

Energy Security Improvements Impact Analysis

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Agenda

- Continued Discussion of Model Assumptions and Stakeholder Questions
- Future Cases – Preliminary Central Case Results
 - Update of Central Results Presented July 30, 2019
- Preliminary Scenario Analysis Results

Continued Discussion of Model Assumptions and Stakeholder Questions

Reminders About Analysis

Evaluation of Impact, Not a Forecast of Future Outcomes

- Study is an analysis of impacts of ESI under different scenarios
 - Scenarios reflect different market conditions, including different resource mixes, fuel resources, weather conditions, etc.
 - Impacts reflect the *difference* between outcomes under Current Market Rules and Energy Security Improvements
 - Some impacts may not be particularly sensitive to assumptions
 - Not a *forecast or assessment* of future market outcomes

New Information on Data and Assumptions

Refer to Appendices and Supplemental Materials

- Stakeholders requested additional information on a variety of topics
- Additional information provided on certain topics in supplemental materials, including updates to the previously posted data/assumptions memorandum. We do not plan to discuss the following topics, for which new information has been provided, unless there are requests to do so:
 - Technical details on risk premium calculation
 - RER quantity and breakdown
 - Assumptions about demand response

Questions Related to Central Case Results

To Be Addressed as We Review Updated Results

- Several questions were raised about preliminary Central Case results presented at the July 30, 2019 MC meeting which will be addressed as a review of updated results
 - Approach to accounting for market response to FER payments
 - Medium Case – intuition for certain results
 - Total net cost of DA energy option across cases
 - Reliability metrics

Non-Winter Results

Information from Winter Cases for non-Winter Periods

- At present, the Impact Analysis quantitatively evaluates only Winter months
- Stakeholder questions indicate interest in understanding how results for Winter months might reliably inform an understanding of likely non-Winter impacts
- In general, among the analyses performed, Low Case results likely provide the most useful information about non-Winter period impacts
- However, many differences between Winter and non-Winter market conditions could lead non-Winter impacts to differ from Low Case impacts – for example:
 - Summer peak loads and marginal capacity available to meet DA energy option requirements
 - Expected fuel oil inventory levels in non-Winter months under CMR
 - Available NG supply given lower LDC demand
 - Supply from resources potentially subject to seasonal variation (wind, solar, hydro)
 - Transmission congestion, which may be greater in summer months (with peak loads) and shoulder months (with scheduled outages)
 - RT LMP volatility
 - EIR quantity

Update on ESI Offer Risk Premium Estimates

Estimation of Risk Premium

- In principle, risk premium reflects many factors:
 - Risk premium reflects incremental level of financial risk assumed by accepting the DA energy option
 - Risk premium likely grows disproportionately with the level of risk (i.e., non-linear relationship between variability and premium)
 - Risk premium reflects operational risks and intertemporal constraints that would limit the value of physical energy inventory in providing a financial hedge
 - Value of physical energy inventory in providing a financial hedge depends on the marginal cost (MC) of energy inventory (lower MC provides greater value)
 - For some positions, risk premium could be negative (i.e., DA energy option payment might provide a “more sure” payment than selling in RT with no DA position)

ESI Offer Risk Premium Estimates

Current Estimates of Risk Premium

- Estimates of option risk premium build off the observable risk premiums for forward positions (e.g., a DA energy position)
 - Assume that the risk premium for an unhedged forward position is 2%
 - Assume a 50% increase in risk premium to reflect operational and intertemporal constraints – *not* resource specific
 - For example, risk a unit does not start-up, lag in dispatch (relative to price changes), failure to dispatch (due to long-lead times), limited energy supplies, etc.
 - Reflect relative size of forward energy price and DA energy option price in each hour
 - Reflect relative size of the risk, as measured by the standard deviation of the (negative) returns, factoring in the physical inventoried energy hedge
 - Risk premium is linear in (relative) variation in option returns (i.e., non-linearity is not assumed)

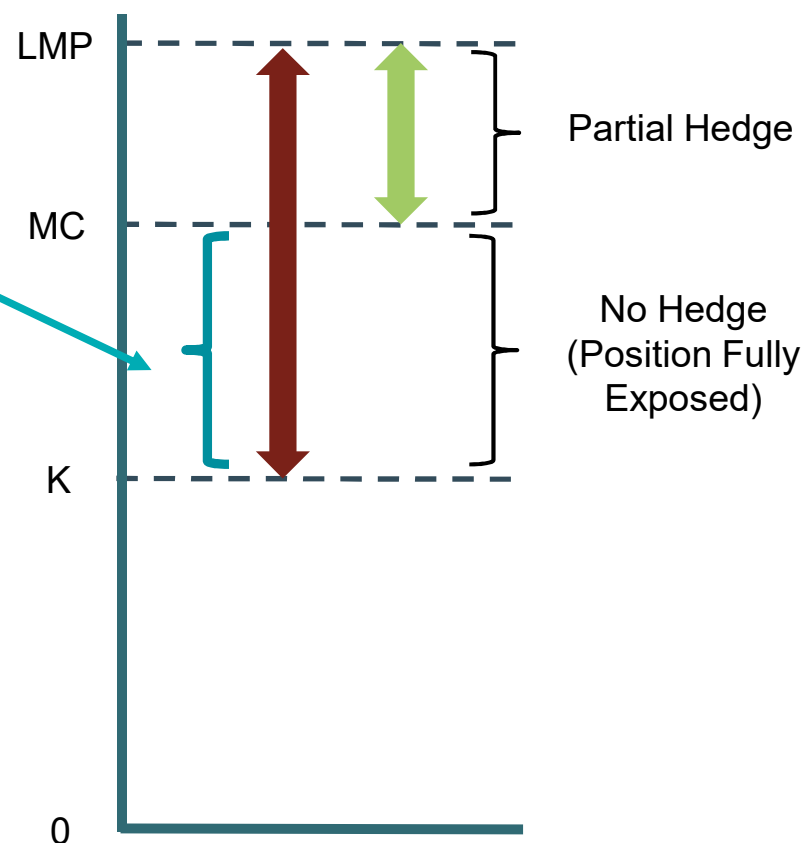
Approach to Estimating ESI Risk Premium

Risk Premium Depends on Exposure Created by Option Position

Risk premium is resource-specific, depending on the resource's marginal costs relative to K in each hour

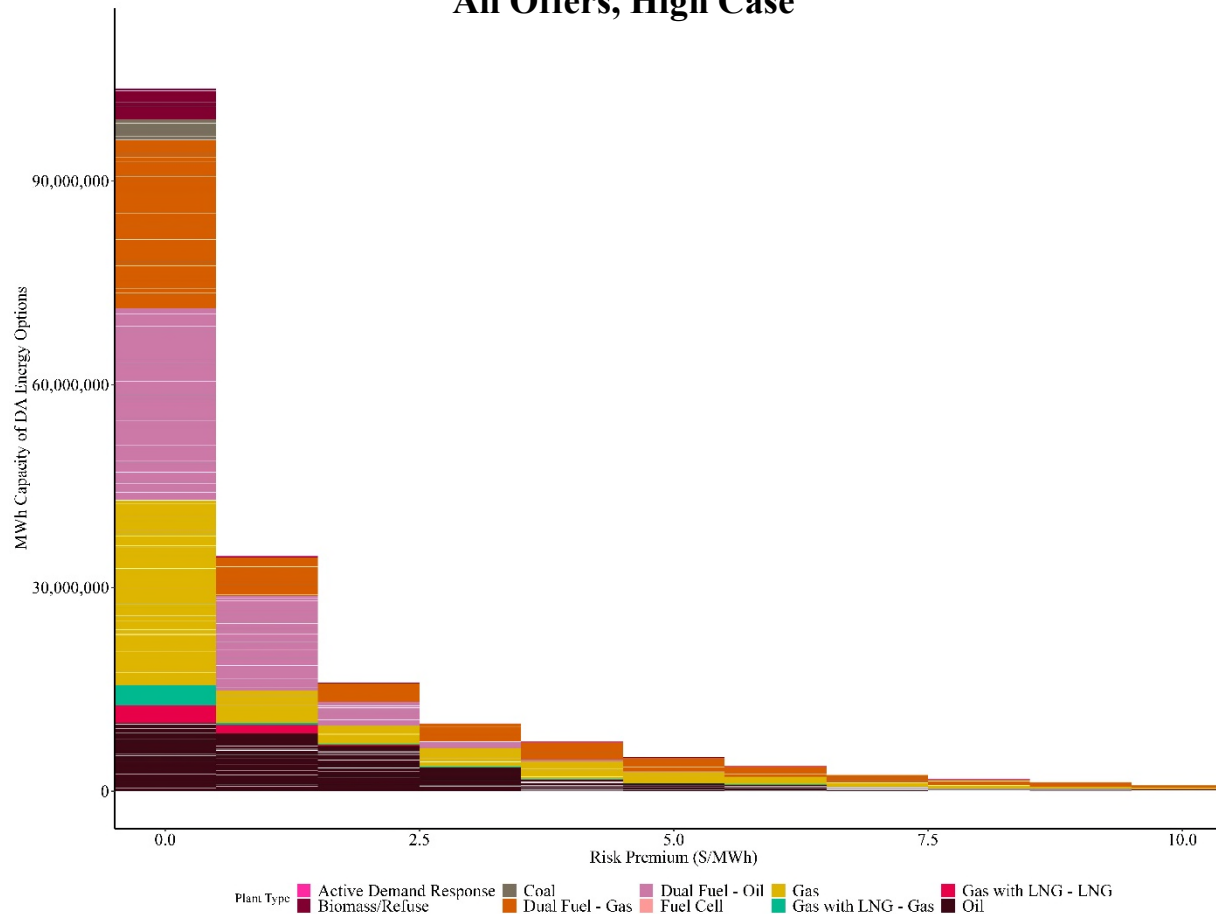
Difference in risk based on observed differences in variability of returns on positions as MC varies

Analysis is *preliminary*



Risk Premium

**Estimated Risk Premium, MWh Capacity by Premium Size & Technology Type
All Offers, High Case**



Notes:

[1] “Gas with LNG – [fuel]” refers to Gas units with an LNG contract, offering with the specified fuel type.

