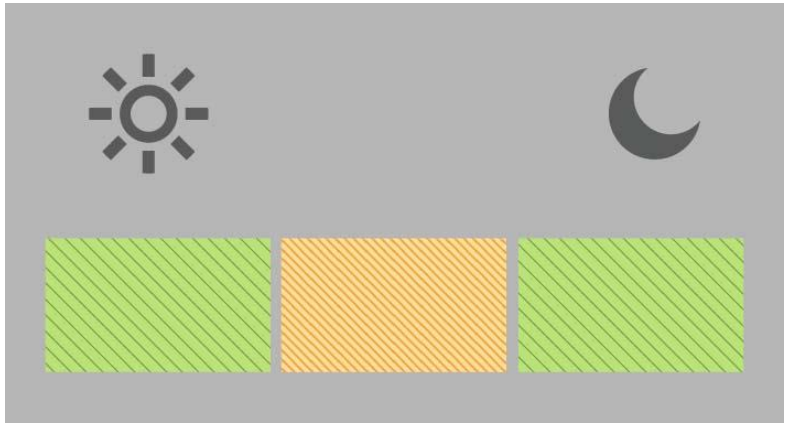


Background: Current Issue

- With primarily solar energy, the grid cannot eliminate all nonrenewable resources. Known as the Duck Curve.



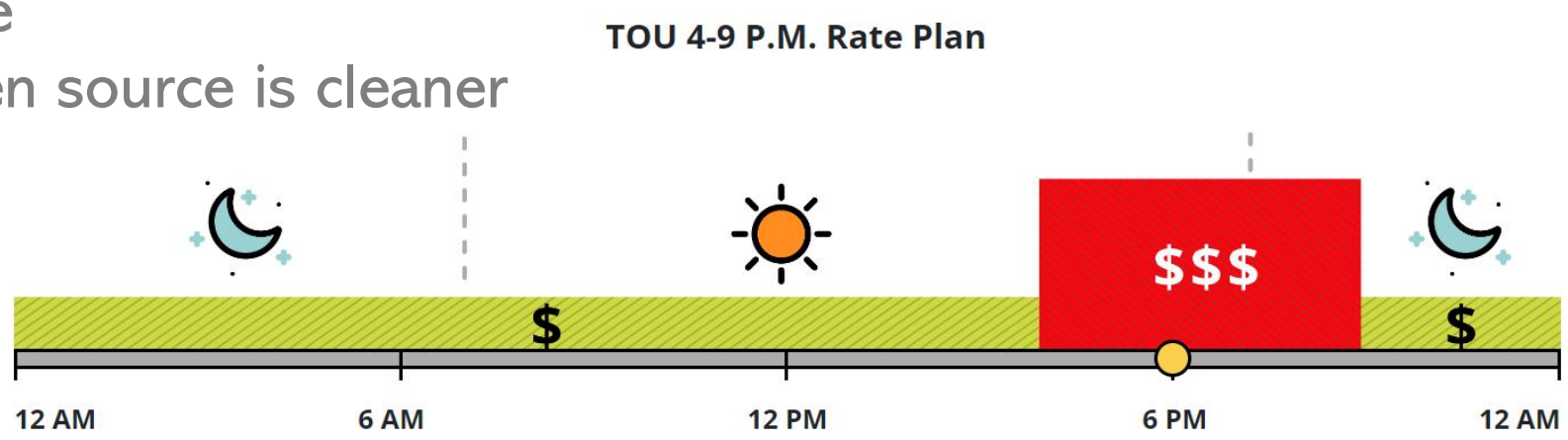
TOU Rates



- On-peaks hours around late afternoon till early evening.
  - Cost are highest when the demand are largest.
  - Occurs when less renewable resources are available.

