

Nebraska Public Power District

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NEBRASKA WIND & THE SPP MARKETPLACE

1

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October 2014



Operating and Proposed Wind Farms in Nebraska

September 2014



APPROXIMATE SCALE



Legend Status

- ▲ Operating
- Under Construction with a signed PPA Contract
- Proposed
- Status Unknown

Disclaimer: Information comes from many public sources. Author does not guarantee accuracy of information.

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SPP INTEGRATED MARKETPLACE

- Started March 1, 2014
- Has two markets
 - Day Ahead (DA)
 - Real Time (RT)
- Day Ahead (DA)
 - Settled Financially
 - Less Volatile
 - Generally averages a higher price
- Real Time (RT)
 - Settled at the difference between DA Awards and RT Actuals
 - Very Volatile at times
 - SPP Market Charges
- Congestion and Market Prices
 - Where the windfarm is located at does make a difference
- Wind Forecasting
 - Very important
 - Wind Forecasters state 15% to 20% error is good ☹
 - Load Forecast it is 2% to 4%
 - DA forecasting and length of time from forecast to actual has a impact

DAY AHEAD PRICES VS REAL TIME PRICES

Numbers from March 1, 2014 to September 30, 2014				
DA Price (Hours) below Offer	DA Price (Hours) Below \$0	Lowest (hour) DA Price	RT Price below Offer (Number of Hours)	Lowest RT Price (Hourly Average)
7	7	(\$7.95)	284	(\$234.14)
0	9	(\$8.57)	72	(\$228.52)
0	8	(\$9.29)	55	(\$259.87)
0	5	(\$9.15)	55	(\$259.87)
6	6	(\$10.80)	231	(\$263.66)
0	2	(\$1.43)	40	(\$217.87)

