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March 30, 2021

MEMORANDUM

TO: Power Committee

FROM: John Ollis, Manager of Planning and Analysis

SUBJECT: Seasonality and Market Prices

BACKGROUND:

Presenter: John Ollis

Summary: This presentation will update the Council on the some of the seasonal and daily attributes of the wholesale electricity price forecasts for the 2021 Power Plan. Per previous discussions with the Power Committee, Staff was asked to further discuss some of the underlying market fundamentals driving this seasonal and daily behavior, and this presentation will delve into further details and implications of these forecasts.

Relevance: The Council periodically updates a 20-year forecast of electric power prices and avoided emissions rate studies using the AURORA model. The AURORA model dispatches all resources in the WECC generating a fundamentals-based wholesale electricity price forecast.

Since the development of the midterm and previous wholesale price forecasts studies, more baseload plant retirements have been announced and further clean policies and goals have been announced. These municipal, utility and state policies/goals along with the retirements and pressures on conventional fossil fuel resources continue to fundamentally change the wholesale market dynamics in the WECC, and this updated

price forecast helps Staff incorporate the effects of these changes on Mid-Columbia market prices.

For the 2021 Power Plan, the Regional Portfolio Model will use the power prices from this study to develop electricity price futures which are used as a starting point for resource valuation in the resource strategy analysis. Additionally, the underlying market supply associated with these prices is used in the Needs Assessment for the plan.

Workplan: Forecast Wholesale Electricity Prices (A.6.3)

Background: The Council's wholesale electricity price forecast is a fundamentals-based, forecast that reflects actual power system operation, relationships of supply and demand for, and transmission of electricity. In addition, underlying a wholesale electricity price forecast in this region would be an understanding of the operating characteristics of future and existing supply and demand-side resources, as well as unit commitment, ancillary services, fuel prices, hydro, wind and solar conditions. The AURORA software captures many of these characteristics of the power system well and has a periodically updated WECC database, and thus, AURORA has been the Council's wholesale market electricity price forecasting model.

More Info: The baseline forecast for the power plan underwent over 4 months of vetting in the System Analysis Advisory Committee. The links below provide some of the conversation the region had about the market price forecast.

[November Power Committee presentation](#)

Previous presentations on this forecast:

[Update on Long Term Buildout in November 4 SAAC](#)

[Update on Long Term Buildout in October 22 SAAC](#)

[Update on Long Term Buildout in October 13 Power Committee](#)

[Update on Long Term Buildout in October 1 Power Committee](#)

[Update on Long Term Buildout in September 29 SAAC](#)

[Update on Proposed Price Forecast in September 15 Power Committee](#)

[Updated Proposed Price Forecast Discussion in September 2 SAAC](#)

[Discussion of Price Forecast in August 2020 Power Committee](#)

[Discussion of Price Forecast in August 2020 SAAC](#)

Previous studies:

[2019 Wholesale Price Forecast Update](#)

[Wholesale Price Forecast in 7th Plan Midterm](#) (see 3-10 through 3-17)

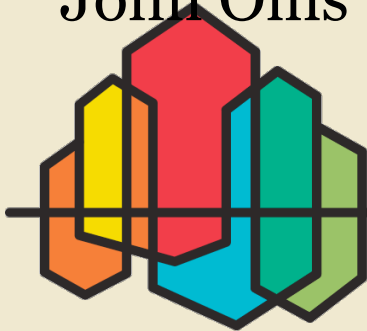
[Avoided Carbon Dioxide Production Rates in the Northwest Power System](#)

Seasonality and Daily Shape of Market Price Forecast

Power Committee

4/6/2021

John Ollis



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FOR A SECURE & AFFORDABLE
ENERGY FUTURE

Summary of Baseline Results

- Prices decrease over time, but seasonal and daily variation increases
- Daily prices shapes no longer closely follow load, they follow load net renewables/market.
 - Predominantly based on a large buildout of inexpensive solar
- Evening ramp between the hours of 6 pm and 12 am is the biggest area of price uncertainty in spring and summer.
- In winter and fall, the morning (4 to 9 am) and evening (6 to 12 am) ramps continue to both be areas of price uncertainty.



AURORA Buildout

Long term capital expansion for the WECC ensures that price simulations in AURORA are informed by an *adequate system* that *meets policies*

Hourly market capability is needed for GENESYS to provide *a good adequacy signal for the NW* informed by changing market fundamentals



Get A Strategy:

AURORA Price Runs

Hourly WECC-wide price simulations inform *market prices* and *associated emissions* in the RPM, both can significantly impact *regional resource strategy economics*

GENESYS

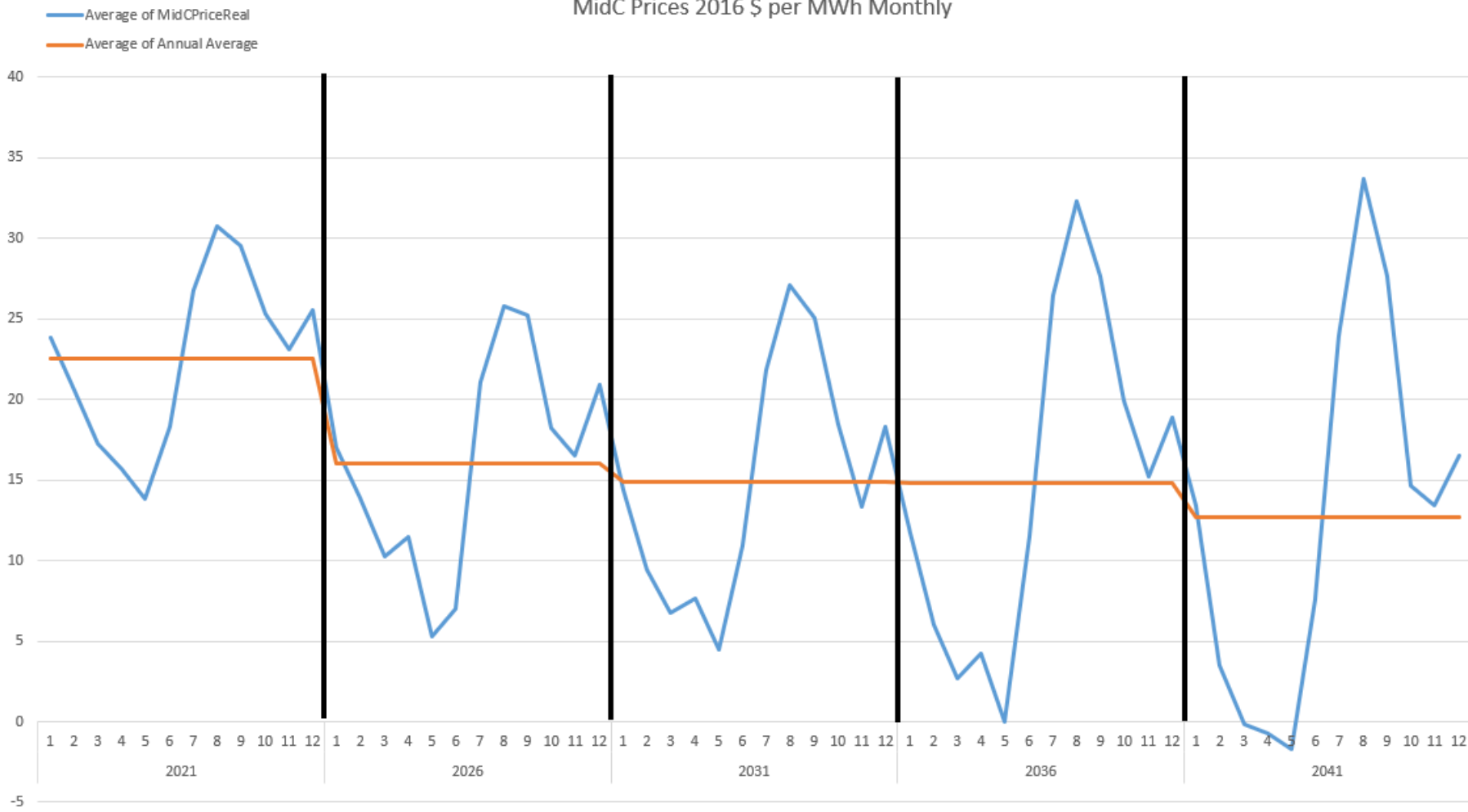


RPM

Hourly analysis in GENESYS creates quarterly ARMs and ASCCs, which the RPM uses *to select an adequate resource strategy*

