ANALYSIS GROUP
ECONOMIC, FINANCIAL and STRATEGY CONSULTANTS

NYISO 2019/2020 ICAP Demand Curve Reset

Continued Modeling Discussions

ICAP Working Group

March 26, 2020

Today:

- Financial Parameters: Preliminary Recommendations
- Preliminary Fuel Hub Recommendations
- Discussion of Revised Energy Storage Modeling
- Overview of Winter-Summer Ratio

Financial Parameters: Preliminary Recommendations

Preliminary Recommendation

After-Tax Weighted Average Cost of Capital (ATWACC)

- **Preliminary Recommendation:** ATWACC = **8.2%** (7.9% in Zone J), reflecting Debt/Equity (D/E) Ratio, Cost of Debt (COD) and Return on Equity (ROE), to be discussed in the following slides

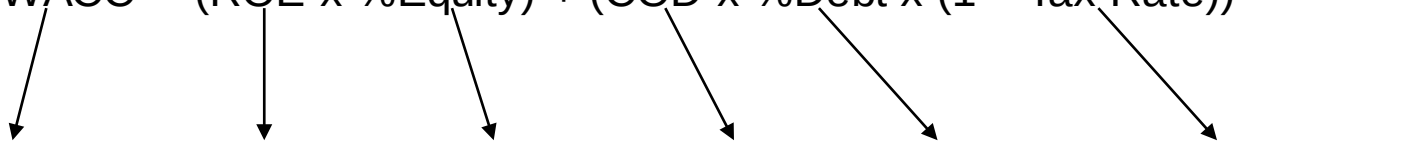
Inputs	NYISO DCR (2016)		Preliminary Recommendation	
Return on Equity	13.4%		**12.75%**	
Cost of Debt	7.75%		**6.1%**	
Debt to Equity Ratio	55%		**55%**	
WACC	10.3%		**9.1%**	
	Zone J	Other zones	Zone J	Other zones
Tax Rate[1]	45.4%	39.6%	**36.4%**	**27.5%**
ATWACC	8.4%	8.6%	**7.9%**	**8.2%**

Note:
[1] ATWACC calculations can vary between zones due to differing state/local tax rates. New York City maintains a corporate income tax that leads to a different ATWACC in Zone J.

Preliminary Recommendation

After-Tax Weighted Average Cost of Capital (ATWACC)

- **Formula:**
- ATWACC = (ROE x %Equity) + (COD x %Debt x (1 – Tax Rate))



8.2%= (12.75% x 45%) + (6.1% x 55% x (1-27.5%))

Note:
[1] State taxes are no longer deductible from federal taxes, so the tax rate is determined by summing the state (and any local tax) with the federal income tax of 21%.
[2] ATWACC calculations can vary between zones due to differing state/local tax rates. New York City maintains a corporate income tax that leads to a different ATWACC in Zone J (Corporate Income Tax of 36.35% in total).

Return on Equity (ROE)

Preliminary Recommendation: Return on Equity = 12.75%

- **Use capital asset pricing model (CAPM) and the implied Beta from the 2016 ICAP Demand Curve reset (DCR) to determine ROE**
- **CAPM Formula to determine ROE:**
  - ROE = Risk-Free Rate + (Beta x Market Risk Premium)
  - 12.75% = 2.5% + (1.49 x 6.9%)

Inputs	NYISO (2016)	Preliminary Recommendation
Risk-Free Rate	3.0%	**2.5%**
Beta	1.49	**1.49**
Market Risk Premium	7.0%	**6.9%**
Return on Equity	13.4%	**12.75%**

Return on Equity (ROE)

Assumptions and Considerations

- Assumed Beta = 1.49
  - With recent changes in ownership structure of independent power producers (IPPs), no (or few) publicly-traded market comparables
    - 3 of 4 companies considered in the 2016 DCR are now privately held (Calpine, Dynegy, Talen)
    - 1 of 4 companies has substantial business in retail and renewables, including long-term contracts (NRG)
  - Finance literature supports conclusion that beta is relatively constant over time in mature industries, absent material changes to market structure
  - Beta used in determining net CONE relatively stable over time across RTOs/ISOs
  - AG is continuing to evaluate the potential impact of forward-looking changes in market structure (e.g., CLCPA, potential future NYISO market changes, etc.)
    - Given ongoing consideration, the preliminary recommendations do not include any specific adjustments to reflect any such factors

Return on Equity (ROE)

Assumptions and Considerations

- Risk-Free Rate = 2.5%
  - Mean of the recent year of 30-year Treasury note yields from February 20, 2019 – February 19, 2020
- Market Risk Premium = 6.9%
  - Long-Term "Historical" Equity Risk Premium from Duff and Phelps (source: Duff and Phelps, *2019 Cost of Capital: Annual U.S. Guidance and Examples*, 2019)
- AG is continuing to consider the potential impact of coronavirus on the risk-free rates and market risk premium
  - The preliminary recommendations do not include any adjustments to account for this consideration

Cost of Debt (COD)

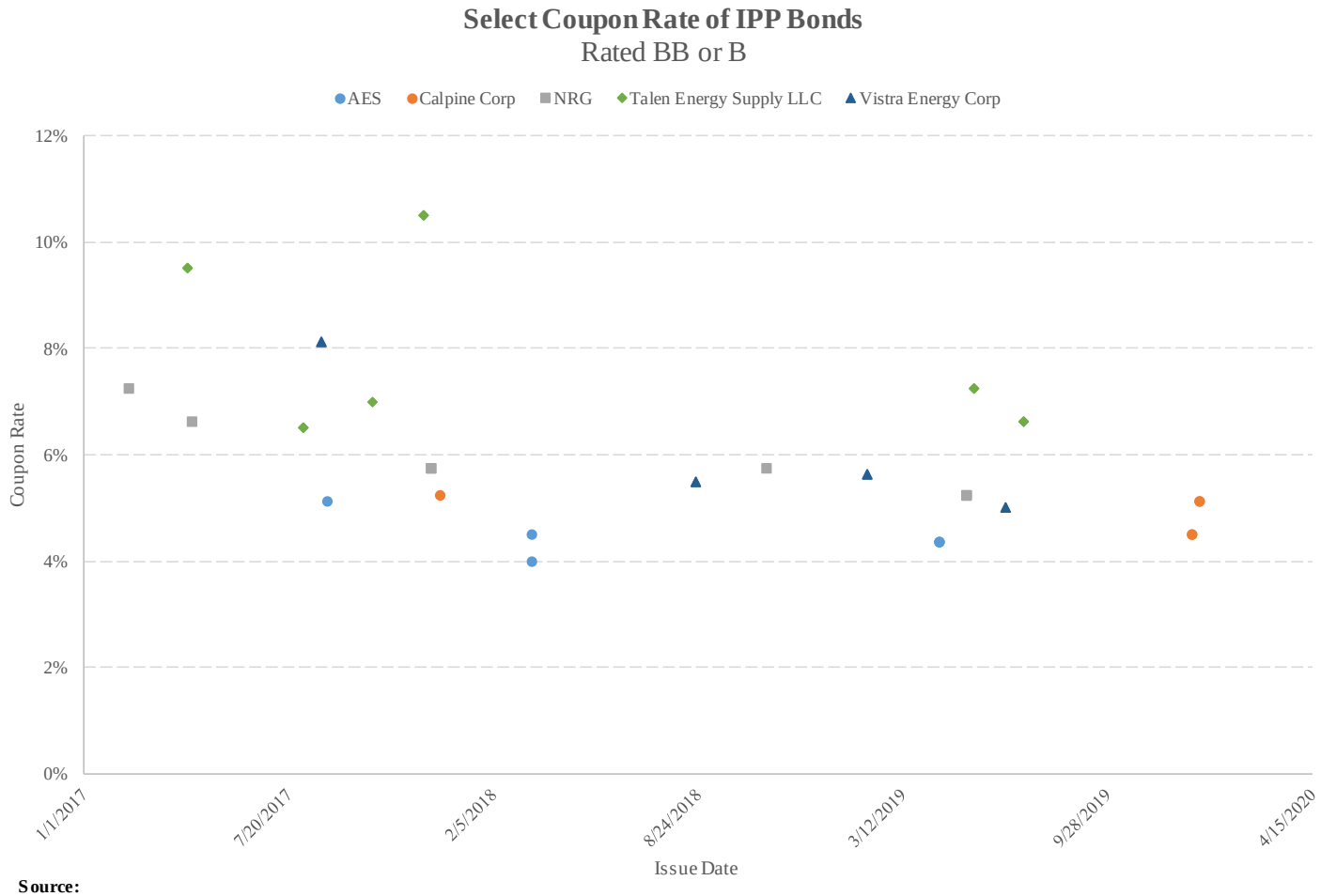
Considerations

- Over the past three years (Jan. 2017 – Feb. 2020) IPPs issued bonds at rates ranging from 4% to 10.5%, with median B rated bond yield of 7.0%

- Current generic corporate bond yields over the past year (Feb. 2019 – Feb. 2020) have ranged from: 3.5% to 5.1% (BB) and 5.0% to 7.1% (B)
  - Rates have gradually declined over the past year
  - Median Yield for B rated bonds is 6.1%

