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Price Forecasting Methods

October 18, 2021

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Outline

- Methodology for forecasting prices
- Results of 2020 Forecast (2021 Forecast in progress)
- Scenarios
  - High Electrification
  - Carbon Pricing

Methodology

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Ascend's Forecasting Philosophy

- **Don't argue with markets**
  - If your forecast (or forecasting consultant) thinks the forward market is wrong, you should invest immediately or get a new forecast
- **Don't argue with long-run equilibrium**
  - Out-of-market profit opportunities won't continue indefinitely
  - Incentives drive investment
- **Think critically about the input assumptions**
  - A fundamental forecast is only as good as its fundamentals
- **Pay attention to geography**
  - Geographic variations in resources and economics
- **Recognize that average behavior isn't the same as real behavior**
  - On average, real-time volatility does not exist

Forecasting Process Inputs

Supply Stack Projection

- Energy and Capacity Mix
- Tx Interconnection Queue
- Announced retirements/builds
- Regional Load forecasts
- Technology Cost Projection
- Policy Drivers
- Stakeholder Demands

Forward Price Curve

- Historical power and gas prices
- Forward market prices
- Energy storage effect on power prices
- Renewable gen effect on power prices
- Variable marginal costs

Price Volatility / Shapes

- Simulated Renewable Generation
- Renewable gen effect on volatility
- Regional load data
- Simulated Energy Storage Dispatch

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Economics is not the whole story with future supply

- **The ESG Trajectory:**
  - Large companies increasingly pursuing renewable energy (e.g. Google, Amazon, Facebook)
  - Customer demand for renewables is driving behind-the-meter installations

- **The Policy Trajectory:**
  - States are not likely to relax clean energy mandates; some will tighten
  - More states are likely to adopt 100% clean energy mandates
  - 180+ Municipalities have goal of 100% clean energy

*A forecast should be based on the **FUTURE** of policy and demand, not the present*

Forecasting Supply Stacks

- Renewables are increasingly the least cost source of ***energy*** (but not capacity)
  - Most new resources will be renewables and storage
- Economics are not the only driving force for renewable buildout
  - Future policy, off taker demand, and stakeholder pressure -> ***more renewables than predicted by a strictly economic model***
- Thermal capacity: declining capacity factors though still needed for reliability
  - Flexible capacity will be key resource for economically accommodating increasing renewable penetrations
- Utility resource plans show increasing levels of renewables and storage builds with retirements of coal and natural gas resources

Supply Projection Details

- **Ascend's is updating its assessment of the supply forecast for the region**
  - IRP document reviews
  - Regional reports (NWPCC, PNUCC, NWPP, etc.)
  - Model updates

- Capacity may be tight in the near term due to fossil fuel retirements

- High clean energy requirements in WA and OR
  - Idaho Power: aiming for 100% clean by 2045; Ascend projects Idaho will reach 90% clean energy by 2045
  - Montana: no state policy goals

Long-run Equilibrium

- Power prices must sustain new supply resources in the long run, BECAUSE:
  - If prices are too low → supply will not get built (until prices rise)
  - If prices are too high → more resources will enter, driving down prices
  - Long run: quantity of resources will be built so as not to leave extra money on the table

- Long-run equilibrium applies to the market as a whole
  - Average prices will trend to an equilibrium level
  - Price volatility will settle into an equilibrium level
  - Price shapes will reach long-run equilibrium
  - Ascend computes long-run equilibrium in PowerSimm with multiple models testing the interaction of prices, volatility and shapes

Forecasting Market Conditions

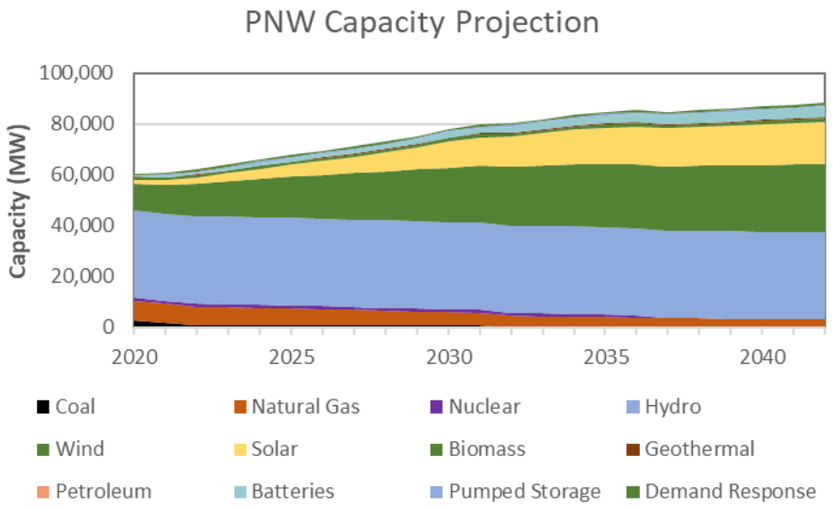
- Supply mix is fundamentally changing; forecasts must account for the impacts of high renewable penetration on price behavior
- A base forecast should align to the best expectation of future conditions (rather than continuation of the status quo)
- Forecasts should adhere to long-run equilibrium in a competitive market
- Geospatial considerations are critical for long-term resource valuation