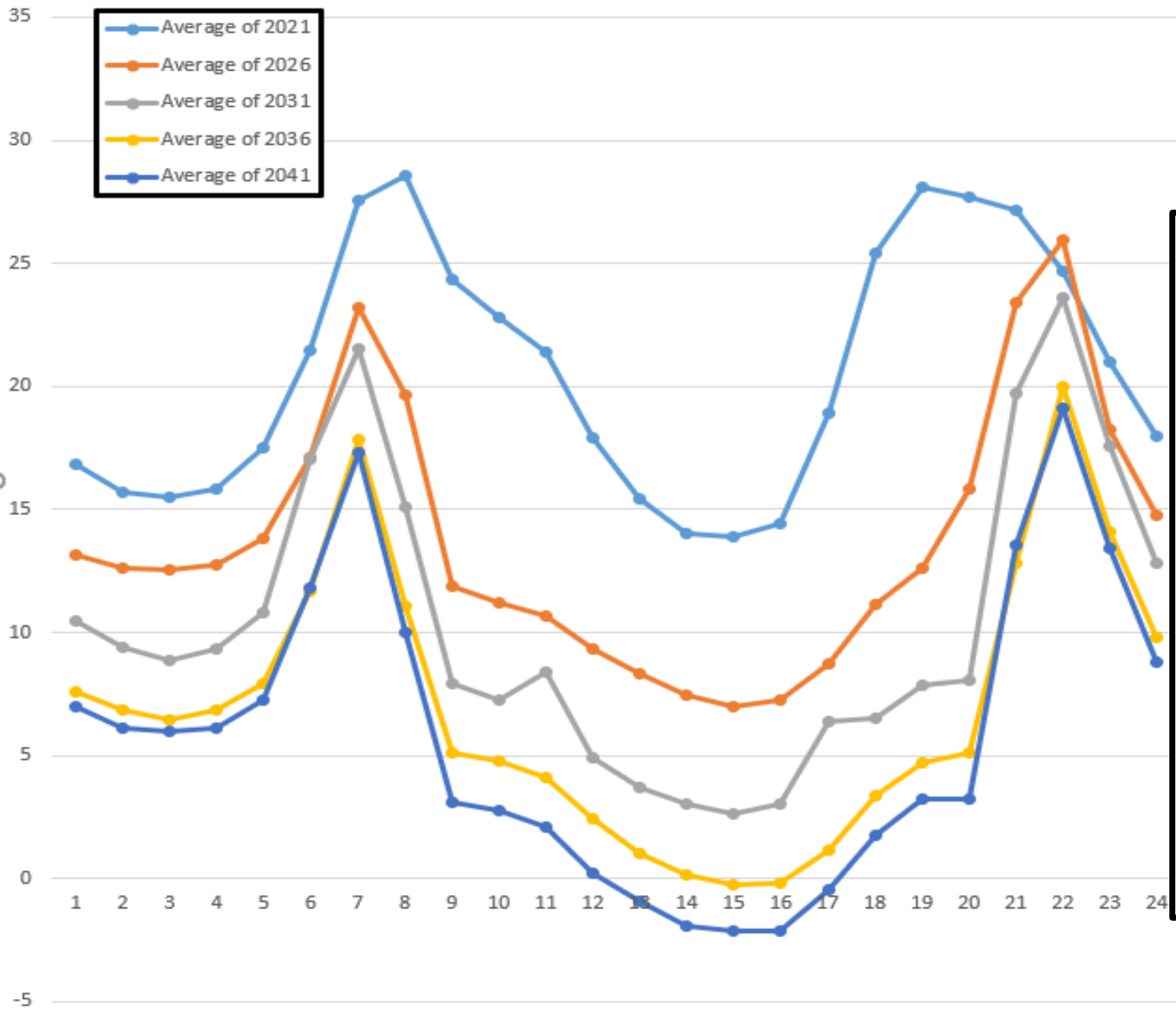


MidC Prices 2016 \$ per MWh Monthly



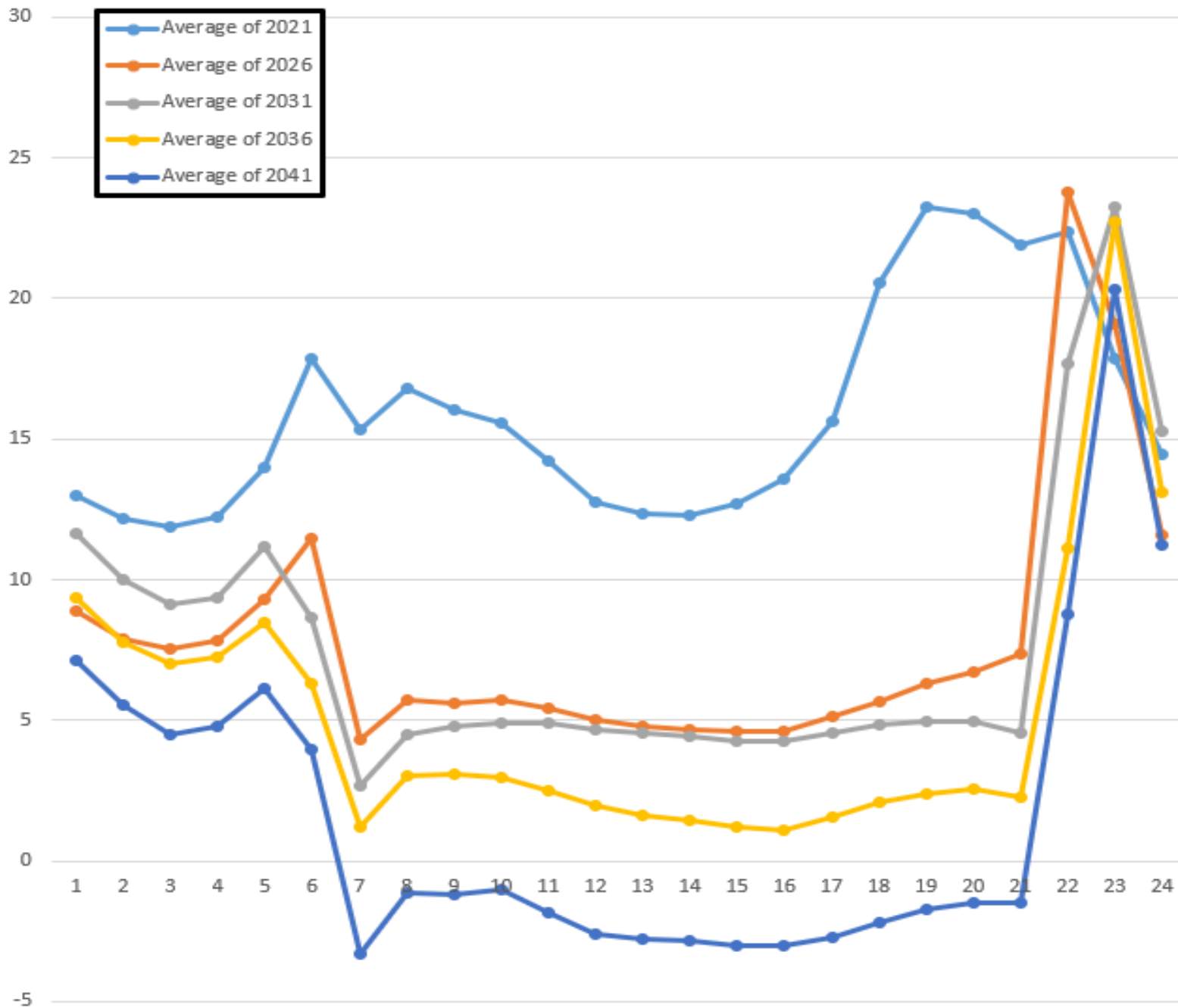
Prices go down annually, seasonal variation increases.
Prices in the summer increase, and decrease in the late winter and spring.

