Looking at Xcel data for insight into demand shifting

- The Energy Information Agency now puts hourly renewable data on the web.
- With the Colorado Energy Plan, we know that we can calculate the supply for 2023 including wind and PV hour by hour (based on scaling historical PV and wind output on the Public Service Company of Colorado node)
- If we matched our demand to supply, we could go to much higher renewables fraction much faster, prospectively rather than reactively creating “pull” for renewables.
- Demand shifting offers a low-cost alternative to batteries until battery prices fall.
- Shouldn’t we do this? Are we really “Ready for 100%” if we don’t?
  - Example: Do we need to see negative pricing (duck curves) *before* we do demand management, even though we know that this is coming?

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Question: How should time-of-use work to accelerate the clean-energy transition?

Method:

-Plot Xcel % renewables vs. hour of day for the 4 seasons, using the last 4 quarters of Xcel data (2018-2019) from EIA. Plot renewable average for each hour for each season.
-Repeat for Colorado Energy Plan, simply scaling the PV and Wind up from the 2018-2019 data to meet the CEP mix of 53% renewable with 40% wind & 13% PV. Assume gas to flexibly meet 47%.

-Note the day-to-day variations in available renewables during each hour of each season
-Contemplate what this means for the effectiveness of average Time-of-use (TOU) rates

Battery storage will smooth the variation shown in these graphs towards the average -- but real-time demand shifting will be able to cut demand during the dark-calm and use power during abundant renewable periods at low or no cost in some cases. Both will be a part of the future grid.

EV charging when there are abundant renewables will improve the economics of renewable energy. Charging during lulls in renewables will impede the clean-energy transition by requiring extra generation from gas.

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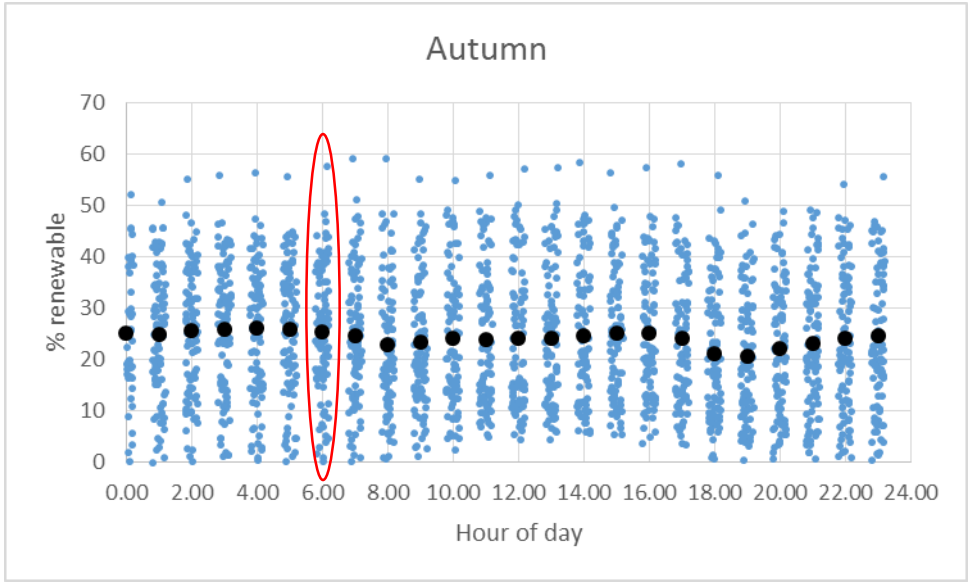
In following graphs, each hour of the day will show the % renewables for 120 days per season

Xcel 2018-2019 Explanation of graphs.



% renewables never exceeded 60%, and rarely was above 45% due to coal plants needing to always be on (in Autumn 2018) except when seasonally off for maintenance.

