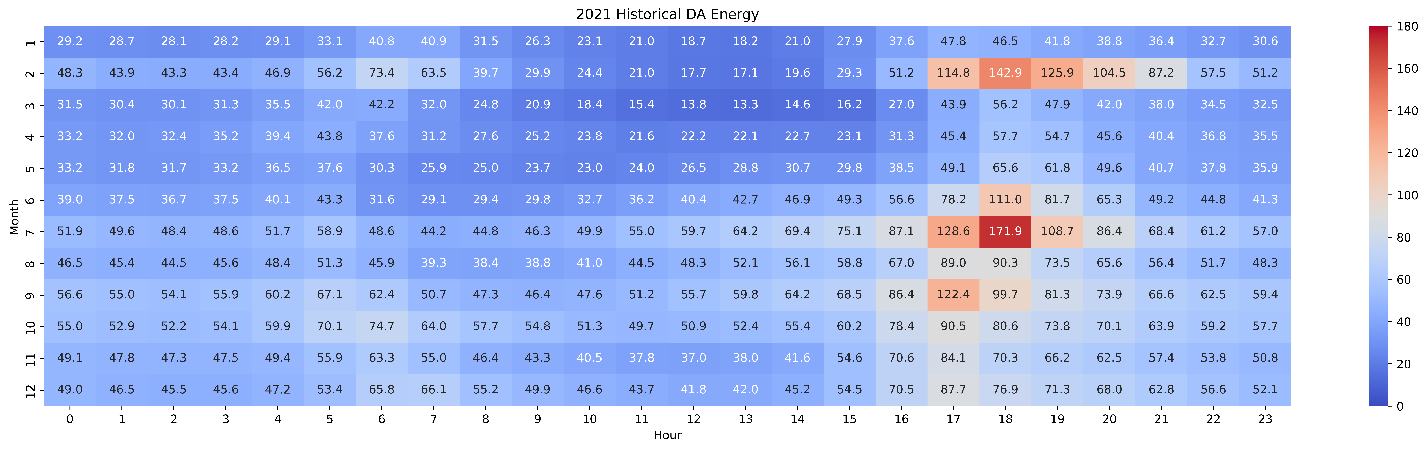
Price Heat Maps

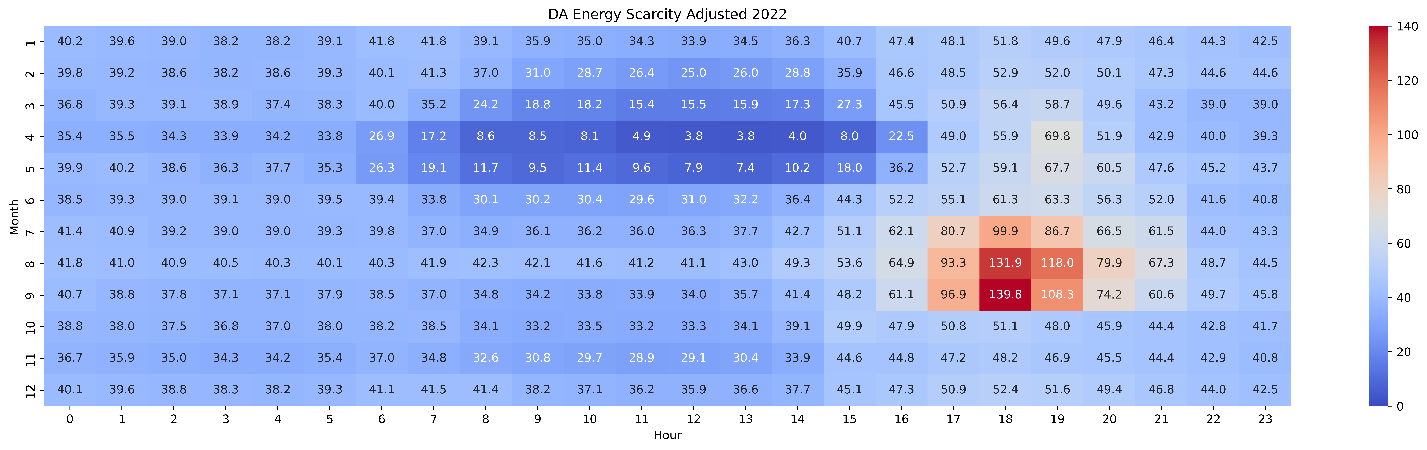
All prices are in $2018 and for zone NP15