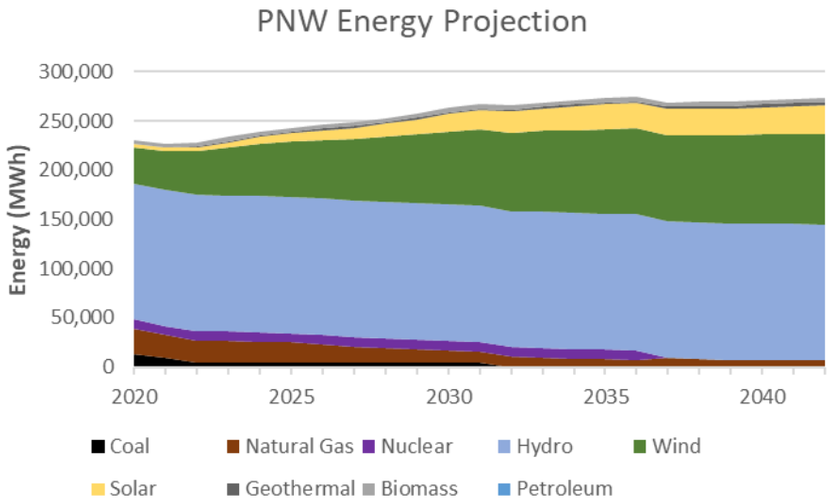
Challenges with Mid-C price forecasts

- Market data on Mid-C is scarce compared to ISO/RTO regions (who have hourly data on renewables, ancillary prices, system load, etc.)
- Hydro power dominates the PNW → high levels of seasonal and annual uncertainty (dry years vs wet years)
- Resource adequacy needs are evolving and uncertain
  - Peak demand is expected to shift more to summer months
  - Capacity value of renewables (ELCC) are not (yet) defined consistently across the region
- Ascend uses IRPs from utilities in the PNW to inform supply stack projections
  - Utility plans are not (yet) coordinated under a single framework

Pacific Northwest Supply

- Demand side management (DR and EE) expected to play a large role in meeting carbon targets
  - NWPCC estimates high DR potential in the region (>2.7 GW)
  - Utility IRP documents plan for more aggressive push with EE and DR
- Coal generation is low and declining quickly
  - Washington and Oregon prohibit coal generation after 2025
- Wind, solar and energy storage will grow quickly
  - Oregon and Washington carbon policies will require much more wind and solar
  - Most solar will include battery storage as shown in IRPs and in development activity in the region





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2020 Forecast Results

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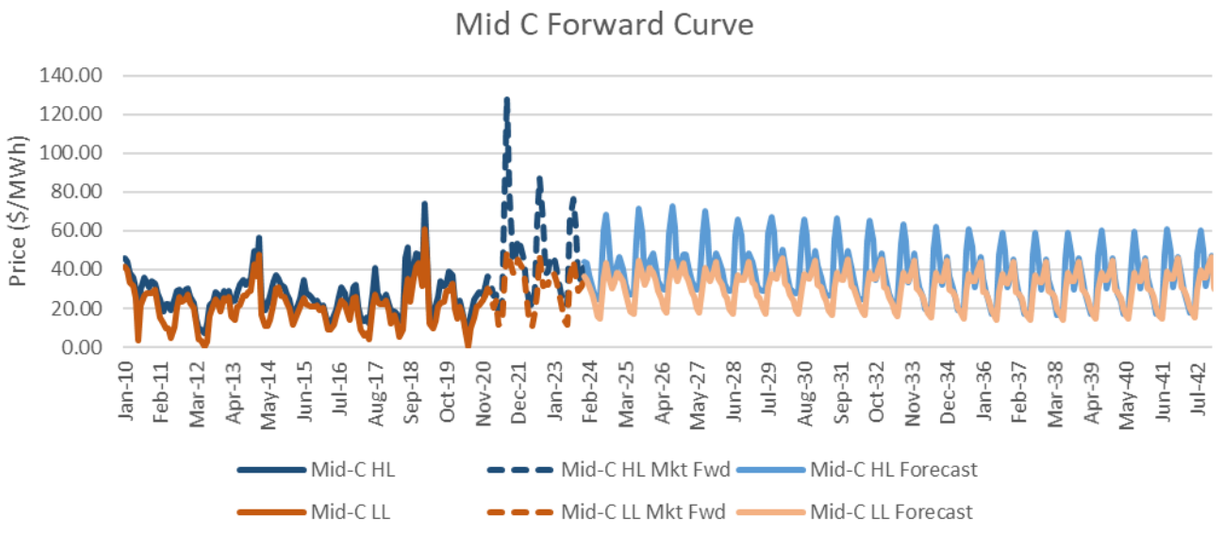
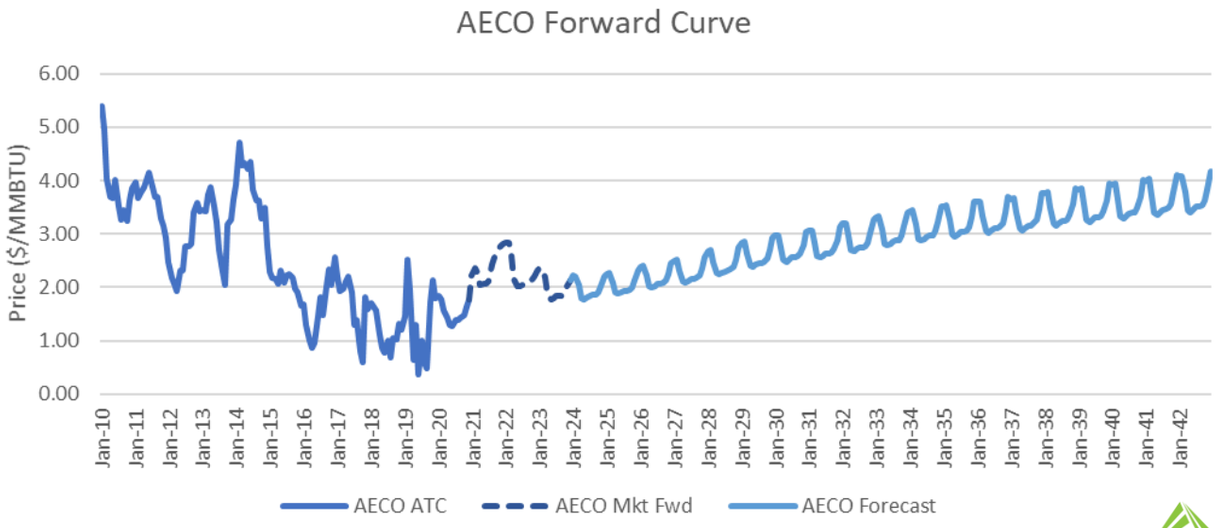
Ascend 2020 Forecasts – Power Prices

