Modeling Update

SOUTH CAROLINA ELECTRICITY MARKET REFORM MEASURES ADVISORY BOARD

PREPARED BY

Hannes Pfeifenberger
Kathleen Spees
Sasha Kuzura
Evan Bennett
Son Phan
Ellery Curtis

PRESENTED FOR

South Carolina EMRM Advisory Board

12/19/2022

Brattle

Agenda

1. Objectives
2. Data Collection and Assumptions Update
3. Benchmarking Results
4. Next Steps

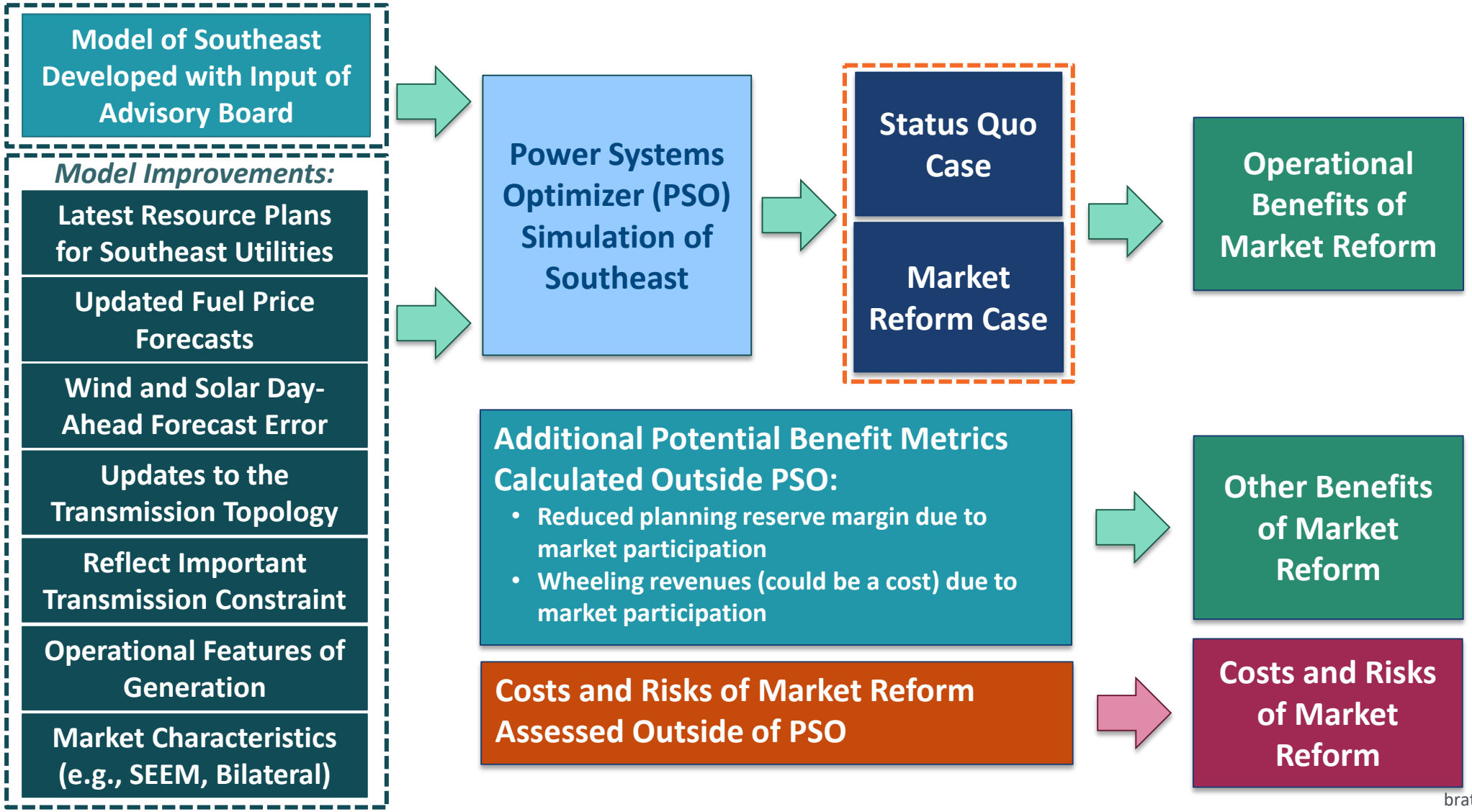
Agenda

1. **Objectives**
2. Data Collection and Assumptions Update
3. Draft Benchmarking Results
4. Next Steps

Objectives for this Meeting

- **Provide an update on data collection and modeling assumptions**
- **Share draft of model benchmarking results**
- **Discuss next steps**

Review of Study Framework and Benefits Calculation



Simulated Market Reform Options

We are planning to simulate four different market reform options that represent part of the spectrum of possible reform options

Market Reform Options

- **Joint Dispatch Agreement in the Carolinas**
- **Energy Imbalance Market in the Southeast**
- **Southeast RTO (w/ Vertically Integrated Utility)**
- **Carolinas in PJM RTO (w/ Vertically Integrated Utility**