Example: Look the 6AM hour during Autumn, 2018, (120 days circled by red)

- For most of the 120 days (blue dots), there are 15-42% renewables available during the 6AM hour
- On one day, there was nearly 60% renewables!
- On average for the season, 25% of power is renewable during this 6AM hour (Black point)
- However, there are 16 days with less than 15% renewables
  - -The grid would be > 85% fossil fueled on these days during this hour!
- If your goal is to use renewables, there is no good average "rule" that works every day

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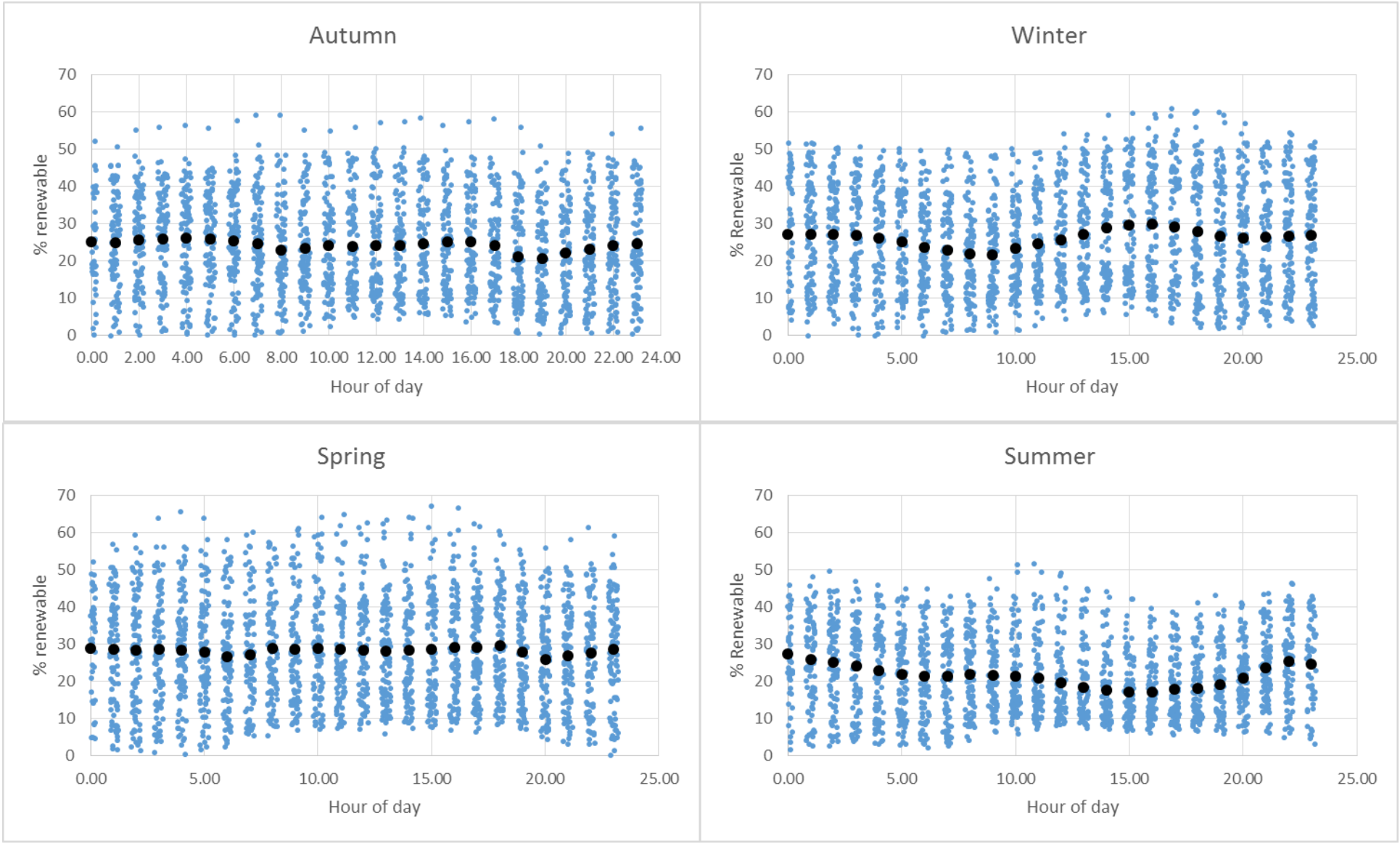
Xcel 2018-2019

No strong trend in % renewables except during Summer. Xcel has mostly wind now.