Risk Premium

**Estimated Risk Premium, MWh by Premium Size & Technology Type
Cleared Offers, High Case**

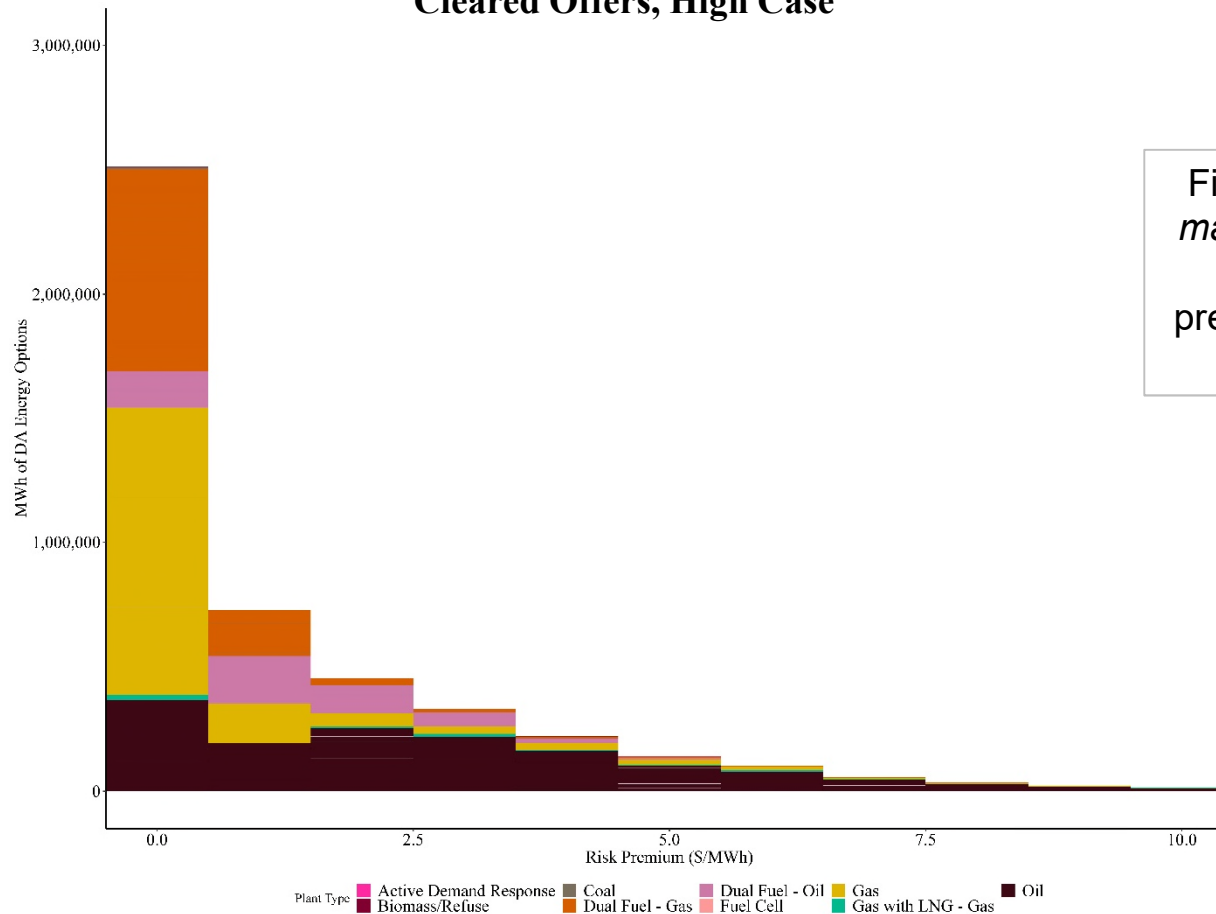


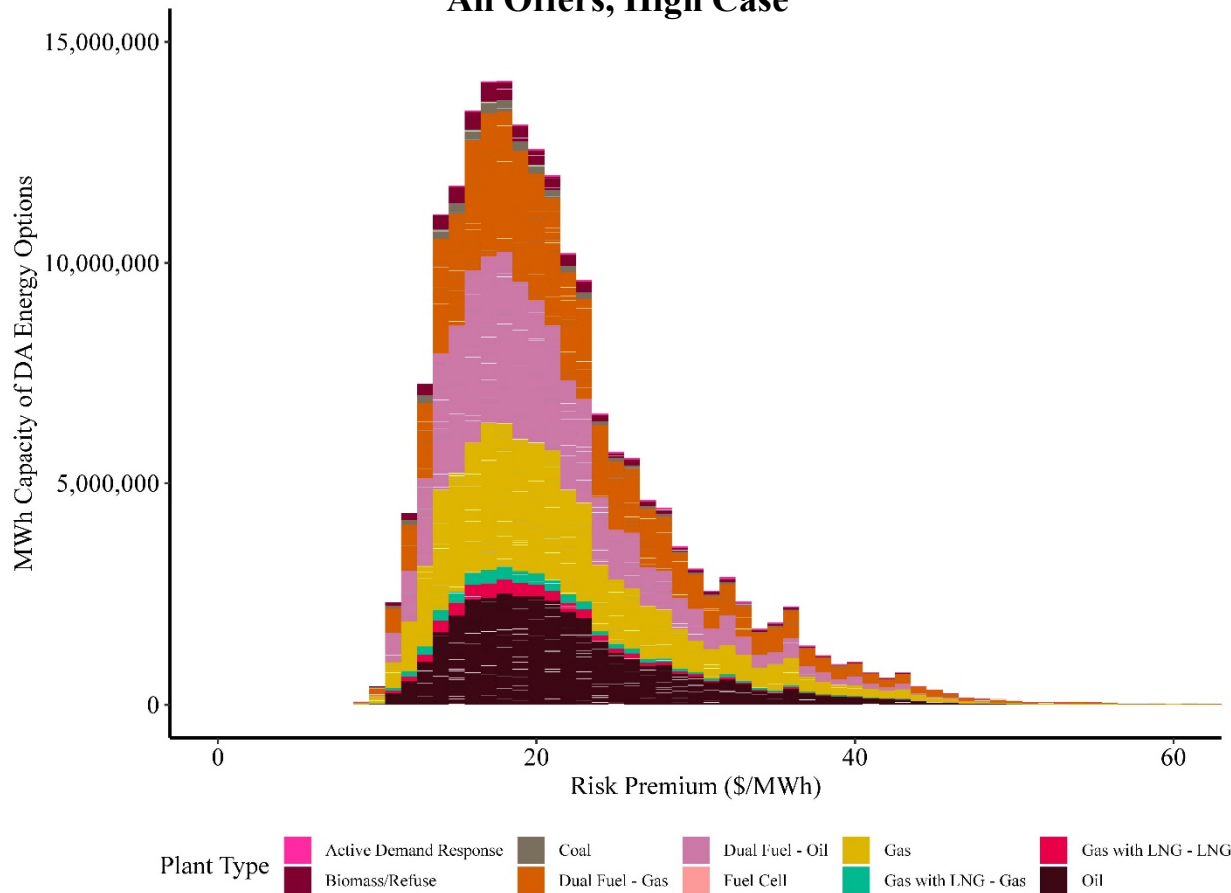
Figure represents marginal and infra-marginal risk premiums for offers that clear

Notes:

[1] “Gas with LNG – [fuel]” refers to Gas units with an LNG contract, offering with the specified fuel type.

DA Energy Option Offers

**Estimated DA Energy Option Offer, MWh by Offer Size & Technology Type
All Offers, High Case**

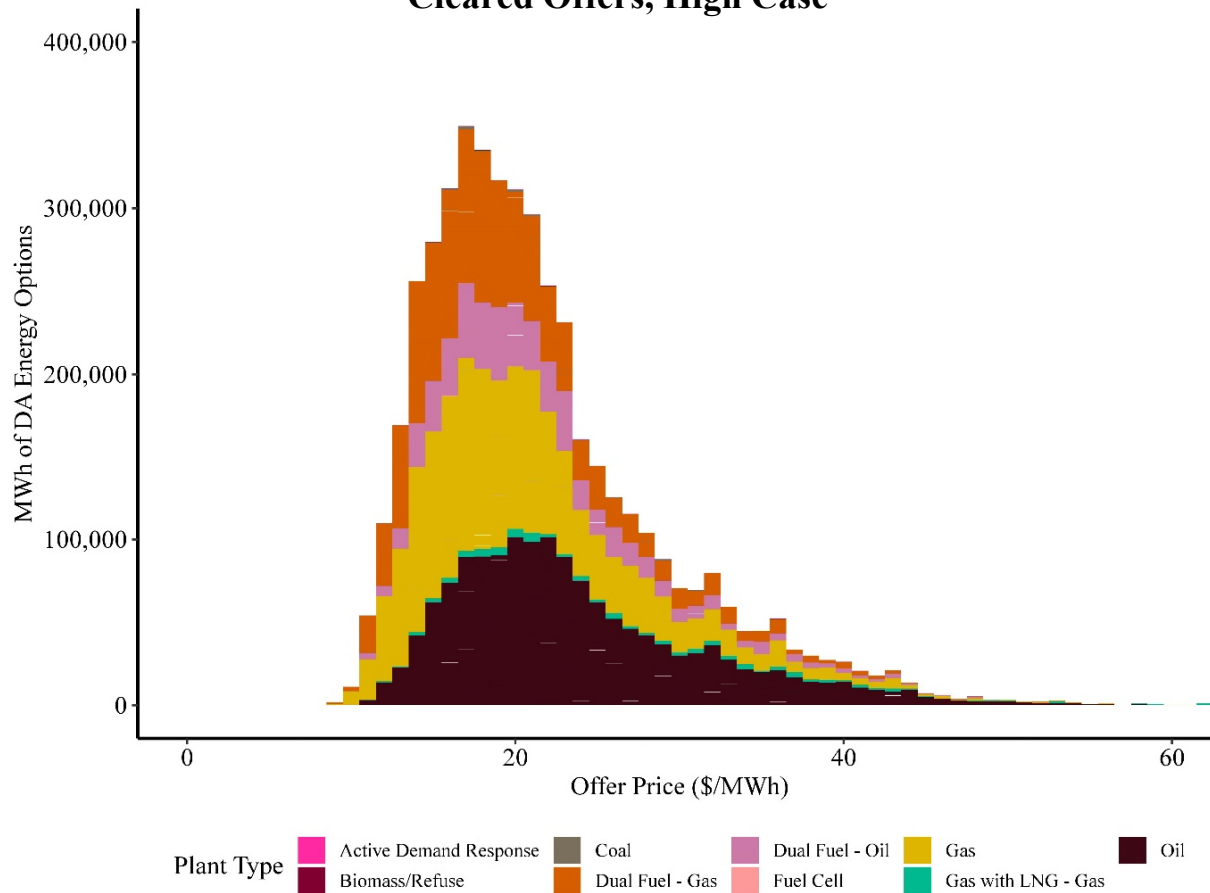


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DA Energy Option Offers

**Estimated DA Energy Option Offer, MWh by Offer Size & Technology Type
Cleared Offers, High Case**



Notes:

[1] "Gas with LNG – [fuel]" refers to Gas units with an LNG contract, offering with the specified fuel type.

Future Cases – Preliminary Central Case Results

ESI Impacts

Fundamentals of Impact Approach

- Impacts are measured as the difference between two cases:
 - **Current Market Rules (“CMR”) Case**, reflecting current market rules and market responses
 - **ESI Case**, reflecting ESI proposed rules and expected market responses
- Analysis will consider different levels of winter severity in a future year, 2025/26:
 - **Low Case** based on 2016/2017
 - **Medium Case** based on 2017/2018
 - One extended cold-snap
 - **High Case** based on 2013/2014
 - Multiple, shorter cold-snap periods
 - Both Medium and High cases provide insight into impacts during different severe winter weather conditions
- Results are *preliminary*, but provide reasonable estimates of impacts for the cases evaluated

Central Case

Underlying Assumptions

- Current fleet (FCA 13 resources, with all approved retirements through FCA 13)
 - Mystic 8 and 9 out
- DOMAC out
 - Repsol in operation, with full supply available on all days to electricity suppliers
 - Under ESI, forward LNG contracts (~610 MW) for capacity not contracted by LDCs to meet design day requirements
- Fuel oil: initial inventory and refilling
 - Under ESI, initial inventory based on Winter Program levels
 - Under CMR, initial inventory based on post-Winter Program levels with daily refill at 25% of ESI rate

Total Customer Payments

High Case, CMR vs ESI

Total Payments by Load, High Case (\$ Million)

Product / Payment		Payments (\$Million)			
		CMR	ESI	Difference	
Energy and RT Operating Reserves	[A]	\$4,476	\$4,243	-\$233 (-5.2%)	Two-part settlement for DA and RT energy
DA Energy Option					
DA Option Payment			\$278		
EIR			\$23		
RER			\$54		
GCR10			\$90		
GCR30			\$111		
RT Option Settlement			-\$229		Net of DA Energy Option Payment and RT Settlement
Net DA Ancillary	[B]		\$49		
FER Payments	[C]		\$327		FER payment to resources supplying energy
Total Payments	[A+B+C]	\$4,476	\$4,619	\$143 (3.2%)	

Total Customer Payments

All Cases, CMR vs ESI

Total Payments by Case (\$ Million)