Mid-C Prices Winter



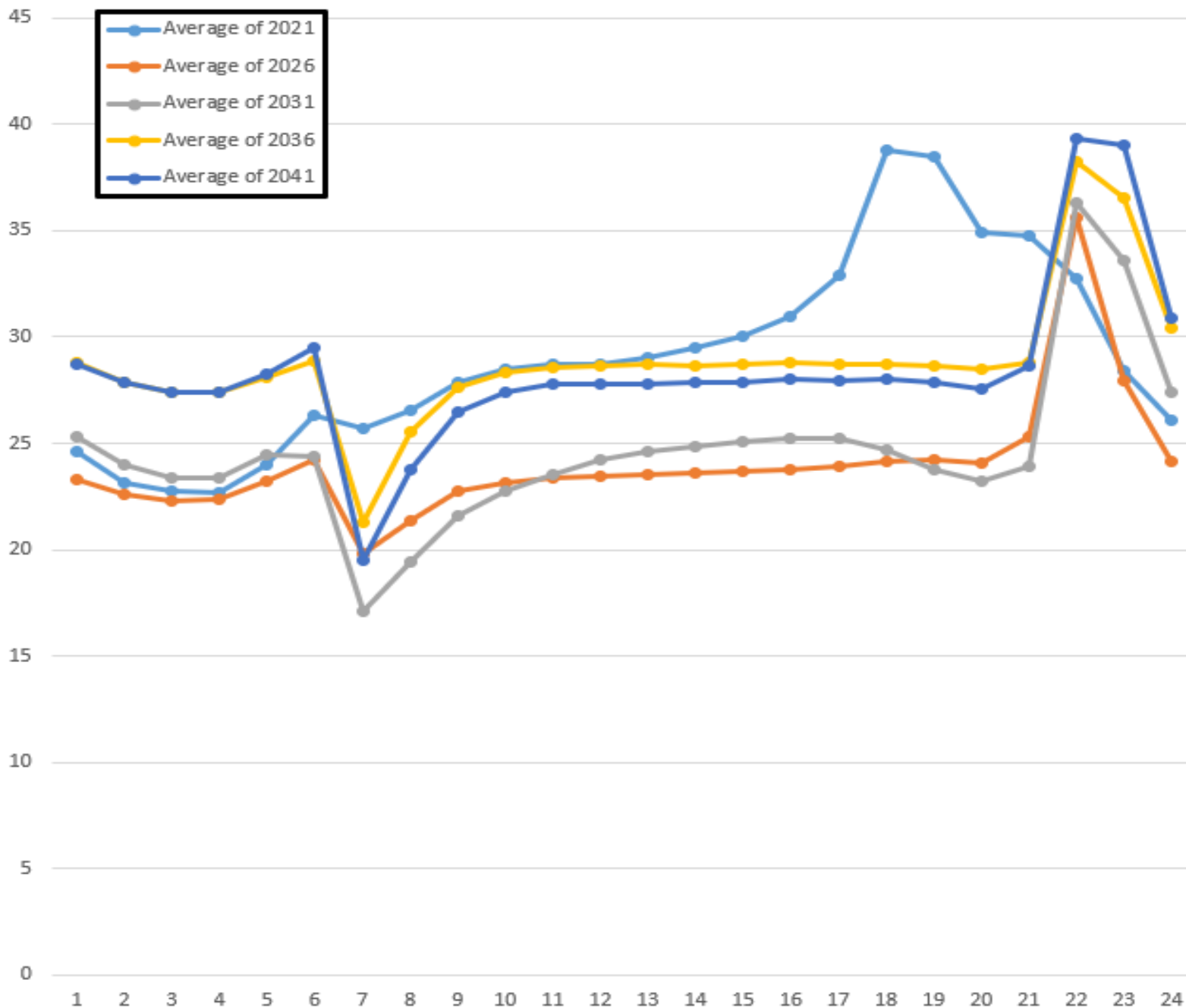
Daily Price Shape:
Prices drop precipitously in middle of the day due to increasing solar generation. Morning and evening ramps likely still have thermals on margin most of the time

Mid-C Prices Spring



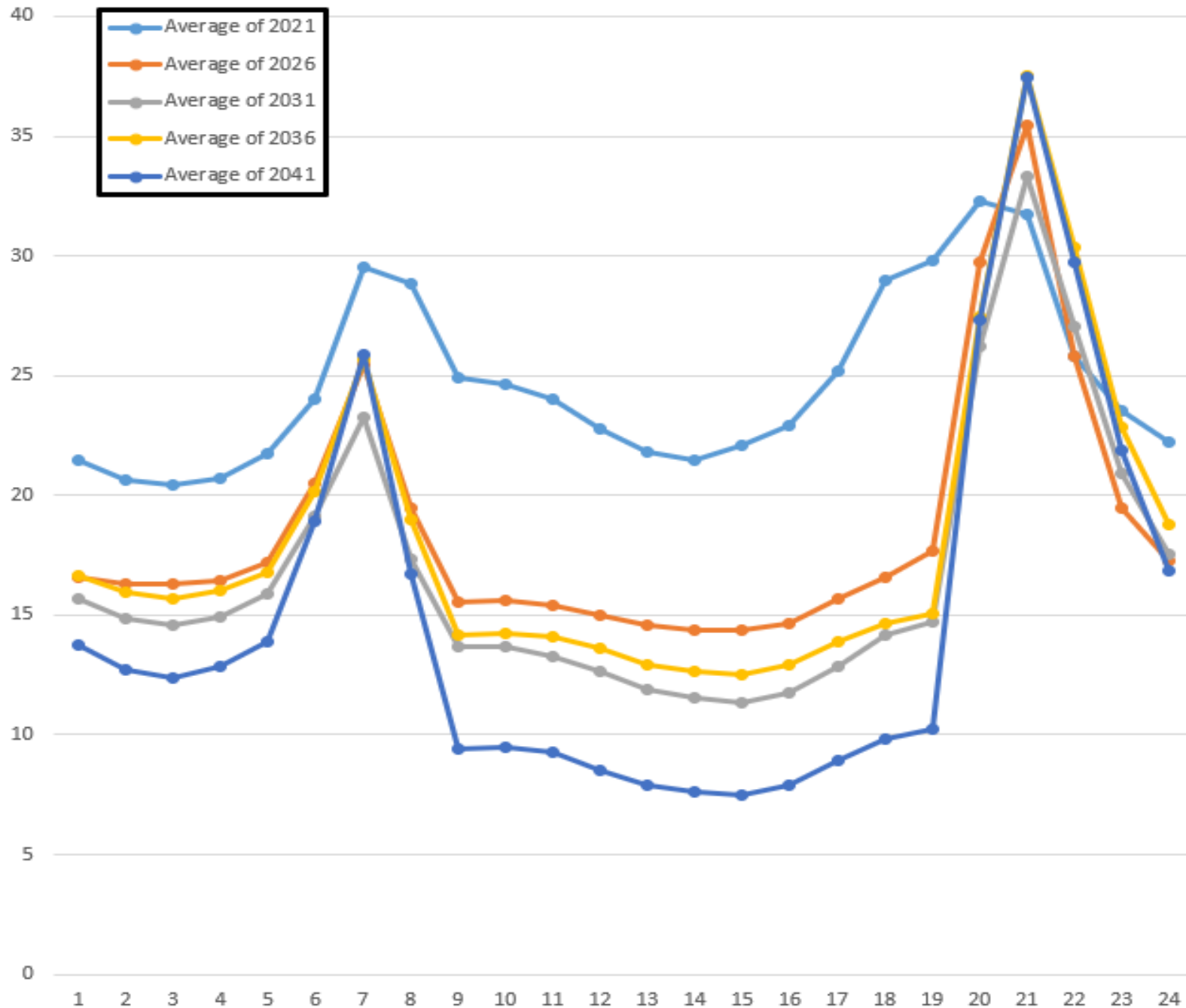
Daily Price Shape:
Prices drop precipitously for most daylight hours.
Evening ramps likely still have thermals on margin much of the time

Mid-C Prices Summer



Daily Price Shape:
Prices drop slightly during morning solar ramp, baseload thermals are on the margin in almost all hours. Prices decrease until 2030s and then increase again.

Mid-C Prices Fall



Daily Price Shape:
Prices drop significantly in middle of the day.
Morning and evening ramps likely still have thermals on margin most of the time

Price Variability By Season, Hydro Condition and Time of Day



- Variability in prices by hydro condition increases
- Daily prices, on average, have fairly predictable seasonal price shapes, even in different water conditions.
- Daily pricing around ramping periods, tends to become more unpredictable especially during the winter.