- Off-peaks hours
  - Cheaper cost when demand is low and/or high levels of renewable energy

- Incentivizes users to:
  - Reduce energy usage
  - Utilize electricity when source is cleaner

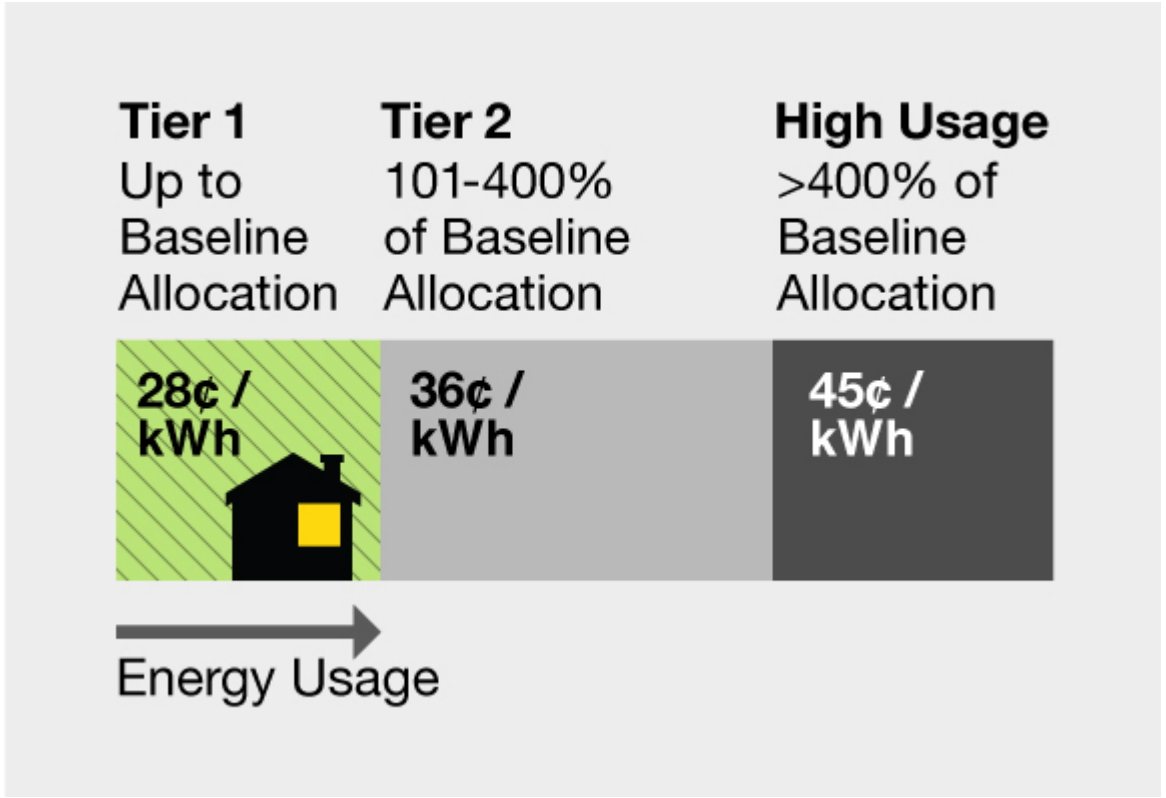


Tiered Rate Plan

Tiered Rate Plans are more traditional billing plans.

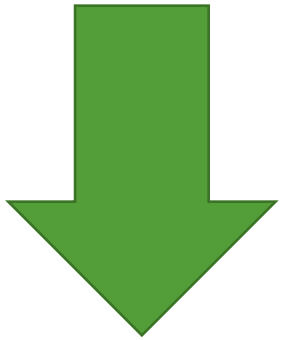
Pro: Encourages lower overall usage
Cons: Fails to account for the energy source.

SCE started offering TOU Rate Plans in 2018, which encourages use of cleaner sources.



How to Help Residential Users?

Which tariff to chose? (lower electricity bill)
How to lower carbon intensity? (reduce emission)
How to decipher the complex data provided by SCE?



A dashboard that provides critical insights to facilitate a user's electricity usage plan