Product / Payment		High Future Case			Medium Future Case			Low Future Case		
		Payments (\$Million)			Payments (\$Million)			Payments (\$Million)		
		CMR	ESI	Difference	CMR	ESI	Difference	CMR	ESI	Difference
Energy and RT Operating Reserves	[A]	\$4,476	\$4,243	-\$233 (-5.2%)	\$3,186	\$2,823	-\$363 (-11.4%)	\$1,827	\$1,824	-\$4 (-0.2%)
DA Energy Option										
DA Option Payment			\$278			\$168			\$88	
EIR			\$23			\$11			\$6	
RER			\$54			\$35			\$18	
GCR10			\$90			\$54			\$28	
GCR30			\$111			\$69			\$36	
RT Option Settlement			-\$229			(\$137)			(\$53)	
Net DA Ancillary	[B]		\$49			\$31			\$35	
FER Payments	[C]		\$327			\$203			\$112	
Total Payments	[A+B+C]	\$4,476	\$4,619	\$143 (3.2%)	\$3,186	\$3,057	-\$129 (-4.0%)	\$1,827	\$1,971	\$144 (7.9%)

- Medium Case lowers total consumer payments, in part, because of relatively large LMP reductions during the extended cold snap due to the incremental inventoried energy (see next slide)
- Low Case costs higher, in part, because of relatively high, positive Net DA Energy Option costs (discussed later)

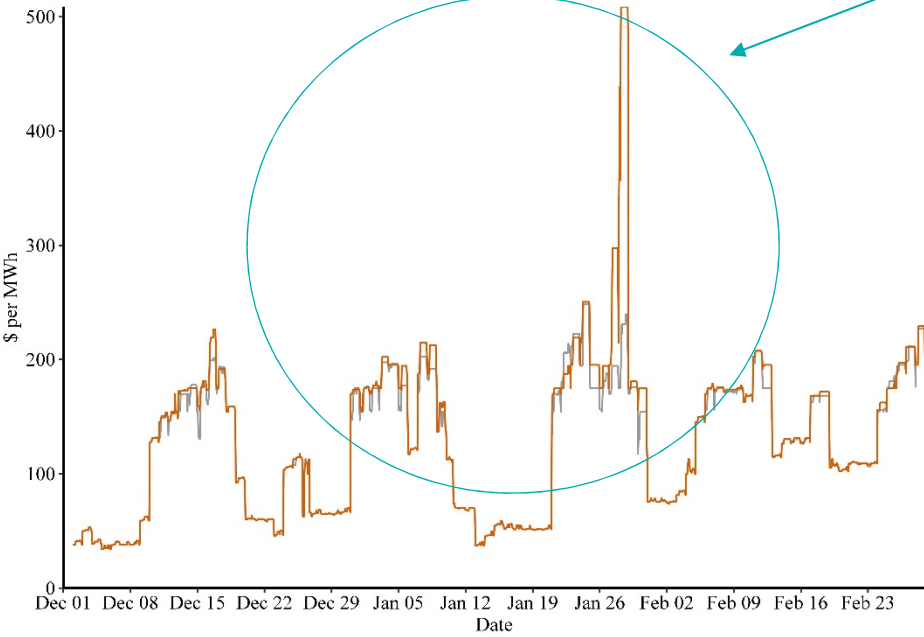
LMP Prices

DA LMPs – High & Medium Cases

LMP reductions from incremental inventoried energy are larger in Medium Case than High Case
- Leads to a larger reduction in total EAS costs

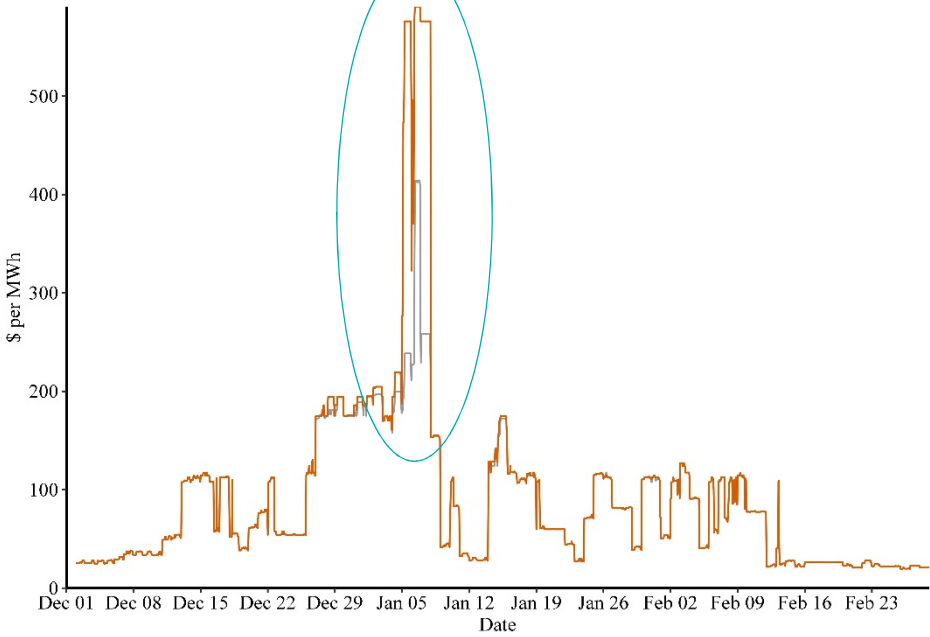
DA LMPs, Central Case, CMR vs ESI (\$ per MWh)

High Case



Data Source: — ESI Solution — CMR Solution

Medium Case



Data Source: — ESI Solution — CMR Solution

Updated Estimates

Fundamentals of Impact Approach

- Updated results reflect several factors, including revised risk premiums and updated RER quantity
- Consider impacts in four components:
 - Payments to DA energy
 - Payments for DA energy options
 - Settlement of DA energy options (at RT LMPs)
 - Payments in RT for deviations from DA energy positions, plus payments for RT operating reserves

DA Energy

Changes in LMPs and new FER Payments

- **Changes in DA LMPs** – potentially reflect many factors, including:
 - Incremental energy inventory available to meet DA and RT energy demand
 - Substitution in resource-level awards between energy and DA energy options
 - Changes in opportunity costs given changes in resource-level energy inventory
- **FER payment** – the incremental payment to generation to capture the “missing” opportunity cost for resources supplying energy that could supply EIR
 - Resources supplying energy provide two services, energy and reduction of EIR
 - Estimated FER payments:
 - *All DA physical clear energy* receives the LMP plus the EIR
 - In equilibrium, assume FER payments made in 50% of hours, as market responses drive day-ahead energy toward forecast energy (i.e., implicitly assumes EIR price = \$0 in half of hours)

FER and DA Load

Follow-up from Last Month's Discussion

- We expect that payments associated with the Forecast Energy Requirement may incent certain market responses, including additional DA load bid in by load-serving entities (LSEs)
- Bid-in DA load will (among other things) reflect two offsetting effects:
 - FER payments can be reduced by increasing DA load so that the EIR requirement is reduced or goes to zero
 - But, energy payments are increased with higher DA load, as higher load will tend to increase DA LMPs
 - Bids for load under ESI may reflect a balance of both effects
- In Central Case, original DA loads are used in model optimization, but DA loads are adjusted (upward) when calculating FER payments (to reflect LSE response)
 - In scenario analysis, we consider a scenario in which DA loads are adjusted (upward) in model optimization and calculation of FER payments

DA Energy

Average DA Payments to Generators, CMR vs ESI (\$ per MWh)

	CMR	ESI			Change	
	DA LMP	DA LMP	FER	DA LMP + FER	DA LMP	DA LMP + FER
Severity	[A]	[B]	[C]	[D]=[B]+[C]	[B]-[A]	[D]-[A]
High	\$134.02	\$127.53	\$10.39	\$137.92	(\$6.49)	\$3.90
Medium	\$97.80	\$86.62	\$6.48	\$93.11	(\$11.18)	(\$4.70)
Low	\$56.69	\$56.58	\$3.65	\$60.22	(\$0.11)	\$3.53

- Payments reflect both LMPs and FER payments
- DA LMPs decline with ESI due to additional inventoried energy
- But, with FER, payments to DA energy increase relative to CMR in High and Low cases

DA Energy Options

Average DA Energy Option Clearing Prices (\$ per MWh) (\$/MWh)

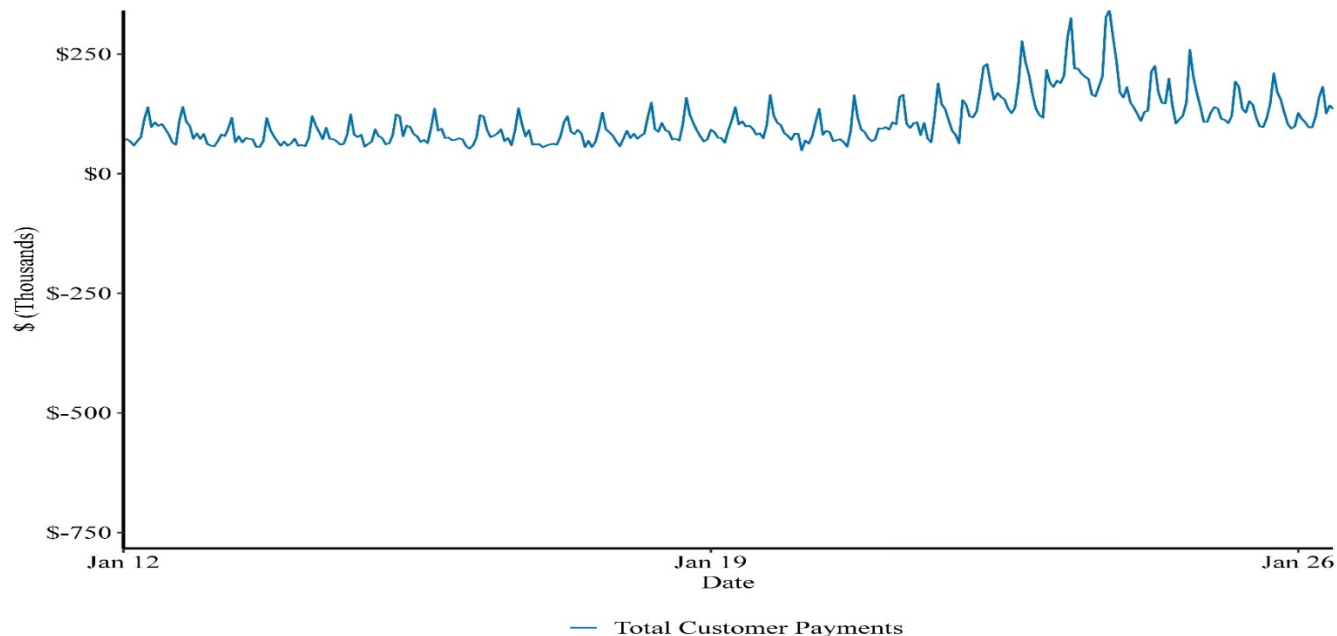
Case	No EIR				
	(% of hours)	EIR	RER	GCR10	GCR30
High Case	10%	\$21.81	\$20.94	\$25.77	\$25.77
Medium Case	22%	\$12.37	\$13.60	\$14.26	\$14.21
Low Case	13%	\$6.71	\$7.16	\$7.64	\$7.61

Note: [1] "No EIR" is the percent of hours in which EIR is 0 MWh.
[2] Prices are weighted by hourly quantity of each ESI product.