# DA Energy Prices

Historical 2021



Scarcity Adjusted 2022

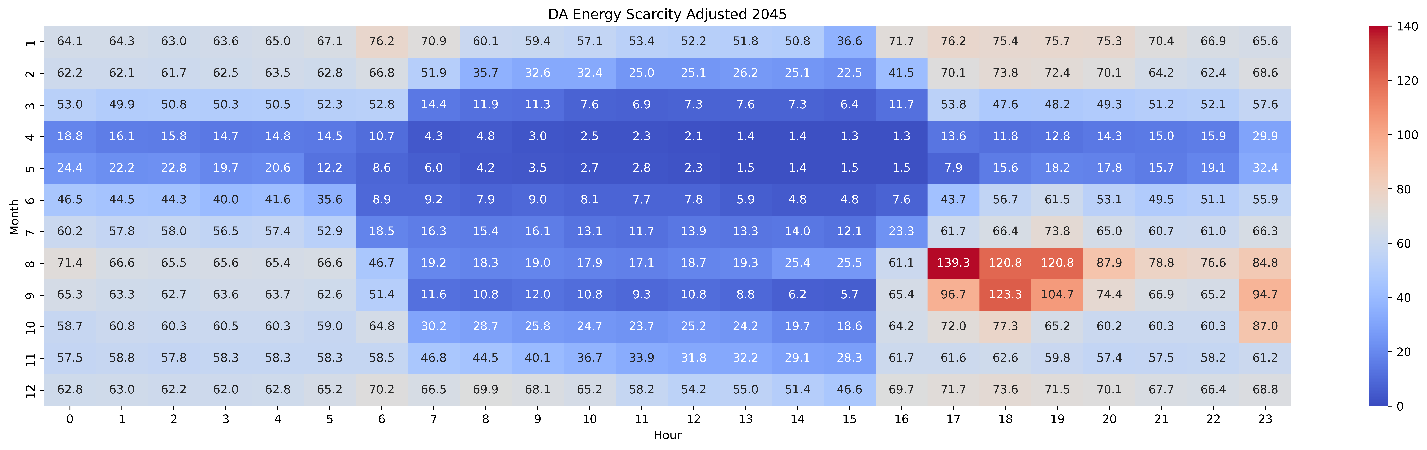


Scarcity Adjusted 2030

Calendar

Description automatically generated

Scarcity Adjusted 2045



# Ancillary Services (AS) Prices

The ancillary services prices are directly from SERVM without any scarcity adjustment. The current set of AS prices still require fine tuning and CPUC SERVM team is going to work on it with Astrape to refine the AS price forecasts for use in the 2022 ACC update.

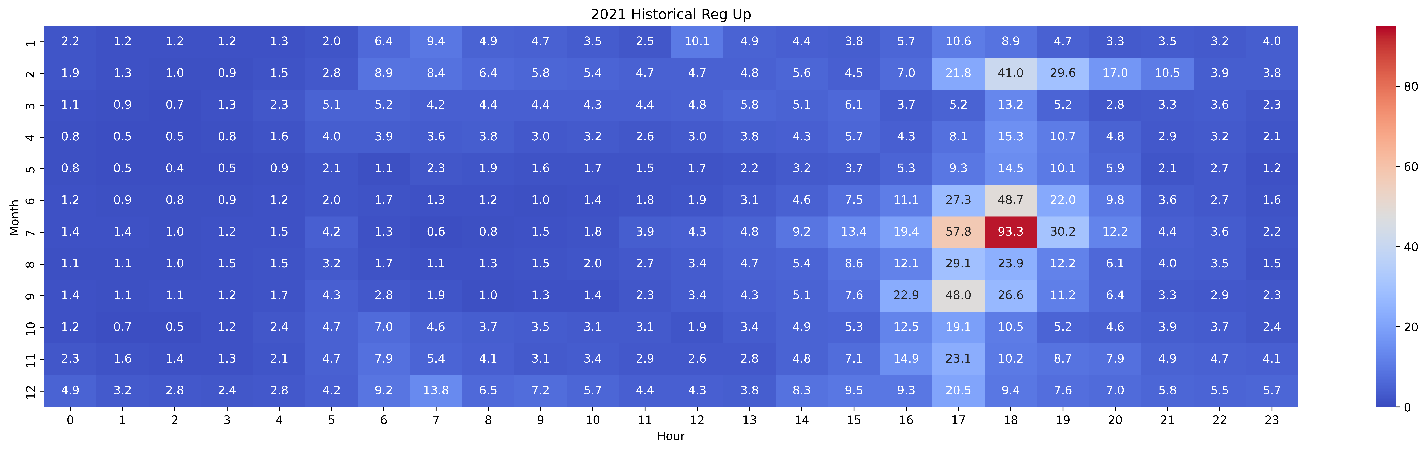
### Description of ancillary service price formation in SERVM from Astrape:

The ancillary services price formation in SERVM includes both the effects of scarcity and the cost of serving the next increment of the respective ancillary service. Scarcity cost is a simple lookup of the current available reserves on the operating reserve demand curve. In most hours, since available reserves exceed the demand of reserves, the scarcity component is at $0 or at an alternate floor price.

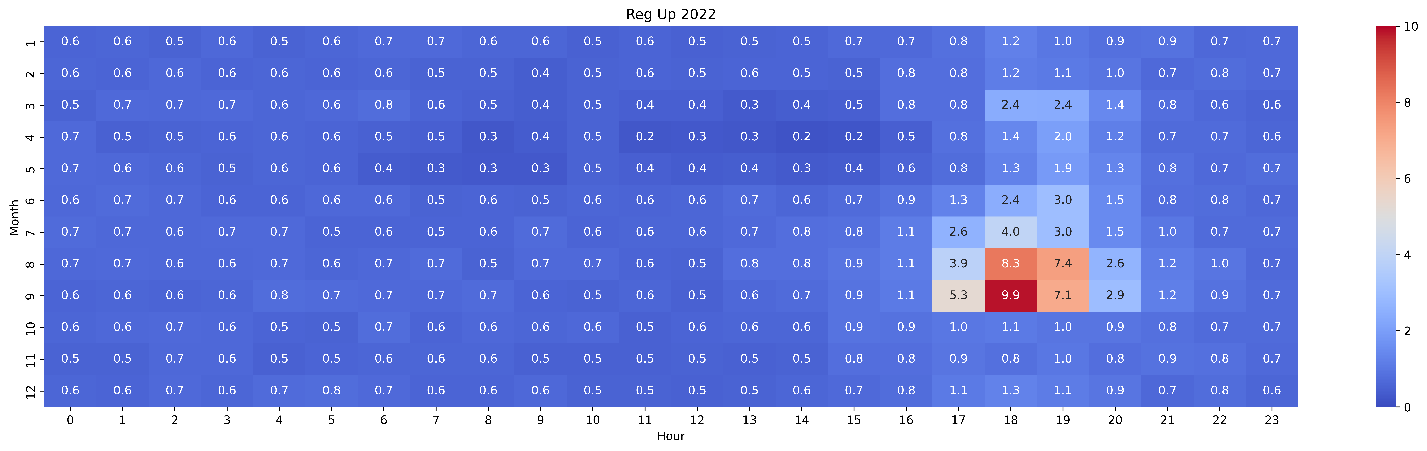
Calculating the cost of the next increment of an ancillary service considers the foregone profits that could have been made from energy market sales. This is a resource’s opportunity cost of providing the ancillary service. At high battery penetrations, the opportunity cost calculation is not straightforward because there are temporal aspects to determining the cost of the next unit of ancillary service. Supplying one more unit of ancillary service could affect the energy schedule of energy limited resources in other hours which would affect pricing in those hours. Calculating the ancillary service price for each hour in isolation resulted in counter-intuitive trends in pricing profiles. An alternate ancillary service price formation algorithm in SERVM that resolves the temporal concerns is in beta testing. The current ancillary service prices reported below reflect only the scarcity pricing component with a price floor.