- Mid-C prices projected to decline slightly in nominal dollars
  - Prices adjusted for inflation decline more substantially
- Expected growth in renewables is primary driver of the decline
  - Growth in renewables driven by utilities' plans, state policies in OR and WA, stakeholder push for more renewables
- AECO gas price projection is based on EIA forecast for the Henry Hub price
- **Ascend's 2021 Forecast is in progress, will update 2020 forecast with current information and assumptions**





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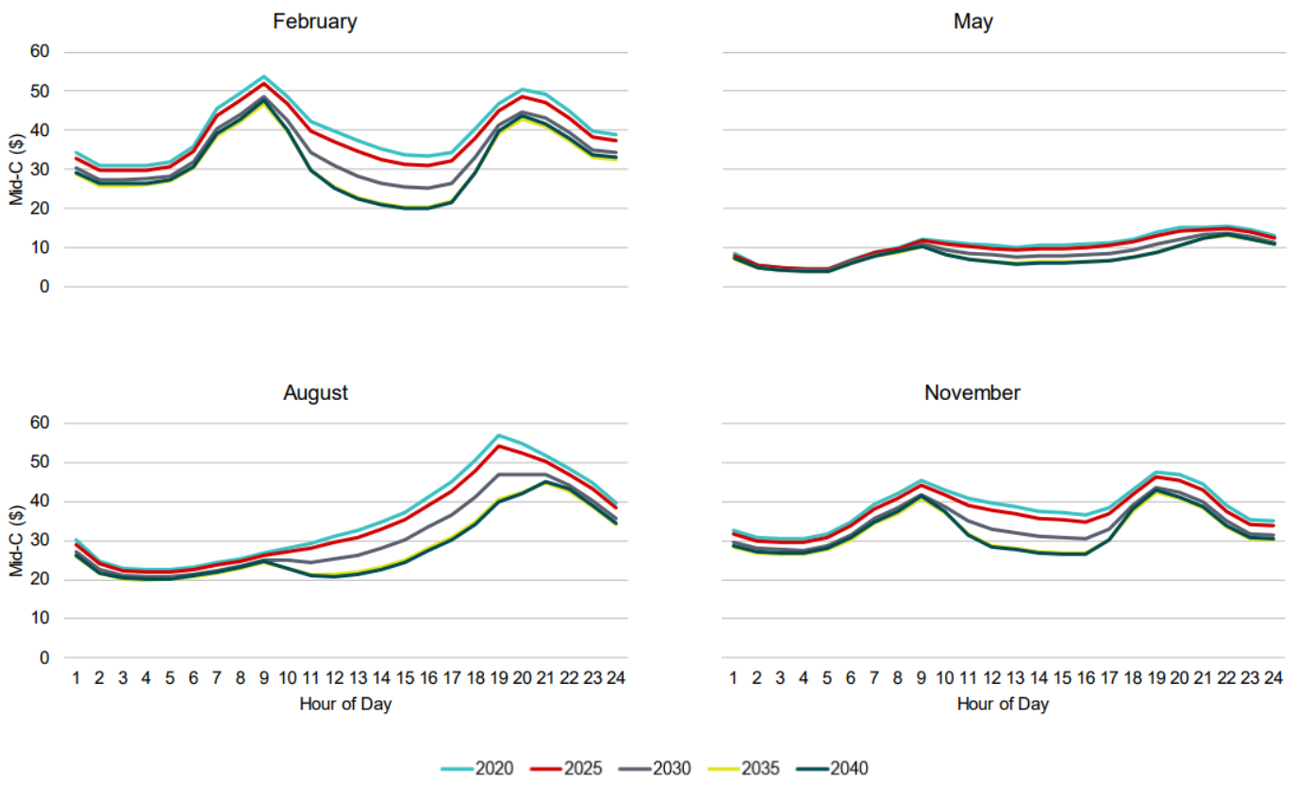
Ascend Current Forecasts – Price Shapes (2020 Vintage)