- Weighted average hourly prices for RER, GCR10 and GCR30 are:
 - Varied across cases given differences in price volatility (and intra-day price variation) in each winter
 - Relatively similar within Cases, although this masks significant hourly variation (next slide)
- EIR price is zero in hours when cleared DA load is greater than forecast load
 - EIR price is larger than RER price in higher in High Case because of differences in hourly (MW) weights used in each calculation (e.g., EIR zero in many hours)

DA Energy Options – Total Customer Payments

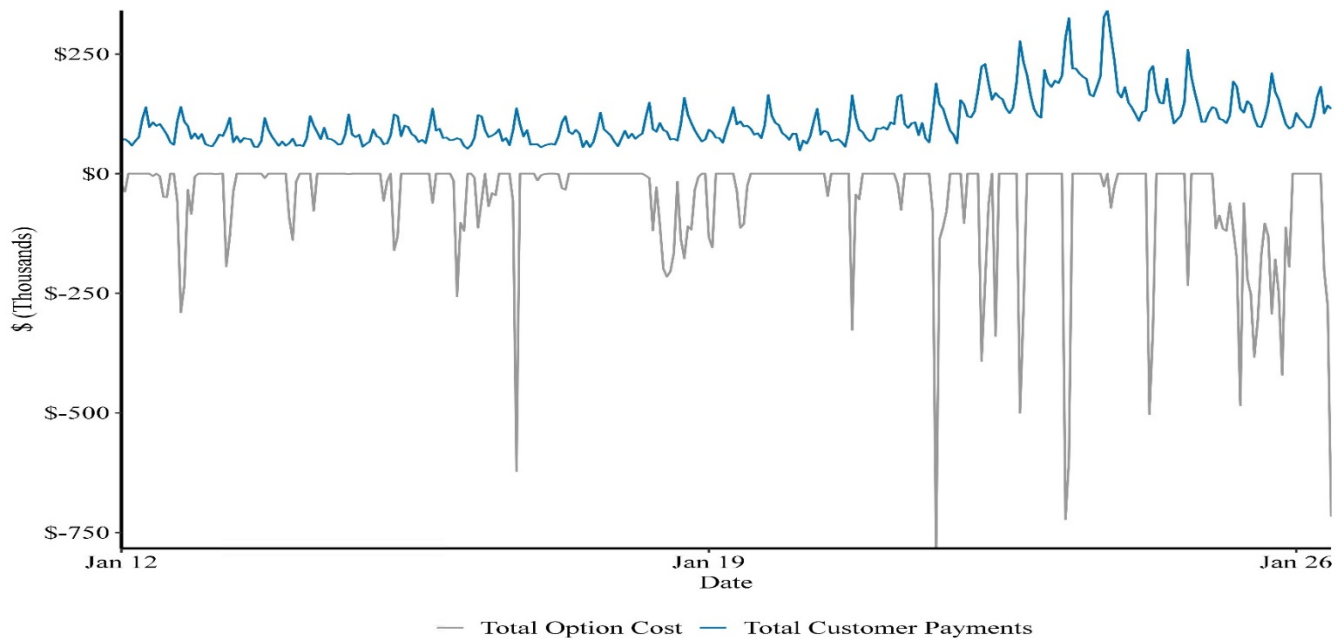
**Hourly DA Energy Option Payments,
All ESI Products, High Case, Jan 12 to Jan 26 (\$ Thousands)**



- Hourly payment covers RER, GCR10, GCR30 and EIR DA energy options
- EIR quantity may vary by hour
- Prices may vary by hour given intraday variation in expected prices, opportunity costs, fuel inventory and other factors

DA Energy Options – RT Option Settlement

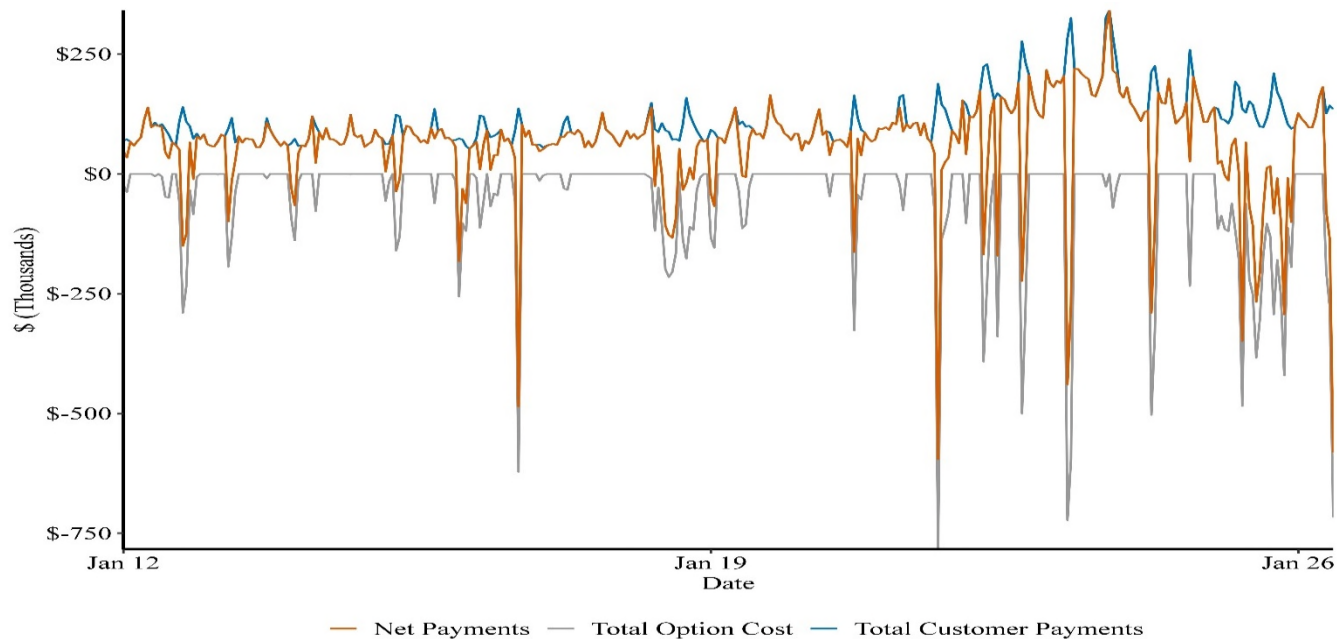
**Hourly DA Energy Option Payments and RT Option Settlement
All ESI Products, High Case, Jan 12 to Jan 26 (\$ Thousands)**



- RT settlement depends on quantity of DA energy options and $LMP - K$

DA Energy Options – Net Payments

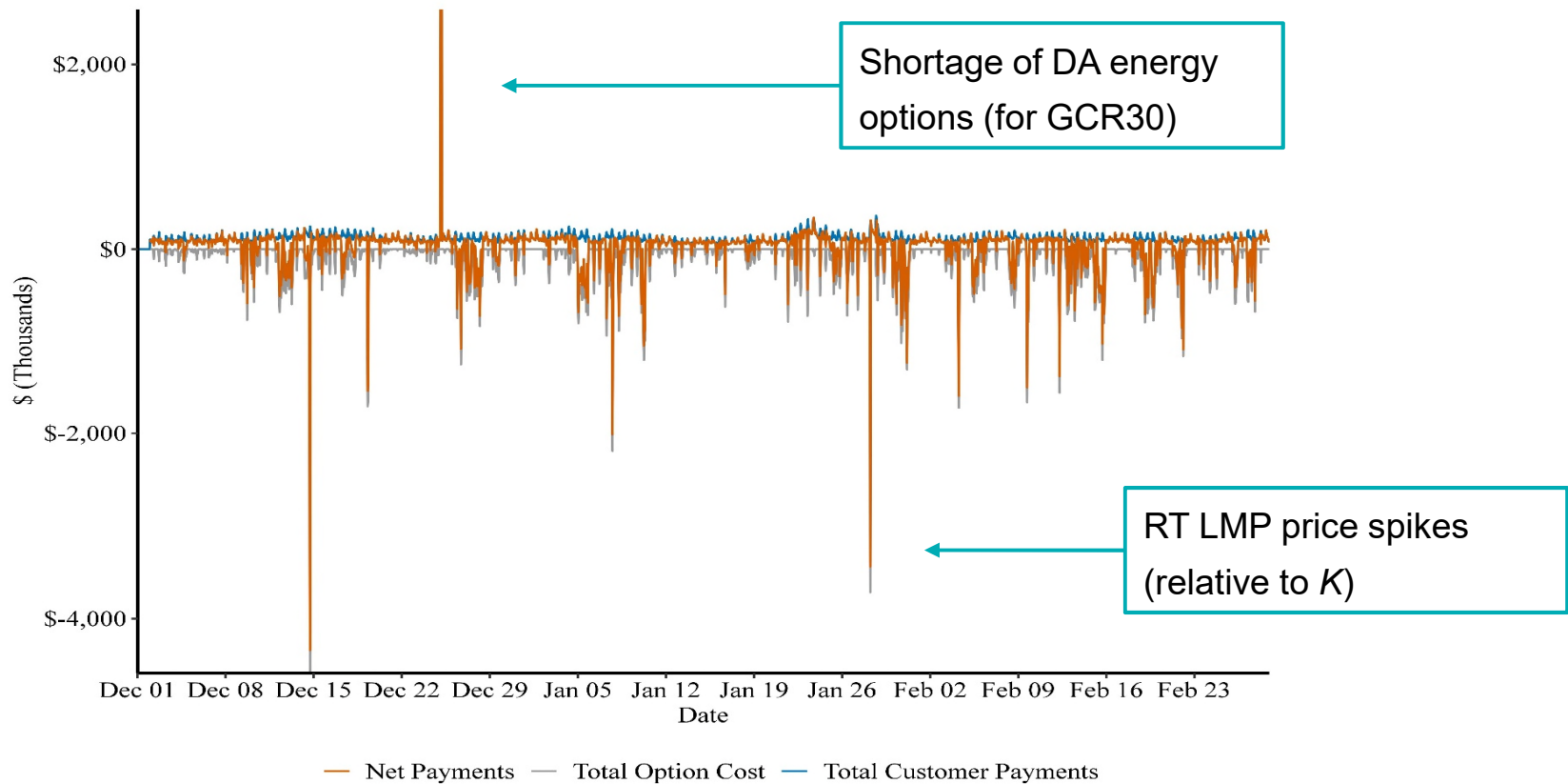
**Hourly DA Energy Option Payments, RT Option Settlement and Net Payments
All ESI Products, High Case, Jan 12 to Jan 26 (\$ Thousands)**



- Net Payment reflects both DA option payments and RT settlement

DA Energy Options – Net Payments

**Hourly DA Energy Option Payments, RT Option Settlement and Net Payment
All ESI Products, High Case (\$ Thousands)**



DA Energy Options - Total Customer Payments

Total ESI Customer Payments, All ESI Products (\$ Million)

DA Energy Option Payments

Case	EIR	RER	GCR10	GCR30	Total DA			Total
					Option Payments	RT Option Settlement	FER Payments	
High Case	\$22.79	\$53.68	\$90.35	\$110.91	\$277.73	-\$228.62	\$326.93	\$376.05
Medium Case	\$10.64	\$34.85	\$53.52	\$68.79	\$167.80	-\$136.98	\$203.26	\$234.07
Low Case	\$6.28	\$18.34	\$27.50	\$35.99	\$88.12	-\$52.88	\$112.02	\$147.26

Note: Total is the sum of Total DA Option Payments, RT Option Settlement, and FER Payments.

