DME Renewable Resource Plan & Planning Approach

Enterprise Risk Consulting, LLC

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Enterprise Risk Consulting, LLC ("ERC")

- Enterprise Risk Consulting, LLC ("ERC") is a consulting firm specializing in energy trading and risk management.
  - Multiple public power clients in ERCOT involving renewable resource acquisition, and ongoing renewable resource portfolio management
  - Design and implementation of risk management programs
  - Hedge strategy design, ongoing strategic and tactical recommendations, trader coaching
  - Hedge program review, policy gap analysis, policy development
  - Credit risk management
  - Risk information system selection and implementation
  - Consultants from senior positions in energy, financial services, and academia
- ERC staff for DME project: 3 consultants with over 90 years of combined experience in the energy industry. Substantial experience in energy consulting for many public power entities, commercial utilities, and power and natural gas marketers.

ERC and Georgetown's Supply Goals

- Neil McAndrews has helped successfully acquire renewable resources for several Texas municipals, including a 100% renewable portfolio for Georgetown, Texas. ERC also assists in the daily management of renewable resource portfolios for several public power entities in ERCOT, including Georgetown.
- We focus on acquisition and integration of renewables into supply portfolios because our goal remains **least cost supply.** Currently renewables are the least cost supply – by far – in Texas.
- The City of Georgetown: their principal reason for 100% renewable adoption was based on least cost and long term planning goals. The 100% goal was not set because they emphasized environmental attributes – it was set because renewables **produce a long term fixed price supply that is lower than any other market alternative**. Conditions were fortuitous – Georgetown had recently left a long term contract and had only a few mid term supplies to meet a very fast growing city.

ERC Project for the City of Denton - Expected Essential Findings

1. Additional renewable resources will be found to be the least cost alternative for the City of Denton.
2. Additional renewable resources will reduce the long term cost volatility of Denton's energy supply.
3. The Denton Energy Center ("DEC") will assist in lowering supply volatility. We are analyzing how it might fit in the resource plan, and we will recommend alternative ways to dispose of prospective excess production potential.
4. DME will need to develop forecasting and congestion management processes to fully integrate renewables into the supply portfolio.

First Principles in Designing & Managing a Portfolio of Renewable Resources

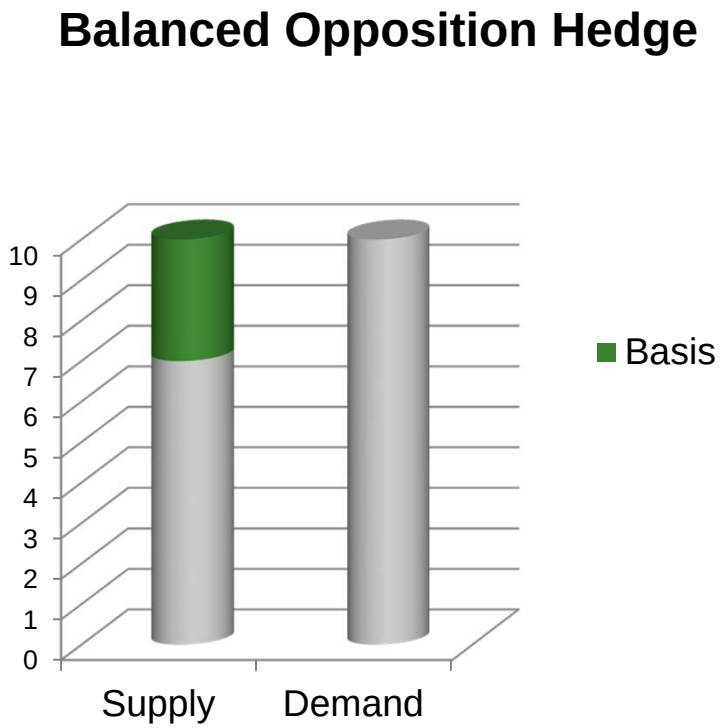
ERC makes renewables work in a portfolio because we avoid common mistakes by following first principles.