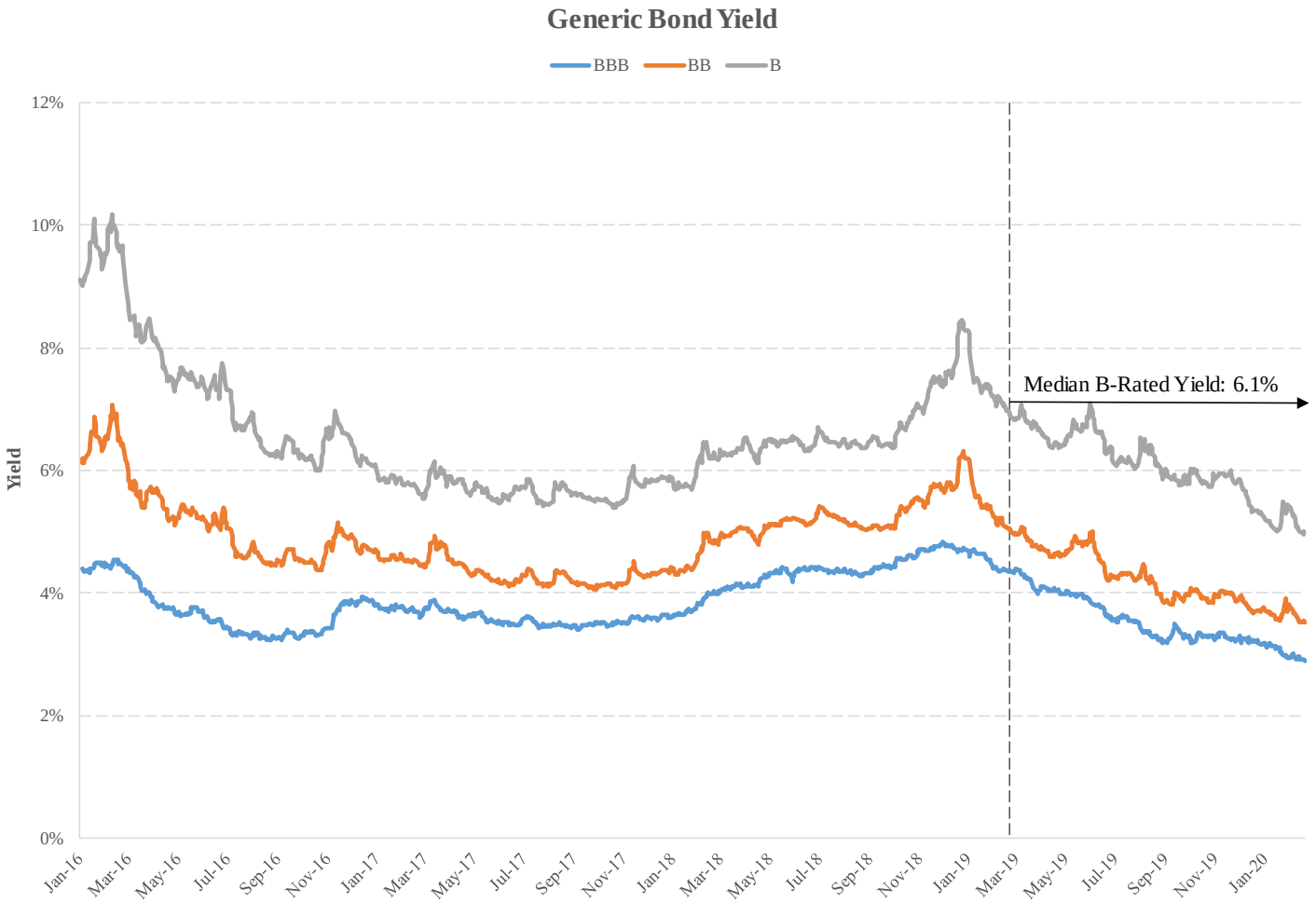
- AG is continuing to consider the potential impact of coronavirus on the cost of debt
  - The preliminary recommendation does not reflect any adjustments for this consideration

Cost of Debt – IPP Bonds



Source:
[1] Bloomberg Finance
Notes:
[1] Includes with Bloomberg Composite Rateing of B or BB

Cost of Debt – Generic Corporate Bonds



Source:
[1] Federal Reserve Bank of St. Louis

Cost of Debt (COD)

Preliminary Recommendation: Cost of Debt = 6.1%

- Our recommendation reflects a balance of considerations, including:
  - Recent bond issues for IPPs,
  - Generic bond rates for entities with comparable (B rated) credit risk, and
  - Recent (pre-Coronavirus) market trends

Capital Structure (D/E Ratio)

Considerations

- Capital structure is the mix of financing (debt and equity) used to develop a project (or finance a company)
  - Capital structure is parameterized as the share of debt to equity, commonly referred to as the debt-to-equity ratio ("D/E ratio")
- In principle, projects can be developed under a wide range of capital structures
- Particular structure pursued by a developer may reflect many factors, including company finances and the risk profile of development (including availability of long term contracts)
- Factors affecting the D/E ratio include nature of revenue streams given the market's structure and project-specific management and financing

Capital Structure (D/E Ratio)

Considerations

- Structure of financing for IPPs within the power sector remains relatively constant over time

- Given the unique structure and risk of the New York market, AG recommends a slightly more conservative (lower equity) strategy as compared to a higher debt-equity ratio (e.g., 60/40 ratio)

Preliminary Recommendation: Capital structure reflecting a 55/45 D/E Ratio

Amortization Period

- **Choice of amortization period reflects a balance of considerations which differ by technology**
  - Fossil plant physical life (before major overhauls) expected to be 20 years or more
  - Battery storage units have uncertain economic life given limited operational experience
  - Many factors that create risks to cash flows, particularly over long time horizons, including policy, market, technology and economic factors
- **Potential to establish schedule in advance (as part of the DCR) of changing amortization period assumption over the course of the reset period; assumptions may vary depending on technology**
  - The requirements of the CLCPA impacting fossil plant operation past 2040 do not similarly affect battery storage units
    - The operational life for a new fossil unit could be assumed to reduce for each year of the reset period given the reduction in the remaining years prior to 2040

Amortization Period

Preliminary Recommendation: Amortization period extends to 2040 for all fossil plants, assume a fixed 20 year period for battery storage

- **Current recommendation reflects balance of risks**
  - Length of amortization for fossil plants will shorten over time, accounting for the requirements of the CLCPA

Capability Year	Potential Operational Life of New Fossil Unit	Length of Amortization Period for Fossil Plants
2021-2022	18.7 Years	18 Years
2022-2023	17.7 Years	17 Years
2023-2024	16.7 Years	16 Years
2024-2025	15.7 Years	15 Years

Note:
[1] The potential commercial operating life was calculated by counting the number of years between May 1st of the Capability Year and January 1st, 2040.

Amortization Period

- **Alternative options include:**
  - Discount or zero out net energy and ancillary services (EAS) revenues after 2040 for fossil plants in connection with maintaining a 20 year amortization period, implicitly assuming operation on alternate zero-emissions fuel source
  - Shorter amortization period for storage resources to reflect limited historical operating experience and balancing the required costs of augmentation over time to maintain operational capability
  - 20 year amortization period for all units (consistent with 2016 DCR) without net EAS revenue adjustments beyond 2040 for fossil plants

Preliminary Fuel Hub Recommendations

Decision Criteria for Fuel Hub Selection

- Market Dynamics: Gas hub price index reflects some historical relationship between gas hub pricing and LBMPs
  - Ideally, prices should reflect a long term equilibrium rather than short run arbitrage opportunities (real or apparent), recognizing that other factors (e.g., congestion) influence LBMP price spikes
- Liquidity: Gas hub price index with consistent depth of historical data
- Geography:
  - Lines with a geographic relationship to potential peaking plant locations going forward
  - Reported hub price indices (which reflect average prices over a broad geographic area) with a logical nexus to prices at relevant delivery points
- Precedent/Continuity: Gas hubs supported by information from multiple sources and used for similar purposes (e.g., 2016 DCR, stakeholder and Market Monitoring Unit [MMU] feedback, other NYCA-related studies and evaluations)
  - Preliminary recommendations/considerations from the MMU were posted with the meeting material for the February 25, 2020 ICAPWG meeting
  - Appropriate choice of price index can vary with study objectives

Decision Criteria for Fuel Hub Selection

Recommendation:

- Natural gas hubs and pricing points will remain fixed for the duration of the ICAP Demand Curve reset (DCR) period
- Natural gas hubs recommendations by zone:
  - Load Zone C: **Preliminary Recommendation Remains Under Review**
  - Load Zone F: Iroquois Zone 2
  - Load Zone G (Rockland): TETCO M3
  - Load Zone G (Dutchess): Iroquois Zone 2
  - Load Zone J: Transco Zone 6 NY
  - Load Zone K: **Preliminary Recommendation Remains Under Review**

- The following slides present additional support for these recommendations

Alternative Gas Hub Choices from Previous Studies

Reminder: Gas hubs used for pricing in previous studies

Zone	2020 DCR (Preliminary Recommendation)	2016 DCR	2018 State of the Market Report (MMU)	CARIS Phase I (2019)
NYCA - C	**[Decision in Progress]**	TETCO M3	Dominion North	Zones A-E: Dominion South (65%) TCO - Columbia(5%) Dawn (30%)
NYCA - F	**Iroquois Zone 2**	Iroquois Zone 2	Iroquois Zone 2	Zones F-I: Iroquois Zone 2 (30%) Tennessee Zone 6 (45%) TETCO M3 (20%) Iroquois Waddington (5%)
LHV – G (Rockland)	**TETCO M3**	Iroquois Zone 2	Iroquois Zone 2 (50%) Millennium East (50%)	
LHV – G (Dutchess)	**Iroquois Zone 2**			
NYC - J	**Transco Zn 6 NY**	Transco Zn 6 NY	Transco Zn 6 NY	Transco Zn 6 NY
LI - K	**[Decision in Progress]**	Transco Zn 6 NY	Iroquois Zone 2	Iroquois Zone 2 (60%) Transco Zone 6 (40%)