The analysis will need to start with an assessment of the Status Quo, including the SEEM

- We model the entire Southeast, incorporating Advisory Board members' data
- We will simulate one 2030 scenario for each option and compare against the Status Quo

Proposed Market Reform Options to Analyze

For market options not explicitly modeled, we would assess them based on the negative/positive experiences in other jurisdictions, and other credible analyses of costs, benefits, and risks that are applicable to South Carolina

Proposed Market Reform Options to Assess Qualitatively and Based on Experience in Other Jurisdictions

- Partial Retail Choice
- Full Retail Choice
- Additional Reforms of IRP Process
- Generation Divestiture
- Securitization of Retiring Thermal Assets
- Retail Rate Re-Design
- Community Choice Aggregation
- Creation of Distribution System Operators

Modeling Steps And Progress Since Last Time

Step 1 – Benchmark and Calibrate the Model (Largely Complete)
- Simulate the Southeast using 2020 inputs to verify system dynamics
- Ensure that SEEM member entities and PJM are correctly represented

Step 2 – Create 2030 Status Quo Case (In Progress)
- Model SEEM market
- Get input from the Advisory Board
- Update inputs to forecasted 2030 values

Step 3 – Test Market Reform Options (In Progress)
- Model study market constructs
- Compare benefit metrics against status quo case

Agenda

1 Objectives

2 Data Collection and Assumptions Update

3 Draft Benchmarking Results

4 Next Steps

Data Collection Matrix

Data collection is largely finished.

- We have a few remaining questions as we sort through data collected
- We are now implementing it into the model

● = Data collected and implemented in model
● = Data collected and being implemented
● = Some outstanding items/questions

Data Collection Status

Generation Operational	●
Future Generation Resource Mix	●
Fuel Price Forecasts	●
Transfer Capabilities	●
Demand Forecasts	●
Forecast Uncertainty	●
Transmission Upgrades	●
SEPA Hydro Budgets	●
Market Participation Parameters	●
System Operation Discussions	●