The Dashboard

SOUTHERN CALIFORNIA EDISON
An EDISON INTERNATIONAL Company

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"Data for period starting: 2021-07-01 00:00:00  for 24 hours"
Energy   Consumption  time period,Usage (Real energy in kilowatt-hours)(Real
energy in kilowatt-hours),Reading quality
"2021-07-01 00:00:00 to 2021-07-01 01:00:00","0.270",""
"2021-07-01 01:00:00 to 2021-07-01 02:00:00","0.230",""
"2021-07-01 02:00:00 to 2021-07-01 03:00:00","0.240",""
"2021-07-01 03:00:00 to 2021-07-01 04:00:00","0.270",""
"2021-07-01 04:00:00 to 2021-07-01 05:00:00","0.250",""
"2021-07-01 05:00:00 to 2021-07-01 06:00:00","0.220",""
"2021-07-01 06:00:00 to 2021-07-01 07:00:00","0.290",""
"2021-07-01 07:00:00 to 2021-07-01 08:00:00","0.820",""
"2021-07-01 08:00:00 to 2021-07-01 09:00:00","0.660",""
"2021-07-01 09:00:00 to 2021-07-01 10:00:00","0.480",""
"2021-07-01 10:00:00 to 2021-07-01 11:00:00","0.320",""
"2021-07-01 11:00:00 to 2021-07-01 12:00:00","0.330",""
"2021-07-01 12:00:00 to 2021-07-01 13:00:00","0.220",""
"2021-07-01 13:00:00 to 2021-07-01 14:00:00","0.240",""
"2021-07-01 14:00:00 to 2021-07-01 15:00:00","0.260",""
"2021-07-01 15:00:00 to 2021-07-01 16:00:00","0.360",""
"2021-07-01 16:00:00 to 2021-07-01 17:00:00","0.510",""
"2021-07-01 17:00:00 to 2021-07-01 18:00:00","2.360",""
"2021-07-01 18:00:00 to 2021-07-01 19:00:00","5.270",""
"2021-07-01 19:00:00 to 2021-07-01 20:00:00","0.810",""
"2021-07-01 20:00:00 to 2021-07-01 21:00:00","0.880",""
"2021-07-01 21:00:00 to 2021-07-01 22:00:00","0.570",""
"2021-07-01 22:00:00 to 2021-07-01 23:00:00","0.400",""
"2021-07-01 23:00:00 to 2021-07-02 00:00:00","0.350",""
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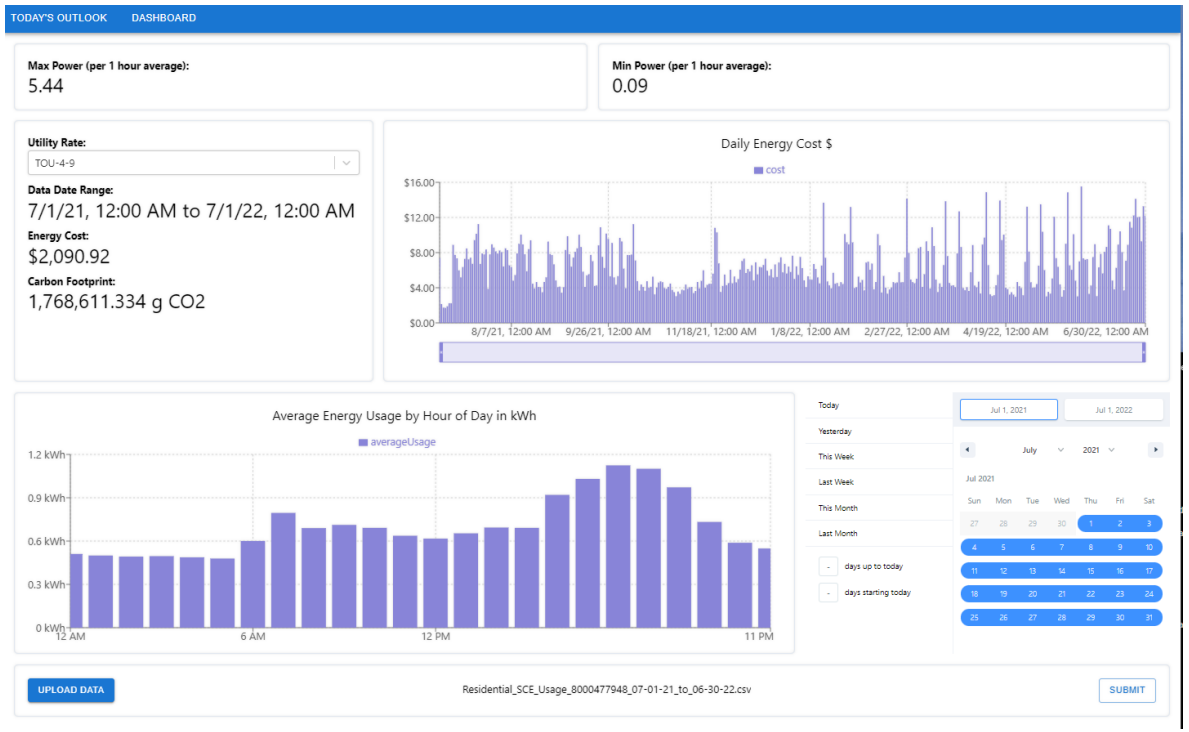