- A first principle is that ERCOT is an "energy only" market.
- ERCOT market design requires that load only needs to acquire adequate energy schedules and most of the supply risk is then neutralized.
- A first principle is that the supplies must work as an efficient "opposition hedge". The opposition supply resource involves both an energy component and a basis component as seen in the next slides.
- Many renewable resource supply portfolios in Texas have poor economic performance because of misapplied portfolio management and failure to complete the "opposition hedge".

Goal – a Balanced Opposition Hedge

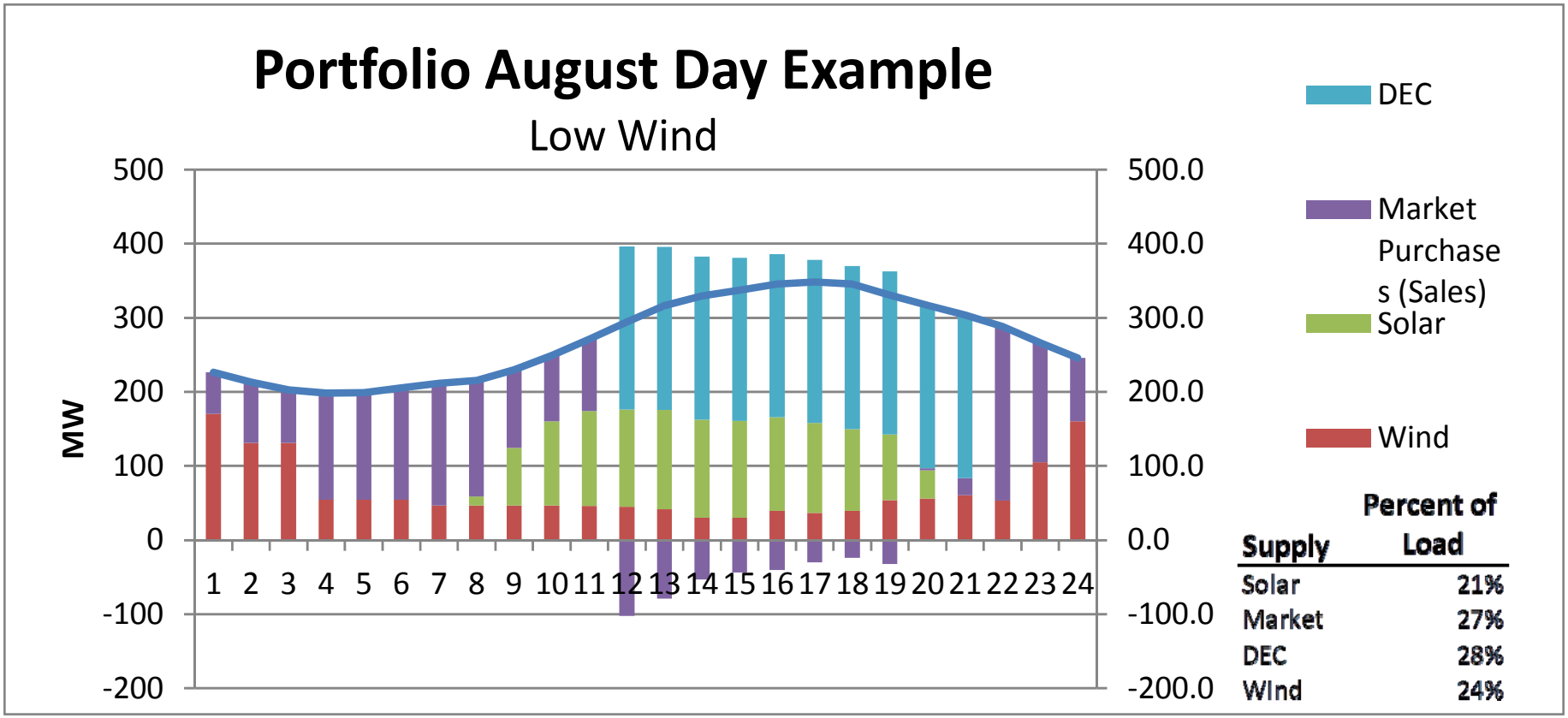
- Supply and demand must be highly uncorrelated to form an opposition hedge – the addition of highly uncorrelated supply to demand results in a balanced portfolio with substantially reduced price uncertainty.
- On the supply side there are two hedge components: energy and basis. These two hedges are needed to hedge the load's energy and congestion risk.

