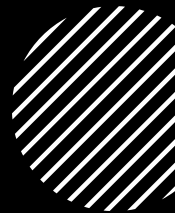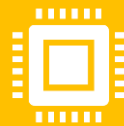# Long Duration Storage

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CAISO has successfully implemented three long duration storage models

Hydro (daily energy limit, monthly plan)

Pumped hydro (discrete pumping state, commitment costs)

Hybrid (market participant manages state of charge, provides telemetry so CAISO can verify feasibility after the fact)

Each of these models has limitations in representing other forms of long duration storage, such as batteries, aggregated EVs or gravity storage, in the wholesale markets

Another complication: California's decarbonization plans assume a long duration storage use case over periods longer than daily markets or monthly RA plans can capture
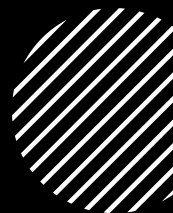
Seasonal energy shifting

Backup energy to cover renewable unavailability

Potential for uses of stored energy to be used outside of electric markets

Potential model enhancements

Enhanced pumped storage model allowing variable pumping bid curve

Enhanced hydro model: throughput limits and monthly energy plan

Enhanced NGR model: incorporate charge/discharge state change and enable initial and final SOC values in DA markets to be bid in at an opportunity cost; spread bidding

"MSG"-style models: configurations and/or bids based on state of charge ranges