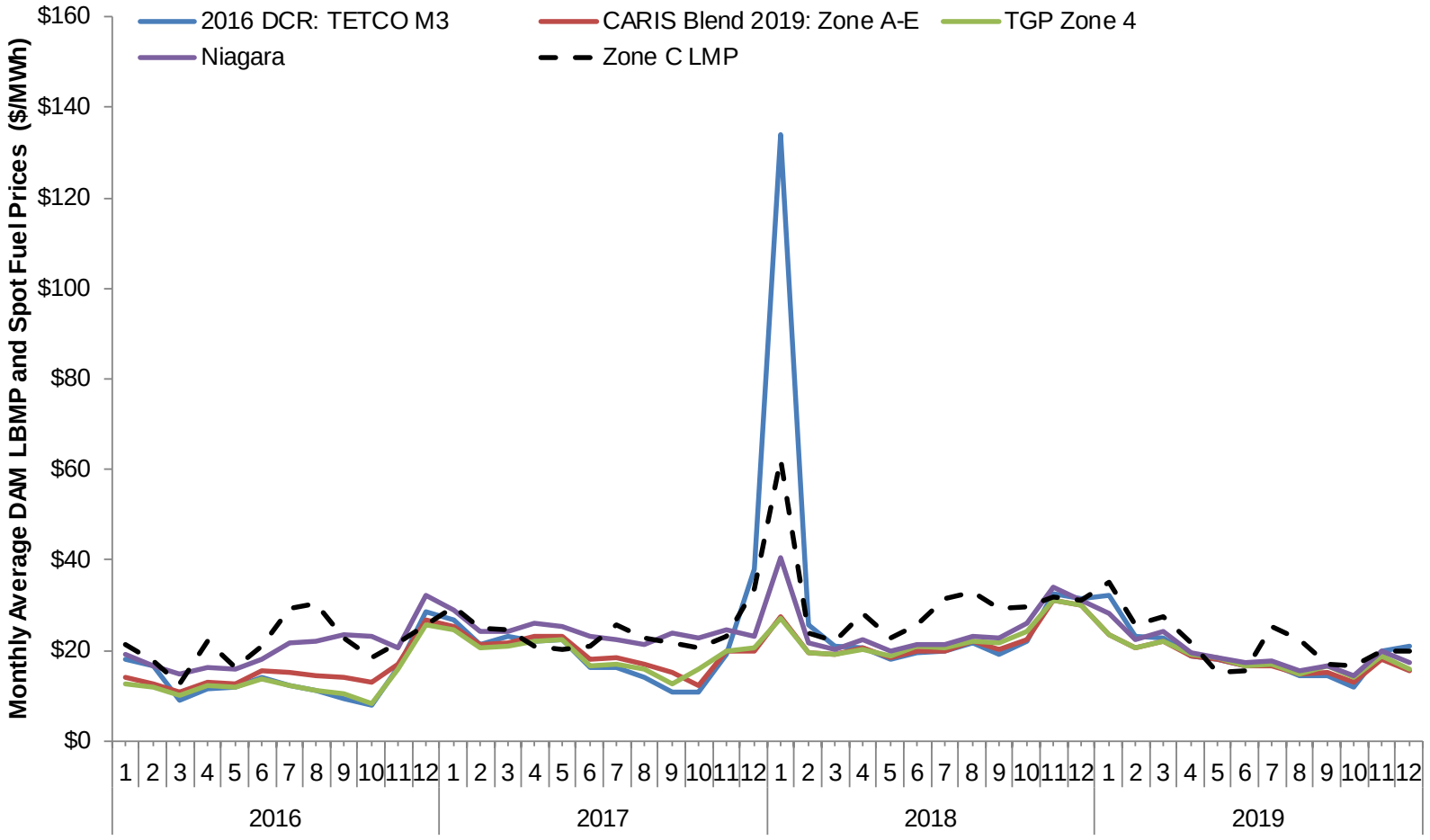
Load Zone C

- Preliminary Recommendation: Remains under review at this time; potential options considered to date are summarized below

Decision Criteria		TETCO M3	TGP Z4	Niagara	CARIS 2019 A-E Blend
Market Dynamics		Yes	Low Correlation	Yes	Low Correlation
Liquidity		Yes	Yes	Variable	Yes
Geography		No	Yes	Yes	No
Recommendation					
Precedent	2016 DCR	Yes (Zone C)	No	No	No
	CARIS (2019) Phase I	No	No	No	Yes
	SOM (2018)	No	No	No	No

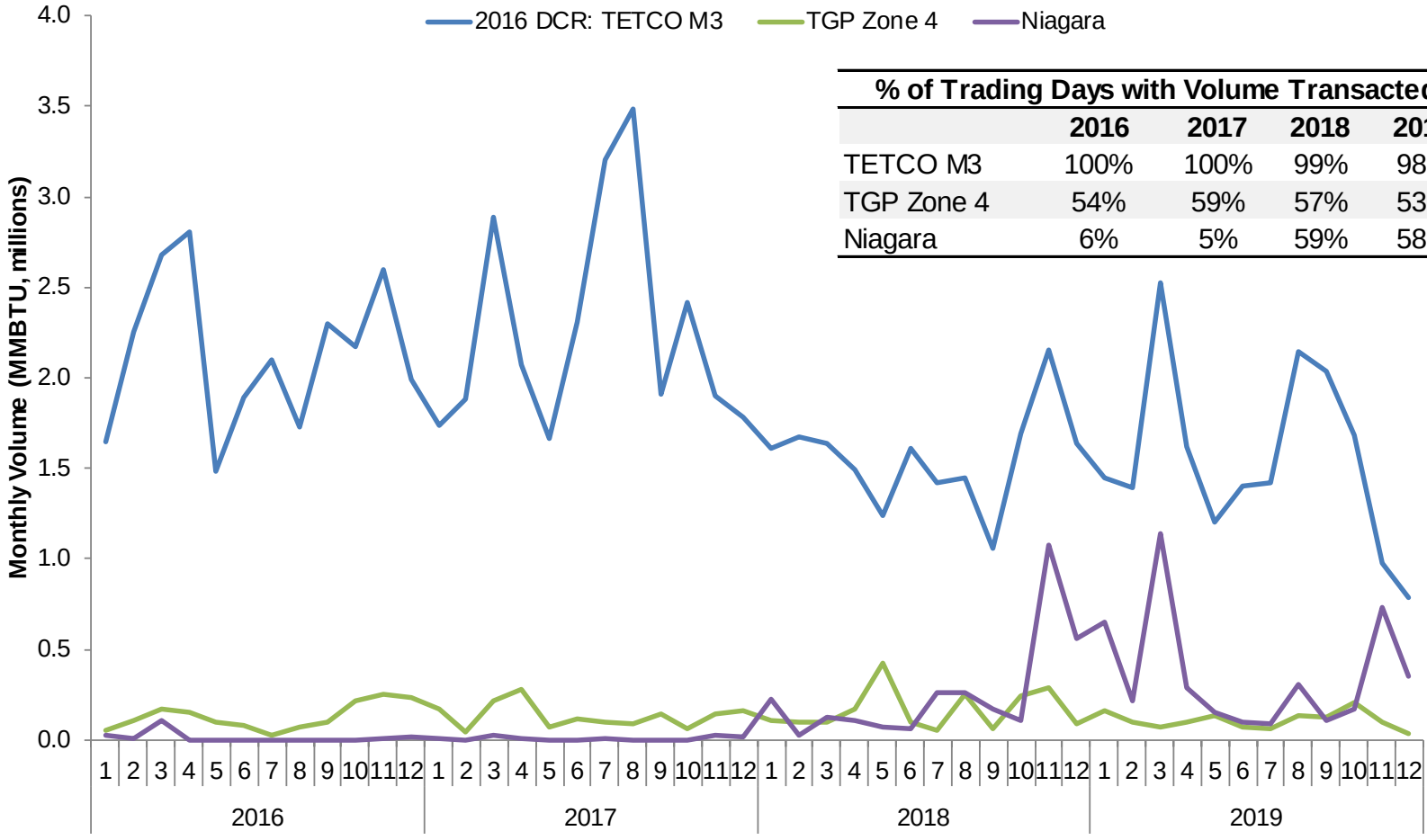
Note: CARIS Blend (Zones A-E) is comprised of a weighted average of spot prices at Dominion South (65%), Dawn Ontario (30%), and TCO Pool (5%).

Load Zone C (LBMP and Gas Prices)



Note: CARIS Blend (Zones A-E) is comprised of a weighted average of spot prices at Dominion South (65%), Dawn Ontario (30%), and TCO Pool (5%). Fuel prices are converted using a heat rate of 8 MMBtu/MWh.
Sources: SNL (Fuel Prices); NYISO (DAM LBMPs).

Load Zone C (Trade Volume, MMBTU)



% of Trading Days with Volume Transacted				
	2016	2017	2018	2019
TETCO M3	100%	100%	99%	98%
TGP Zone 4	54%	59%	57%	53%
Niagara	6%	5%	59%	58%