# Reg UP

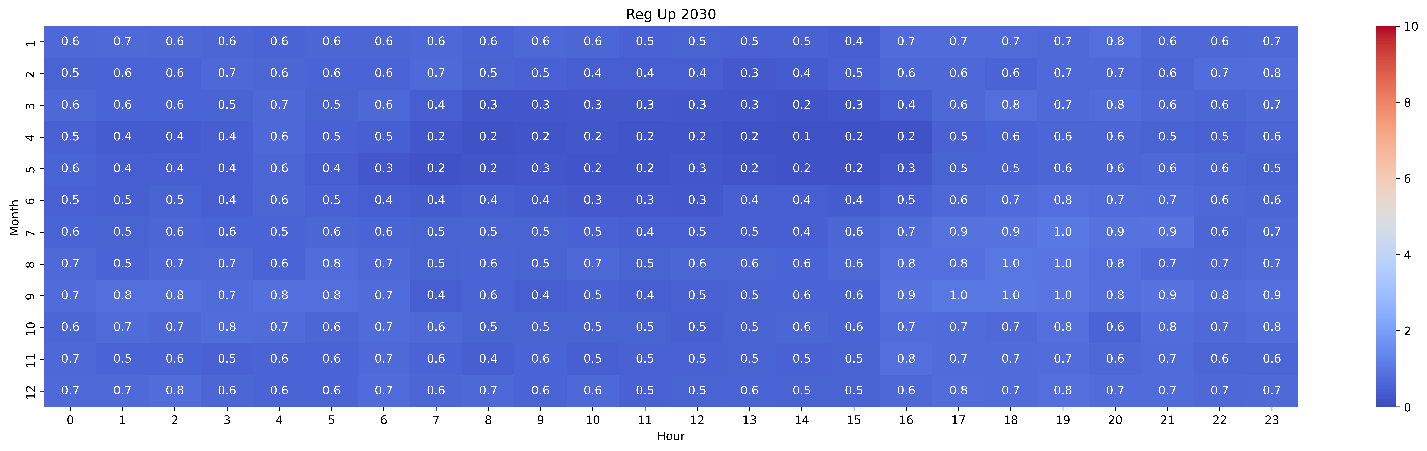
Historical 2021



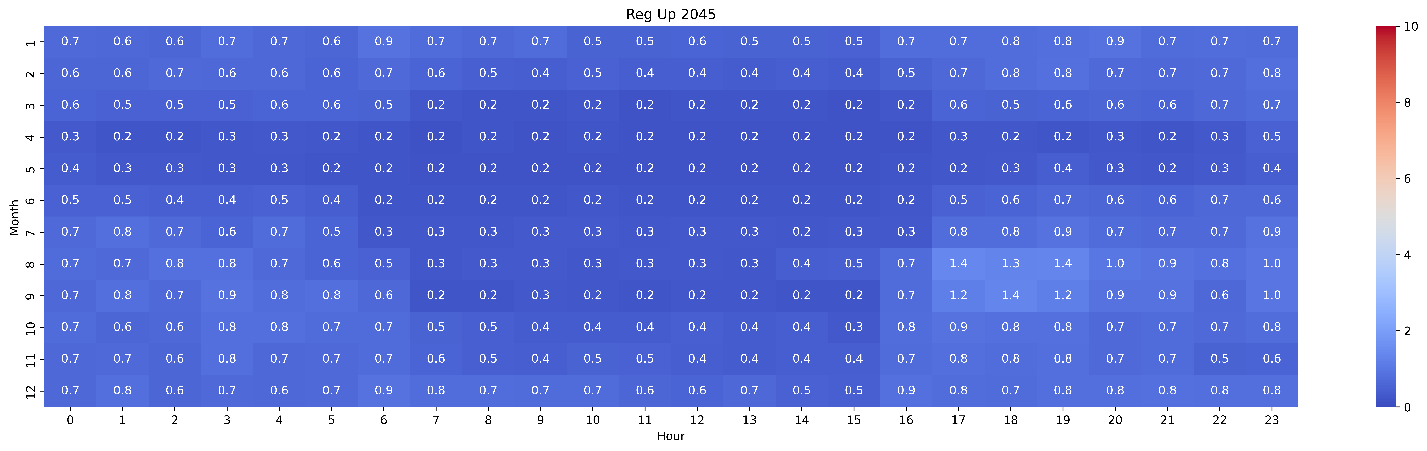
2022



2030



2045

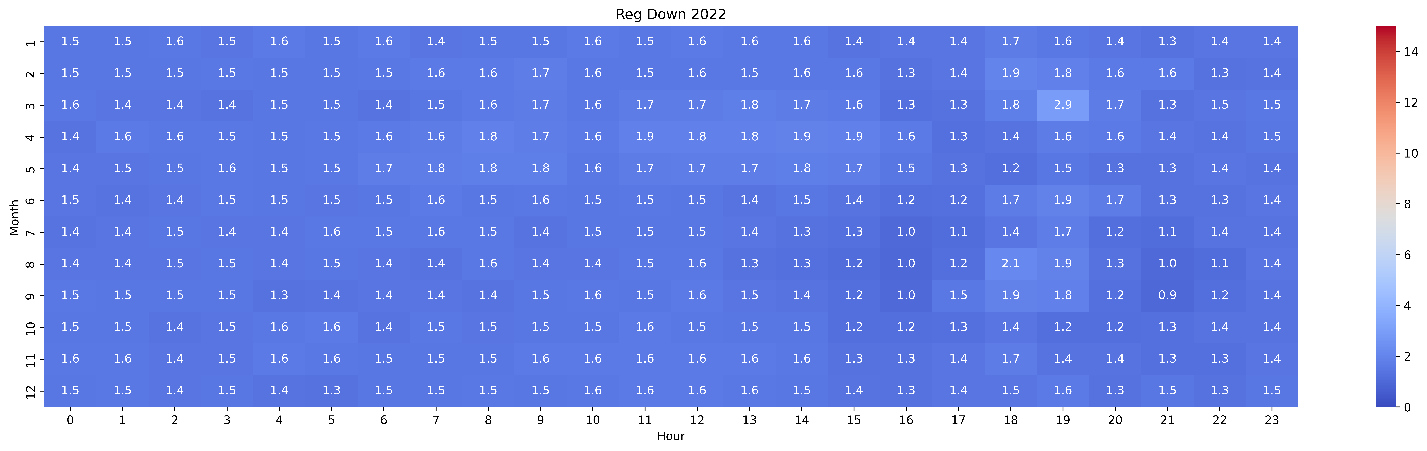


# Reg Down

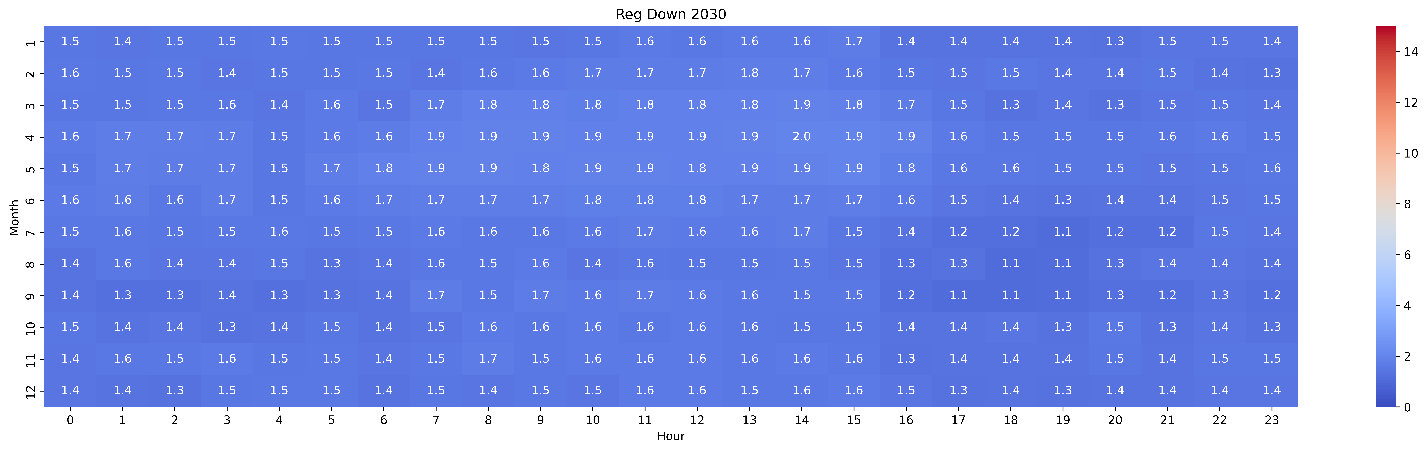
Historical 2021



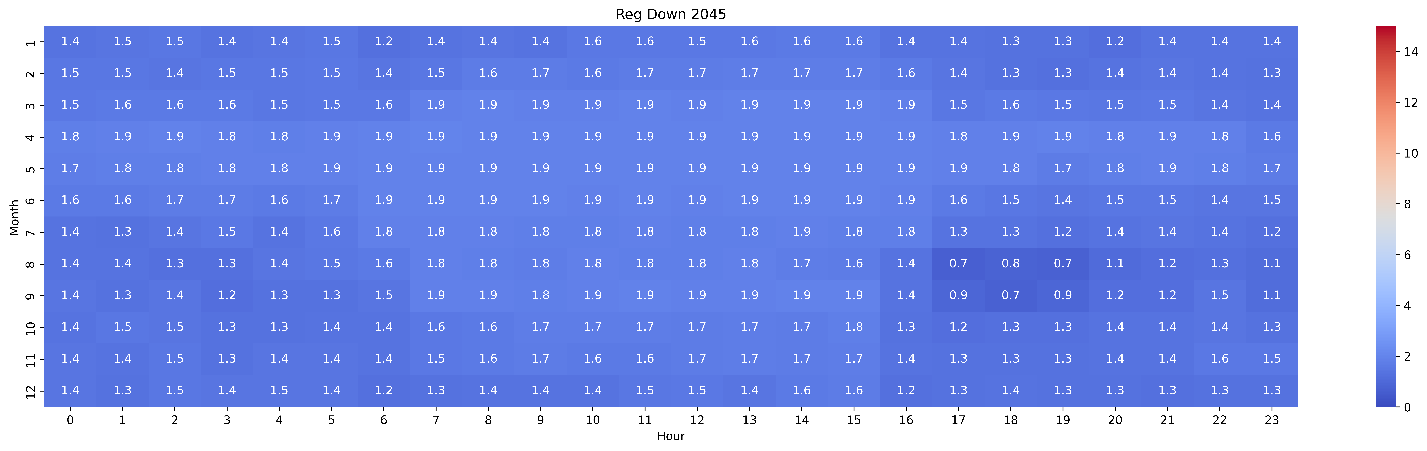
2022



2030

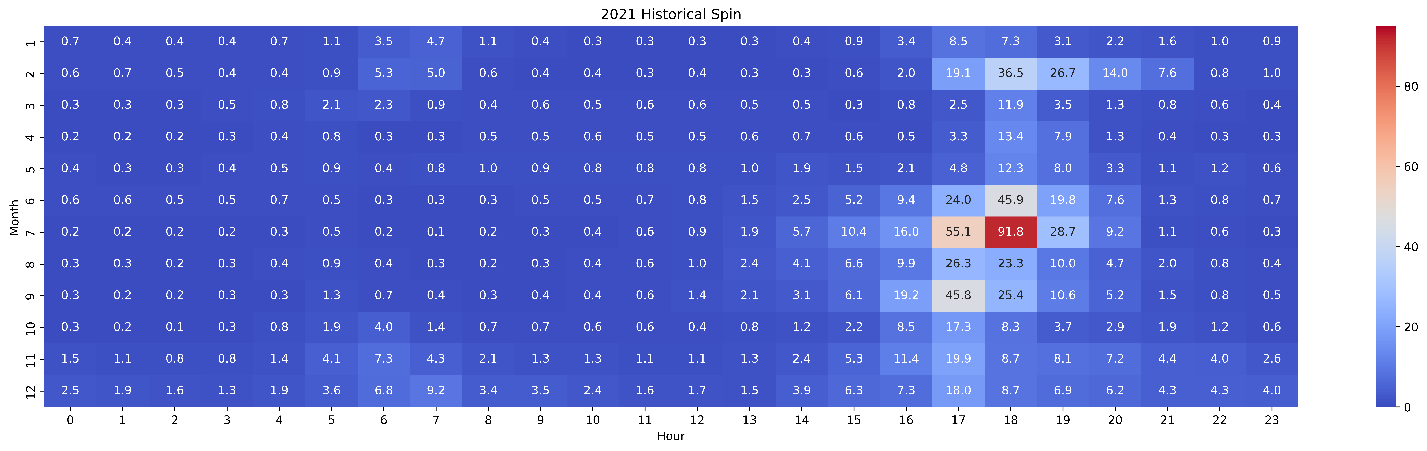


2045

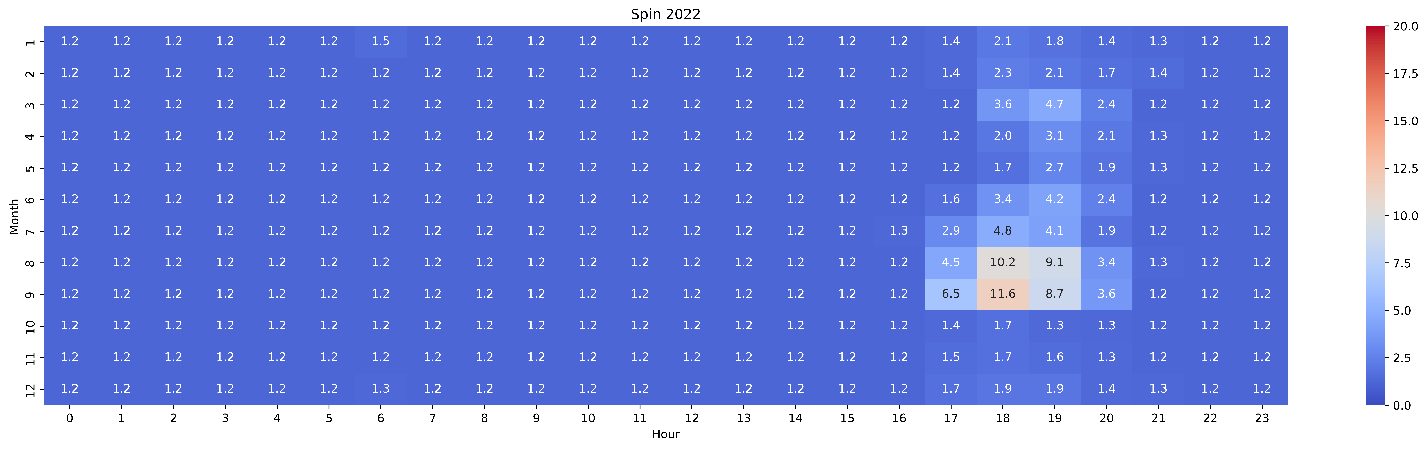


# Spin

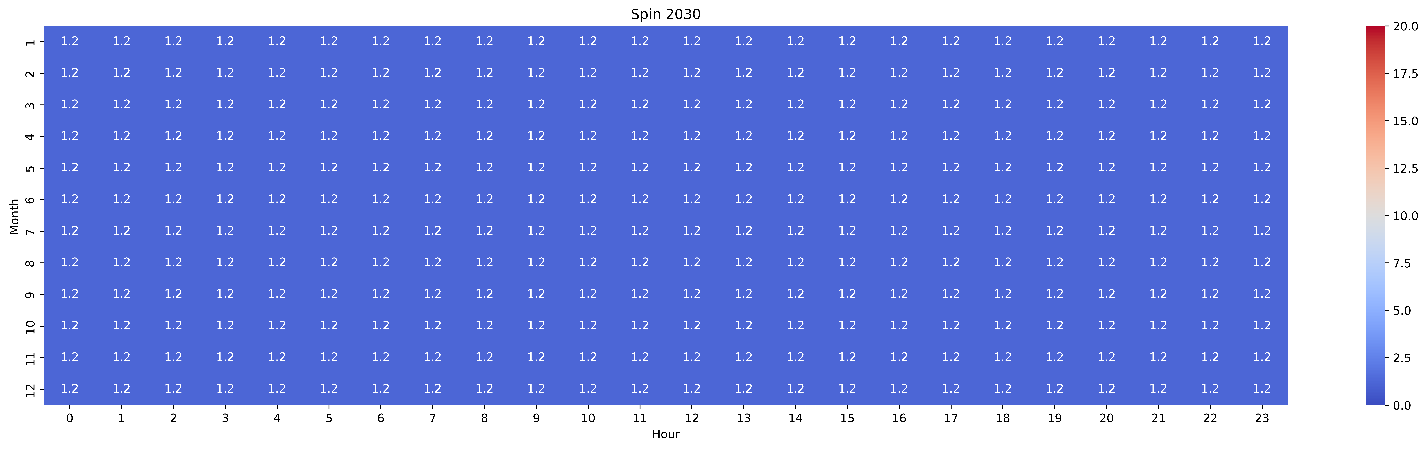
Historical 2021