- Price shapes in the 2020 forecast were expected to become more pronounced in February and August with flatter profiles in spring and fall months
  - Price shapes are determined by net load profiles (load minus renewable gen)
  - Future load profiles estimated based on projected growth of DSM and EVs



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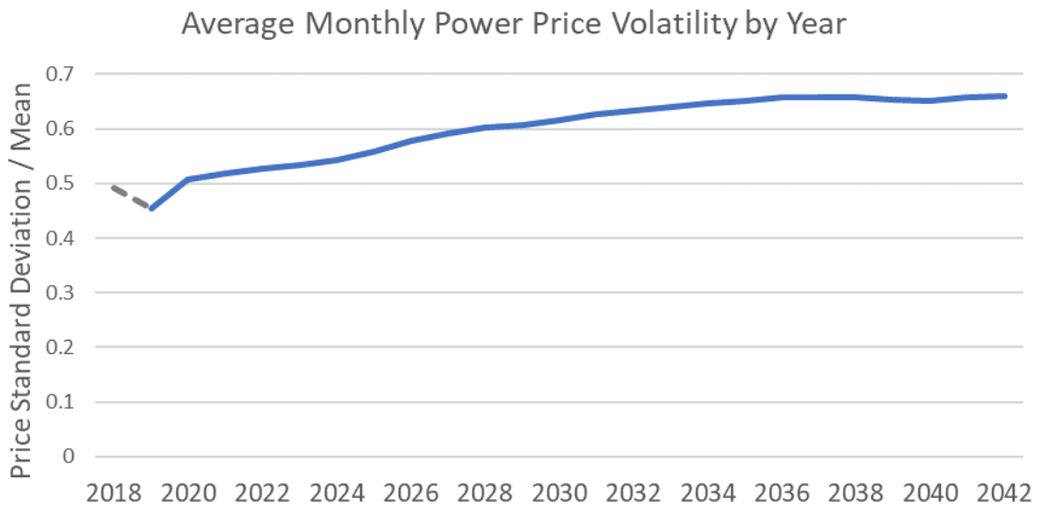
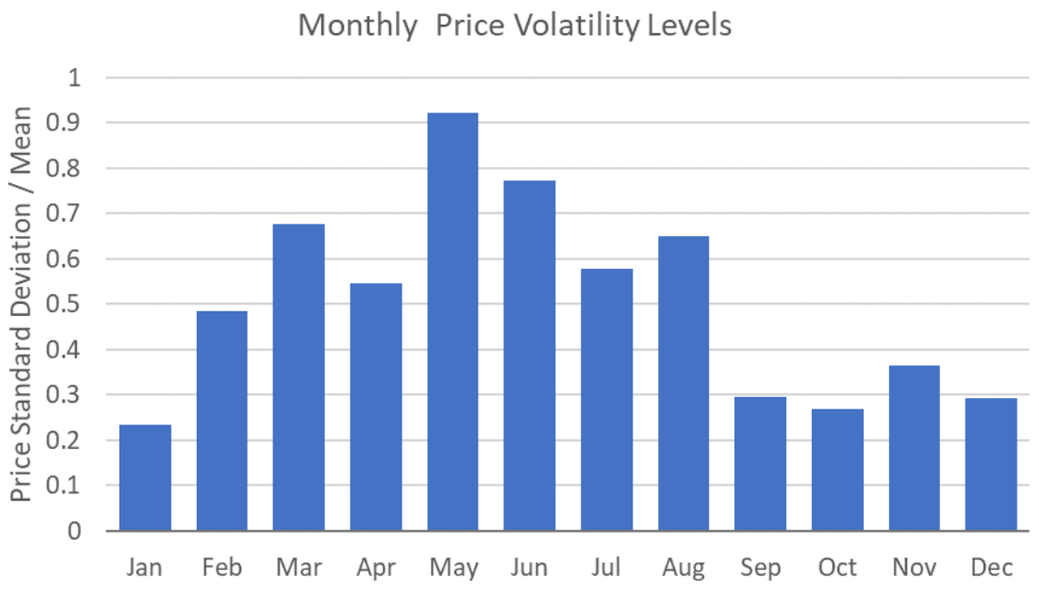
Ascend Current Forecasts – Price Volatility (2020 Vintage)

- Price volatility projected to grow modestly until the mid 2030s then level off
  - Renewable growth → increase volatility
  - Energy storage → decreases volatility
- Recently, volatility is highest in May and June
- Flexible generation will provide more value in a volatile market





