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Opportunities for Energy Storage in CAISO

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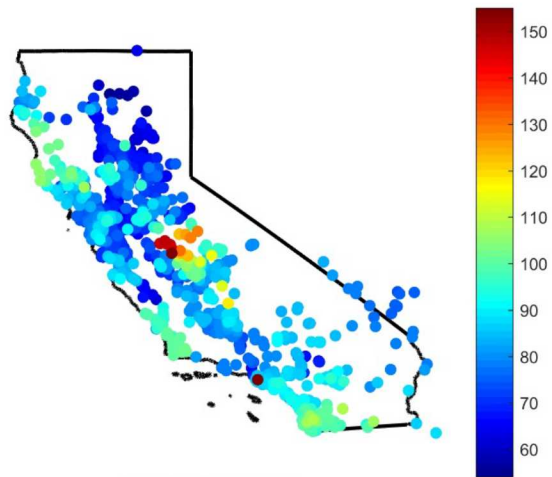
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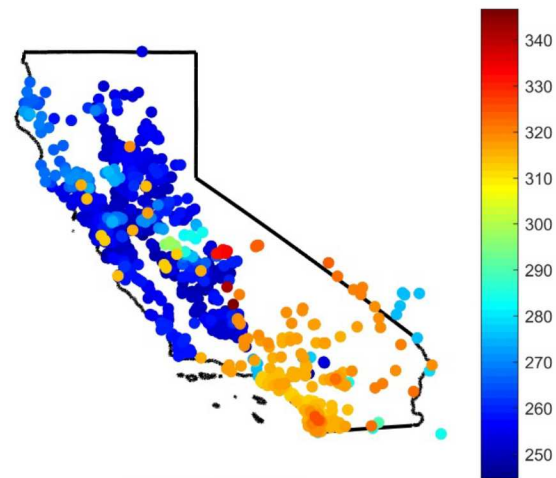
Background

- Goals:
 - formulate the optimization problem for maximizing energy storage revenue in CAISO
 - Arbitrage and frequency regulation
 - Analyze several years of historical data (2014-2016) at ~2,000 nodes (assume perfect foresight)
- Formulated the LP optimization problem
- Assumed a 1 MW/4 MWh system, 85% efficiency
- Expected outcome: frequency regulation provides more revenue opportunity

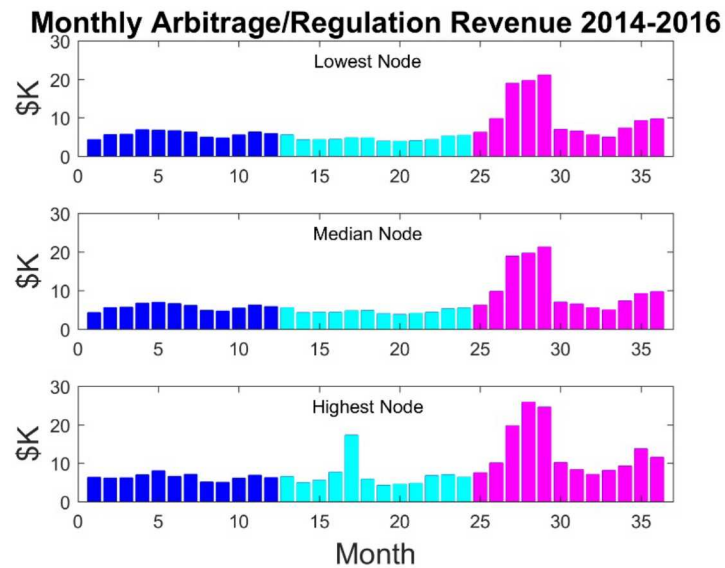
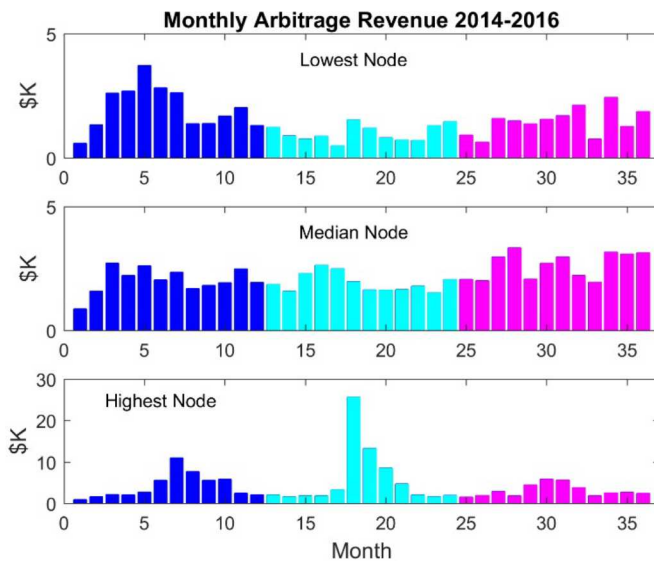
Results



2014-2016 Total DAM
Arbitrage Revenue (\$K)



2014-2016 Total DAM
Arbitrage plus Regulation Revenue (\$K)



Conclusions/Recommendations

- Arbitrage revenue opportunity is highly location dependent
- Frequency regulation provides the maximum revenue opportunity
- Because there are only a few frequency regulation zones – this reduces the impact of location
- Optimum policy – frequency regulation all the time

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