Windfarm #1 and Windfarm 5 do not receive Production Tax Credits

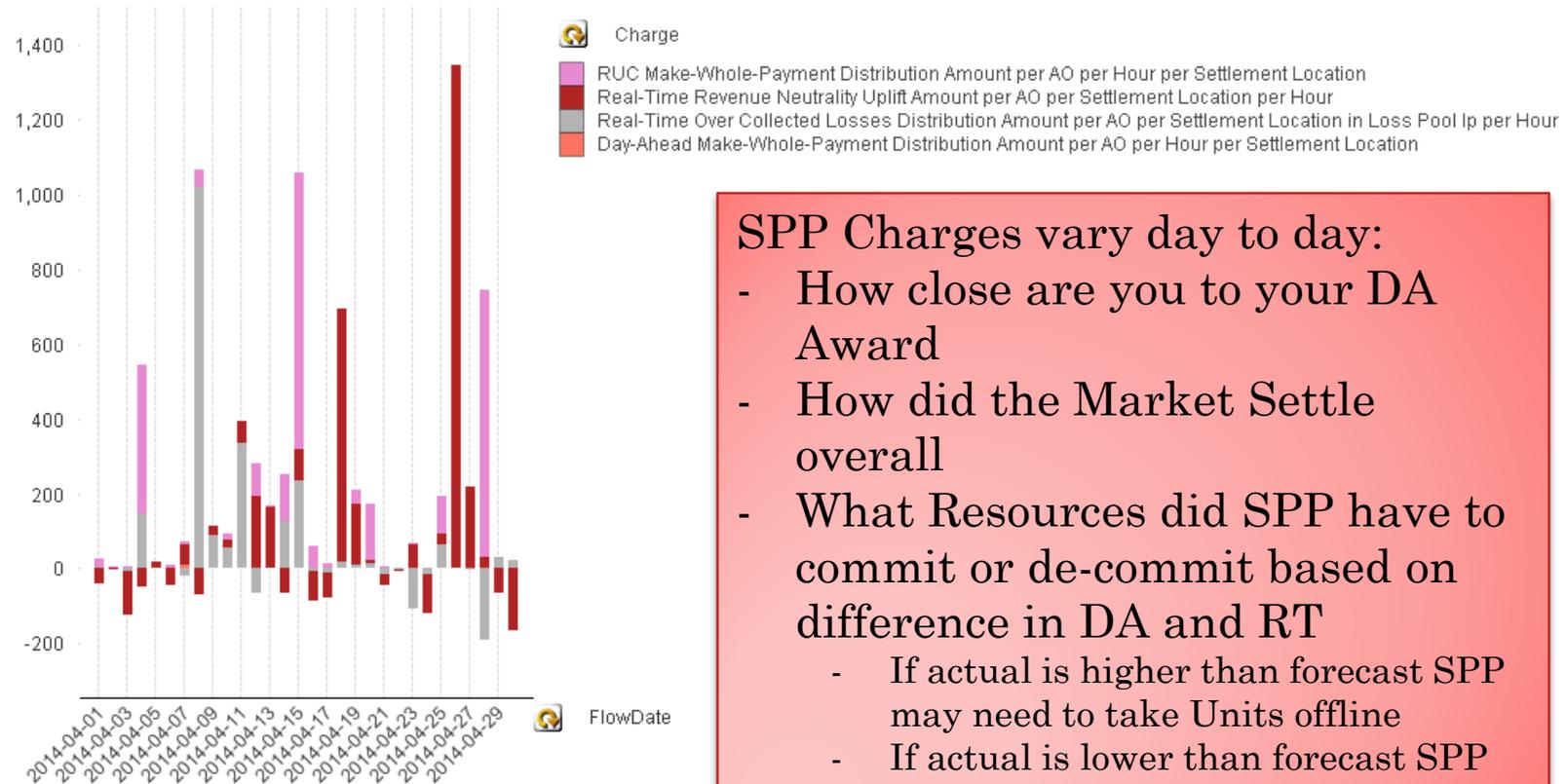
SPP IM MARKET REAL TIME VOLATILITY

- DA is a Hourly Financial Market
 - All Cleared Mws and Prices are hourly
- Real Time (RT) is a five minute Market
 - All Deployments are every Five Minutes
 - All Prices are every Five Minutes
 - Can see volatile prices in 5 minute market
 - Actual RT LMP Prices for he24 at AWEF on September 30th
 - Priced every 5 minutes
 - Positive and negative prices throughout hour
 - Many more 5 minute prices are negative than the hourly numbers from previous Slide

HE 24 at AWEF on September 30th - Five minute Market Real Time LMP Prices													Average for hour
Time	0	5	10	15	20	25	30	35	40	45	50	55	60 minutes
Mw	12.6	12.5	12.5	13.9	16	16.5	15.9	16.2	15.7	15.8	16.2	16.9	15.06
RT Price	(\$34.85)	\$8.64	(\$28.97)	\$17.09	\$18.31	\$18.80	\$19.53	\$16.77	\$19.14	\$21.52	(\$28.92)	\$8.51	\$4.63

SPP CHARGES

Charge level data



SPP Charges vary day to day:

- How close are you to your DA Award
- How did the Market Settle overall
- What Resources did SPP have to commit or de-commit based on difference in DA and RT
 - If actual is higher than forecast SPP may need to take Units offline
 - If actual is lower than forecast SPP may need to put Units online