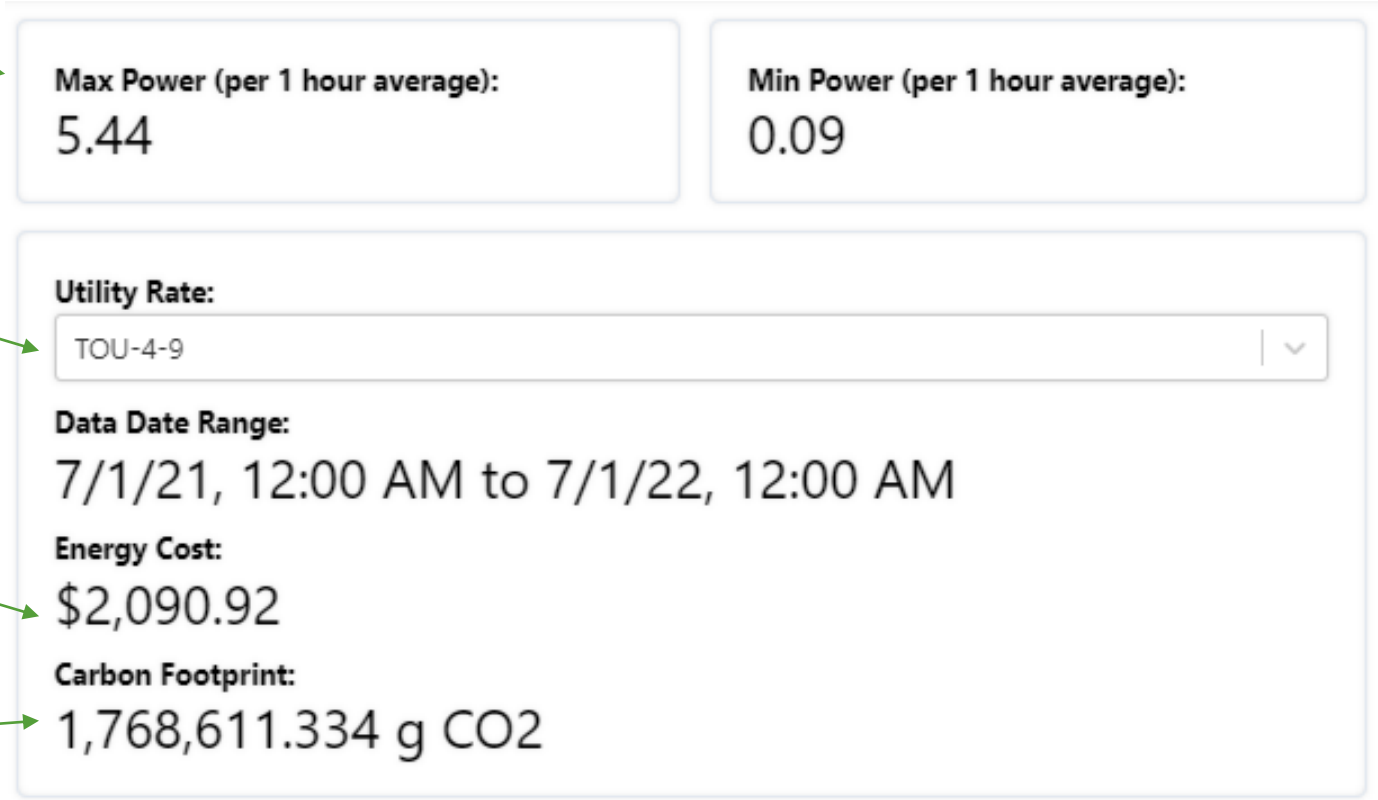
Major Functionalities

Min/Max Average Power

Selected Utility Tariff

Estimated Utility Cost