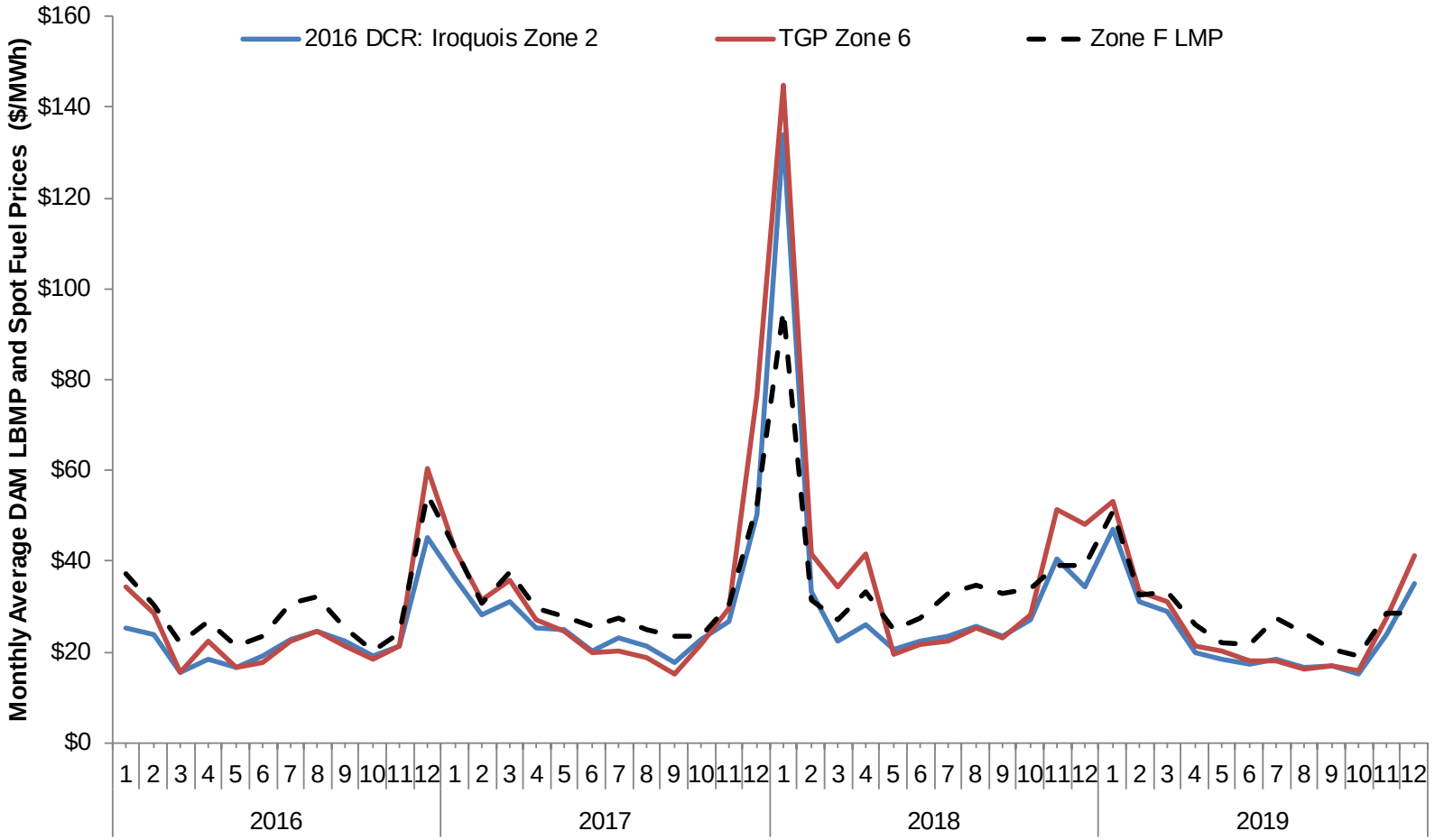
Source: SNL Financial

Load Zone F

- Preliminary Recommendation: Iroquois Zone 2; has a strong historical precedent as a proxy gas hub in Load Zone F, is sufficiently traded, has a strong correlation with market prices; and is geographically well situated
- Potential options considered to date are summarized below

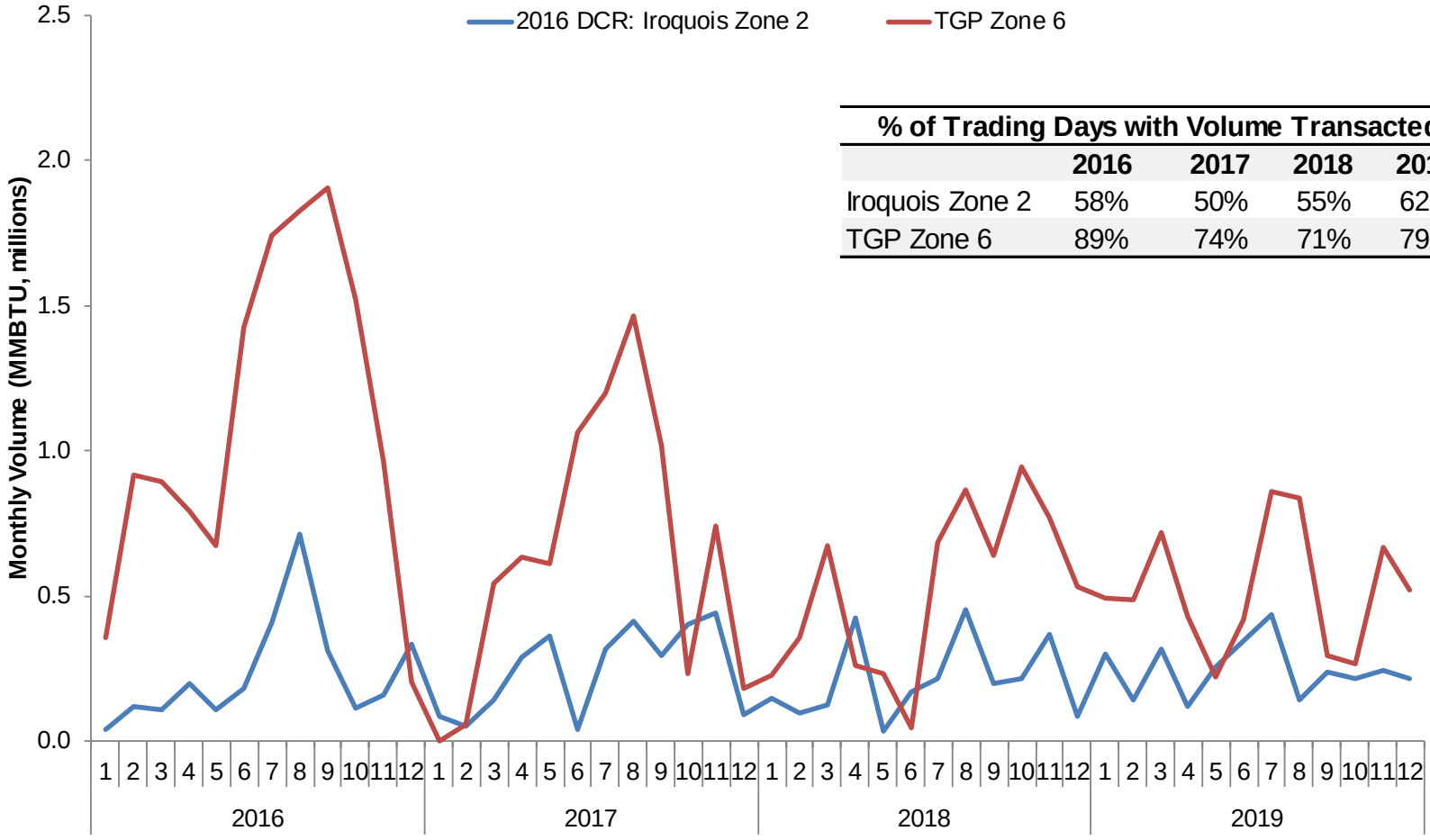
Decision Criteria		TGP Z6	Iroquois Zone 2
Market Dynamics		Yes	Yes
Liquidity		Yes	Yes
Geography		No	Yes
Recommendation			✓
Precedent	2016 DCR	No	Yes (Zone F)
	CARIS (2019) Phase I	Part of Zone F-I blend	Part of Zone F-I blend
	SOM (2018)	No	Yes (Zone F)

Load Zone F (LBMP and Gas Prices)



Note: Fuel prices are converted using a heat rate of 8 MMBtu/MWh.
Sources: SNL (Fuel Prices); NYISO (DAM LBMPs).

Load Zone F (Trade Volume, MMBTU)



% of Trading Days with Volume Transacted				
	2016	**2017**	**2018**	**2019**
Iroquois Zone 2	58%	50%	55%	62%
TGP Zone 6	89%	74%	71%	79%

Source: SNL Financial

Load Zone G (Rockland County)

- Preliminary Recommendation: TETCO M3; is sufficiently traded, has a strong correlation with market prices, and is particularly suited based on location for deliverability to Load Zone G (Rockland County)
- Potential options considered to date are summarized below

Decision Criteria		Iroquois Zone 2	TETCO M3	SOM 2018 G Blend	CARIS 2019 F-I Blend
Market Dynamics		Yes	Yes	Yes	Low Correlation
Liquidity		Yes	Yes	Variable	Variable
Geography		No	Yes	Yes	No
Recommendation			✓		
Precedent	2016 DCR	Yes (Zone G)	No	No	No
	CARIS (2019) Phase I	Part of Zone F-I blend	Part of Zone F-I blend	No	Yes (Zone F-I)
	SOM (2018)	No	No	Yes (Zone G)	No

Note: CARIS 2019 Blend (Zones F-I) is comprised of a weighted average of spot prices at Iroquois Zone 2 (30%), Tennessee Zone 6 (45%), TETCO M3 (20%), and Iroquois Waddington (5%). SOM (State of the Market) 2018 Blend (Zone G) is comprised of a weighted average of spot prices at Iroquois Zone 2 (50%) and Millennium Pipeline (50%).