Any given hour at night can have 0-60% renewables that could be predicted the day ahead

Black dots are the seasonal average for each hour



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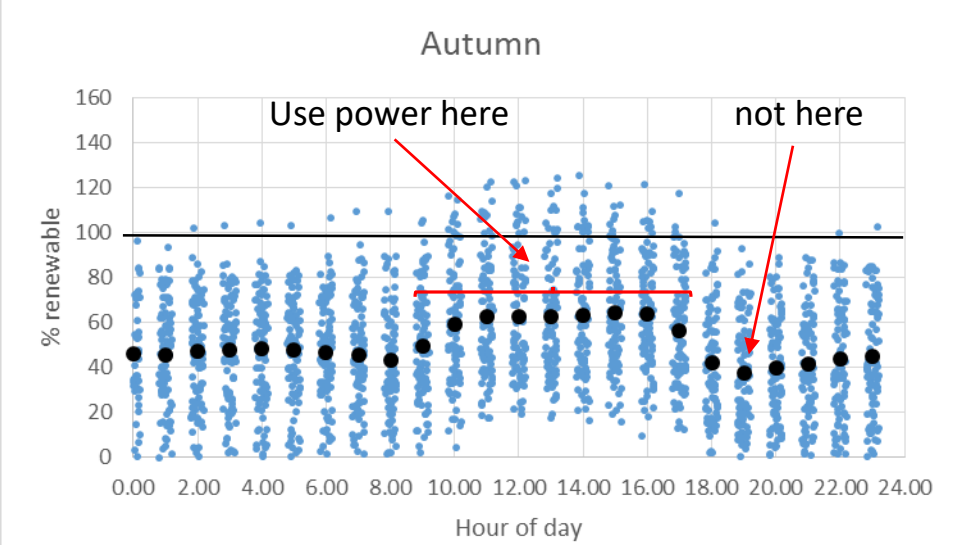
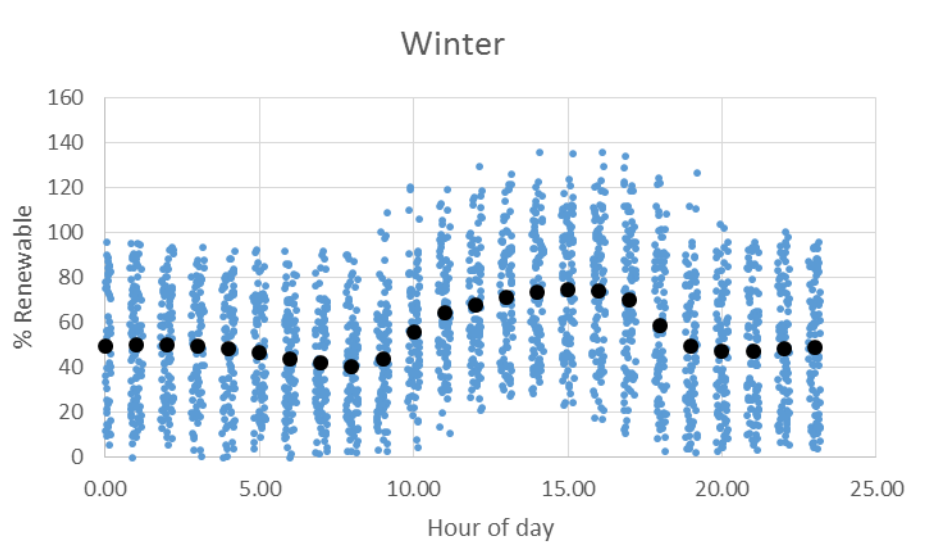
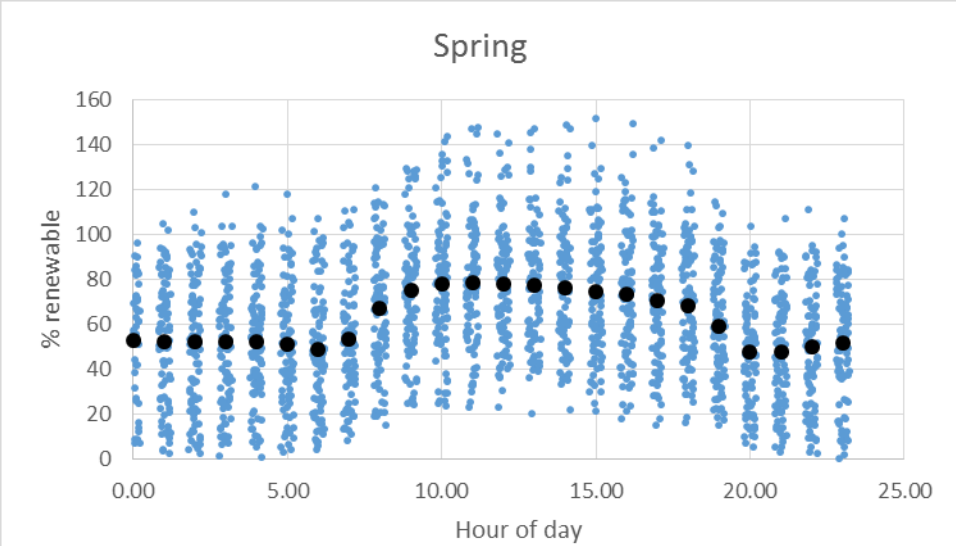
Xcel with CEP (2023+) 13:40% Solar:Wind: Average TOU