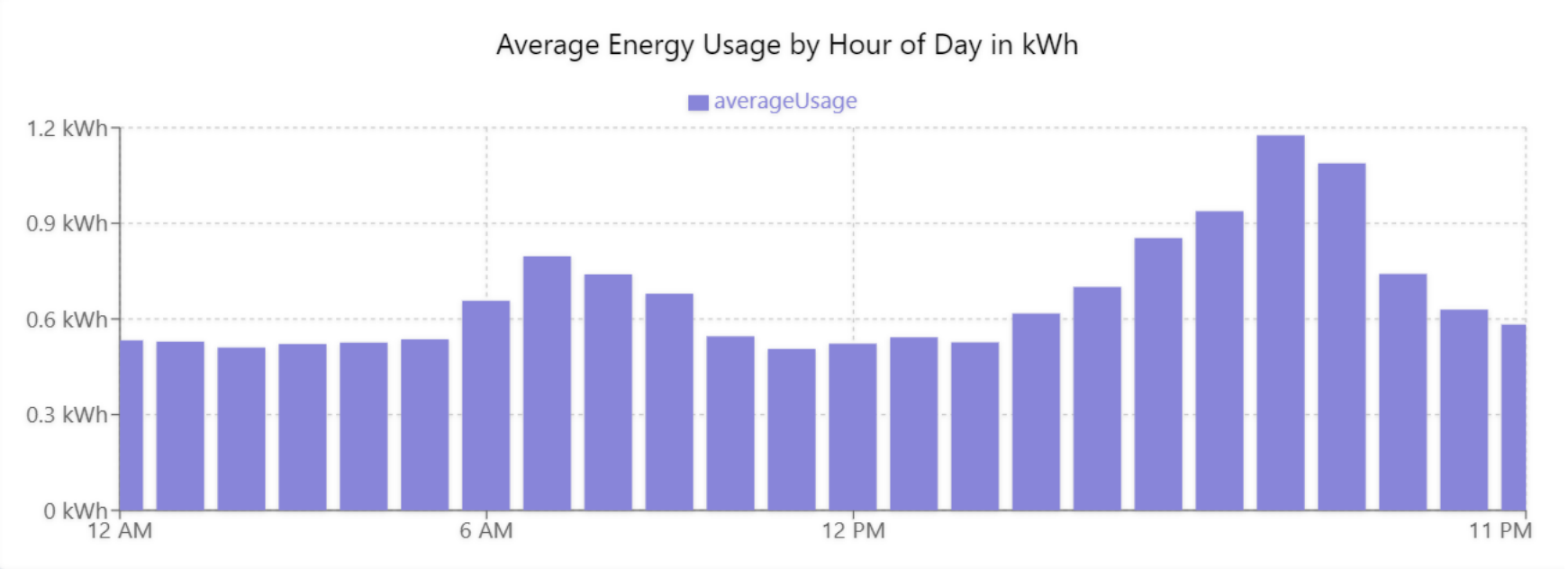
Carbon Emission



Comparing Various Tariffs

TOU-PRIME	TOU-D-4-9PM	TOU-D-5-8PM
$1,949.78	$2,090.92 (+7%)	$2,106.16 (+8%)