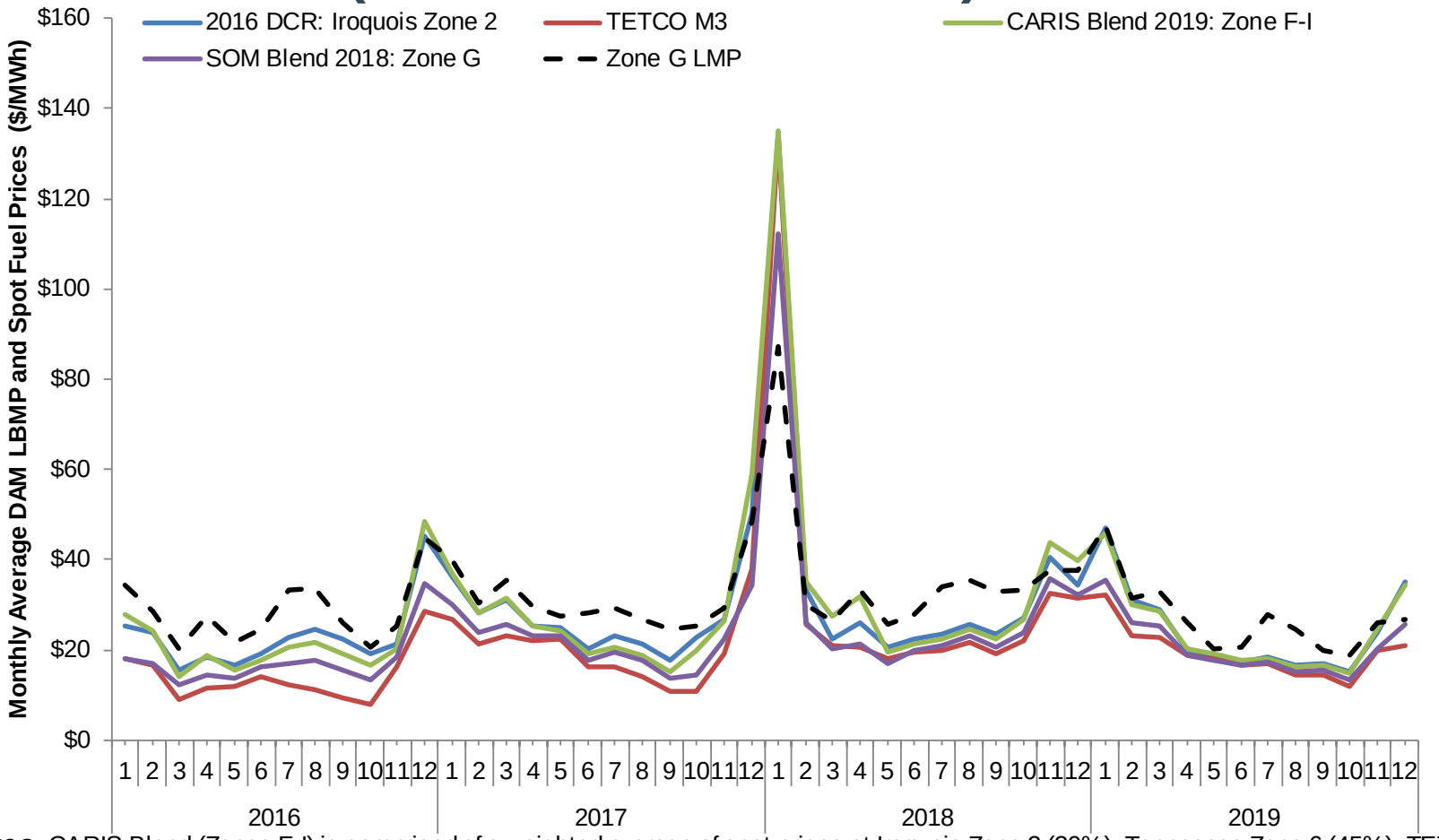
Load Zone G (Dutchess County)

- Preliminary Recommendation: Iroquois Zone 2; is sufficiently traded, has a strong correlation with market prices, and is particularly suited based on location for deliverability to Load Zone G (Dutchess County)
- Potential options considered to date are summarized below

Decision Criteria		Iroquois Zone 2	TETCO M3	SOM 2018 G Blend	CARIS 2019 F-I Blend
Market Dynamics		Yes	Yes	Yes	Low Correlation
Liquidity		Yes	Yes	Variable	Variable
Geography		Yes	Yes	Yes	No
Recommendation		✓			
Precedent	2016 DCR	Yes (Zone G)	No	No	No
	CARIS (2019) Phase I	Part of Zone F-I blend	Part of Zone F-I blend	No	Yes (Zone F-I)
	SOM (2018)	No	No	Yes (Zone G)	No

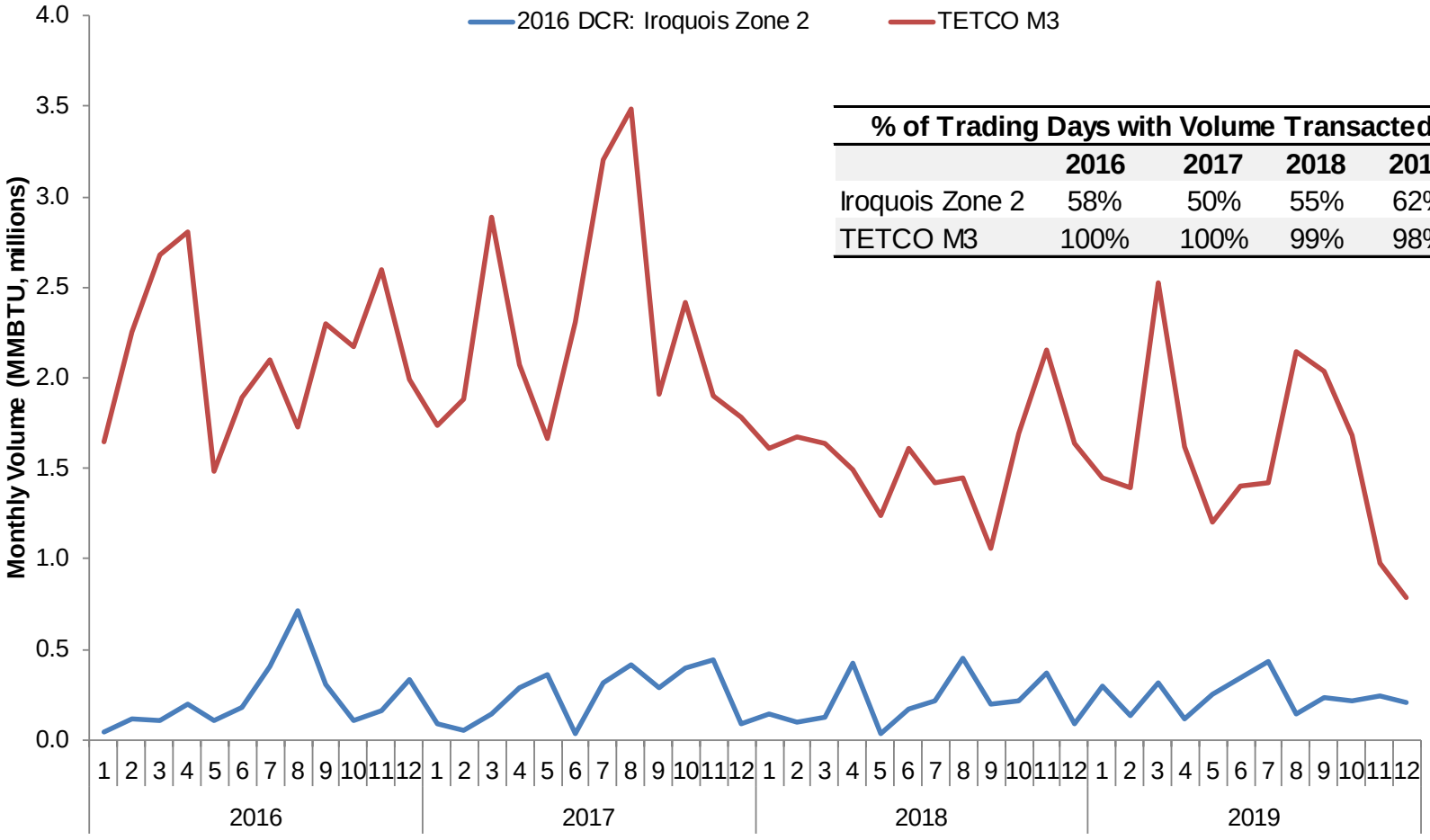
Note: CARIS 2019 Blend (Zones F-I) is comprised of a weighted average of spot prices at Iroquois Zone 2 (30%), Tennessee Zone 6 (45%), TETCO M3 (20%), and Iroquois Waddington (5%). SOM (State of the Market) 2018 Blend (Zone G) is comprised of a weighted average of spot prices at Iroquois Zone 2 (50%) and Millennium Pipeline (50%).

Load Zone G (LBMP and Gas Prices)



Notes: CARIS Blend (Zones F-I) is comprised of a weighted average of spot prices at Iroquois Zone 2 (30%), Tennessee Zone 6 (45%), TETCO M3 (20%) and Iroquois Waddington (5%). SOM (State of the Market) 2018 Blend (Zone G) is comprised of a weighted average of spot prices at Iroquois Zone 2 (50%) and Millennium Pipeline (50%). Fuel prices are converted using a heat rate of 8 MMBtu/MWh.
Sources: SNL (Fuel Prices); NYISO (DAM LBMPs).

Load Zone G (Trade Volume, MMBTU)



% of Trading Days with Volume Transacted				
	2016	**2017**	**2018**	**2019**
Iroquois Zone 2	58%	50%	55%	62%
TETCO M3	100%	100%	99%	98%