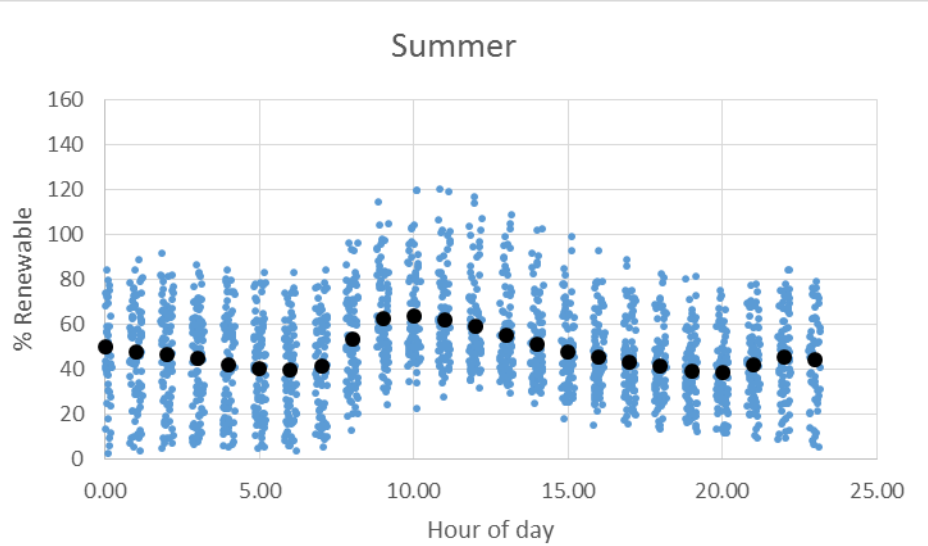
On average, in 2023 the % renewables will peak during daylight PV, all 4 seasons. You could, for example, use more renewables if you used power between 9 and 5 each day (8-3 in summer).