- Total ESI customer payments reflect three components:
 - DA energy option payments
 - Real-time option settlement
 - Forecast Energy Requirement (FER) payments
- In total, incremental payments range from \$147 to \$376 million
 - FER payments are a large portion of these payments

Net Payments for DA Energy Options (Before FER Payments)

Elements of ESI Customer Payments: Expected Settlement Costs and Risk Premiums (\$ Million)

Product		Settlements (\$Million)								
		Offers at Expected Real Time Option Settlement Only			Risk Premium (Implied)			Total		
		High	Medium	Low	High	Medium	Low	High	Medium	Low
Energy and Real-Time Reserves	[A]	\$4,208	\$2,825	\$1,823	\$35	-\$2	\$1	\$4,243	\$2,823	\$1,824
Day-Ahead Ancillary Services										
EIR		\$21	\$10	\$6	\$2	\$1	\$0	\$23	\$11	\$6
RER		\$51	\$33	\$18	\$3	\$2	\$0	\$54	\$35	\$18
GCR10		\$75	\$49	\$25	\$16	\$4	\$2	\$90	\$54	\$28
GCR30		\$91	\$64	\$33	\$19	\$5	\$3	\$111	\$69	\$36
Option Cost		-\$229	-\$137	-\$53	\$0	\$0	\$0	-\$229	-\$137	-\$53
Net Day-Ahead Ancillary	[B]	\$9	\$18	\$29	\$40	\$13	\$6	\$49	\$31	\$35
FERP	[C]	\$308	\$187	\$109	\$19	\$16	\$3	\$327	\$203	\$112
Total Payments	[A+B+C]	\$4,525	\$3,030	\$1,961	\$95	\$27	\$10	\$4,619	\$3,057	\$1,971

Net payments for DA energy options (before FER payments) reflects two components:

- RT settlement against portion of DA offers reflecting the *expected cost* of RT settlement
 - In expectation, DA offers reflecting *expected* RT settlement costs should net out against *actual* RT settlement costs
 - But, for a particular realization of winter prices, actual netting could be positive or negative
 - In our model, netting leads to positive payments of \$9 million (High Case) to \$29 million (Low Case)
- Risk premium – in expectation, does not net out against RT settlement
 - Table provides approximation of total risk premium payments, from of \$6 million (Low Case) to \$40 million (High Case)

Resource Outcomes

ESI Consequences for Resources May Vary Across the Fleet

- The model analyzes changes in production outcomes, including:
 - Production costs
 - Total and net revenues
 - Energy mix
- Shifts in revenues and resource use reflect many factors
 - Energy vs energy option revenues
 - Changes in energy inventory
 - Substitutions resulting from ESI

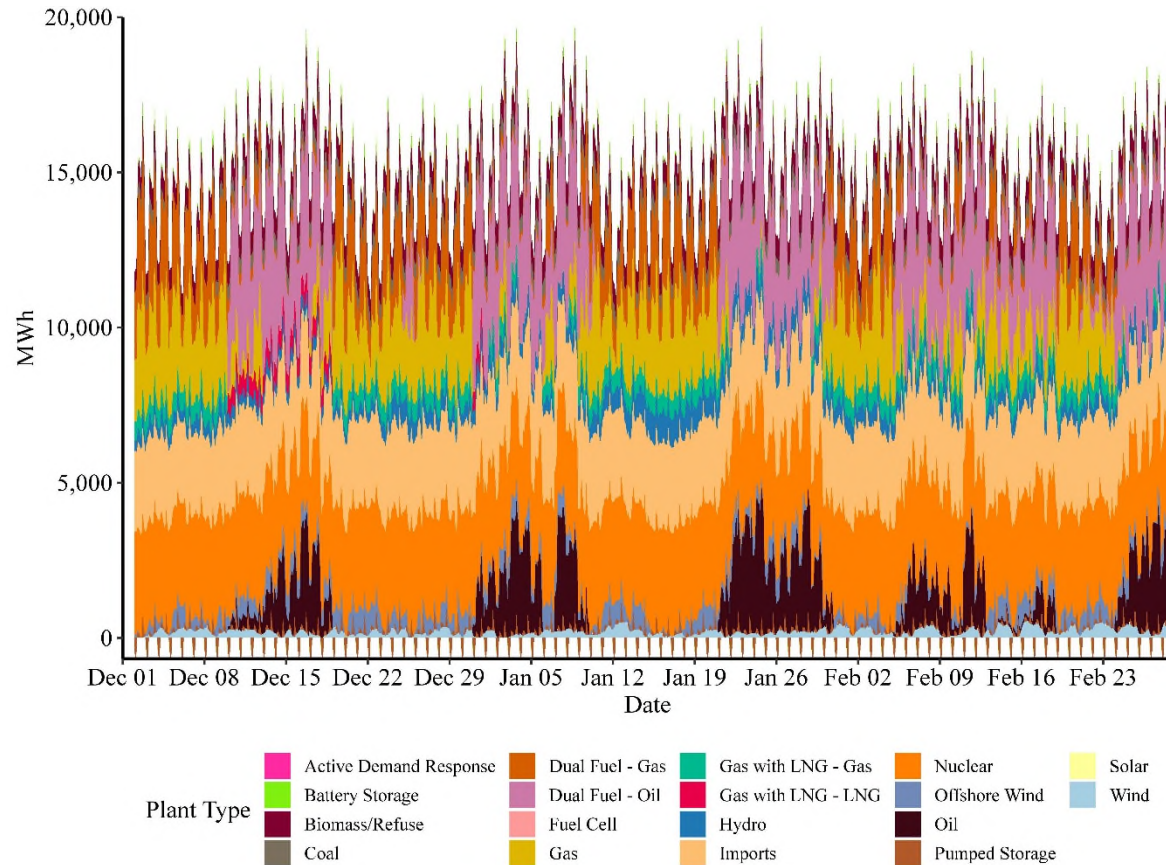
Total Winter Generation Mix

Energy and DA Energy Options by Resource Type, CMR vs ESI, High Central Case (MWh)

Resource Type	Nameplate Capacity (MW)	DA CMR Energy (MWh)	DA ESI Energy (MWh)	DA Energy Options (MWh)	Change in DA Energy (MWh)	Percent Change in DA Energy
Active Demand Response	167	15,292	15,037	1,101	(255)	(1.67%)
Battery Storage	458	(20,009)	(20,009)	0	0	0.00%
Biomass/Refuse	785	1,521,669	1,520,239	6,321	(1,430)	(0.09%)
Coal	535	953,280	953,280	12,556	0	0.00%
Dual-Fuel	7,928	6,894,798	7,084,798	1,890,060	190,000	2.76%
Fuel Cell	21	34,814	34,797	766	(17)	(0.05%)
Gas	7,987	3,482,932	3,315,411	1,989,805	(167,520)	(4.81%)
Gas with LNG	616	1,050,511	1,096,083	121,905	45,573	4.34%
Hydro	1,987	1,241,219	1,241,219	1,521,268	0	0.00%
Imports	2,850	6,032,748	6,032,748	8,452	0	0.00%
Nuclear	3,344	7,104,576	7,104,576	0	0	0.00%
Offshore Wind	800	867,965	867,965	0	0	0.00%
Oil	6,304	1,889,848	1,823,498	1,697,761	(66,350)	(3.51%)
Pumped Storage	1,778	(29,552)	(29,552)	4,410,779	0	0.00%
Solar	1,671	0	0	0	0	0.00%
Wind	1,401	419,629	419,629	0	0	0.00%

Hourly Winter Day-Ahead Energy Positions

Hourly Cleared DA Energy by Resource Type, With ESI, High Central Case (MWh)

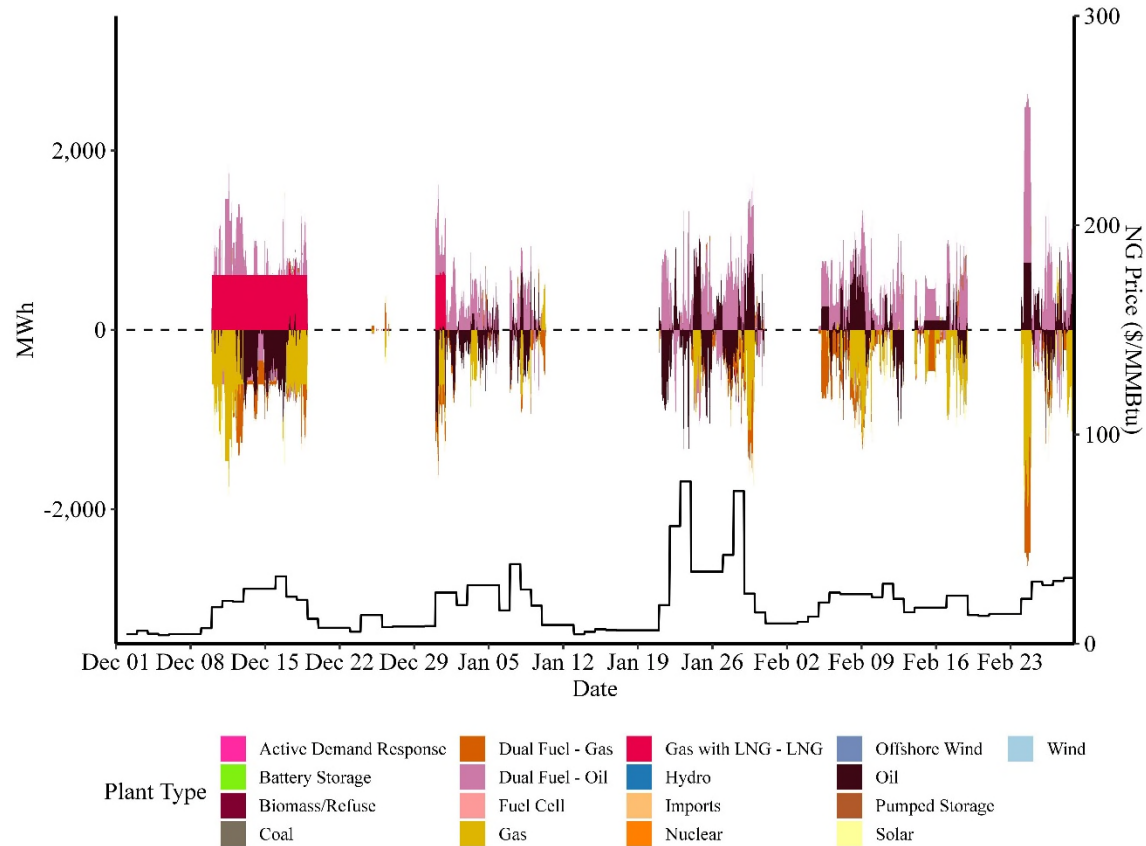


Notes:

[1] “Gas with LNG – [fuel]” refers to Gas units with an LNG contract, offering with the specified fuel type.

Hourly Winter Day-Ahead Energy Positions

Difference in Hourly Cleared DA Energy by Resource Type, CMR vs ESI, High Central Case (MWh)



Notes:

[1] “Gas with LNG – [fuel]” refers to Gas units with an LNG contract, offering with the specified fuel type.