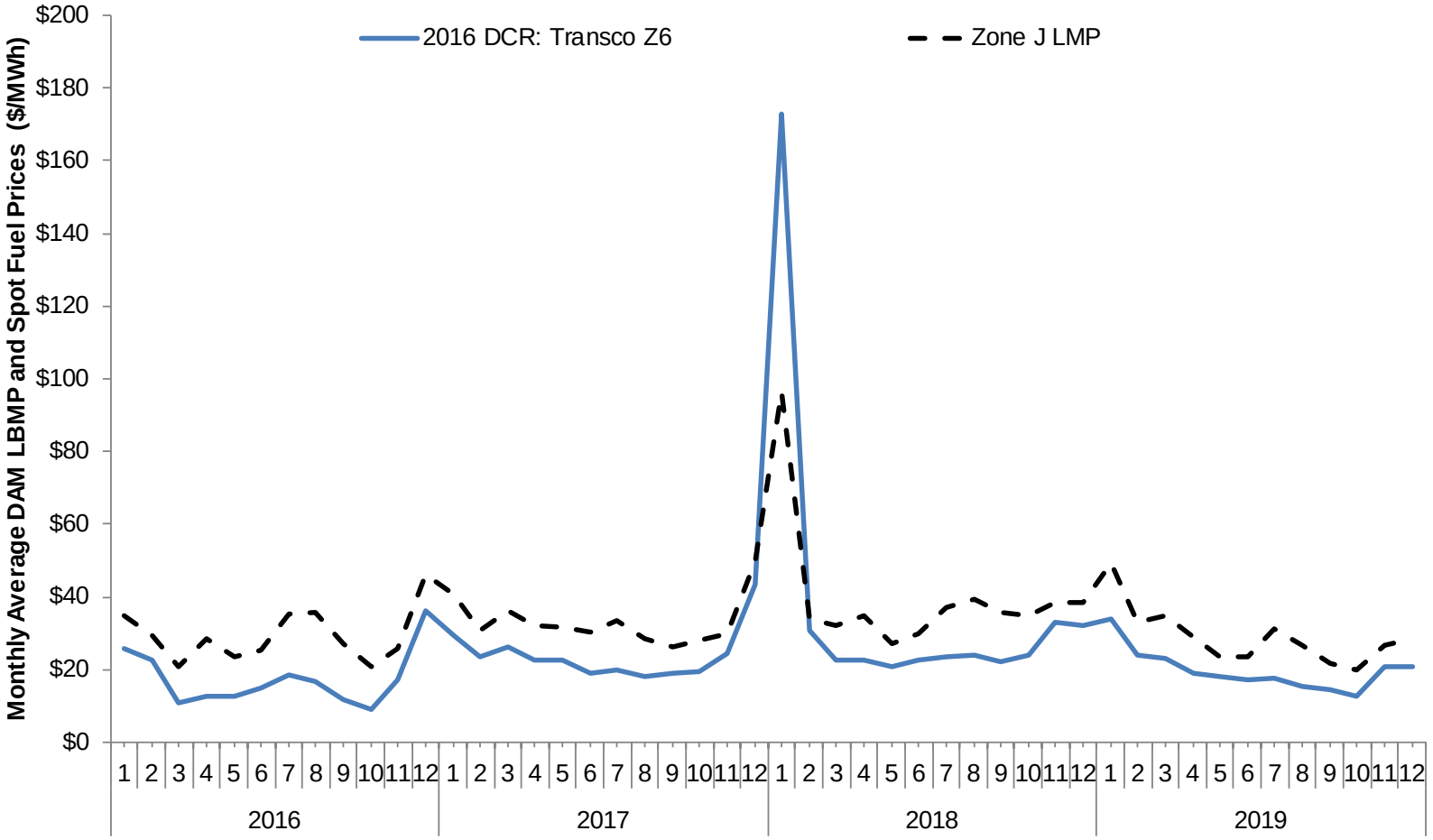
Source: SNL Financial

Load Zone J

- Preliminary Recommendation: Transco Zn 6 NY; has a strong historical precedent as a trading hub in Load Zone J, is sufficiently traded, and has a strong correlation with market prices

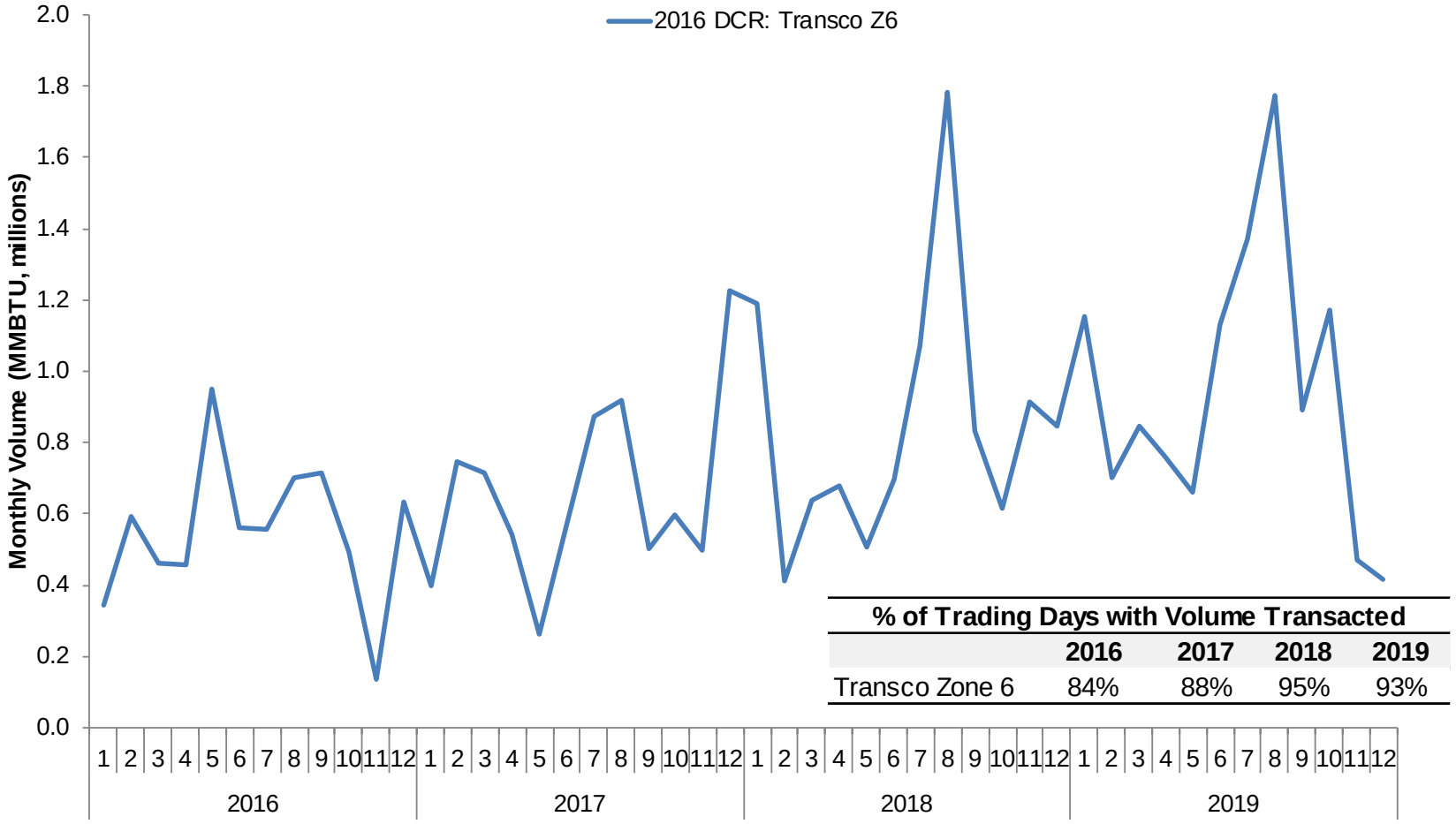
Decision Criteria		Transco Z6
Market Dynamics		Yes
Liquidity		Yes
Geography		Yes
Recommendation		✓
Precedent	2016 DCR	Yes (Zone J)
	CARIS (2019) Phase I	Yes (Zone J)
	SOM (2018)	Yes (Zone J)

Load Zone J (LBMP and Gas Prices)



Note: Fuel prices are converted using a heat rate of 8 MMBtu/MWh.
Sources: SNL (Fuel Prices); NYISO (DAM LBMPs).

Load Zone J (Trade Volume, MMBTU)



% of Trading Days with Volume Transacted				
	2016	2017	2018	2019
Transco Zone 6	84%	88%	95%	93%

Source: SNL Financial

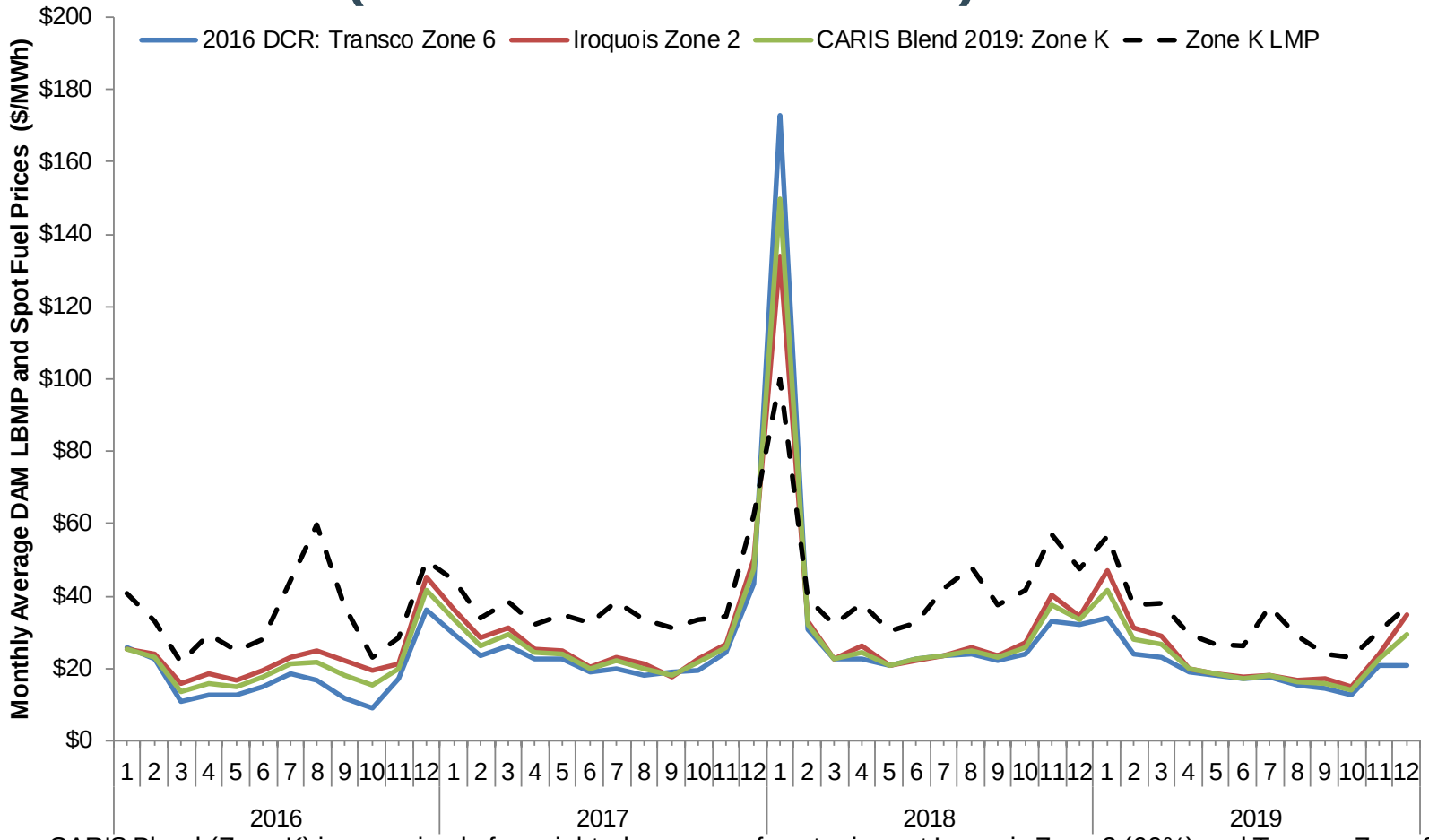
Load Zone K

- Preliminary Recommendation: Remains under review at this time; potential options considered to date are summarized below