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More Details

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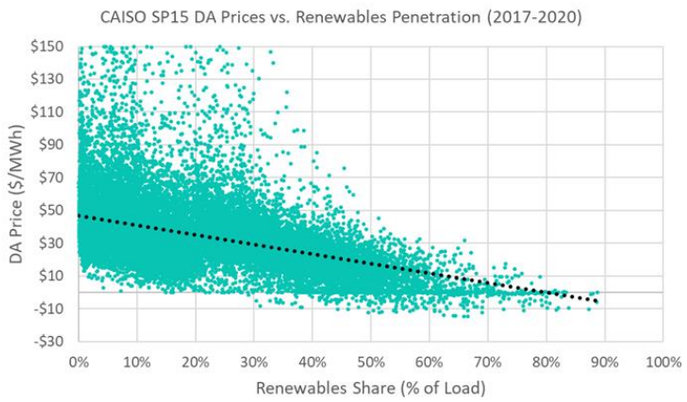
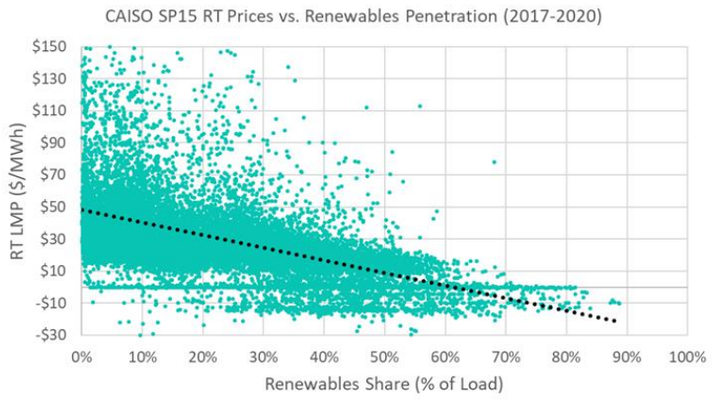
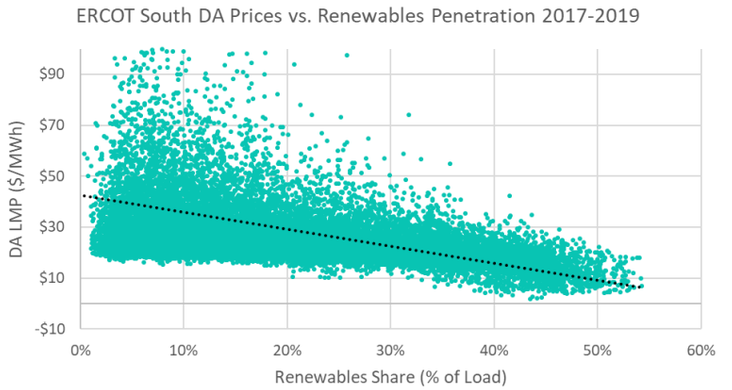
Price Depression with Increasing Renewables Occurs Across Markets

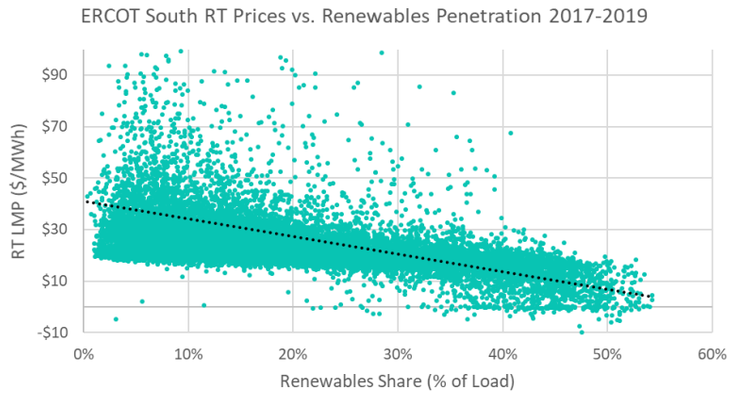
Across all markets with substantial renewable penetrations, prices are negatively correlated with renewable generation in both the DA and RT markets. With large amounts of renewables in the queues, these price dynamics are expected to manifest throughout the US