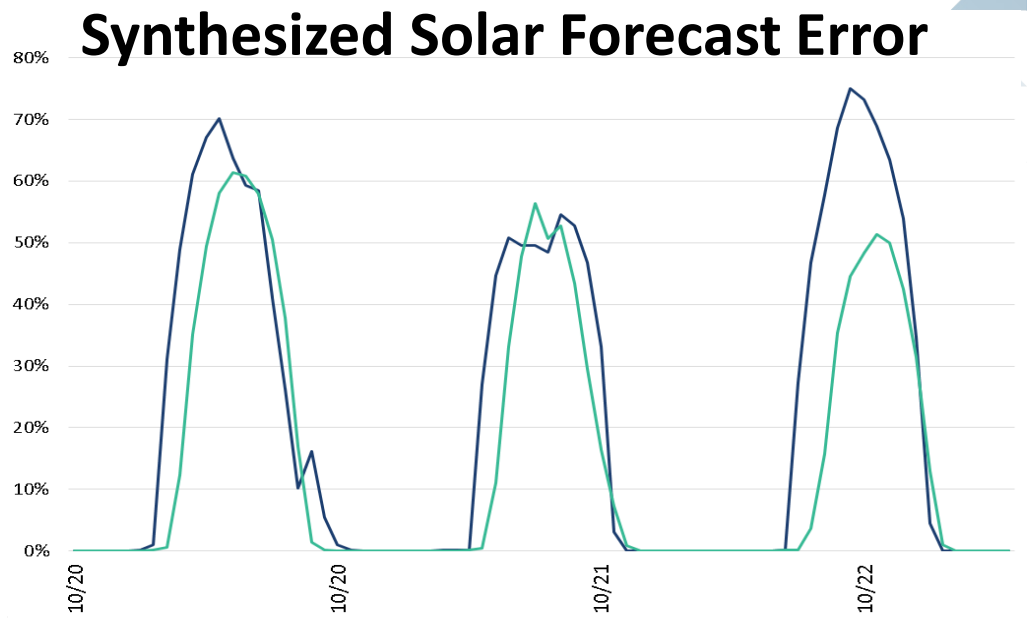
Day Ahead Forecast Uncertainty

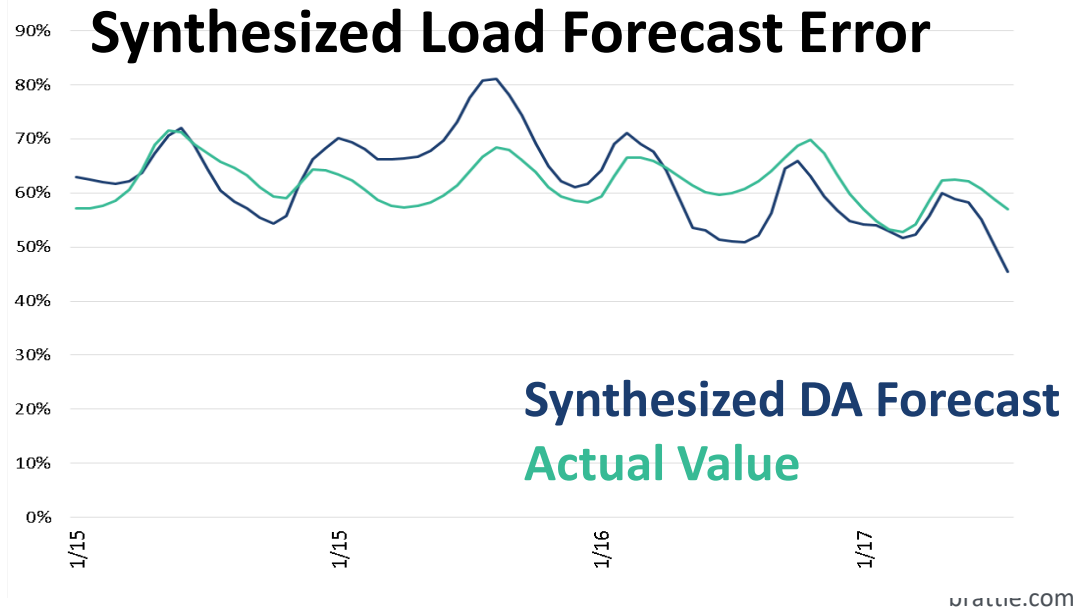
Duke provided hourly DA forecast errors for total load and solar

Error synthesis method:

- Assume daily forecast error shapes are independent
- Create sample of daily error shapes
- Draw random samples, with replacement
- Apply shapes to existing load and solar profiles
- Re-scale to actual values

We intend to use persistent forecast error for wind.