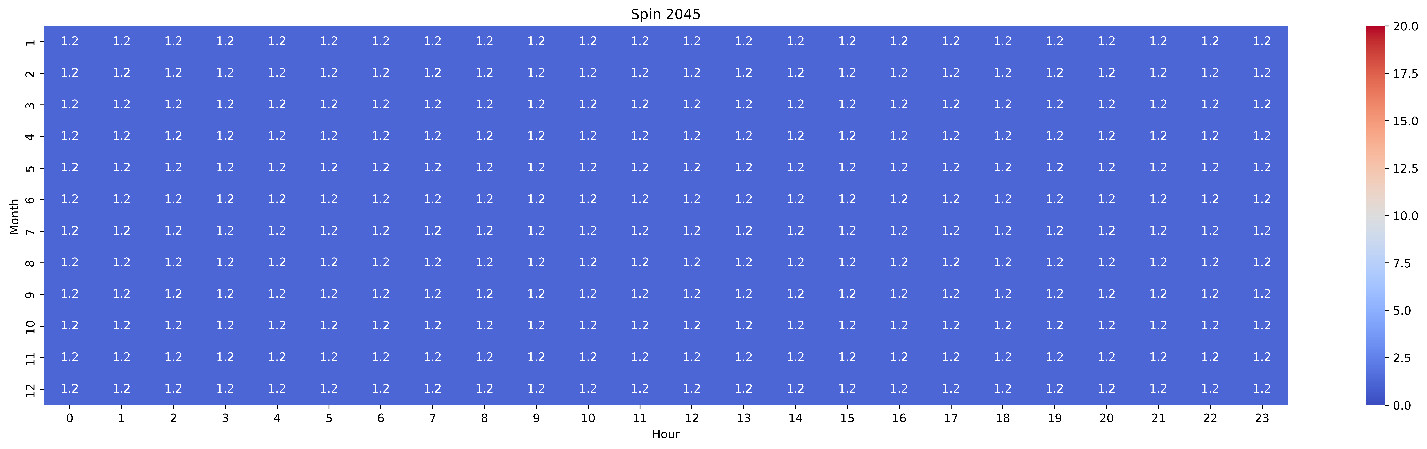
2022



2030

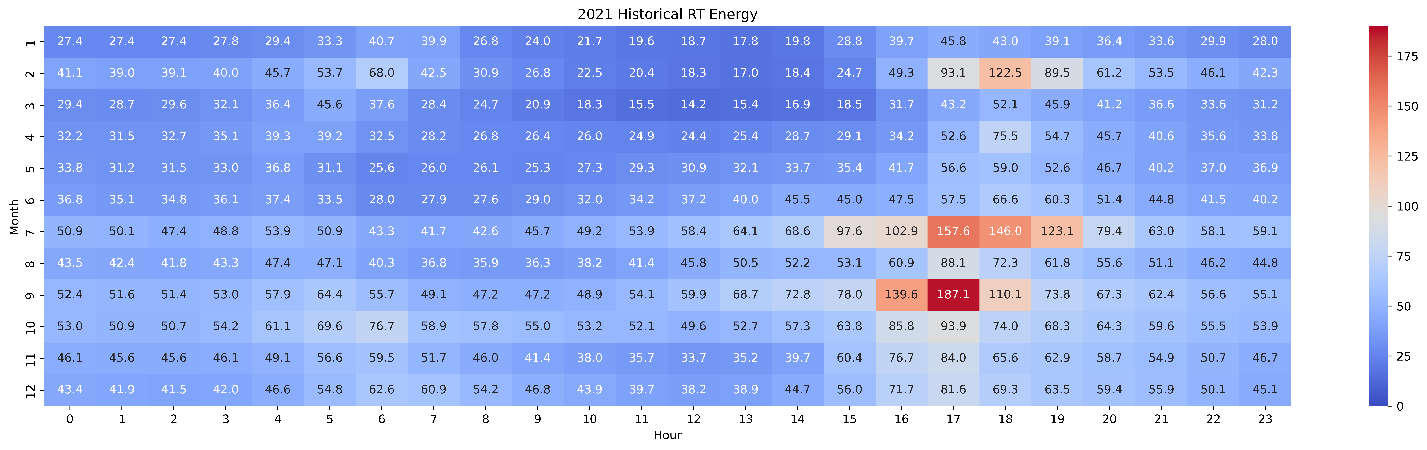


2045

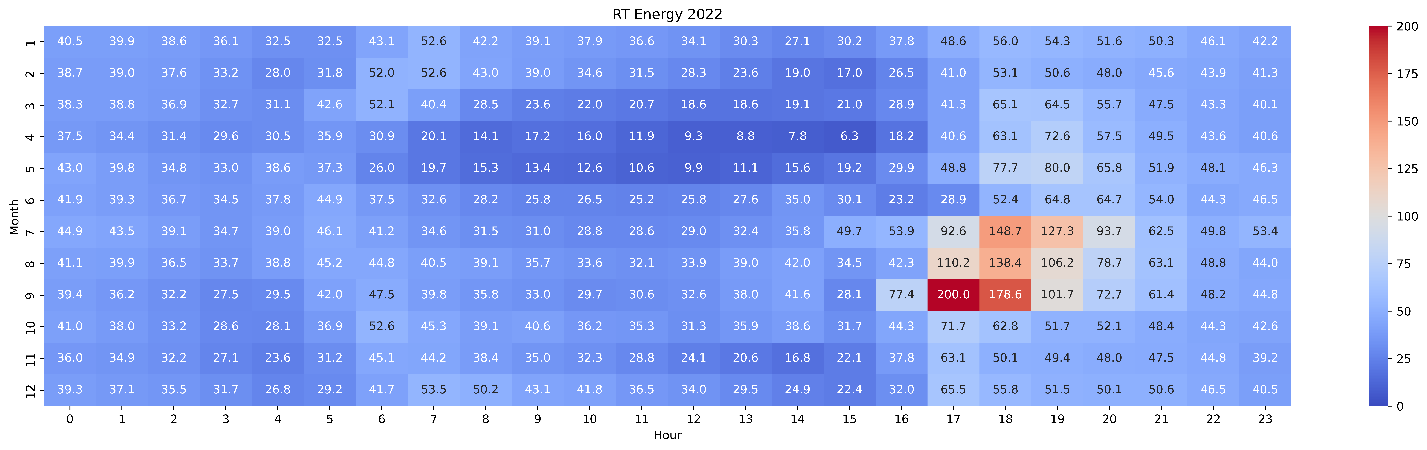


# RT

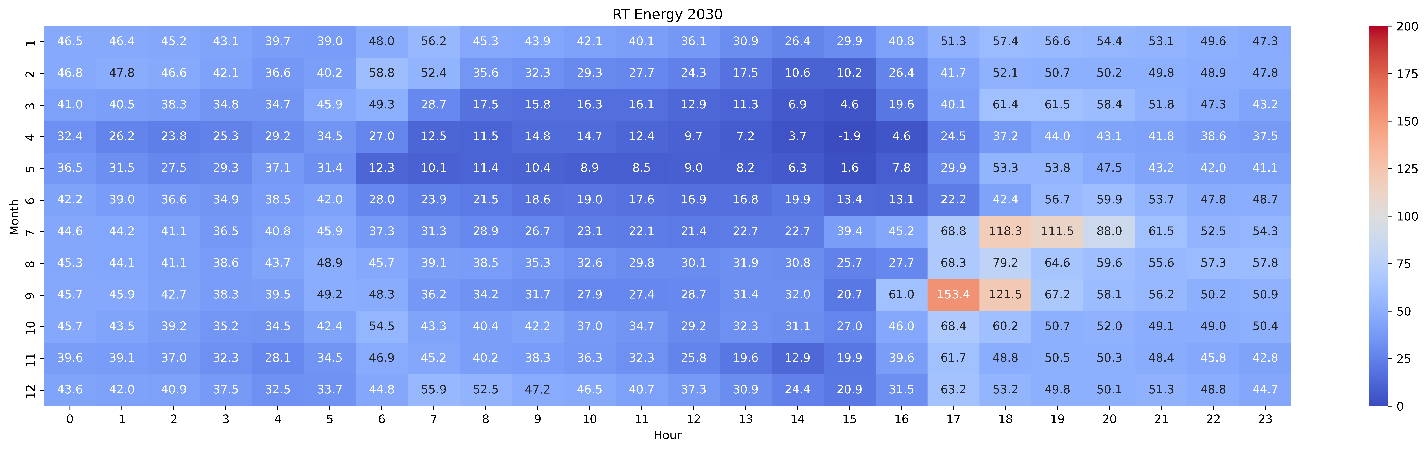
Historical 2021



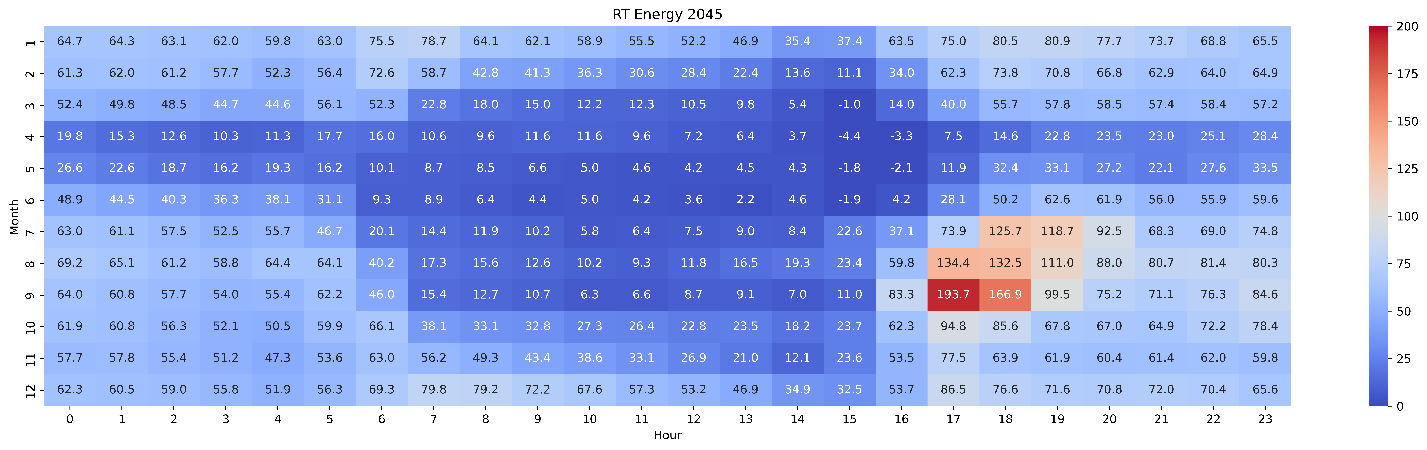
2022



2030



2045

Duration Curves

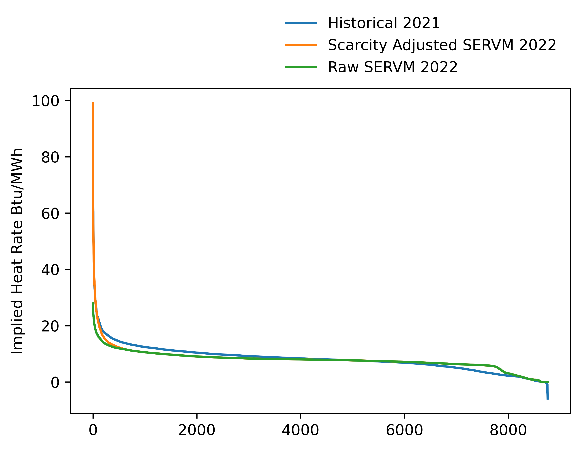
For the 2022 ACC, E3 deploys a similar approach as in 2021 ACC that scales up the implied heat rate of the top 5% hours of the year.