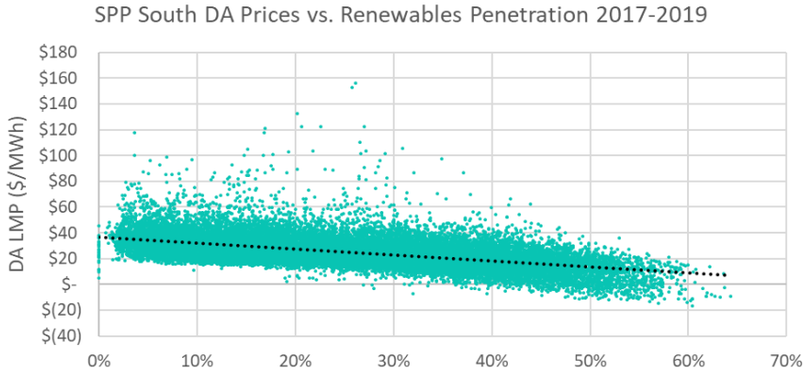


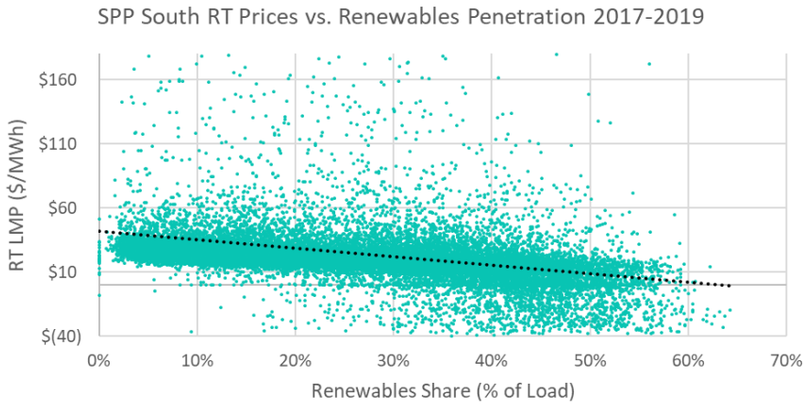
CAISO





ERCOT





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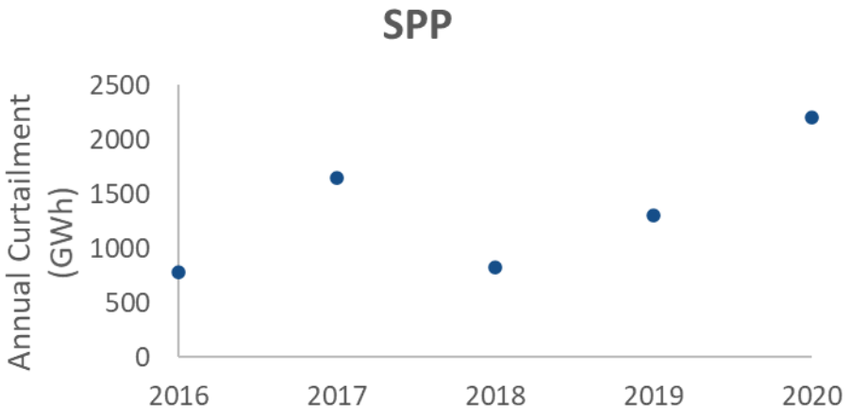
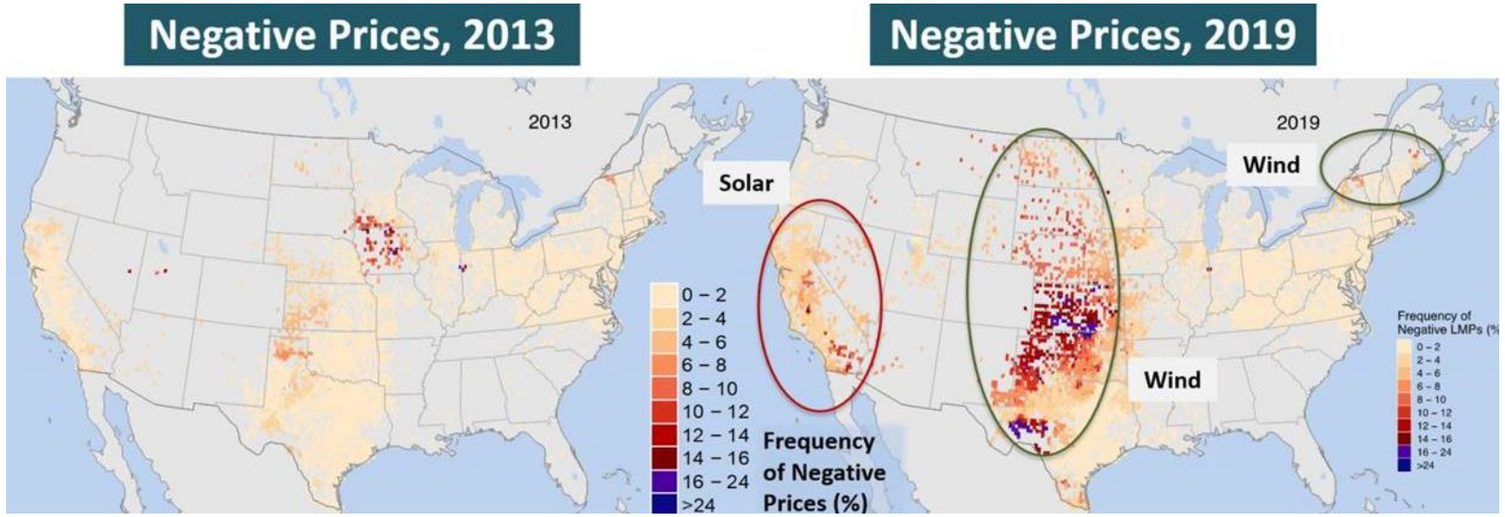
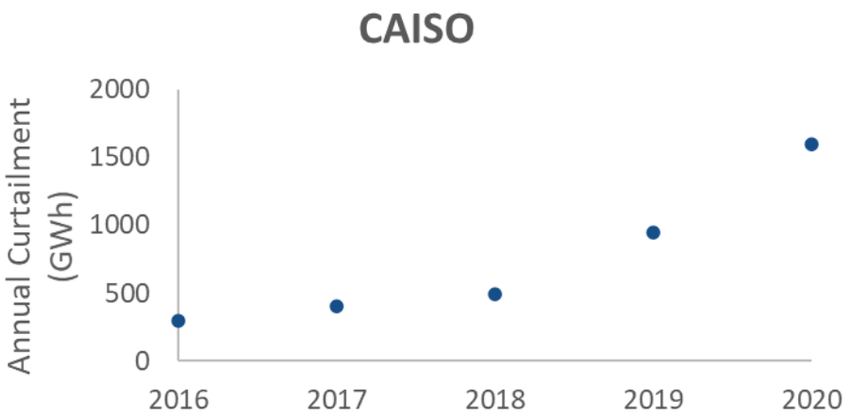
Curtailed Power Becomes Increasingly Common at High Penetration

Curtailment and negative prices are becoming more frequent, with weather uncertainty and operational constraints causing curtailment at much lower penetrations than predicted by many production cost models. These price dynamics will spread as renewable deployment grows.