Basis is hedged – price differential is fixed between Resource Node and Load Zone:



Supply Outcome

During summer, wind is often lowest, and accurate market purchases are required to "firm" the supply even under high annual renewable quantities.

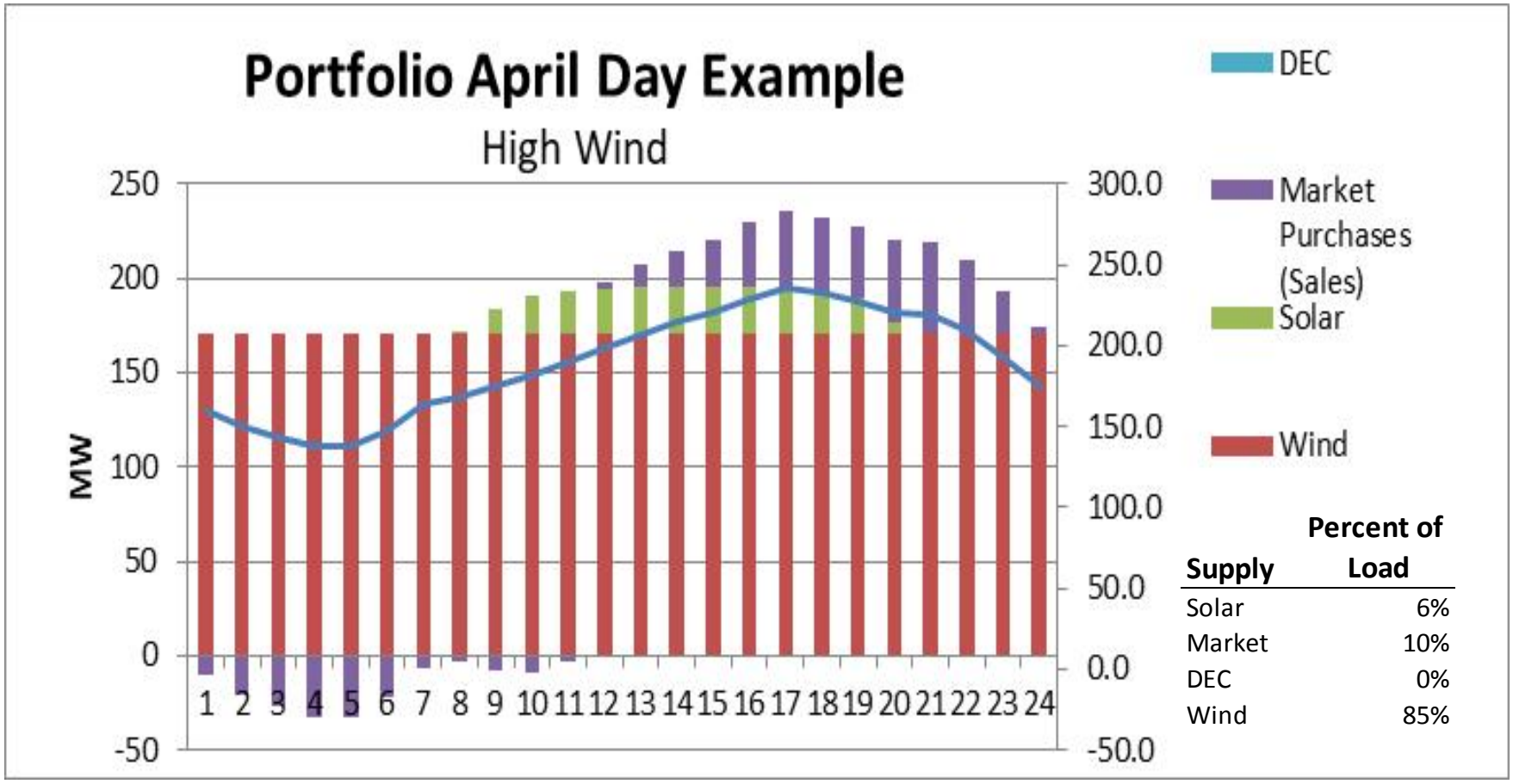


Denton Energy Center

- Initial models of price suggest that the DEC is likely to have excess capacity for most of the year.
- Under some prospective coal retirement schedules, the DEC capacity factor may be higher, but this is very uncertain.
- In either case, it may be an opportunity to sell excess DEC potential production on a seasonal basis to capture additional revenue to pay debt service.
- Because most 70% to 100% renewables portfolios produce too much renewable production during the spring and fall season, it may be beneficial to sell excess renewable power during these periods using the DEC to firm the transaction.
- Another way of enhancing the DEC is to sell options on some of its excess production.