Decision Criteria		Transco Z6	Iroquois Zone 2	CARIS 2019 K Blend
Market Dynamics		Low Correlation	Low Correlation	Low Correlation
Liquidity		Yes	Variable	Variable
Geography		Yes	Yes	Yes
Recommendation				
Precedent	2016 DCR	Yes (Zone K)	No	No
	CARIS (2019) Phase I	Part of Zone K blend	Part of Zone K blend	Yes (Zone K)
	SOM (2018)	No	Yes (Zone K)	No

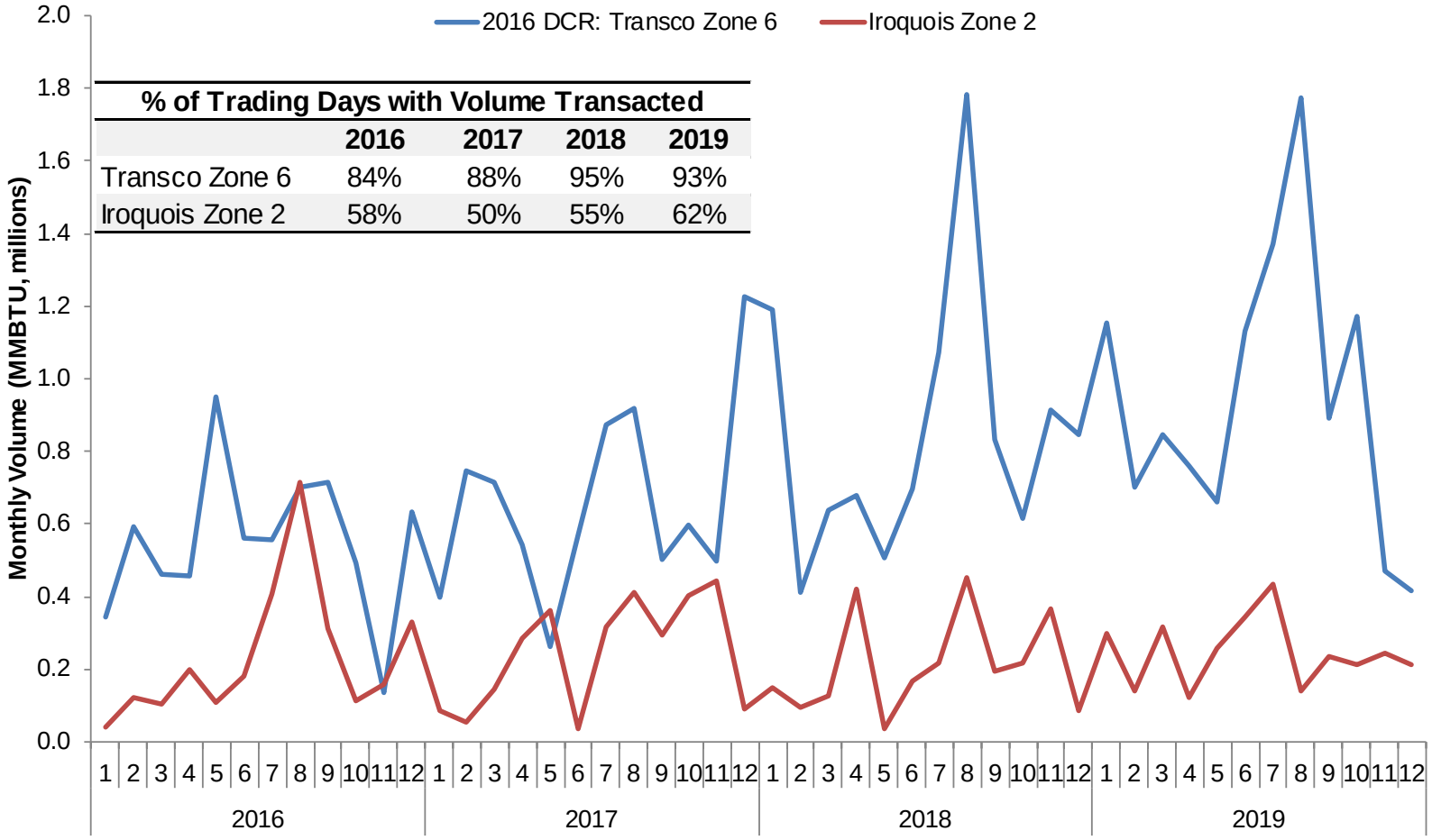
Note: CARIS Blend (Zone K) is comprised of a weighted average of spot prices from Iroquois Zone 2 (60%) and Transco Zone 6 NY (40%).

Load Zone K (LBMP and Gas Prices)



Notes: CARIS Blend (Zone K) is comprised of a weighted average of spot prices at Iroquois Zone 2 (60%) and Transco Zone 6 NY (40%). Fuel prices are converted using a heat rate of 8 MMBtu/MWh.
Sources: SNL (Fuel Prices); NYISO (DAM LBMPs).

Load Zone K (Trade Volume, MMBTU)



% of Trading Days with Volume Transacted				
	2016	2017	2018	2019
Transco Zone 6	84%	88%	95%	93%
Iroquois Zone 2	58%	50%	55%	62%

Source: SNL Financial

Discussion of Revised Energy Storage Modeling

Energy Storage Net EAS Revenues

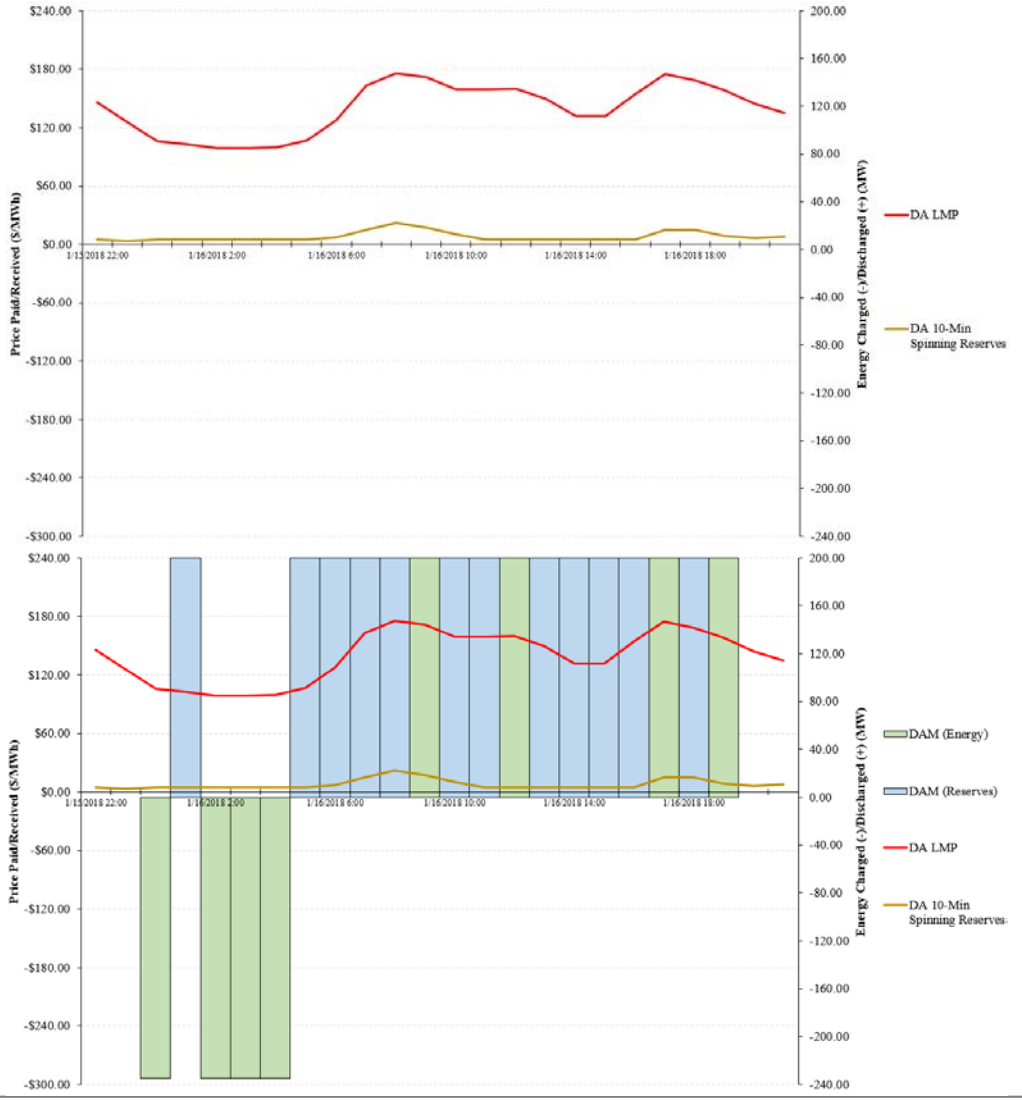
Refinement of potential approach

- Net EAS revenue model refined to reflect day-ahead (DA) and real-time (RT) information availability
- 2-Stage Model
  - Stage 1: DA schedule is set based on DA energy and 10-minute spinning reserve prices; co-optimized to maximize total revenues
    - Potential for multiple cycles per day depending on prices
    - Optimal charge and discharge hours determined daily by unit/zone
  - Stage 2: RT charge/discharge based on profitable deviations from DA position based on hour-by-hour RT prices
    - Decision to discharge/recharge outside of DA schedule accounts for a risk premium (can be set to zero)
    - Recharge based on expectation of low RT prices: battery will recharge in future hour when DA prices are lowest, but pay RT prices for transacted energy
- Charge costs and discharge revenues based on:
  - DA and RT energy and reserve prices
  - Transmission service charges (applicable to recharge) and Rate Schedule 1 charges
- Variable O&M/degradation costs assumed per MWh discharged, round-trip storage efficiency assumed at 85%