Black dots are the seasonal average for each hour









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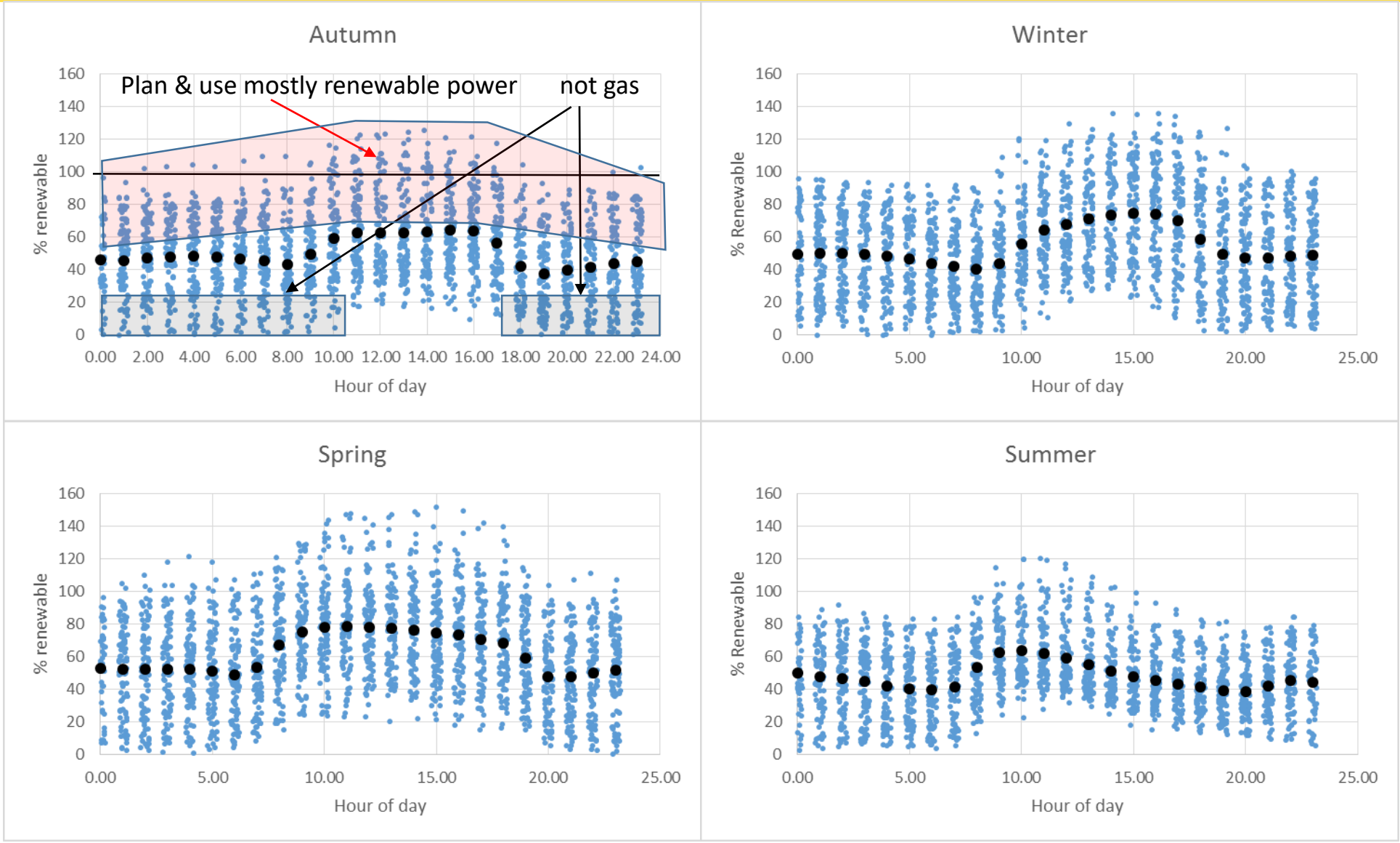
Xcel with CEP (2023+) With day/week-ahead prediction

With renewable prediction, you can use renewables when they are available and use less power when they are not. Flexible power users could use mostly renewable power and lower the demand for fossil fuels.