Operational / Reliability Metrics

Develop New Metrics to Capture Energy Security

- We report multiple metrics related to the fuel system to describe changes in system operations and reliability from ESI (compared to CMR)
 - As measured in our model, certain operational metrics, such as operating reserve shortages, are at low levels in the Central Cases
 - Metrics are more sensitive under scenarios with lower energy security (e.g., higher load, diminished fuel availability)
- Given certain metrics are relatively insensitive in many scenarios, we develop other metrics aimed at measuring changes in reliance on the fuel system
 - With these metrics, analysis can measure the extent to which ESI mitigates energy security risks

Operational / Reliability Metrics

Multiple Metrics to Capture Different Aspects of Energy Security

- **Operating reserve shortages.** Hours of 10- or 30-minute operating reserve shortage
- **Natural gas system physically binding.** Hours in which natural gas system is physically binding
- **NG peakers without energy inventory used to meet operating reserves (“Uncovered NG peakers”).** Hours when gas peakers without energy inventory are used to meet operating reserves but either (1) the gas system is fully utilized (“physically binding”), or (2) NG prices are high ($> \$16 / \text{MMBtu}$) (“economically binding”)
- **Natural gas consumption during high priced natural gas hours.** Change in natural gas consumption during periods when NG prices are high ($> \$16 / \text{MMBtu}$), net of NG from forward LNG contracts
- **Minimum daily deliverable energy from oil-fired units.** Minimum daily quantity of energy (MWh) available from oil-only and dual-fuel resources given actual fuel inventory

Operational / Reliability Metrics

Multiple Metrics to Capture Different Aspects of Energy Security

Change in Reliability Metric with ESI compared to CMR Future Cases, Central Assumptions

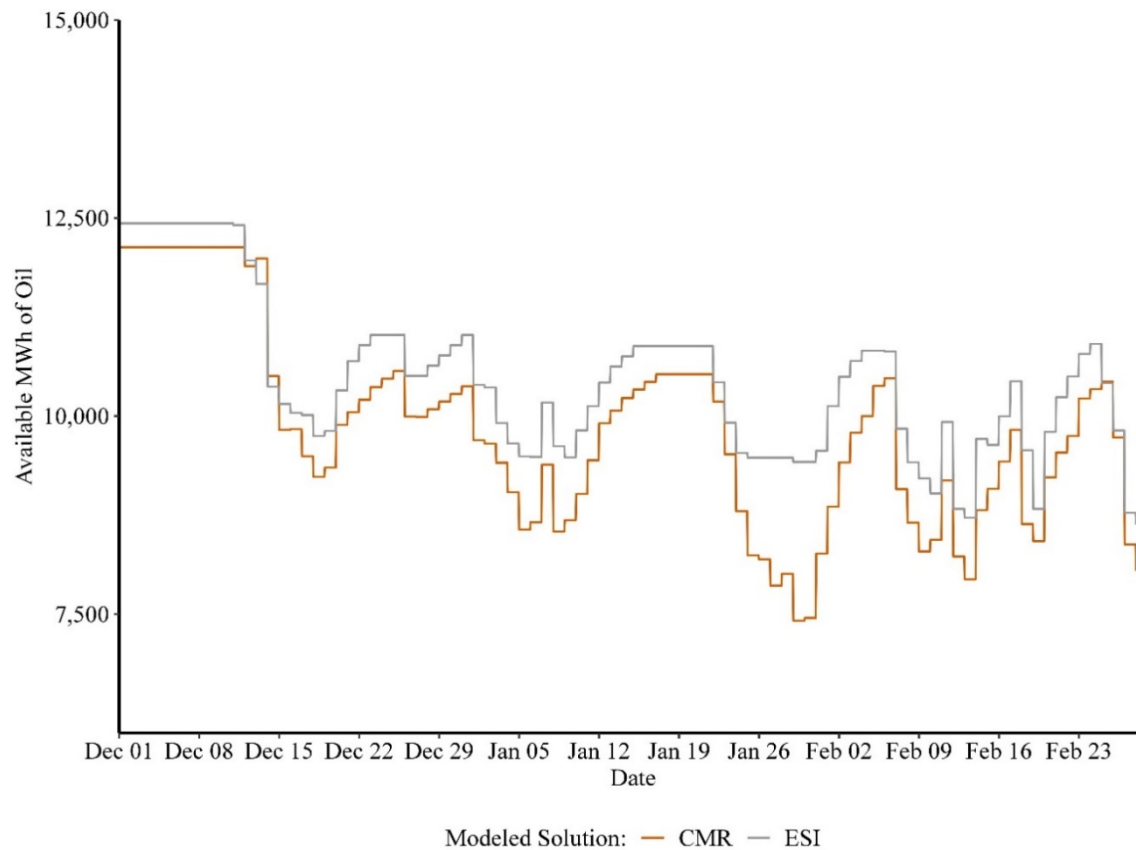
Scenario Name/Acronym	Operating Reserve Shortages (Hours)	NG Physically Binding (Hours)	Uncovered NG Peakers: NG Physically or Economically Binding (Hours)	Natural Gas Used in Generation When NG Economically Binding (MMBtu)	Daily Available Oil Generation Minimum (MWh)
High Future Case	0	(34)	(23)	(2,640,320)	29,393
Medium Future Case	0	(4)	(2)	(805,690)	35,413
Low Future Case	0	2	5	0	4,778

- ESI generally relaxes energy physical and economic constraints
- In several instances, ESI tightens physical constraints, suggesting substitution across fuel systems
 - For example, in the medium case, NG use during high priced periods increases, suggesting substitution from oil to NG

Scenarios - Reliability

Daily Oil Available for Real Time Generation, High Case (MWh)

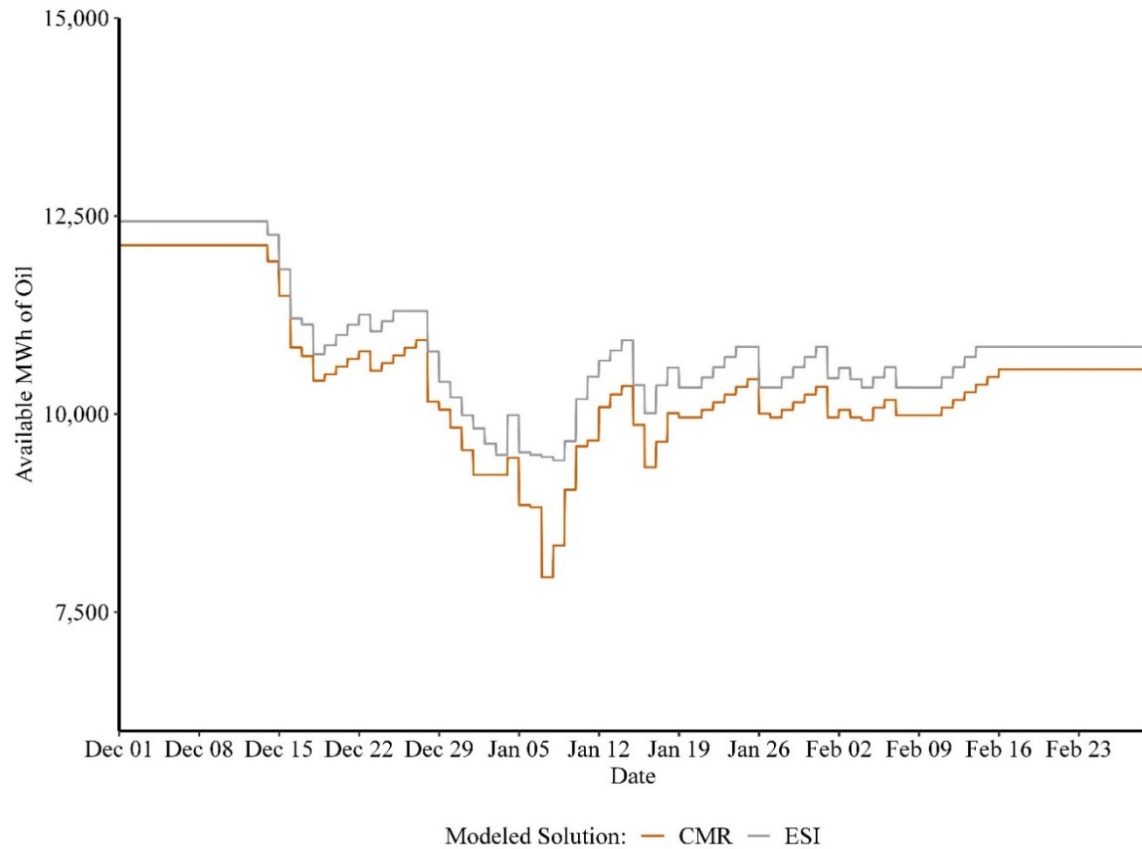
Maximum Daily Potential Generation from Oil-fired Resources, CMR vs ESI, High Case (MWh)



Scenarios - Reliability

Daily Oil Available for Real Time Generation, Medium Case (MWh)

Maximum Daily Potential Generation from Oil-fired Resources, CMR vs ESI, Medium Case (MWh)



Preliminary Scenario Analysis Results

Scenarios Presented

Scenario Name/Acronym	Scenario Description
Central Case	"Central Case" Current Market Rules (CMR) and Energy Security Improvements (ESI) assumptions, updated but largely as presented at July 30 Markets Committee Meeting.
ESI Products - RER Plus	"Central Case", plus an additional 50% hourly RER requirement (1,800 MW total).
ESI Products - No EIR/RER	"Central Case", without EIR or RER products (under development, preliminary runs shown).
Supply Shocks	Unexpected real-time outages, experienced during coldest portion of historic base winter.
Shock HQ 1 Day	Shock is modeled in real-time market, but not expected in day-ahead market.
Shock HQ 5 Days	Shock is modeled Day 1 in real-time market, but not expected in Day 1 day-ahead market. Resource is expected out day-ahead in remaining days (Days 2-5).
High Load	Load is increased by 5%, with no other modeling changes.
DA Load Adjusted for EIR (50%)	Day-ahead cleared load and EIR requirement adjusted such that EIR requirement is zero in 50% of hours.
Resource Mix	Changes in retirements and replacements to future-year resource mix. For all scenarios: ~1,500 MW at-risk resources and an additional ~1,000 MW of oil resources retired.
Oil Retirements; Renewable Replacement	3,824 MW nameplate (1,300 MW derated) of new offshore wind added; 1,200 MW of new hydro imports added.
Oil Retirements; Gas Replacement	2,500 MW of new natural gas CC resources added, none with dual-fuel capability.
Oil Retirements; Gas / Dual Fuel Replacement	2,500 MW of new natural gas CC resources added, 50% with dual-fuel capability.
High LNG Supply	Assume additional LNG availability of 0.4 Bcf/day to both ESI and CMR cases (all winter severities). Under ESI, assume an incremental 0.4 Bcf/day available for LNG forward contracts, for a total of 0.52 Bcf/day available for forward contracts.

Scenarios Presented

Set of Scenarios Presented Today

- The scenarios evaluated seeks to be responsive to the set of stakeholder requests we have received to date
- Additional scenarios are still under development that are responsive to stakeholder requests
 - These include scenarios with other key retirements of resources and infrastructure that provide energy security (as requested by stakeholders)
 - We are still assessing requests received recently
- Results are preliminary, and we continue to evaluate results to develop more insight into expected ESI impacts

Scenarios - Summary Results

High Future Case

Summary of Modeled ESI Impacts by Scenario, High Future Case

Scenario Name/Acronym	Prices (\$/MWh)			Customer Payment (\$ Million)		
	Change in DA LMP (ESI - CMR)	Average FER Price	Average Option Price (GCR, RER)	Change in Energy and Ancillary Services (+ FER in ESI) (ESI - CMR)	Energy Options (DA Cost net of RT Settlement)	Change in Total Customer Payments
High Future Case - Central Case						
Central Case	(\$6.49)	\$10.39	\$24.66	\$94	\$49	\$143
High Future Case - August Scenarios						
ESI Products - RER Plus	(\$6.33)	\$10.46	\$24.35	\$101	\$51	\$152
ESI Products - No EIR/RER	(\$7.41)	NA	\$25.46	(\$261)	\$45	(\$217)
Shock HQ 1 Day	(\$6.58)	\$10.39	\$24.66	\$91	\$49	\$140
Shock HQ 5 Days	(\$29.81)	\$10.42	\$27.22	(\$635)	\$75	(\$560)
High Load	(\$13.41)	\$10.47	\$26.73	(\$195)	\$70	(\$126)
DA Load Adjusted for EIR (50%)	(\$5.10)	\$10.74	\$24.47	\$135	\$47	\$182
Oil Retirements; Renewable Replacement	(\$2.43)	\$9.98	\$23.59	\$232	\$36	\$269
Oil Retirements; Gas Replacement	(\$9.75)	\$10.42	\$39.18	\$2	\$195	\$197
Oil Retirements; Gas / Dual Fuel Replacement	(\$2.77)	\$10.42	\$32.17	\$200	\$125	\$325
High LNG Supply	(\$6.30)	\$10.32	\$24.71	\$94	\$49	\$143