Agenda

1 Objectives

2 Data Collection and Assumptions Update

3 **Draft Benchmarking Results**

4 Next Steps

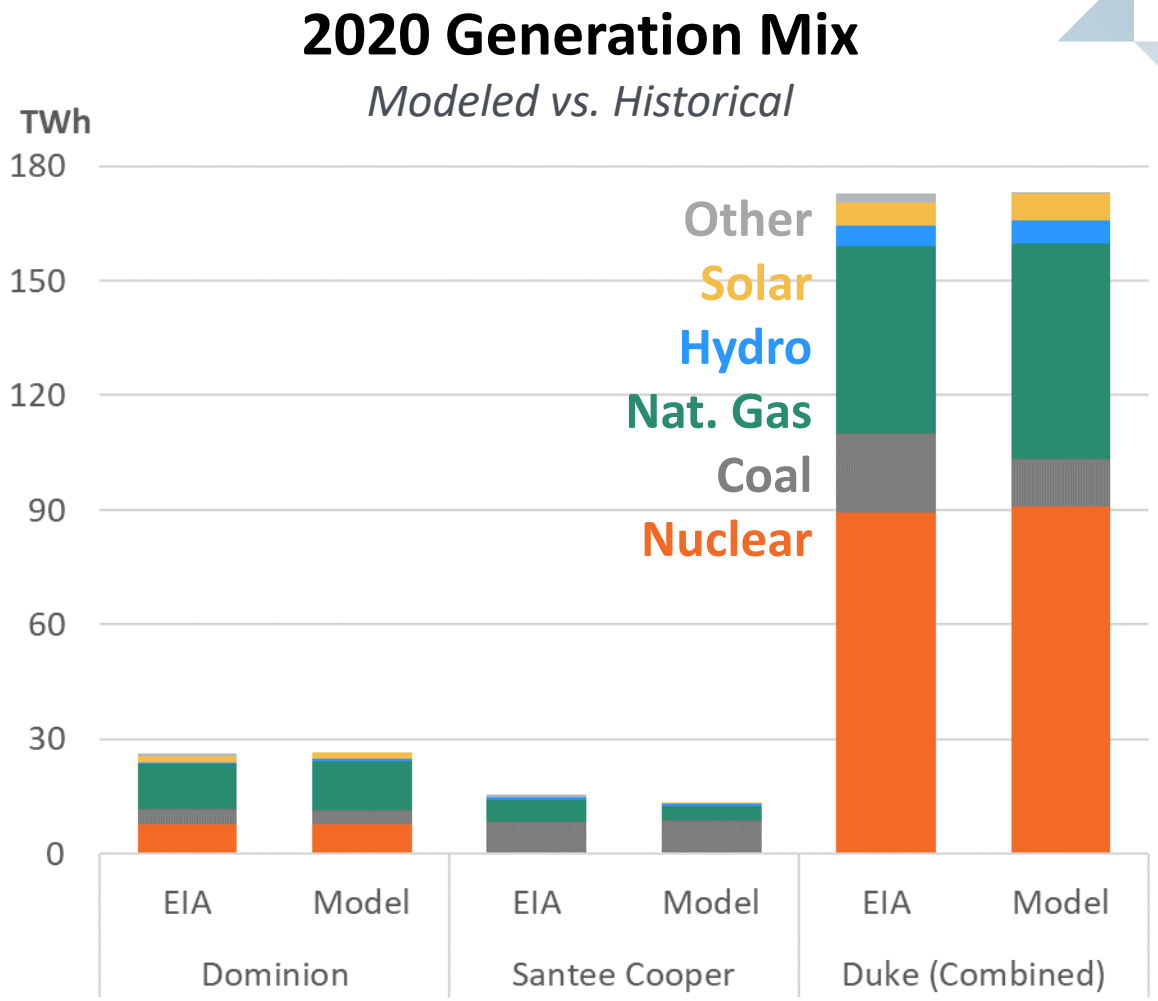
Generation Mix

Modeled generation is benchmarked against 2020 data from EIA Form 923

- Differences in totals are due to trading

The Carolinas generation mix benchmarks well against historical data

- Santee Cooper under-generating due to higher imports, pushing down goal coal/gas generation
- Tuning coal/gas generation balance in Duke
- Duke PSH runs 60% less than historical

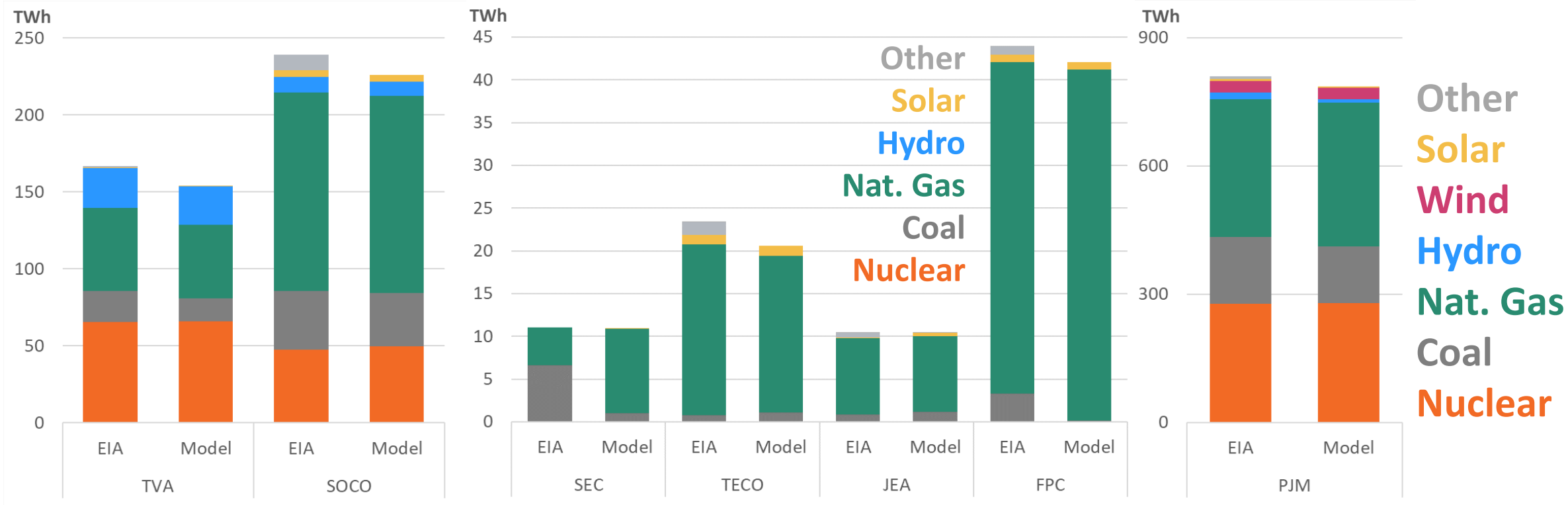


Note: Dual-fuel gas units listed as gas.

Generation Mix

Modeled generation mix matches well to historical values, with differences due to modeled trading.