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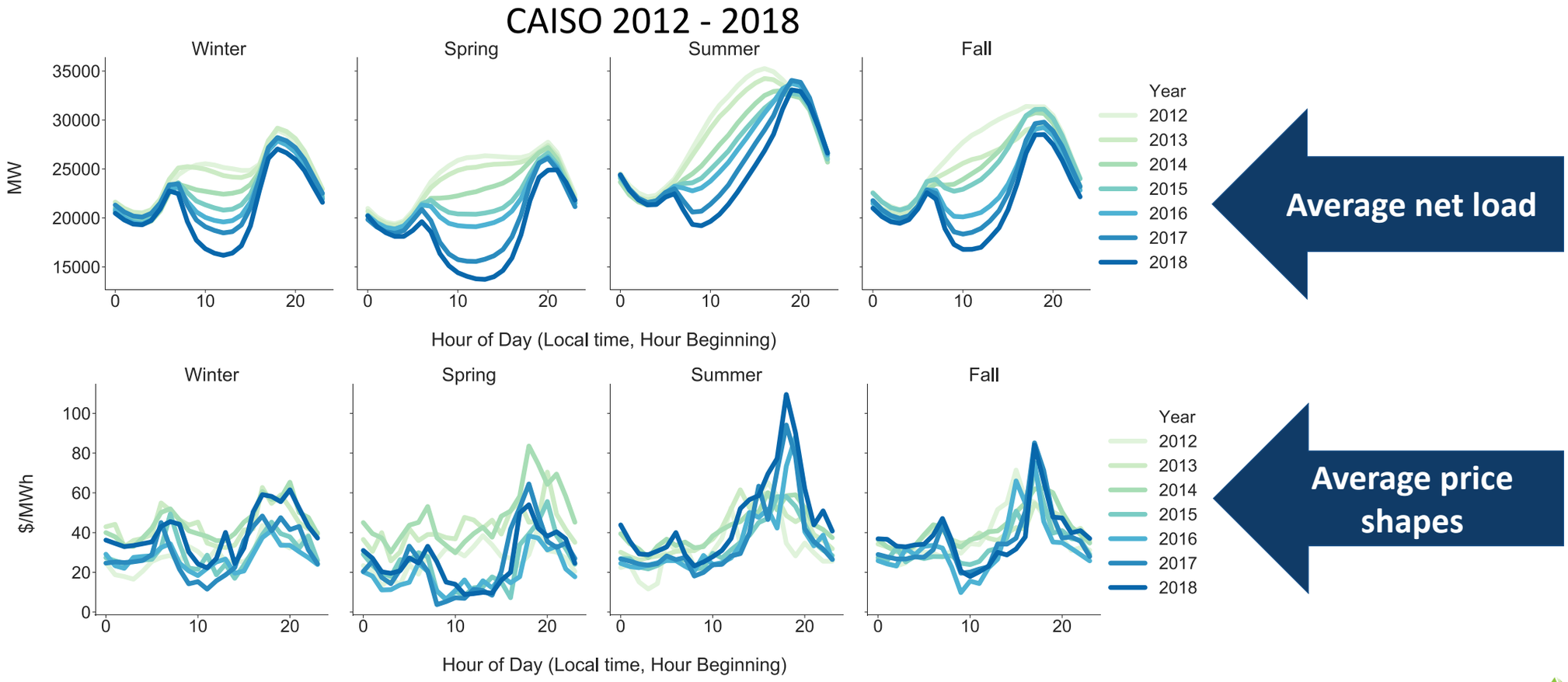
Renewables affect daily price shapes

- Renewable growth in CAISO has pushed mid-day prices down while keeping prices higher in the evenings.
- Ascend's forecasts are consistent with historical trends in regions with high renewable growth rates
- The Pacific Northwest will have different prices shapes since wind will play a large role