Stage 1: Assignment of Day-Ahead Schedule

- Given historical day-ahead energy and reserve prices for a given zone on a given day

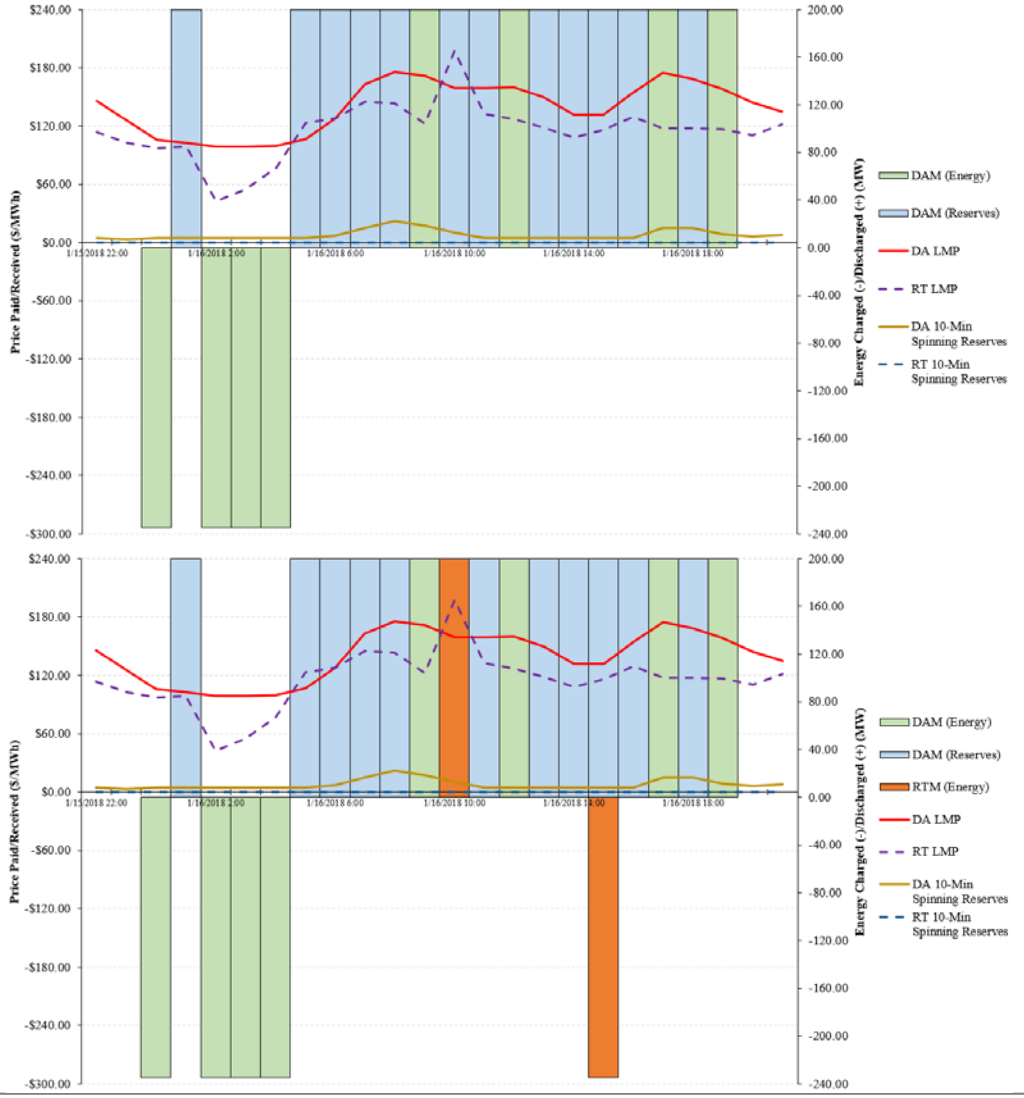
- Optimal day-ahead energy and reserves schedule is set to co-optimize energy and reserve revenues



Stage 2: Additional Real-Time Cycling

- Given historical real-time energy and reserve prices known hour by hour

- Additional real-time cycles are added into the hourly schedule if profitable (limited to bounds of previously determined day-ahead energy and reserve schedule)



Overview of Winter-to-Summer Ratio

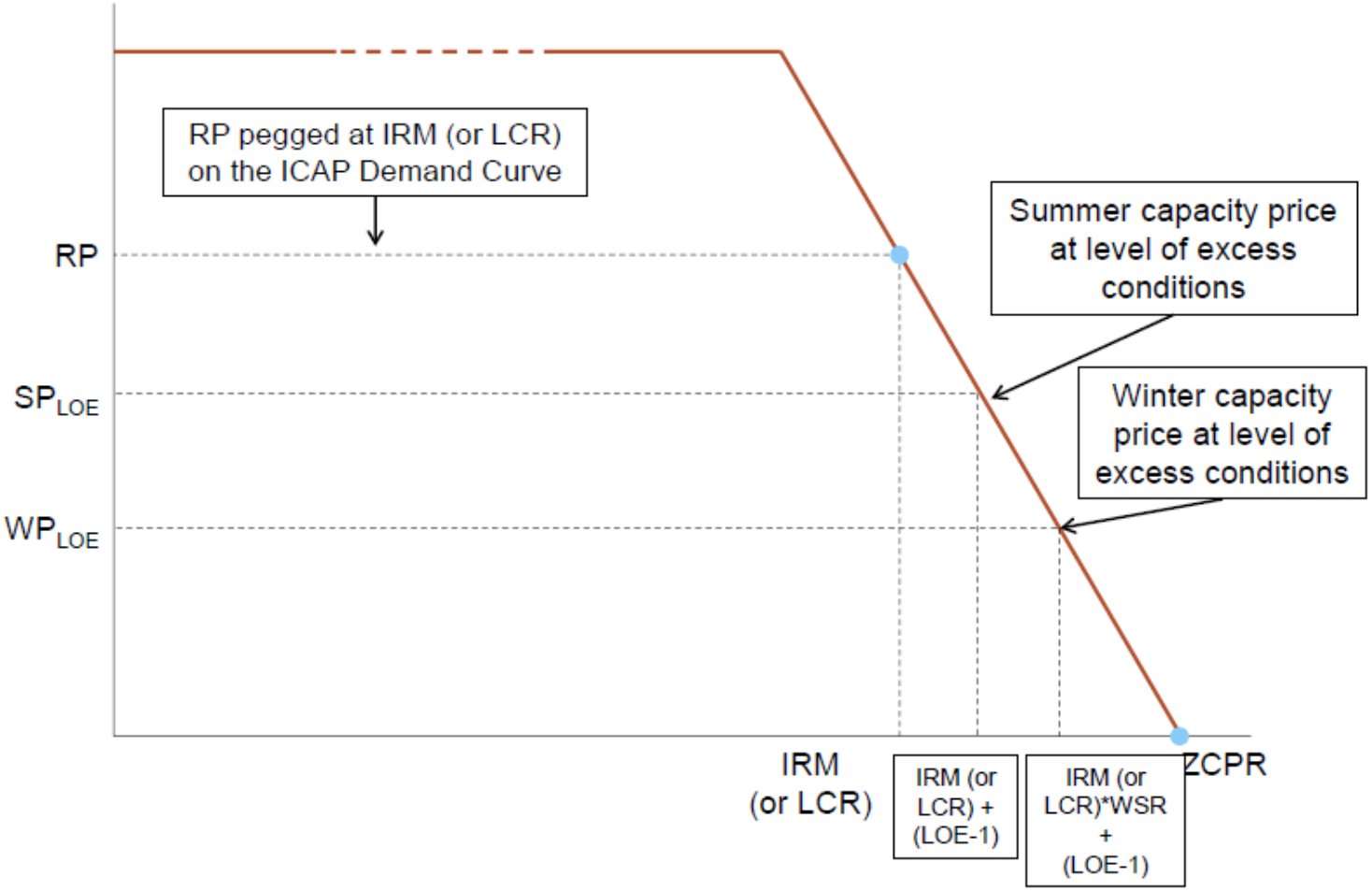
Winter-to-Summer Ratio

Definition and Data Sources

- The winter-to-summer ratio (WSR) will be calculated by NYISO as the ratio of total winter available ICAP to total summer available ICAP in each year
  - Total winter ICAP and total summer ICAP are calculated as a rolling average from the same three-year historical period that is used when calculating net EAS revenues
  - Adjustments to historic data is made for certain resource specific qualifying market entry and exit circumstances
- The WSR captures differences in the quantity of capacity available between winter and summer seasons
- The WSR and tariff prescribed level of excess (LOE) is accounted for in establishing the reference point (RP) values of the ICAP Demand Curves to ensure revenue adequacy over the course of a Capability Year

Winter-to-Summer Ratio

Illustrative ICAP Demand Curve



Next Steps

Key issues for discussion in the coming months

- Analysis Group
  - Continued discussion of financial parameters and net EAS revenue model assumptions
  - Development and discussion of preliminary net EAS revenue estimates and preliminary net CONE values
- Burns & McDonnell
  - Finalization of cost estimates for peaking plant technologies

Contact

Paul Hibbard, Principal
617 425 8171
Paul.Hibbard@analyisgroup.com

Todd Schatzki, PhD, Principal
617 425 8250
Todd.Schatzki@analyisgroup.com