Modeled 2020 Generation Mix vs. Historical

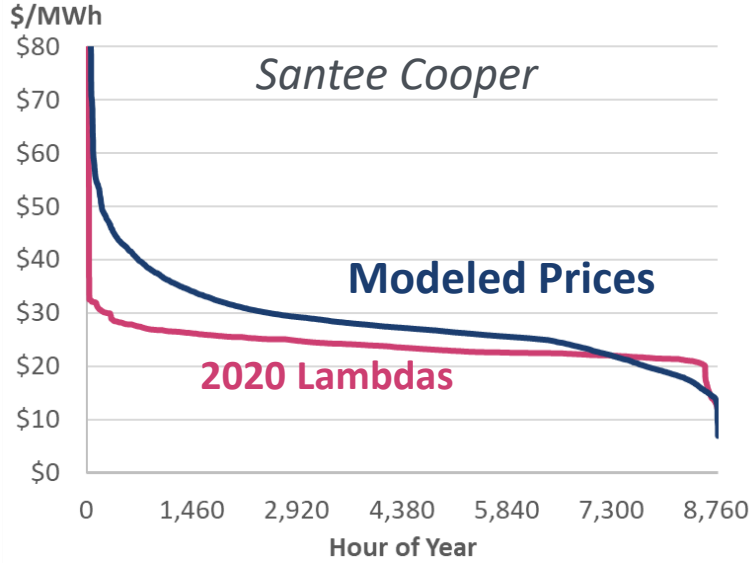


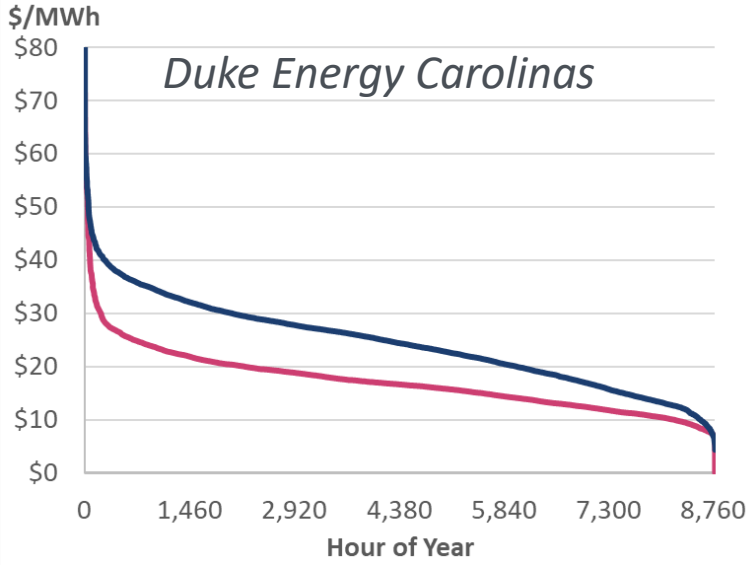
Energy Prices

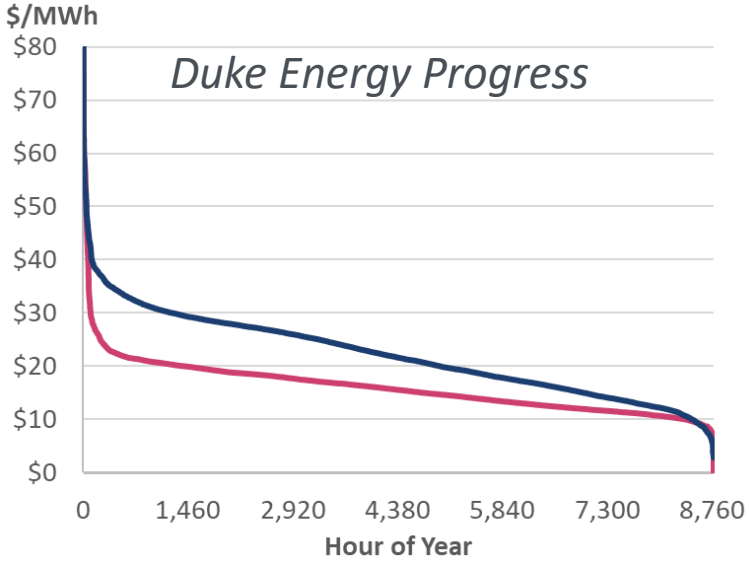
We benchmark modeled day-ahead load-weighted average LMPs against system lambdas from FERC 714 filings

Modeled prices do not always match historical marginal unit costs.