Scenarios - Summary Results

Medium Future Case

Summary of Modeled ESI Impacts by Scenario, Medium Future Case

Scenario Name/Acronym	Prices (\$/MWh)			Customer Payment (\$ Million)		
	Change in DA LMP (ESI - CMR)	Average FER Price	Average Option Price (GCR, RER)	Change in Energy and Ancillary Services (+ FER in ESI) (ESI - CMR)	Energy Options (DA Cost net of RT Settlement)	Change in Total Customer Payments
Medium Future Case - Central Case						
Central Case	(\$11.18)	\$6.48	\$14.09	(\$160)	\$31	(\$129)
Medium Future Case - August Scenarios						
ESI Products - RER Plus	(\$10.81)	\$6.50	\$14.27	(\$147)	\$36	(\$111)
ESI Products - No EIR/RER	(\$10.89)	NA	\$14.56	(\$354)	\$27	(\$326)
Shock HQ 1 Day	(\$11.57)	\$6.49	\$14.82	(\$174)	\$39	(\$135)
Shock HQ 5 Days	(\$11.57)	\$6.49	\$14.82	(\$174)	\$39	(\$135)
High Load	(\$28.52)	\$6.51	\$16.82	(\$741)	\$60	(\$681)
DA Load Adjusted for EIR (50%)	(\$9.41)	\$5.90	\$13.76	(\$124)	\$27	(\$97)
Oil Retirements; Renewable Replacement	(\$2.26)	\$6.11	\$13.12	\$119	\$20	\$138
Oil Retirements; Gas Replacement	(\$81.83)	\$6.48	\$30.77	(\$2349)	\$208	(\$2141)
Oil Retirements; Gas / Dual Fuel Replacement	(\$92.01)	\$6.47	\$20.91	(\$2679)	\$105	(\$2574)
High LNG Supply	(\$8.96)	\$6.30	\$13.43	(\$89)	\$23	(\$66)

Scenarios - Summary Results

Low Future Case

Summary of Modeled ESI Impacts by Scenario, Low Future Case

Scenario Name/Acronym	Prices (\$/MWh)			Customer Payment (\$ Million)		
	Change in DA LMP (ESI - CMR)	Average FER Price	Average Option Price (GCR, RER)	Change in Energy and Ancillary Services (+ FER in ESI) (ESI - CMR)	Energy Options (DA Cost net of RT Settlement)	Change in Total Customer Payments
Low Future Case - Central Case						
Central Case	(\$0.11)	\$3.65	\$7.51	\$108	\$35	\$144
Low Future Case - August Scenarios						
ESI Products - RER Plus	(\$0.10)	\$3.65	\$7.48	\$109	\$39	\$148
ESI Products - No EIR/RER	(\$0.14)	NA	\$7.62	(\$5)	\$27	\$23
Shock HQ 1 Day	(\$0.10)	\$3.65	\$7.51	\$109	\$35	\$144
Shock HQ 5 Days	(\$0.15)	\$3.65	\$7.52	\$107	\$35	\$142
High Load	(\$0.31)	\$3.65	\$7.52	\$107	\$35	\$143
DA Load Adjusted for EIR (50%)	(\$0.00)	\$3.22	\$7.51	\$95	\$34	\$130
Oil Retirements; Renewable Replacement	\$0.03	\$3.63	\$7.49	\$112	\$35	\$147
Oil Retirements; Gas Replacement	(\$0.20)	\$3.63	\$7.51	\$105	\$35	\$140
Oil Retirements; Gas / Dual Fuel Replacement	(\$0.16)	\$3.63	\$7.50	\$106	\$35	\$141
High LNG Supply	\$0.02	\$3.65	\$7.50	\$113	\$35	\$148

Scenarios - Customer Payment Impacts

Impacts Vary Across Cases and Scenarios

- Across scenarios in the High and Low cases, payments generally increase
 - In the High Cases, payments increase from \$140 to \$325 million; in two cases – 5 Day Shock and High Load – payments decrease, as the incremental available energy can mitigate LMP increases
 - In the Low Cases, payment increases are relatively uniform, from \$130 to \$148 million
- In the Medium Cases, payments decrease in all but one scenario (oil retirements with renewable replacement); reductions are greatest when oil retirements are replaced with natural gas resources

Total Customer Payments – Shock HQ 5 Days

Low, Medium and High Future Cases

Total Payments by Case (\$ Million)

Product / Payment		High Future Case			Medium Future Case			Low Future Case		
		Payments (\$Million)			Payments (\$Million)			Payments (\$Million)		
		CMR	ESI	Difference	CMR	ESI	Difference	CMR	ESI	Difference
Energy and RT Operating Reserves	[A]	\$5,422	\$4,459	-\$962 (-17.8%)	\$3,307	\$2,931	-\$377 (-11.4%)	\$1,859	\$1,854	-\$5 (-0.3%)
DA Energy Option										
DA Option Payment			\$303			\$176			\$88	
EIR			\$23			\$11			\$6	
RER			\$54			\$35			\$18	
GCR10			\$102			\$57			\$28	
GCR30			\$125			\$73			\$36	
RT Option Settlement			-\$229			(\$137)			(\$53)	
Net DA Ancillary	[B]		\$75			\$39			\$35	
FER Payments	[C]		\$328			\$203			\$112	
Total Payments	[A+B+C]	\$5,422	\$4,862	-\$560 (-10.3%)	\$3,307	\$3,173	-\$135 (-4.1%)	\$1,859	\$2,002	\$142 (7.7%)

Total Customer Payments – High Load

Low, Medium and High Future Cases

Total Payments by Case (\$ Million)

Product / Payment		High Future Case			Medium Future Case			Low Future Case		
		CMR	ESI	Difference	CMR	ESI	Difference	CMR	ESI	Difference
Energy and RT Operating Reserves	[A]	\$5,359	\$4,818	-\$541 (-10.1%)	\$4,407	\$3,452	-\$956 (-21.7%)	\$2,062	\$2,051	-\$11 (-0.5%)
DA Energy Option										
DA Option Payment			\$298			\$197			\$88	
EIR			\$23			\$11			\$6	
RER			\$54			\$35			\$18	
GCR10			\$99			\$66			\$28	
GCR30			\$122			\$85			\$36	
RT Option Settlement			-\$229			(\$137)			(\$53)	
Net DA Ancillary	[B]		\$70			\$60			\$35	
FER Payments	[C]		\$346			\$214			\$118	
Total Payments	[A+B+C]	\$5,359	\$5,233	-\$126 (-2.3%)	\$4,407	\$3,726	-\$681 (-15.5%)	\$2,062	\$2,204	\$143 (6.9%)

Total Customer Payments – ESI Products - No EIR/RER

Low, Medium and High Future Cases

Total Payments by Case (\$ Million)

Product / Payment		High Future Case			Medium Future Case			Low Future Case		
		CMR	ESI	Difference	CMR	ESI	Difference	CMR	ESI	Difference
Energy and RT Operating Reserves	[A]	\$4,476	\$4,214	-\$261 (-5.8%)	\$3,186	\$2,832	-\$354 (-11.1%)	\$1,827	\$1,823	-\$5 (-0.2%)
DA Energy Option										
DA Option Payment			\$199			\$125			\$63	
EIR			NA			NA			NA	
RER			NA			NA			NA	
GCR10			\$89			\$55			\$28	
GCR30			\$110			\$70			\$36	
RT Option Settlement			-\$154			(\$98)			(\$36)	
Net DA Ancillary	[B]		\$45			\$27			\$27	
FER Payments	[C]		NA			NA			NA	
Total Payments	[A+B+C]	\$4,476	\$4,259	-\$217 (-4.8%)	\$3,186	\$2,860	-\$326 (-10.2%)	\$1,827	\$1,850	\$23 (1.2%)

Total Customer Payments – Oil Retirements, Gas/Dual Fuel Replacement

Low, Medium and High Future Cases

Total Payments by Case (\$ Million)

Product / Payment		High Future Case			Medium Future Case			Low Future Case		
		CMR	ESI	Difference	CMR	ESI	Difference	CMR	ESI	Difference
Energy and RT Operating Reserves	[A]	\$5,017	\$4,890	-\$128 (-2.5%)	\$6,400	\$3,518	-\$2,882 (-45.0%)	\$1,758	\$1,753	-\$5 (-0.3%)
DA Energy Option										
DA Option Payment			\$354			\$242			\$88	
EIR			\$23			\$11			\$6	
RER			\$54			\$35			\$18	
GCR10			\$124			\$86			\$27	
GCR30			\$153			\$110			\$36	
RT Option Settlement			-\$229			(\$137)			(\$53)	
Net DA Ancillary	[B]		\$125			\$105			\$35	
FER Payments	[C]		\$328			\$203			\$111	
Total Payments	[A+B+C]	\$5,017	\$5,343	\$325 (6.5%)	\$6,400	\$3,826	-\$2,574 (-40.2%)	\$1,758	\$1,899	\$141 (8.0%)

Scenarios - Prices

Impacts Vary Across Cases and Scenarios

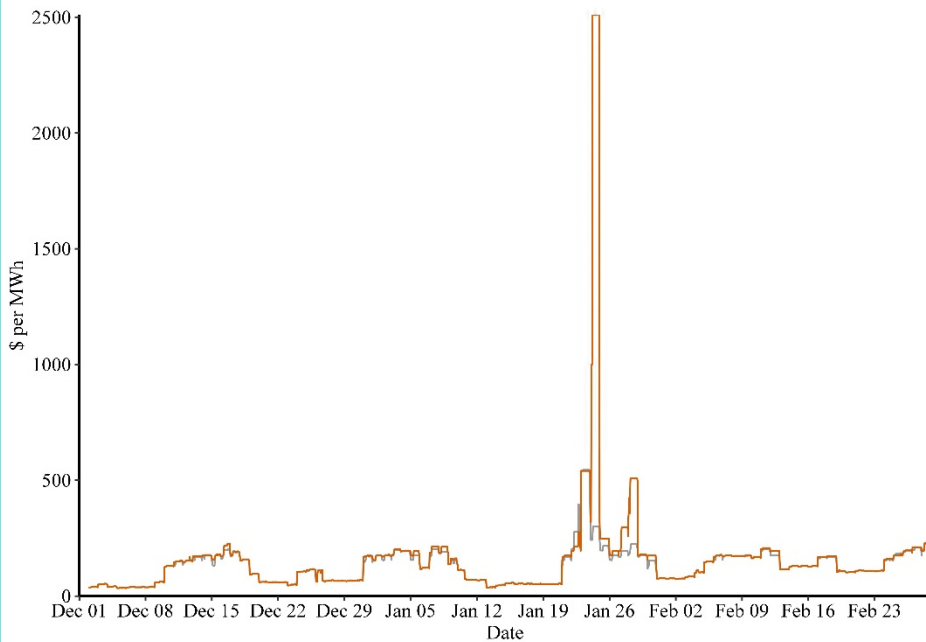
- Variation in DA LMP impacts across scenarios relatively large across Medium and High cases
 - Value of incremental energy inventory (and potential substitutions) depends on market circumstances, particularly given steep supply curve
 - In High Case, DA LMP reduction ranges from \$2.77 to \$29.81 per MWh with ESI
 - In Medium Case, DA LMP reduction ranges from \$2.26 to \$92.01 per MWh with ESI
- Relatively little variation in average FER payment and average DA option price across cases
 - DA energy option offer less steep than energy offer curve – only the risk premium is driven by variation in MC within the fleet
 - Note that differences in DA option prices and FER payments *across* Cases persists **and** that model does not capture the impacts of market structure and conditions on expected RT settlement volatility
 - It would be reasonable to expect higher (lower) FER payments (driven by higher price volatility) for Scenarios with higher (lower) DA LMPs and/or DA LMP impacts