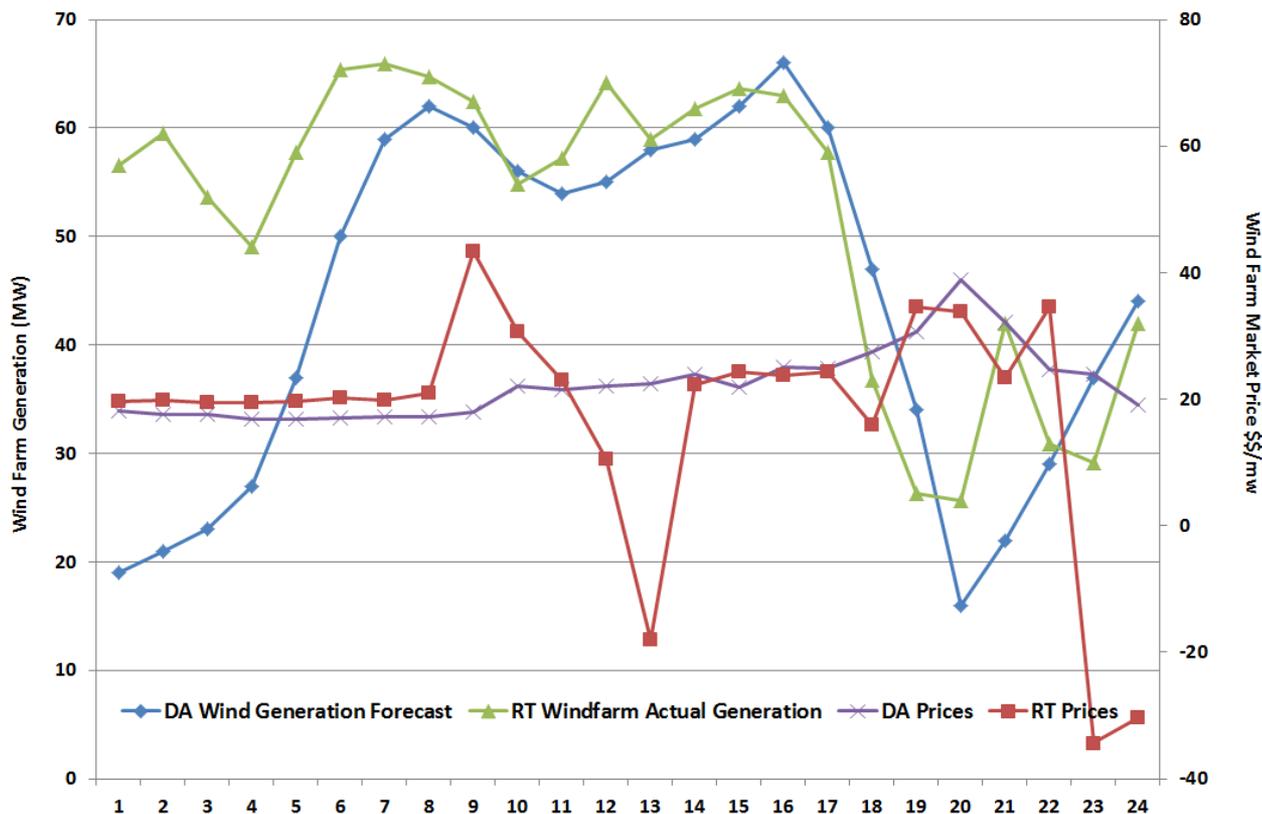


WIND GENERATION IMPACTS TO NPPD

- With SPP the Balancing Authority (BA) NPPD follows Directives from SPP for reliability needs
 - Additional Resources that can move may be needed to manage intermediate resources
 - Ancillary Market provides a pricing mechanism for SPP to acquire needed resources for Operational Reserves
 - Includes Reg Up, Reg Dn, Spinning, and Supplemental
- Wind Generation impacts NPPD's from different locations
 - Nebraska
 - SPP
 - MISO
 - WAPA (joining SPP on October 1, 2015)
- Risk for Transmission Flowgate Congestion is highest when wind output is high during low load periods
 - High Volatile Prices
 - One five minute pricing period impacts
 - Spring and Fall Maintenance periods have a impact as well



Windfarm in the SPP IM October 5, 2014



Example of DA Forecast vs Actual and DA Prices vs RT Prices

- Shows the forecast error
- Shows how volatile the prices can be
- Prices tend to follow forecasting error



RESEARCH ITEMS FOR A RTO MARKET

- **Investigate ways to factor in economic impact of Wind Generation**
 - Reduce financial and operational risks for resources needed for Reliability
 - Need other Resources to manage Intermediate Resources
 - This would include Quick Start Units, multiple start Units, Units with Ramping capabilities, etc.
 - Forecasting for Wind Generation and Load needs to improve
 - Better look ahead tools for Operators of RTO's
- **Moving projects from Non-Dispatchable Variable Energy Resources (NDVER) to Dispatchable Variable Energy Resources (DVER)**
 - Are projects capable?
 - PURPA Qualified Units (QF's)
 - What are the potential costs and benefits?
 - How can the RTO models be improved to manage Wind Generation to show the benefit
- **Improvement in Generator Studies to determine what transmission is needed for Generators**
 - Some sites are price takers and have no Transmission Scheduled



o Thank You