E3 develops one set of scarcity factors and applies to all price regions modeled; this is based on the understanding that scarcity conditions in CA’s major demand center tends to ripple across all zones within the state. The scarcity adjustments across zones in the state should therefore be coordinated. For the selected scarcity-setting zone, E3 benchmarks SERVM prices before scarcity adjustments against actual 2021 historical prices.

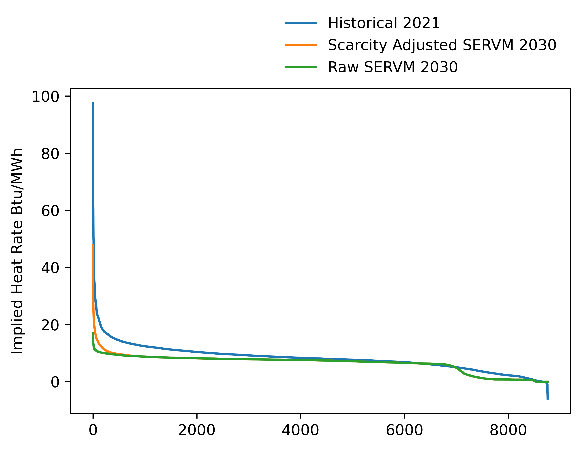
E3 backs out the marginal heat rates as implied by prices in the benchmark year rather than work directly with prices. Working with implied heat rates effectively factors out the differences in gas and carbon prices, which are temporally variable and do not offer specific insight into the electricity system. Using the marginal heat rates, E3 identifies the number of hours in which scarcity exists in