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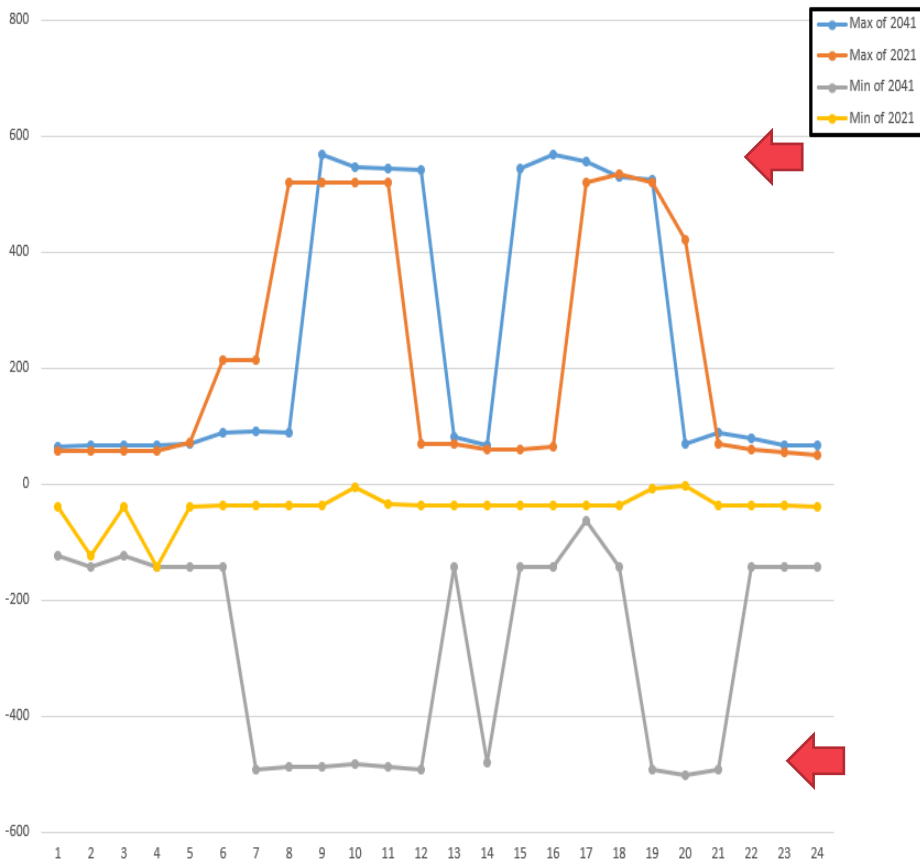
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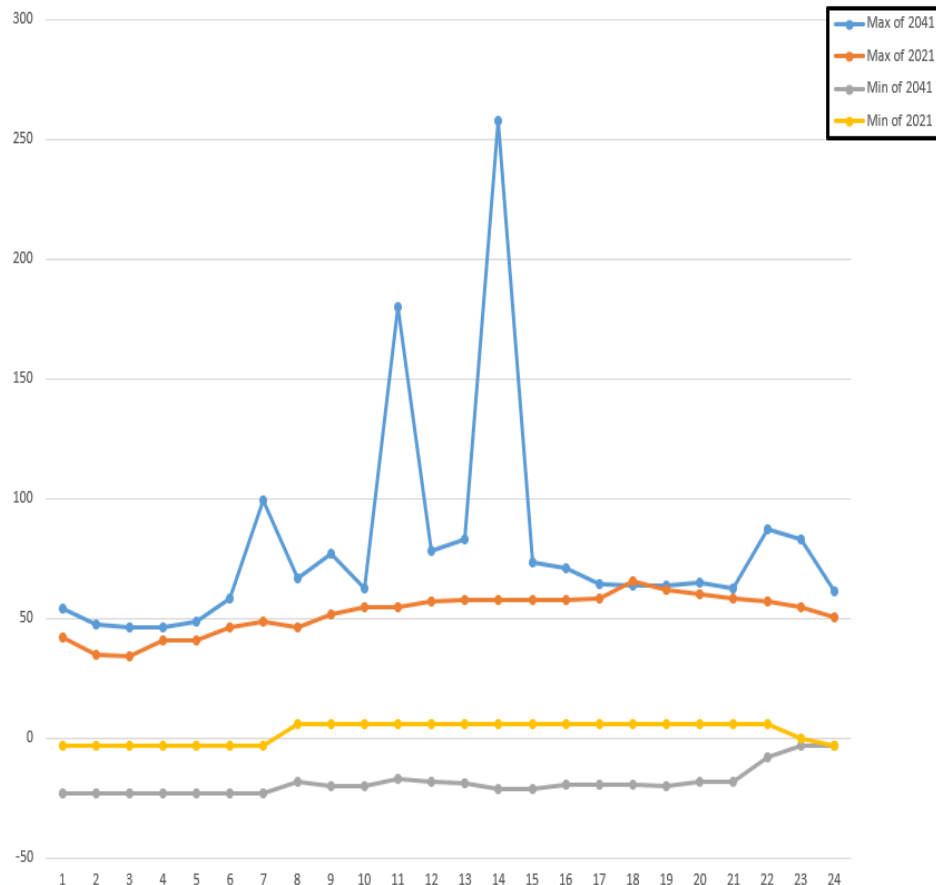