Black dots are the seasonal average for each hour



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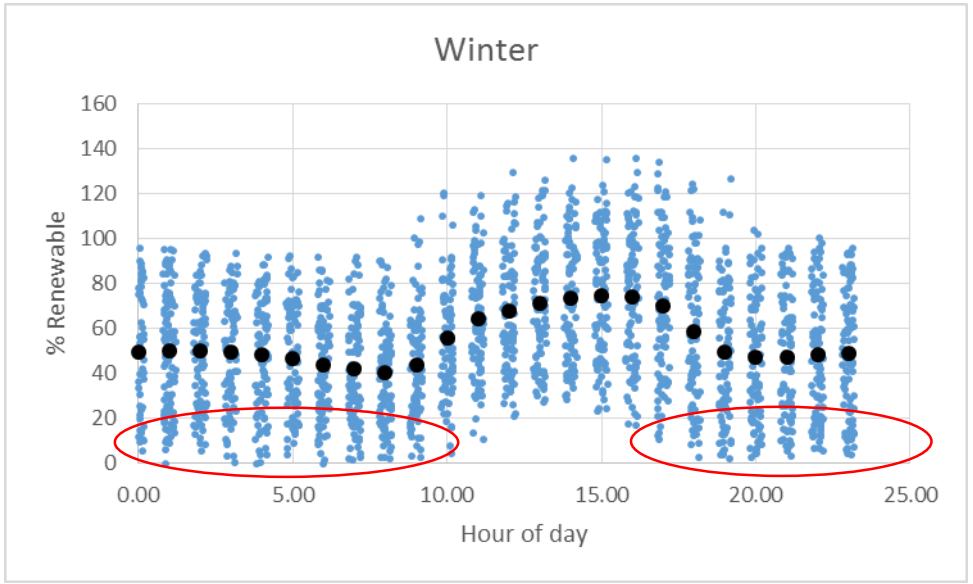
Conclusions page 1:

-Traditional time-of-use plans assume that every weekday (seasonally) is the same
-Traditional TOU shifts demand away from expensive daytime peaks towards nighttime coal since coal can't be turned off. These plans primarily support the economics of coal by shifting demand to "night-time".
-Now, with wind and PV, TOU plans should predict which specific hours each day will be high % renewable.
-Day-ahead and week-ahead demand and renewables predictions would enable an effective TOU plan to drive de-carbonization, especially for EV charging.
-There are days where hours in the night have NO WIND
-Every day has significant PV. How much varies day-to-day
-Average seasonal algorithms for TOU are better for PV than wind
-Even in winter, PV can *predictably* cover significant demand in CO
-Predictive optimization of energy use would much more effectively take advantage of PV (and especially wind) to balance grid

This EIA data is utility PV only. With rooftop PV (1/3 of PV in CO), we are probably already at the stage where we should shift demand towards PV use (especially morning) year round. Soon, we should shift towards 9AM-4PM year round. Boulder probably already has a rooftop PV daily peak.



Estimated CEP. Storage or flexible demand would enable much higher renewable percentage by aligning power use with renewables availability.

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Day-ahead & week ahead predictions:

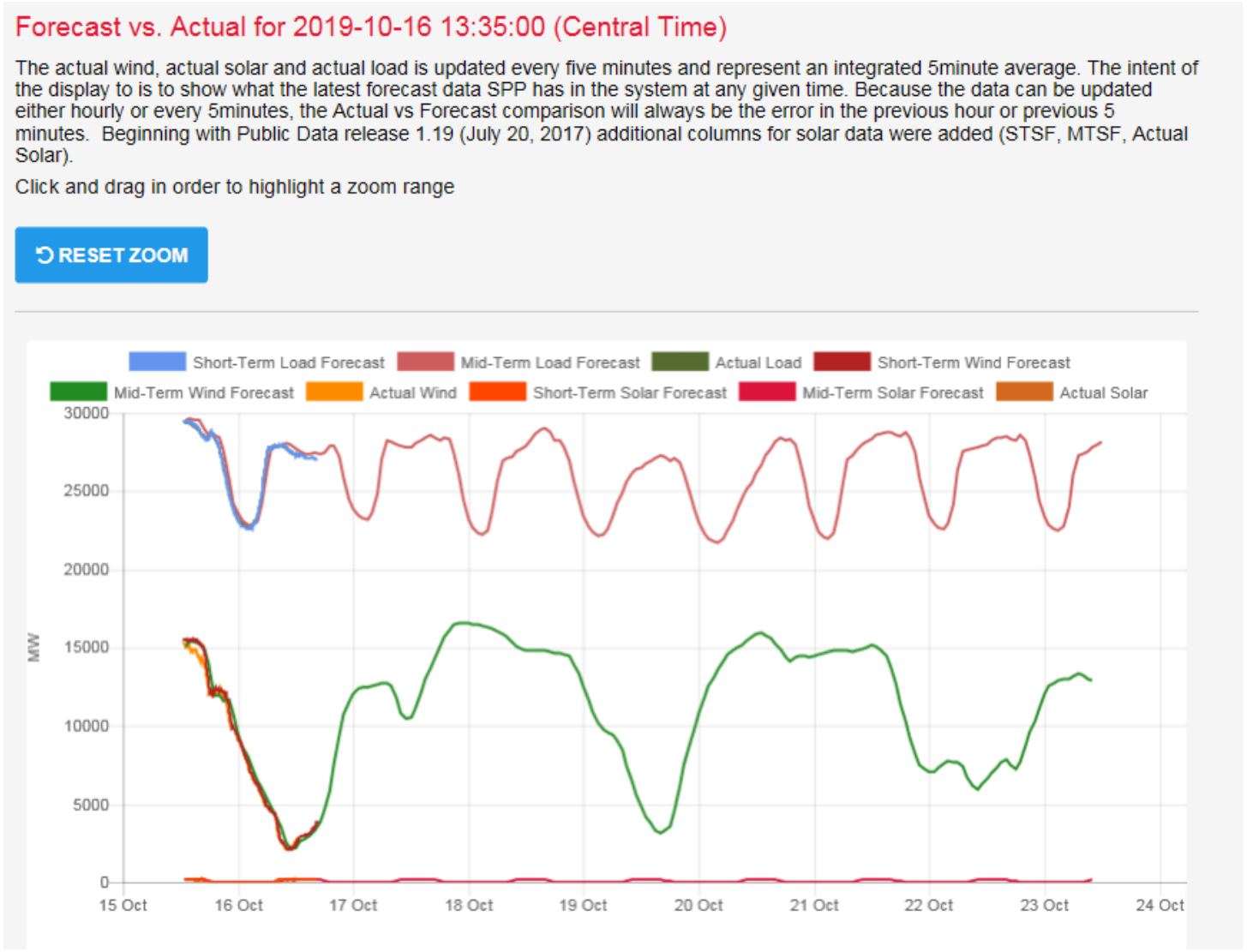
We need Xcel to provide this:

(Available on internet for Southwest Power Pool, SPP, and most other areas of the USA)

https://marketplace.spp.org/pages/forecast-vs-actual

Downloaded 16 Oct. This is a week-ahead PREDICTION for SPP! (at right)

Reality (on 16 Oct) is tracking this prediction. It is obvious which hours EVs should be charged during the week of 17-23 Oct. Other flexible power uses could be scheduled as well to maximize the use of renewables, and minimize the use of gas and coal.