historical benchmark year but is not reflected by the forecasted prices. These hours are then scaled up in the forecast to approximate the historical pattern and magnitude. Finally, it is assumed that these systematic modeling differences between the SERVM forecast and the real world persists across all years modeled. This calculated set of scarcity scalars based on this benchmarked year is applied to each year of the SERVM forecast to adjust for scarcity.

Heat Rates benchmarked with historical implied heat rates

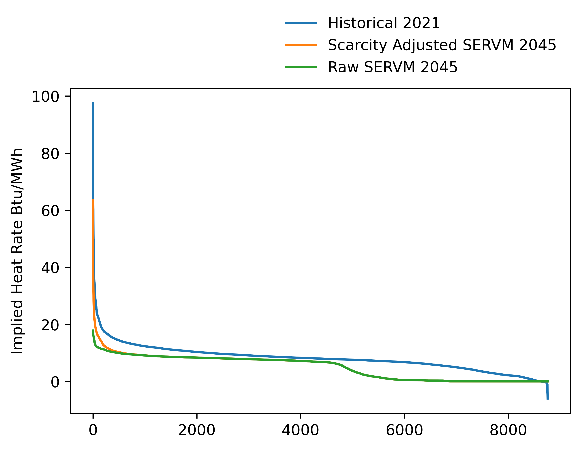
2022



2030



2045



DA Energy Prices benchmarked with historical prices

2022

A screenshot of a computer

Description automatically generated with medium confidence

2030

A computer screen capture

Description automatically generated with low confidence

2045

A computer screen capture

Description automatically generated with low confidence