Price Range Increases Especially During Winter Ramps

Winter Mid-C Price Range



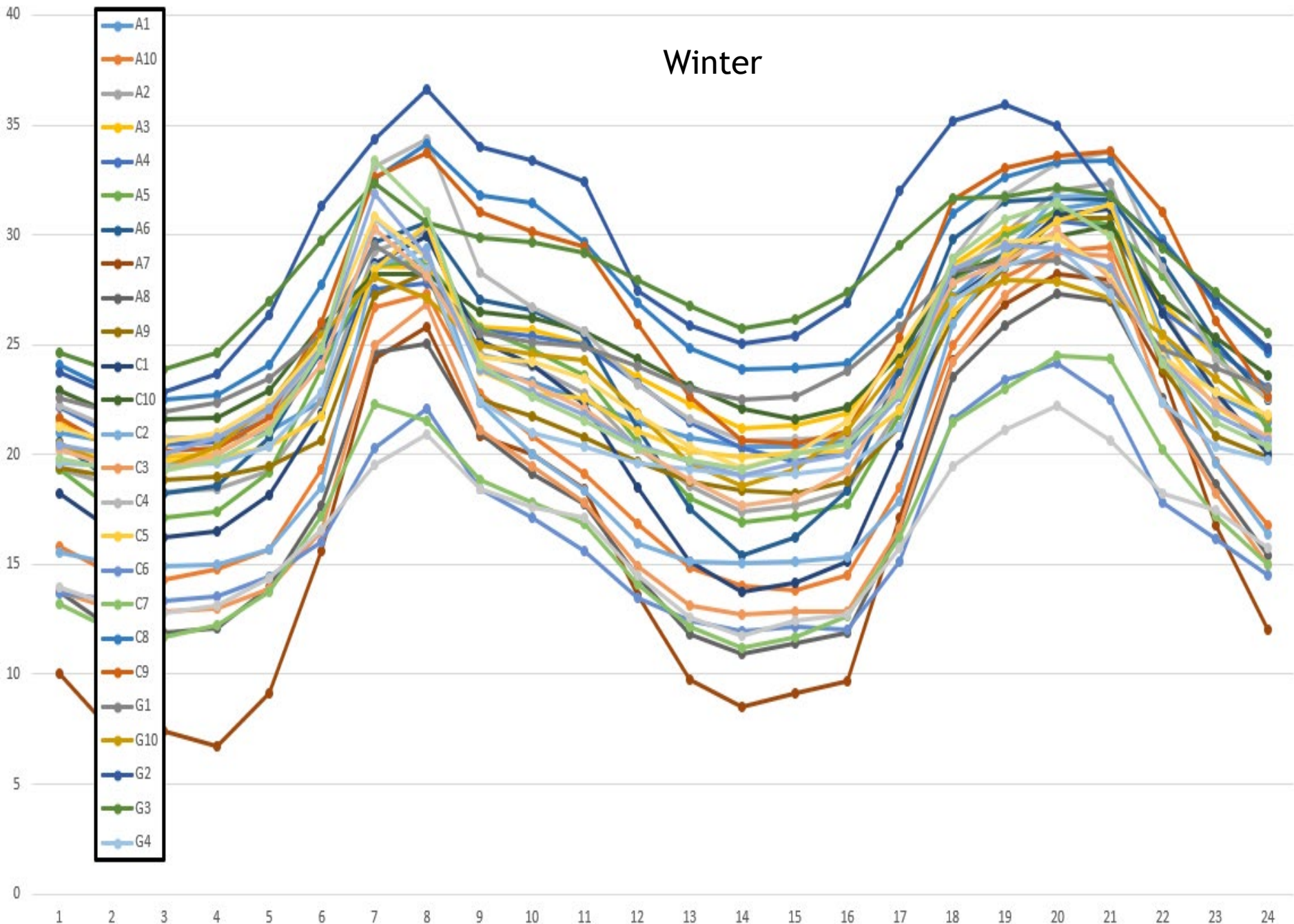
Summer Mid-C Price Range



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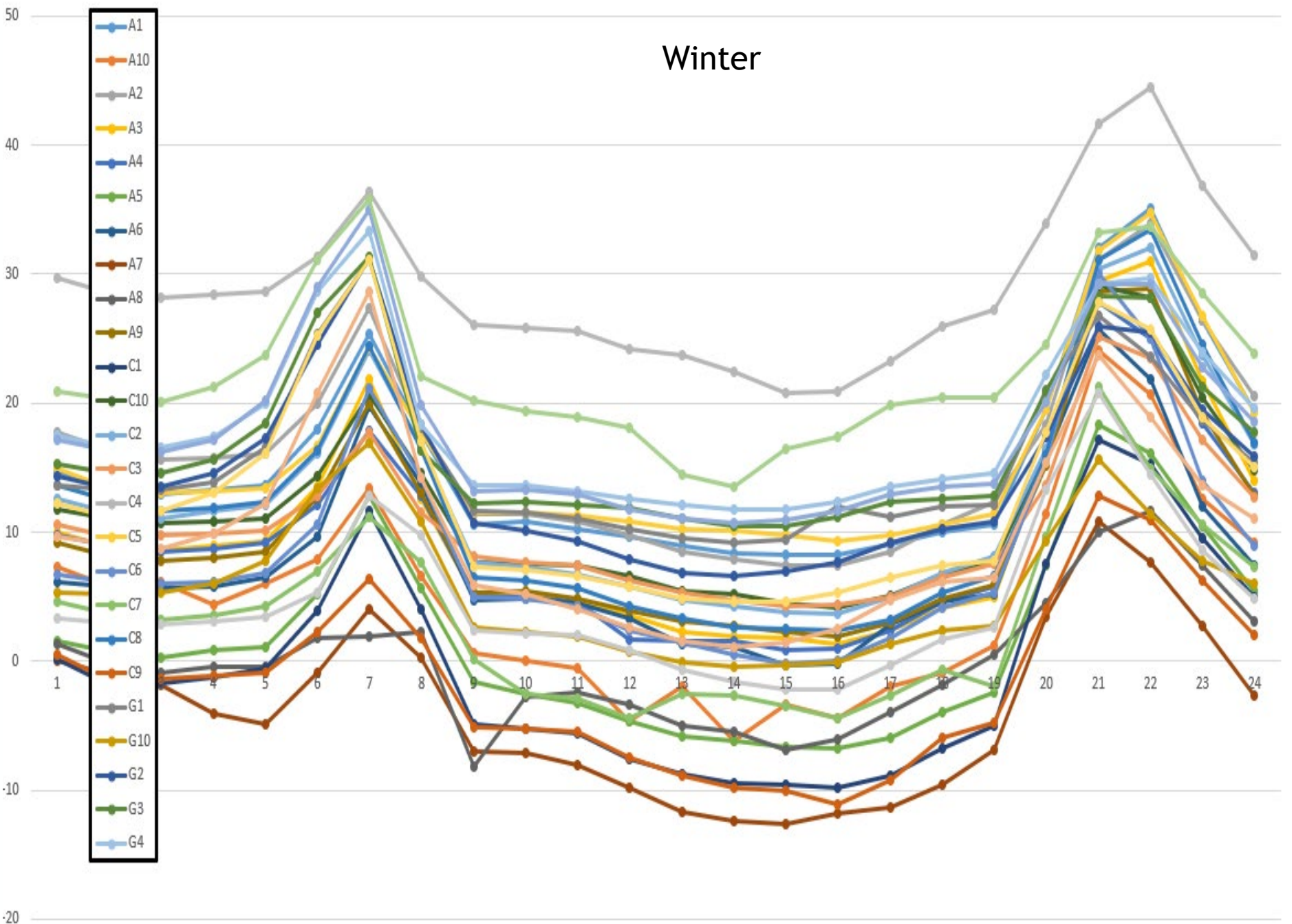
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Winter