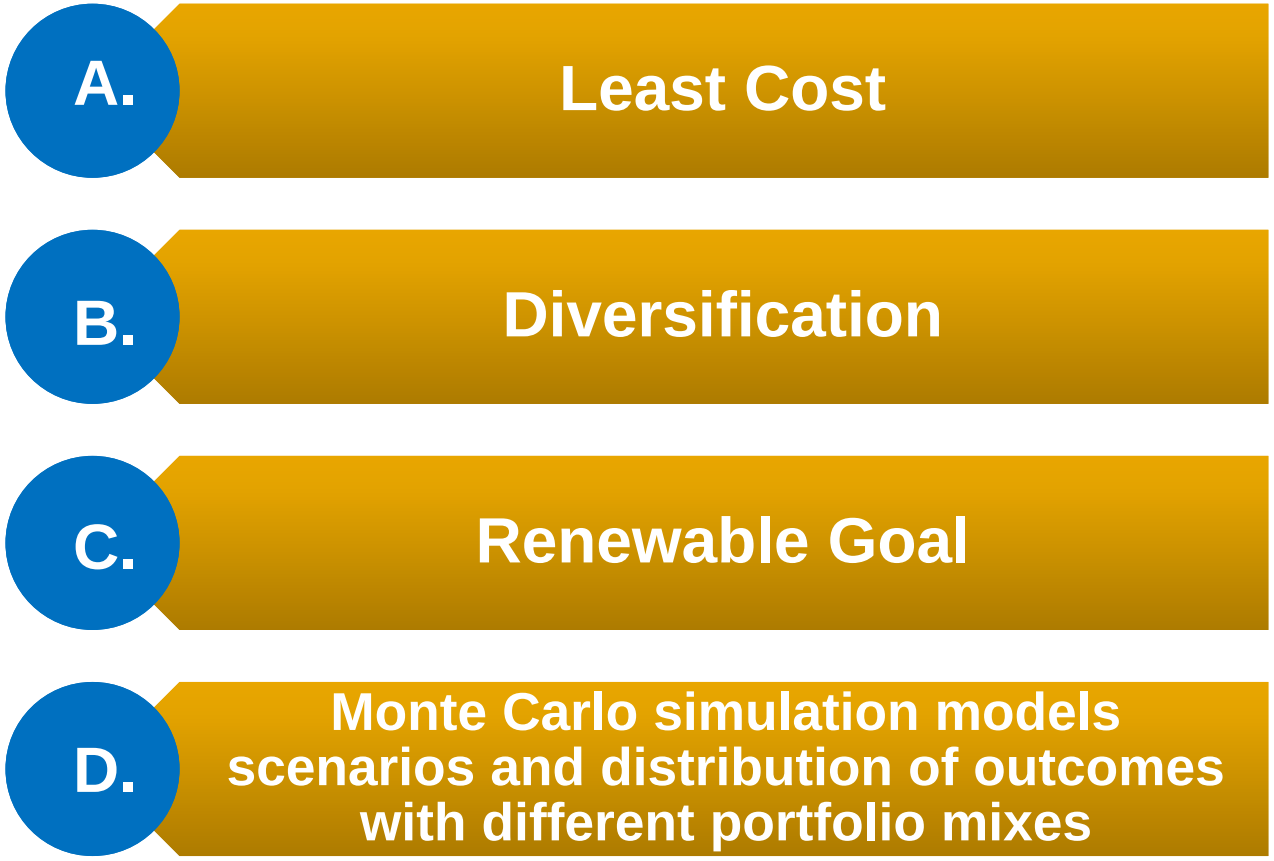
Portfolio Seasonal Balance

Here the excess production is from renewables and some must be disposed of (sold in the market). In this scenario, the DEC is not dispatched by ERCOT's economic dispatch system because it is too high of a heat rate and cost, but market purchases are still needed in some hours.