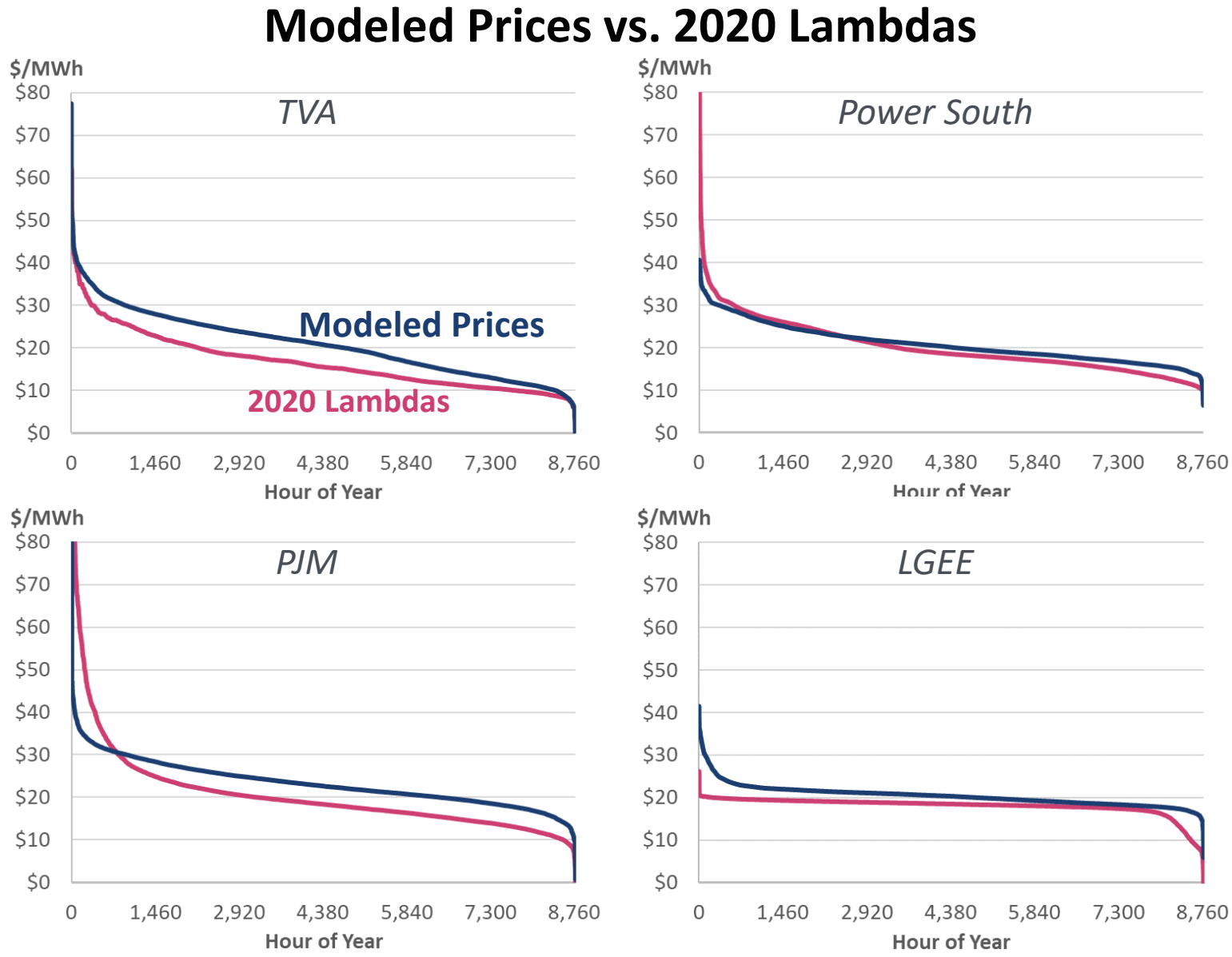
Modeled Prices vs. 2020 Lambdas



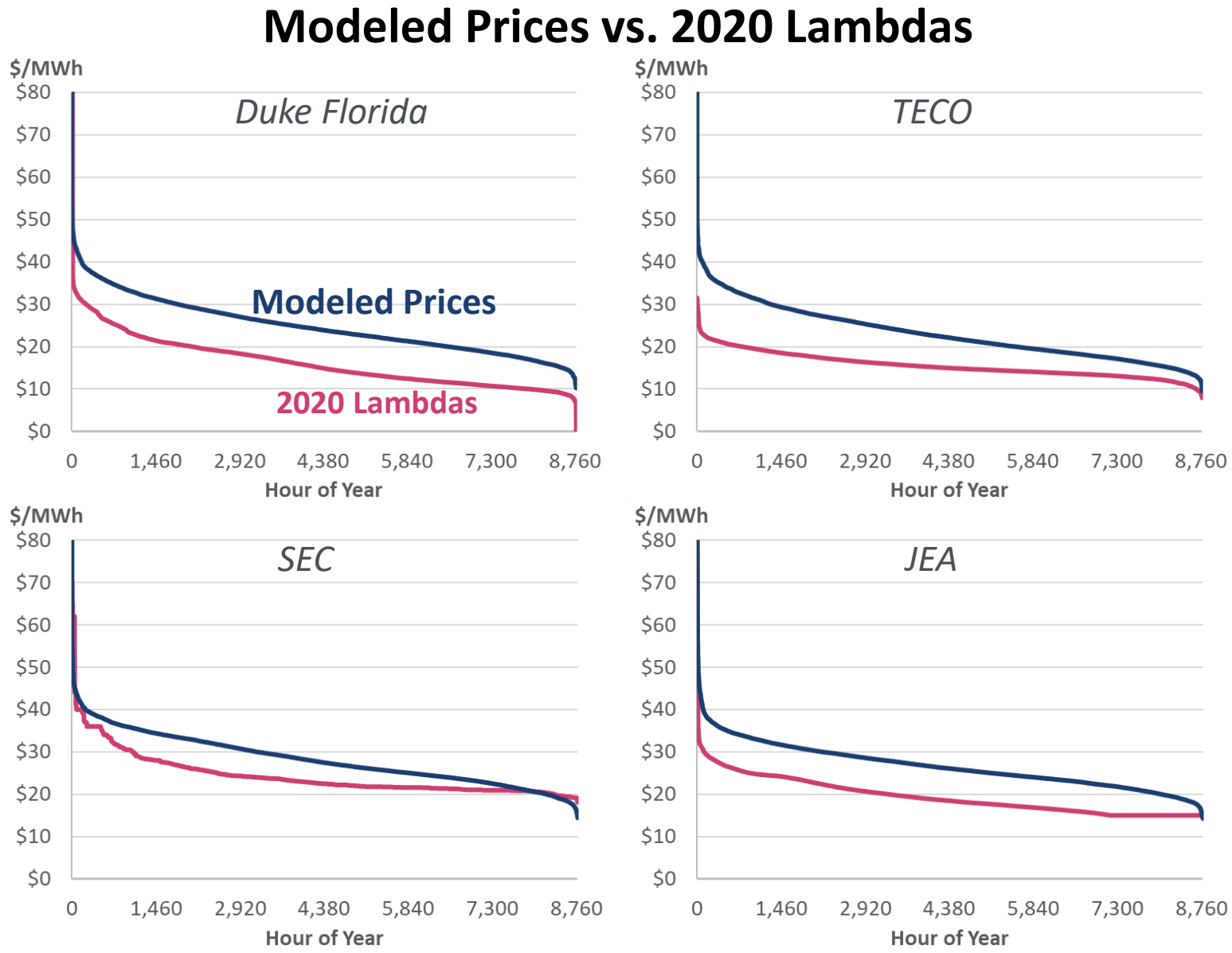




Energy Prices (SERC SEEM Members)



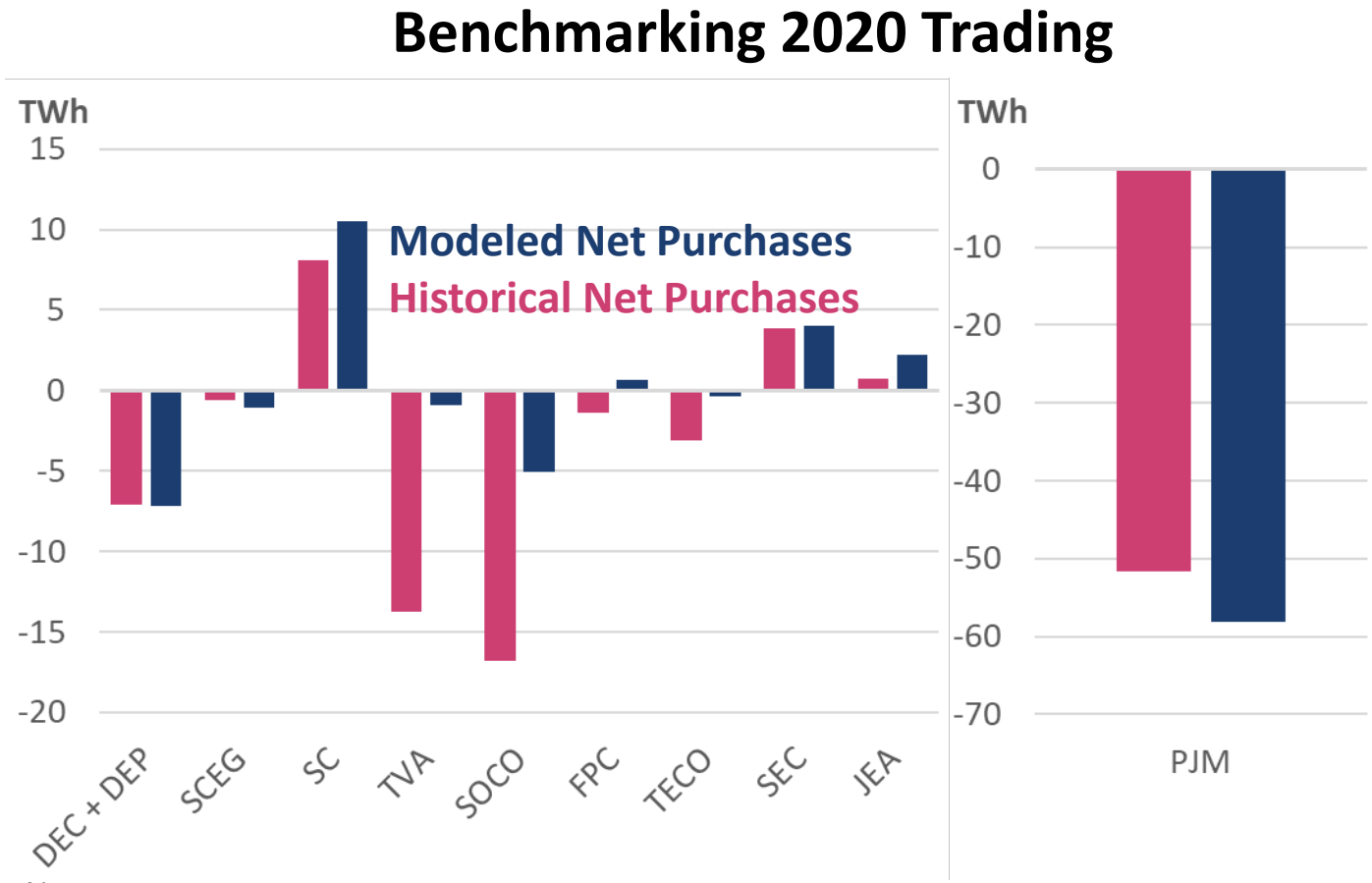
Energy Prices (FRCC SEEM Members)



Trading

We benchmark modeled 2020 day-ahead trading against historical data

- Duke's modeled trades match historical values closely
- Santee Cooper imports more than historical
- TVA/SOCO discrepancies include effects from trades with MISO (not in the model footprint)
- PJM export volumes match historical well



Notes:
Positive values represent net imports, negative values are net exports.
Historical data represent total loads reported in FERC Form-714 minus total generation reported in EIA-923 data.