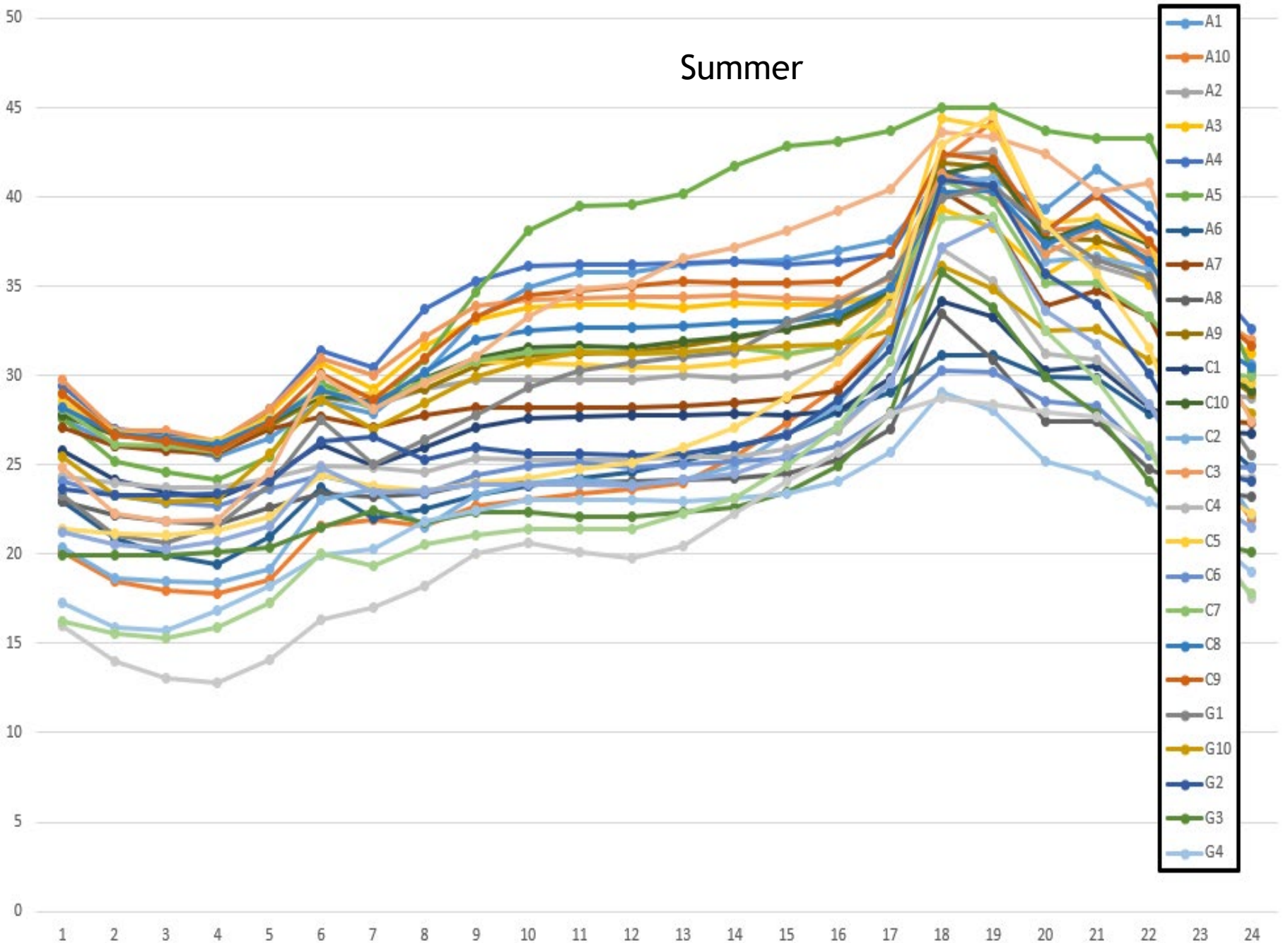
2041 Mid-C Prices Variation

Winter



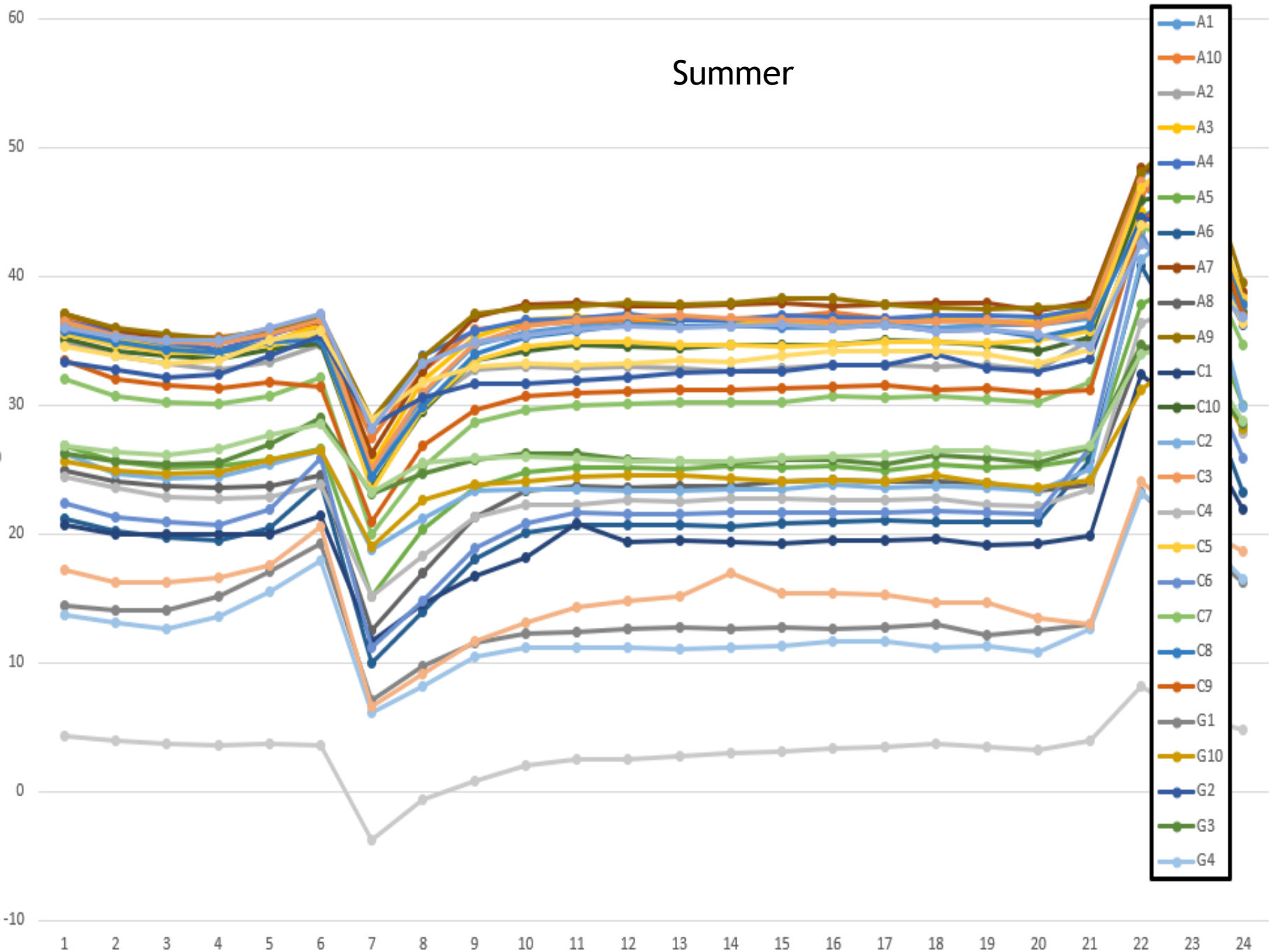
2021 Mid-C Prices Variation

Summer



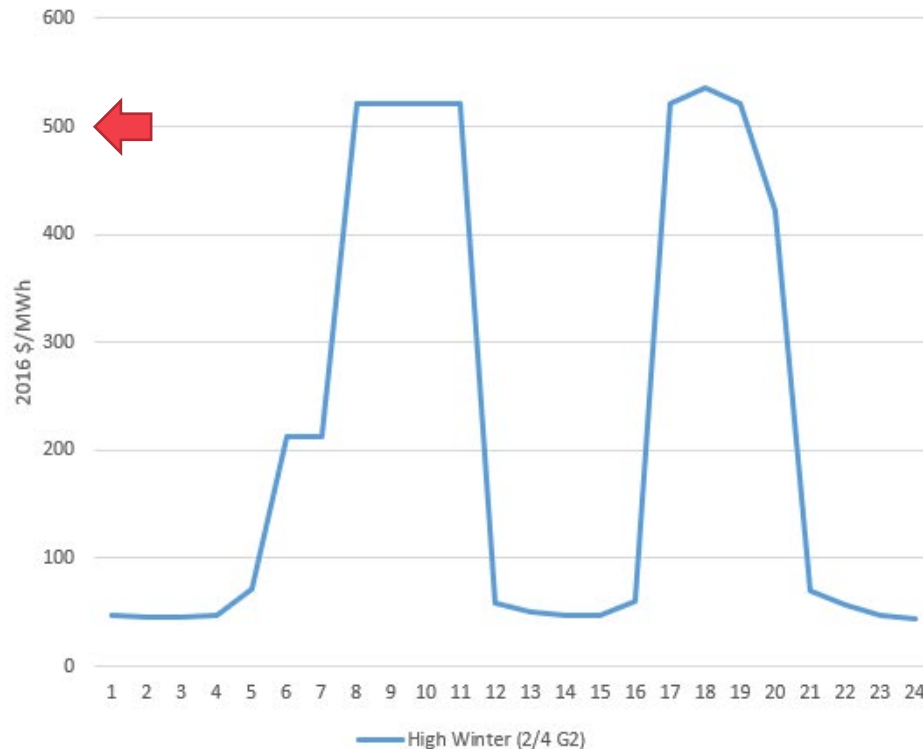
2041 Mid-C Prices Variation

Summer

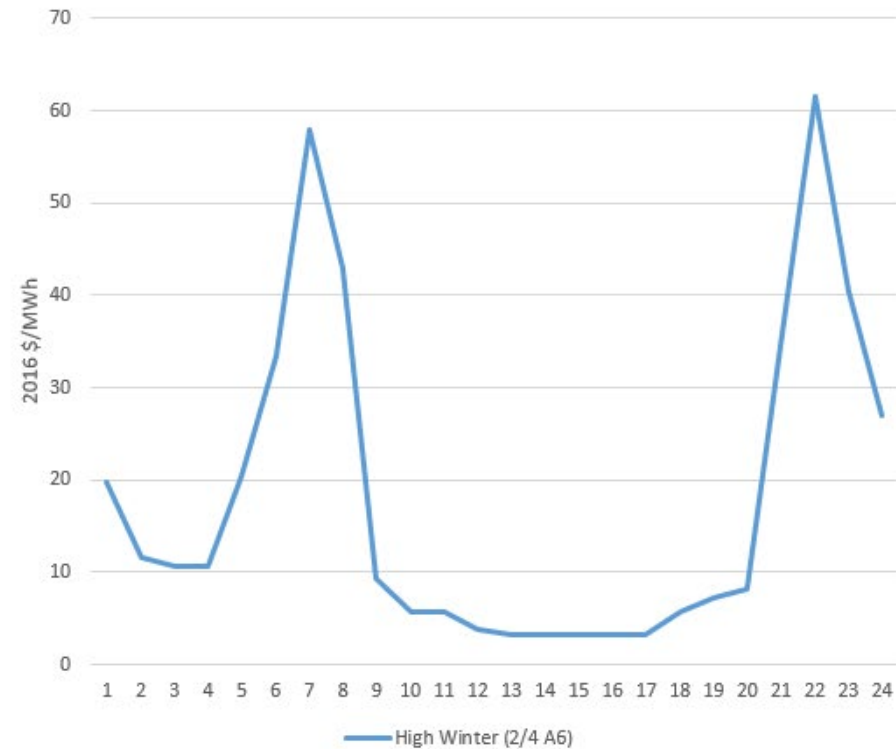


High price winter days tend to have high prices for a shorter duration, primarily during morning and evening ramp periods in later years of study. Prices go down in general as WECC is surplus in many hours.