Supply	Percent of Load
Solar	6%
Market	10%
DEC	0%
Wind	85%

Path to Least Cost and Maximum Renewables



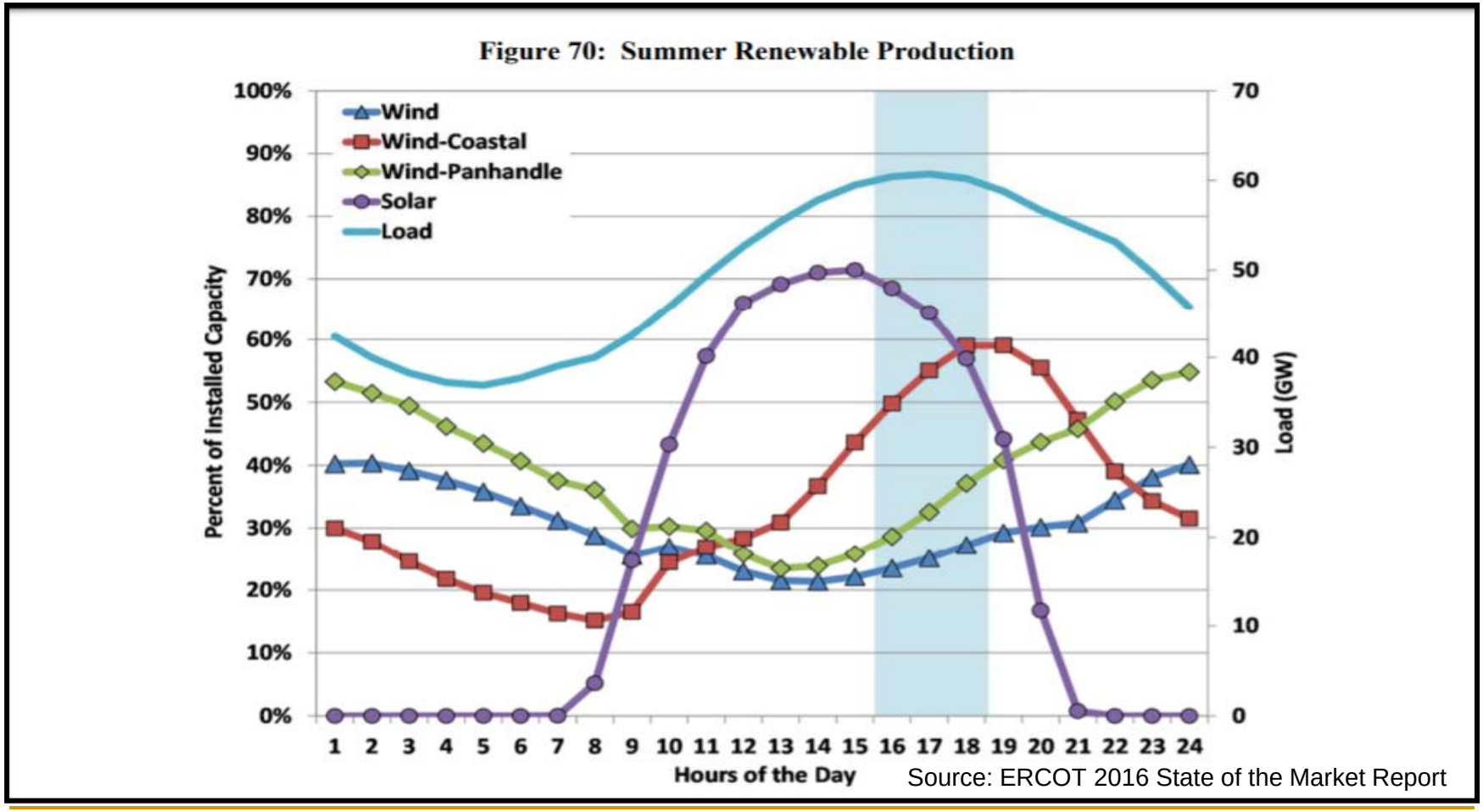
Least Cost

Renewable prices are remarkably low.

- Current wind resources are offered from $17 to $22 per MWh. Solar is offered in the mid $20s/MWh. These power prices are the lowest offered in the last 50 years.
- This is in contrast to four years earlier where wind prices were offered between $40 to $65 /MWh and solar was as much as 5 to 7 times current offers (e.g. City of Austin Webberville site at $165/MWh).
- Subsidies for Solar and Wind are being phased out.
- Natural gas is the marginal fuel nationwide and supply is declining at current price levels while demand is increasing dramatically.

Portfolio Modeling & Diversification

The Monte Carlo process with test the three wind regions, and solar at different levels, and will select the least cost combination.