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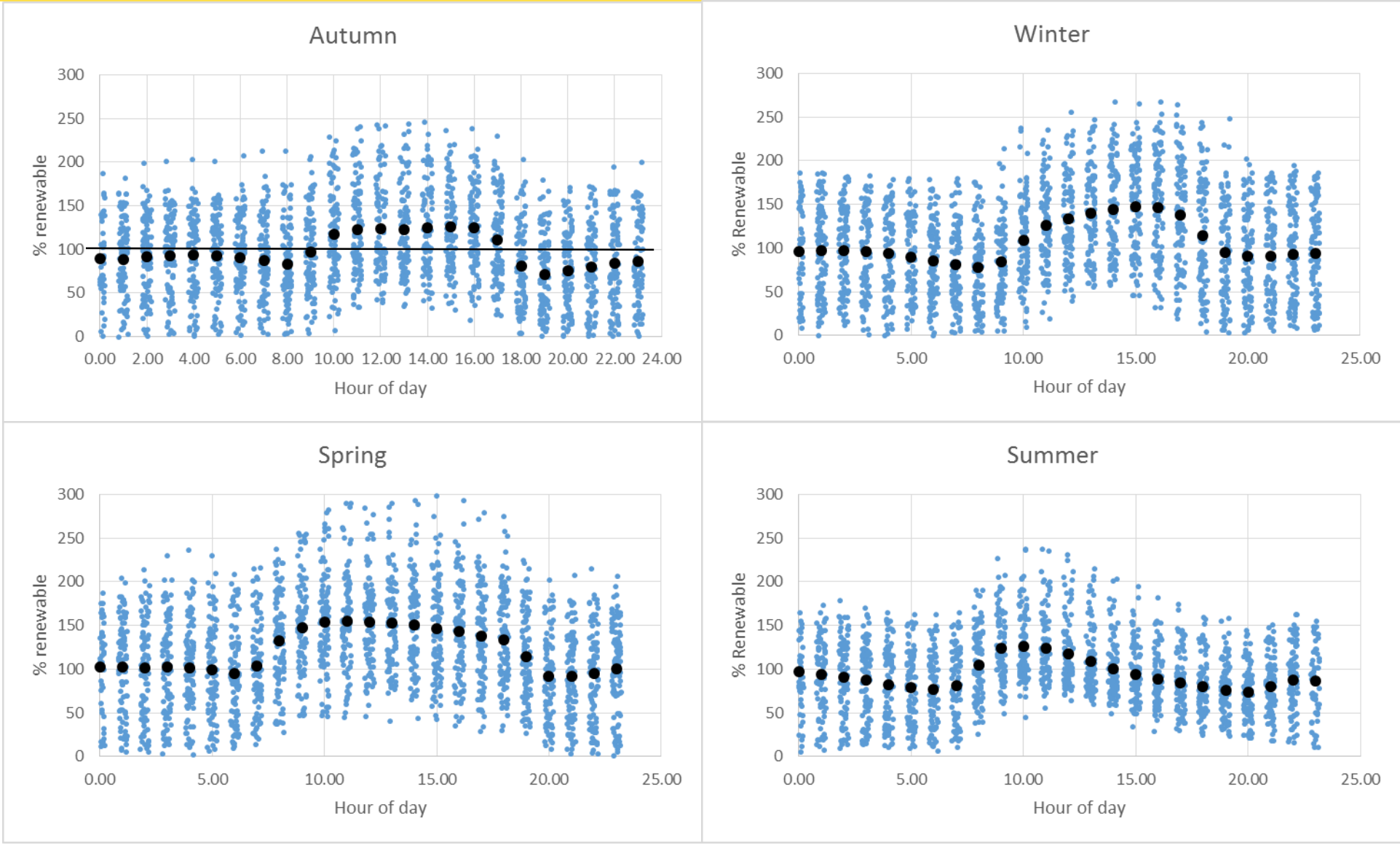
Questions? Ron Sinton ron@sintoninstruments.com

Xcel with 80% renewables 27:78% Solar:Wind

Similar trends to 2023 CEP portfolio.

While near 100% renewables on average, the use of gas could be much further reduced by flexible power use timed to coincide with abundance of PV and wind.

Black dots are the seasonal average for each hour



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