Extreme Price Shapes - Early 2020s

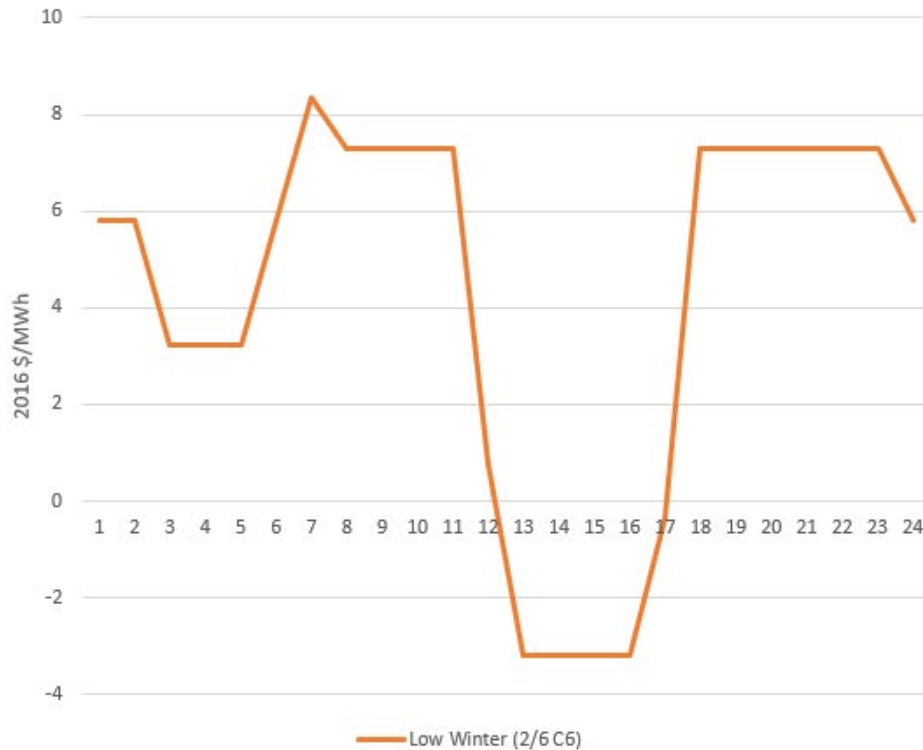


Extreme Price Shapes - Early 2030s

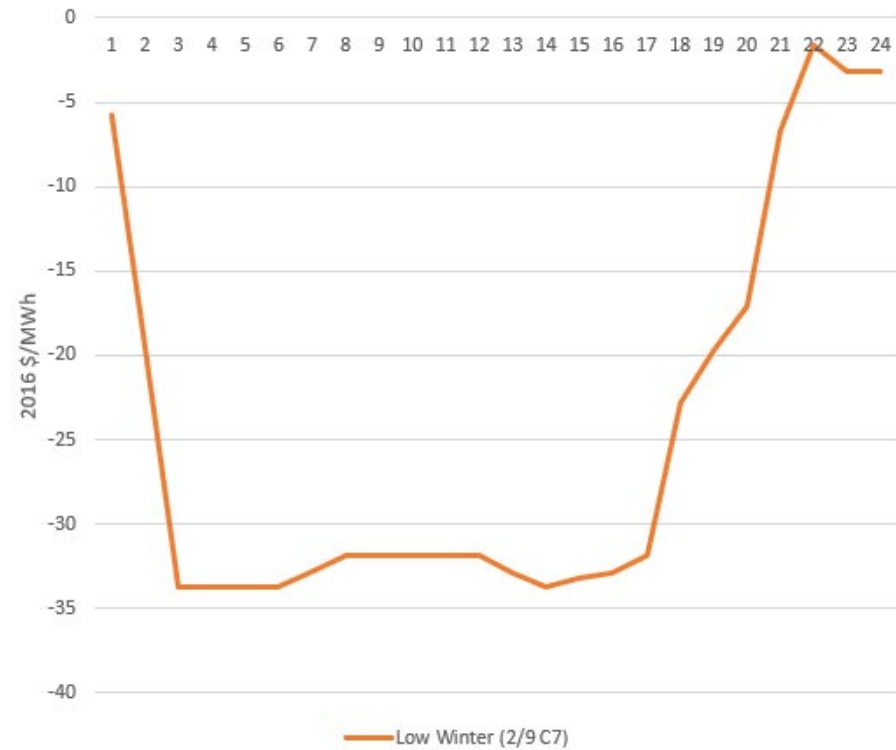


Low price winter days tend to have low prices for a longer duration, primarily during the middle of the day in later years of study. Prices go down in general as WECC is surplus renewables in many hours.

Extreme Price Shapes - Early 2020s



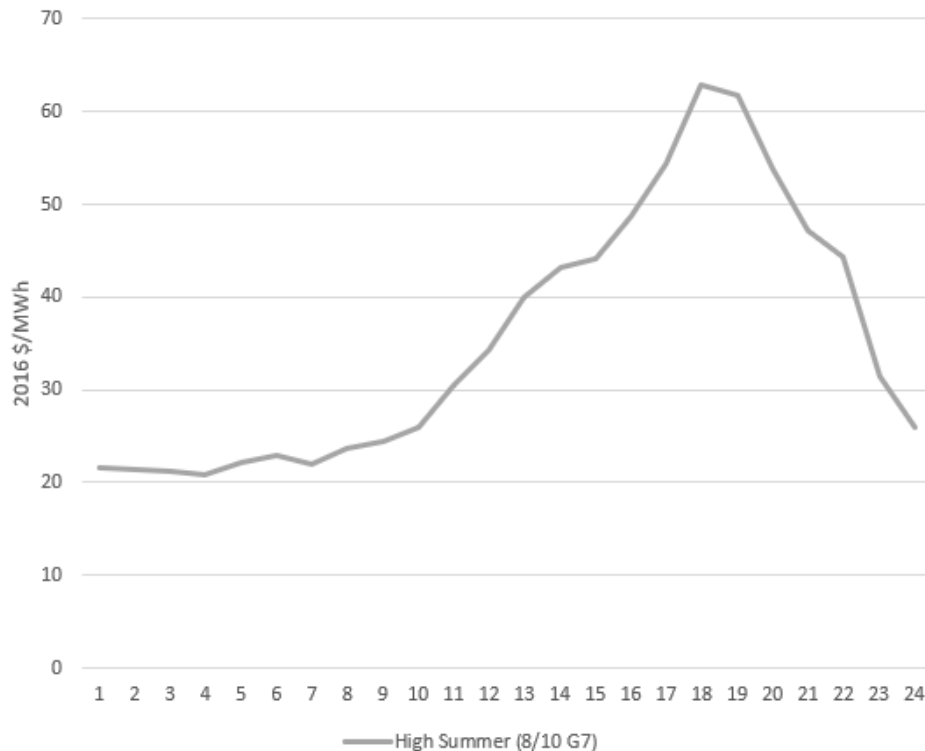
Extreme Price Shapes - Early 2030s



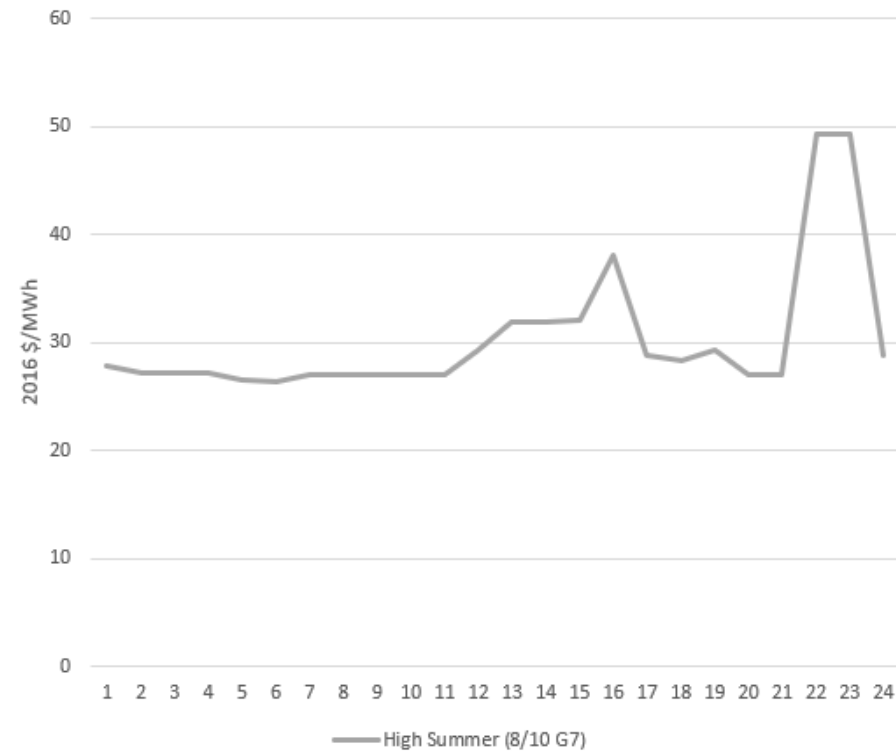
High price summer days tend to have high prices for a shorter duration, primarily during evening ramp periods in later years of study.