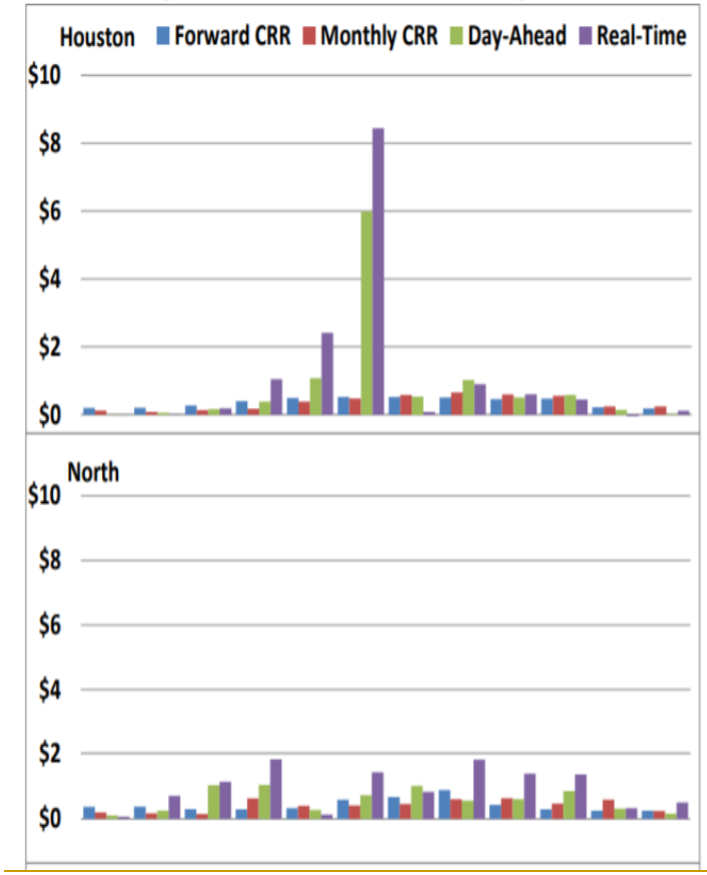
Diversification and Renewables

- Renewables are intermittent producers and carry two risk elements: 1) spotty hedge performance and 2) increased forecast error.
- This is why a portfolio of renewables should be composed of resources that are poorly correlated with each other. Combining assets with lower correlations reduces risk and improves overall hedge correlation and forecast reliability.
  - The main risk reduction is the combination of solar resources and wind resources. A typical correlation between the two is -95%.
  - Wind resource combinations have varying correlations due to differences in quality (e.g., higher capacity factor Coastal wind vs. West Texas wind) and location (e.g., West Texas vs. Panhandle)
- Very few commodity portfolios have the opportunity of such advantageous pairing of assets.