Trading (continued)

Duke's data request responses (reported in FERC Form-714) differ from historical interchange by almost half

- Confirm that modeled Santee Cooper imports are too high

Duke 2020 Interchange By BA

	Purchases			Sales			Net Purchases		
	Historical GWh	Modeled GWh	Difference GWh	Historical GWh	Modeled GWh	Difference GWh	Historical GWh	Modeled GWh	Difference GWh
Duke (Combined)	**3,620**	**5,394**	**1,774**	**6,640**	**12,568**	**5,928**	**-3,020**	**-7,174**	**-4,154**
SC	*308*	*2*	*-307*	*1,298*	*6,457*	*5,160*	*-989*	*-6,456*	*-5,466*
YAD	*1,265*	*602*	*-662*	*0*	*0*	*0*	*1,265*	*602*	*-662*
SCEG	*23*	*6*	*-16*	*254*	*789*	*534*	*-232*	*-782*	*-551*
TVA	*206*	*1,388*	*1,183*	*47*	*953*	*906*	*159*	*435*	*277*
SOCO	*544*	*725*	*181*	*1,732*	*1,530*	*-201*	*-1,188*	*-805*	*382*
PJMRTO FP	*1,275*	*2,670*	*1,395*	*3,309*	*2,839*	*-471*	*-2,034*	*-168*	*1,866*

Note: Net interchange values taken from FERC Form-714

BA Demand Definitions

Data from FERC-714 have some differences with 2020 IRP values.

- Dominion and Santee Cooper values are from 2020 IRPs
- Duke values are based on 2018 IRP and data request values
- Values suggest that planning loads may be different from total demand served

Carolina Utilities Demand Inputs

	Peak			Total		
	IRP GW	Modeled GW	Difference GW	IRP TWh	Modeled TWh	Difference TWh
Duke (Combined)	31.3	33.6	2.3	153.3	165.9	12.6
Dominion	4.9	4.6	-0.3	24.0	23.1	-0.9
Santee Cooper	5.0	4.5	-0.5	22.8	23.7	1.0

Plant-Level Generation

The model is favoring gas generation over coal

- Efficiency data and VOMs received from Advisory Board
- Historical gas prices used
  - Delivery adders from data requests, deflated to 2020
- Coal prices based on public data

We would like to verify coal prices and gas/coal delivery adders with member utilities

Generator Capacity Factor Benchmarking

Unit	Area	Type	Capacity MW	EIA %	Modeled %	Difference %	Difference %
Roxboro	CPL	Coal	2,082	28.6%	31.5%	2.9%	10.2%
Mayo	CPL	Coal	713	10.0%	3.0%	-7.0%	-69.9%
Marshall	Duke	Coal	2,078	33.0%	13.2%	-19.8%	-60.0%
Belews Creek	Duke	Coal	2,220	22.0%	10.4%	-11.6%	-52.8%
Wateree	SCEG	Coal	684	13.8%	9.0%	-4.8%	-34.9%
Williams	SCEG	Coal	610	51.5%	60.3%	8.8%	17.0%
Winyah	SC	Coal	1150	22.4%	4.3%	-18.1%	-81%
Cross	SC	Coal	1760	40.2%	53.7%	13.5%	33.6%
Sherwood H. Smith	CPL	CC	1250	41.2%	77.5%	36.2%	87.9%
H.F. Lee	CPL	CC	1054	36.2%	84.2%	48.0%	132.8%
W.S. Lee	Duke	CC	809	50.6%	95.7%	45.1%	89.2%
Buck	Duke	CC	718	36.0%	91.2%	55.3%	153.7%
Jasper County	SCEG	CC	979	61.1%	83.3%	22.2%	36.4%
Columbia Energy Center	SCEG	CC	638	51.5%	76.8%	25.3%	49.1%
Rainey	SC	CC	520	82.4%	76.8%	-5.7%	-6.9%

Agenda

1 Objectives

2 Data Collection and Assumptions Update

3 Draft Benchmarking Results

4 Next Steps

Next Steps

Receive and implement final benchmarking refinement data

Implement data gathered from Advisors into 2030 model

- Future transmission upgrades
- Reserve requirements

Model 2030 change cases for each market reform option

Evaluate modeled benefits of market reform

Calculate other costs and risk of market participation

Share preliminary results with Advisory Board in January