Source: Lawrence Berkeley National Lab

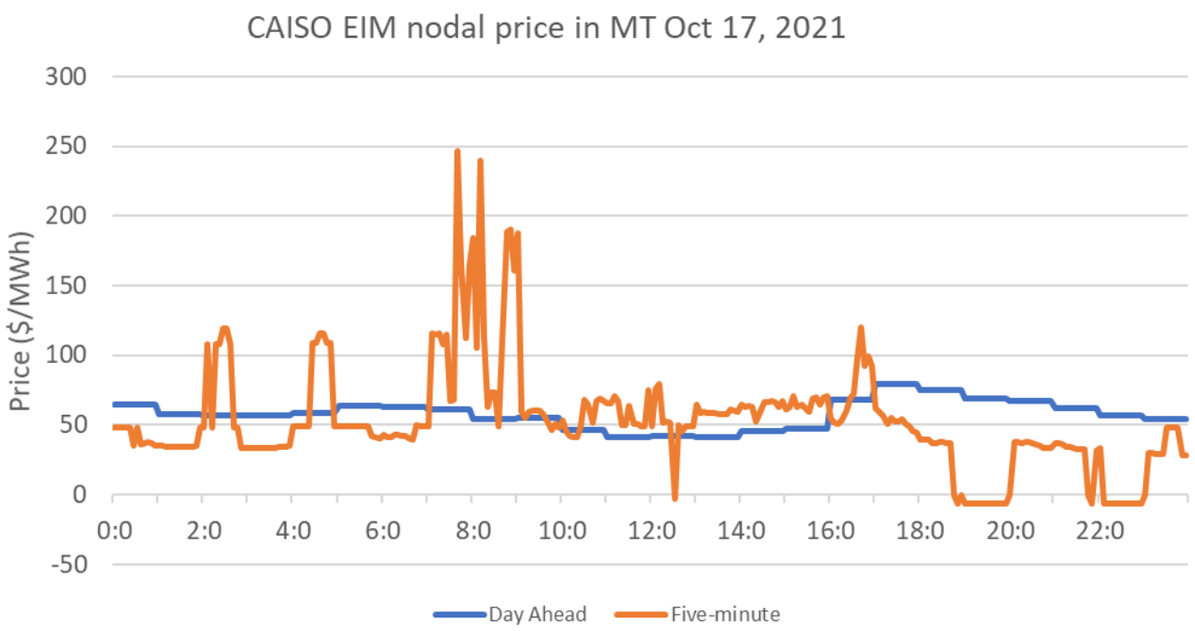
Price Volatility Increases with Renewable Penetration

- Renewables add volatility to the amount of generation in the system
- Generation swings from wind and solar cause shifts in the supply stack → price volatility

	ERCOT			CAISO		
Year	Renewable Share of Gen	DA Price Standard Dev	RT Price Standard Dev	Renewable Share of Gen	DA Price Standard Dev	RT Price Standard Dev
2015	12%	$40	$53	11%	$9	$64
2016	15%	$14	$55	14%	$12	$70
2017	18%	$11	$81	17%	$26	$80
2018	20%	$75	$82	19%	$40	$79
2019	21%	$164	$141	21%	$22	$67
2020	26%	$36	$39	22%	$59	$62

Real Time Price Volatility Increases with Renewable Penetration

Real-time price volatility tends to be short in duration, generating value for flexible resources that hourly models do not capture. This volatility grows as intermittent renewables provide an increasing share of supply.



Scenarios

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Price Scenario – High Electrification

- A high electrification scenario requires a re-run of the price forecast models with a higher load forecast
  - High load means more resources are required to meet load
  - Supply stacks will adjust in the capacity expansion phase
  - Load will follow a different modeled shape to account for the load increase (e.g. high adoption of elec vehicles will lead to charging load in the evenings)
  - Ascend projects load shapes based on assumed EE, DR, and EV profiles which are highly uncertain

- PowerSimm inputs include a high load forecast for NWE and the regional load
  - Regional load drives power prices at Mid-C
  - NWE load affects dispatch of NWE resources

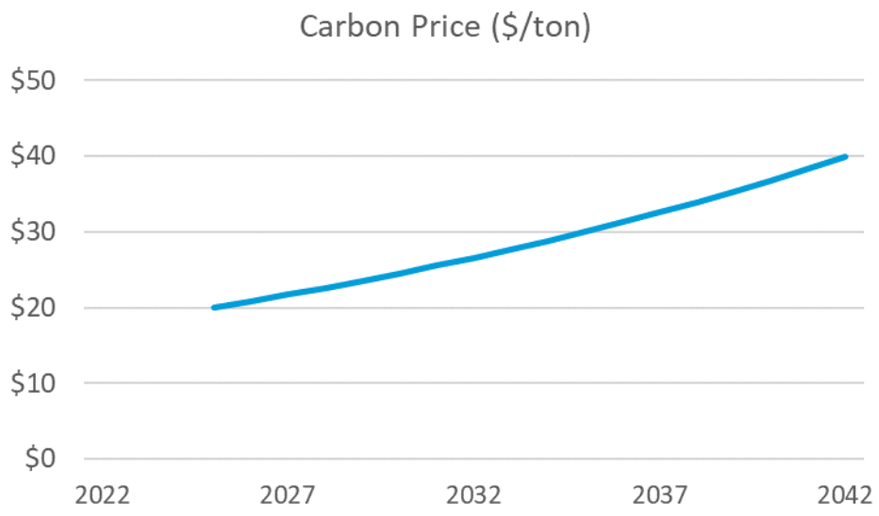
Price Scenario – Carbon Prices

- Carbon prices increase dispatch costs for thermal generators which increases the cost of power

- Ascend applied the carbon price used in previous PSC dockets and the 2019 plan
  - Carbon prices begin in 2025 at $20 per ton ramping up to $40 per ton by 2042

- PowerSimm dispatches resources to Mid-C prices that include the effect of carbon prices

- During the dispatch module, thermal resources incur carbon costs based on emissions rates
  - Natural gas is roughly 0.5 tons CO2 per MWh
  - Coal is roughly 1 ton CO2 per MWh



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