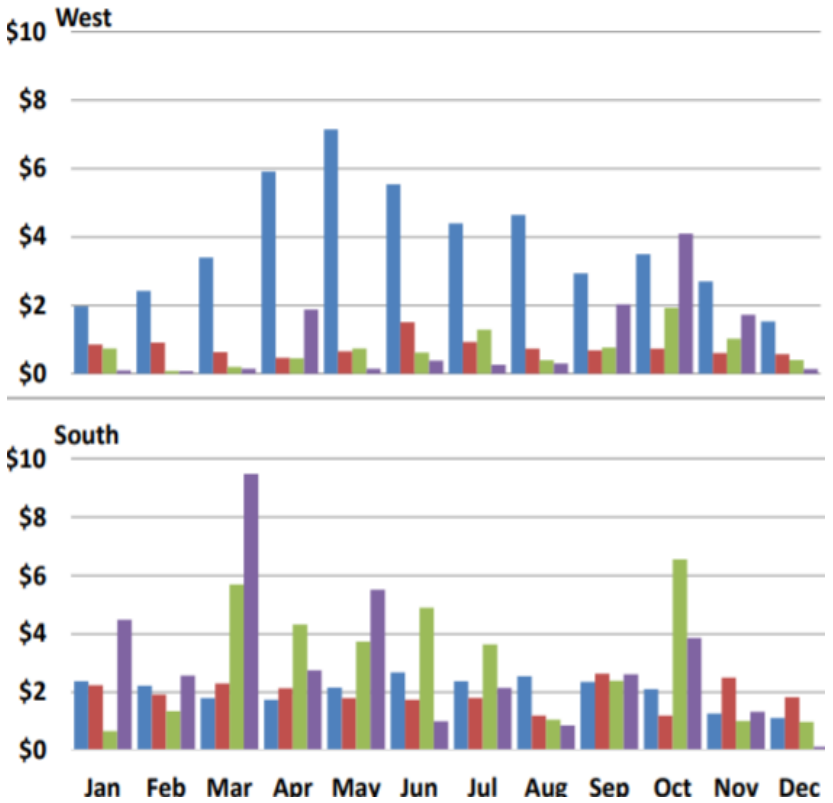
Diversification Includes Congestion Risk

The North Zone historically has lower congestion prices, but most renewables come from the West Zone or South Zone. This requires modeling to select the most economic CRR purchases.

Figure 54: Hub to Load Zone Price Spreads



Source: ERCOT 2016 State of the Market Report



Anticipated Recommendations for the Renewable Plan (Delivery Date: October 16)

- Purchase additional wind with lower correlation to current wind supplies to better complete the supply hedge and achieve greater diversification.
- Purchase solar at two or more additional locations to improve aggregate reliability.
- 30% of load purchased with short to intermediate term solar and wind contracts (e.g. 2 to 5 years)
- Avoid known congestion areas, emphasize 345 kV interconnects
- Expected prices for Renewables in the mid $20s per MWh.
- We will propose variety of alternatives for maximizing the value of the DEC, including how to dispose of prospective excess production potential.

ERC Project, Phase II

- In Part II of the scope of work, ERC will assist Denton in revising an RFP for renewable energy resources, and in drafting an additional RFP if necessary, and will assist in analyzing the responses to renewable energy RFPs.
- Timeline: October 2017 to first quarter 2018
- RFP Evaluation will include:
  - Cost, location and congestion risk
  - Production profiles, wind speeds solar irradiation data and technology type
  - Area transmission and interconnection arrangements
- ERC will also assist in Denton's ongoing negotiations for securing natural gas transportation and supply for the DEC.
- Natural gas evaluation will include:
  - Required transportation
  - Vendor services including storage and capacity optimization, park and loan
  - Costs, settlement support, vendor's nomination process
  - Plans for DEC dispatch modeling, and for balancing natural gas burns with delivery schedules