By the 2030's, significant amounts solar and short duration storage have been built WECC-wide, so the evening ramp high price signal often moves later in the day.

Extreme Price Shapes - Early 2020s

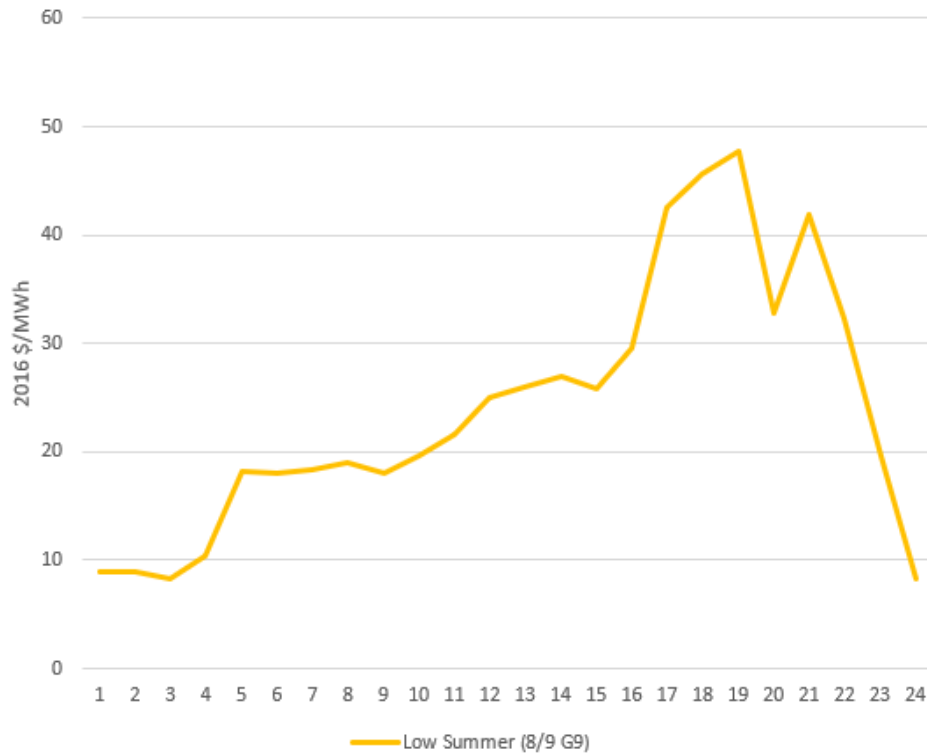


Extreme Price Shapes - Early 2030s



Low price summer days change characteristics significantly during the study with higher priced hours moving from mid-day, evening ramp timeframe to overnight. Prices midday can be very low even during WECC peak load times due to the surplus of solar.

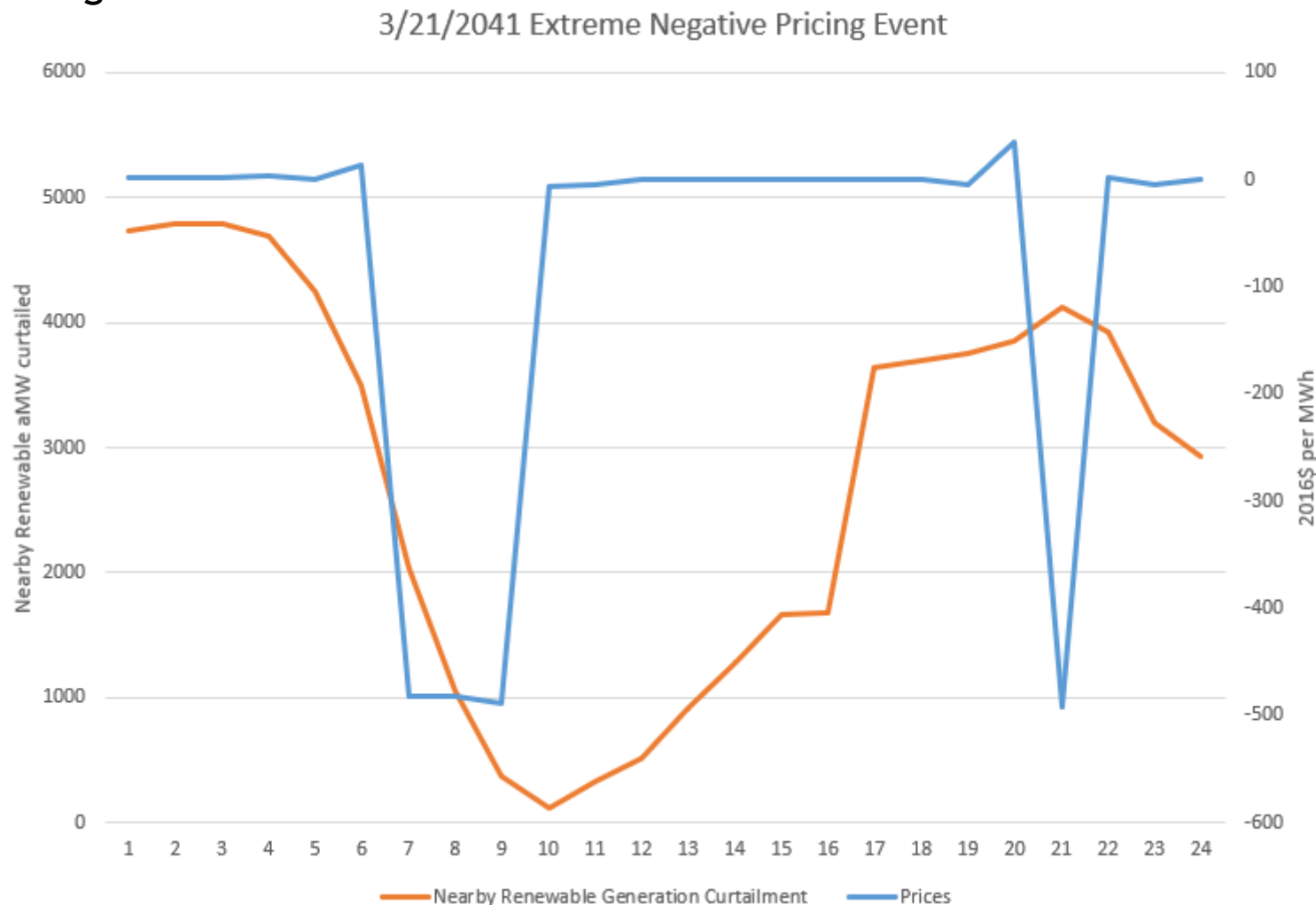
Extreme Price Shapes - Early 2020s



Extreme Price Shapes - Early 2030s



Massive oversupply in spring can cause extreme low price signals. All NW hydro in AURORA is running at minimum daily allowed levels and all renewable generation in the Gorge is shut off.



Conclusions

- As market prices get lower overall due to increasing low cost resources, variability in those prices will increase on a seasonal and daily basis.
- During the morning and evening ramps, operational constraints on thermals, hydro and energy limited resources cause significant variability in pricing.
 - NW hydro well set up to mitigate uncertainty, except in spring.



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A misty mountain landscape with a lake and geometric overlays. The image features a mountain range with a lake in the foreground, partially obscured by thick white mist. Several white geometric shapes, including triangles and polygons, are overlaid on the image, creating a modern, abstract design. The text 'Questions' is prominently displayed in the lower-left area.

Questions

John Ollis

jollis@nwcouncil.org