Data Visualization and Analysis

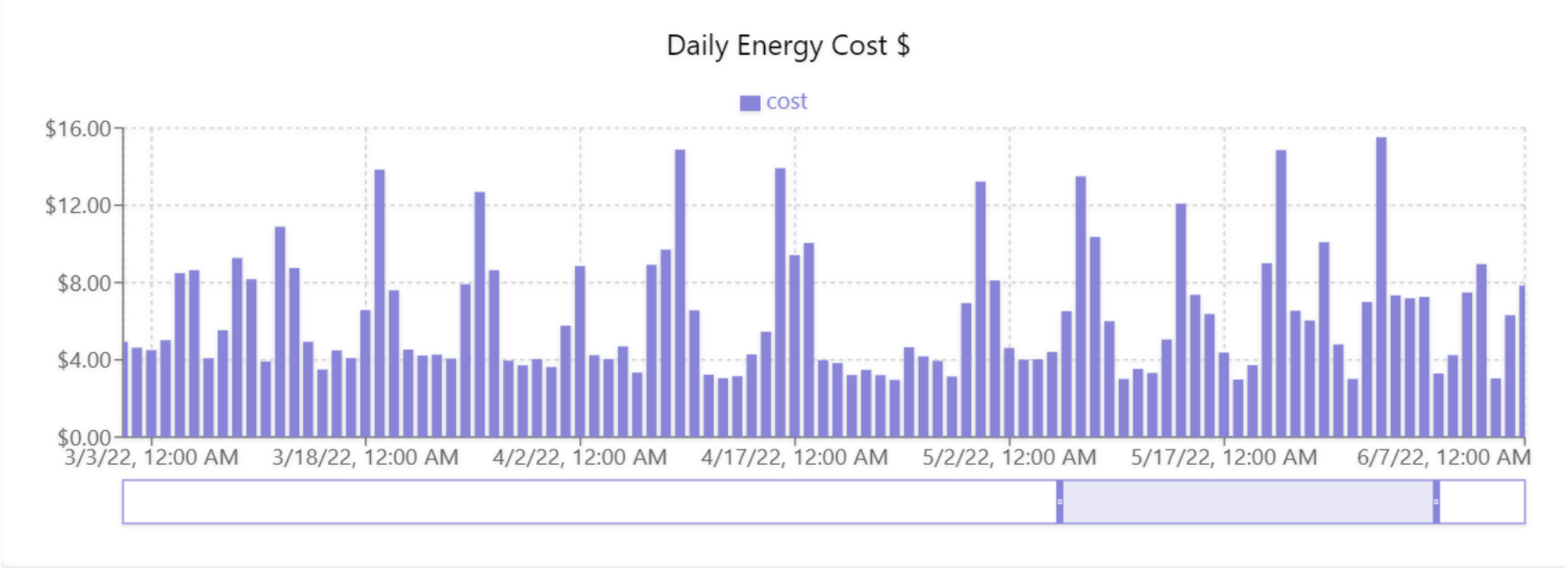


Observation: High energy usage during “on-peak” hours. Thus, higher cost and carbon emission.

Potential Recommendations:

- Load flexibility – shifting energy usage towards off-peak hours
- Energy storage
  - Batteries – Tesla Powerwall
  - Thermal Storage – UCI’s cold water storage tank

Data Visualization and Analysis



Observation: High energy cost on 3/19 (Sat), 3/26 (Sat), 4/9 (Sat)…

- Likely Residential User. High usage during weekends.
- Commercial User will have different daily energy cost.

Potential Recommendations: Utilize days when energy usage/cost is low to fill up storage systems (e.g. batteries).

Today's Outlook

Real-time data imported from CAISO's API.

Future Works

- Time Series Prediction Models
  - Utilize past residential/commercial users usage pattern to predict future loads.
  - Incorporate real-time weather forecast to refine model
- Additional Real-time data from CAISO.
  - Makeup of electricity supply (more accurate measure of CO2 emissions)
- Incorporation of onsite Solar Panel data to provide a more wholistic overview of electricity usage.

THANK YOU!

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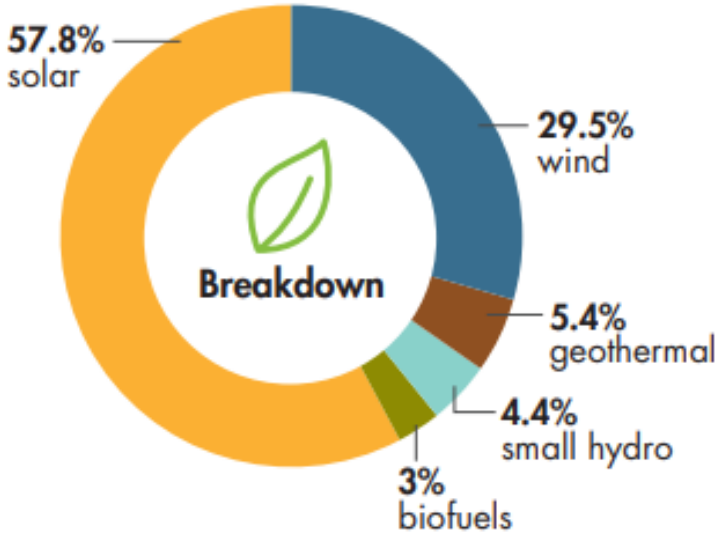
CALPLUG Background: Renewables Breakdown

- Currently, the majority of California's renewable energy comes from solar.
  - Accounts for 58% of all renewable resources

Installed renewable resources *(as of 09/01/2022)*



	Megawatts
Solar	15,608
Wind	7,956
Geothermal	1,465
Small hydro	1,182
Biofuels	804
TOTAL	**27,015**

See Today's Outlook