Scenarios - Prices

DA LMPs - Five Day Supply Shock

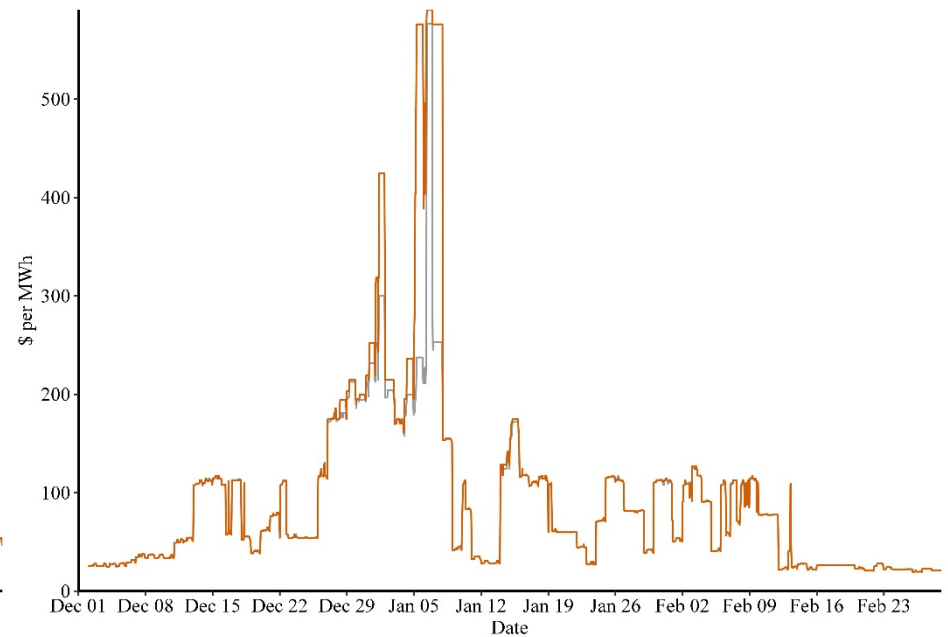
DA LMPs, Supply Shock (5-Day), CMR vs ESI (\$ per MWh)

High Future Case



Data Source: — ESI Solution — CMR Solution

Medium Future Case



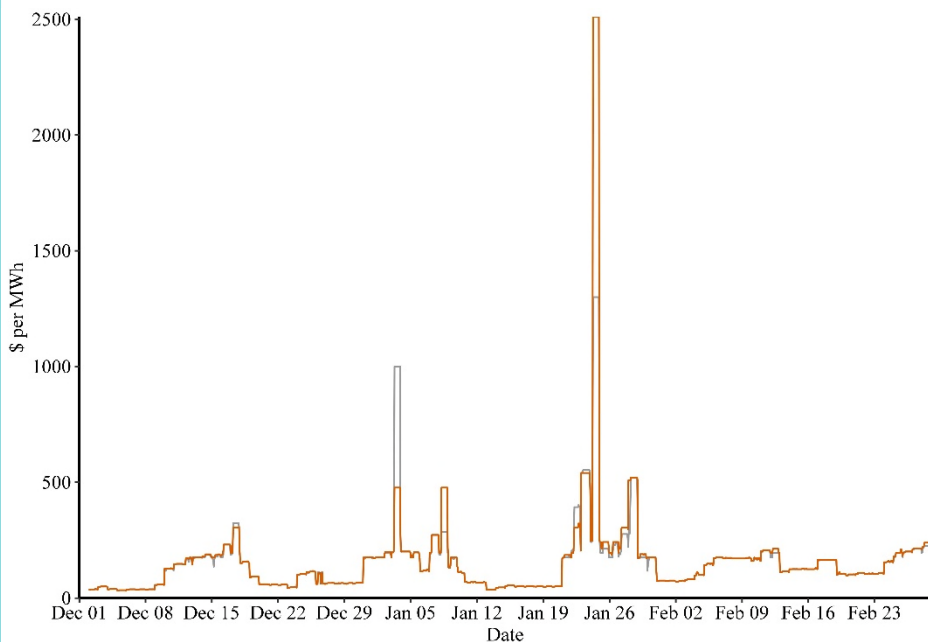
Data Source: — ESI Solution — CMR Solution

Scenarios - Prices

DA LMPs - Oil Retirements, Gas Replacement

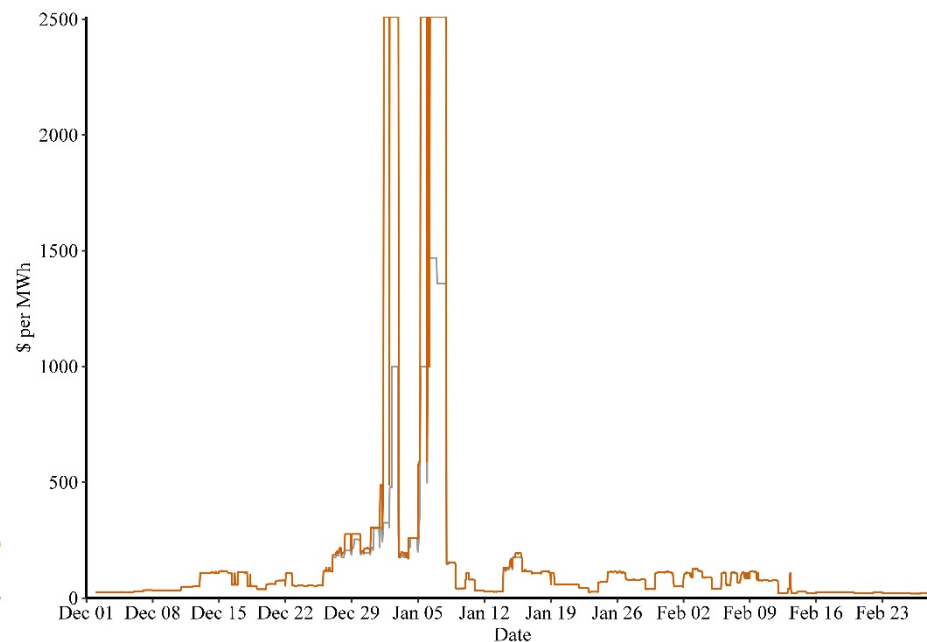
DA LMPs, Oil Retirements (Gas-Only Replacement), CMR vs ESI (\$ per MWh)

High Future Case



Data Source: — ESI Solution — CMR Solution

Medium Future Case



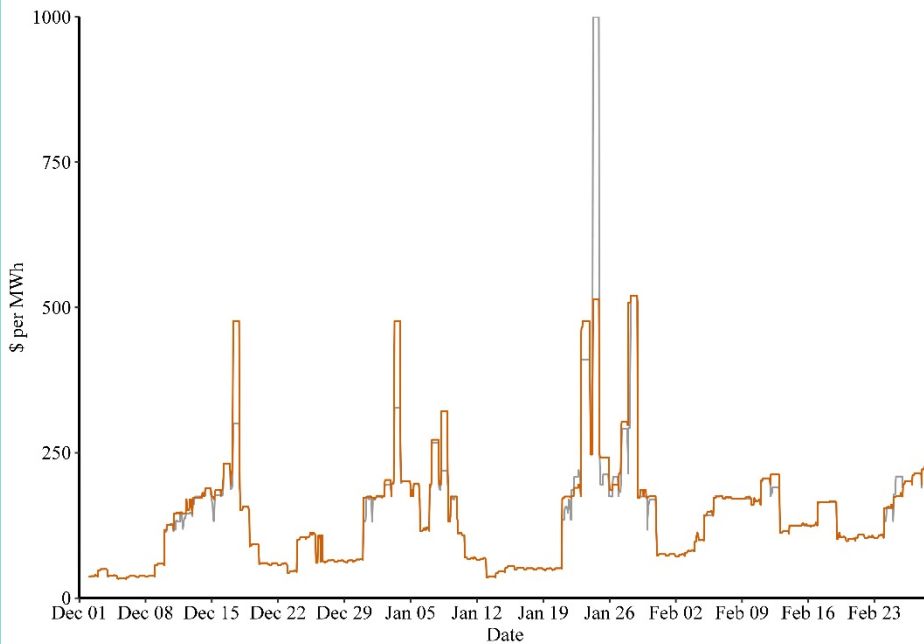
Data Source: — ESI Solution — CMR Solution

Scenarios - Prices

DA LMPs - Oil Retirements, Gas / Dual Fuel Replacement

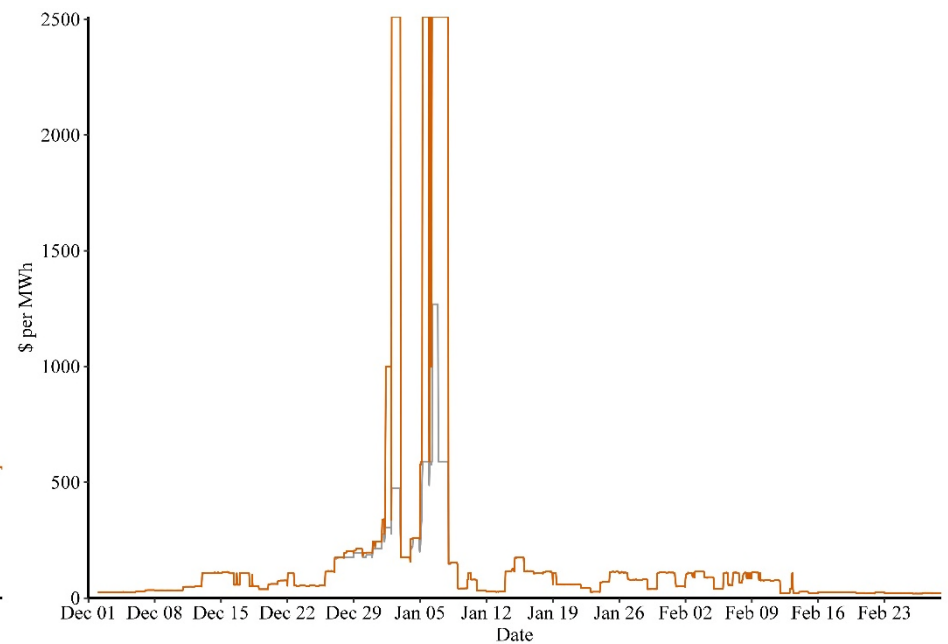
DA LMPs, Oil Retirements (Gas-Only Replacement), CMR vs ESI (\$ per MWh)

High Future Case



Data Source: — ESI Solution — CMR Solution

Medium Future Case



Data Source: — ESI Solution — CMR Solution

Operational / Reliability Metrics

Multiple Metrics to Capture Different Aspects of Energy Security

Change in Reliability Metric with ESI compared to CMR High Future Case

Scenario Name/Acronym	Operating Reserve Shortages (Hours)	NG Physically Binding (Hours)	Uncovered NG Peakers: NG Physically or Economically Binding (Hours)	Natural Gas Used in Generation When NG Economically Binding (MMBtu)	Daily Available Oil Generation Minimum (MWh)
High Future Case - Central Case					
Central Case	0	(34)	(23)	(2,640,320)	29,393
High Future Case - August Scenarios					
ESI Products - RER Plus	0	(29)	(22)	(2,651,986)	30,478
ESI Products - No EIR/RER	0	(35)	(21)	(2,647,391)	30,450
Shock HQ 1 Day	0	(35)	(18)	(2,614,185)	29,592
Shock HQ 5 Days	0	(54)	(50)	(2,855,375)	30,750
High Load	0	(60)	(49)	(2,935,692)	37,789
DA Load Adjusted for EIR (50%)	0	(35)	(28)	(3,031,542)	28,359
Oil Retirements; Renewable Replacement	0	(5)	(2)	(781,595)	9,624
Oil Retirements; Gas Replacement	(11)	(44)	(47)	(2,296,033)	19,010
Oil Retirements; Gas / Dual Fuel Replacement	(15)	(64)	(42)	(3,123,879)	24,251
High LNG Supply	0	(18)	(4)	(5,521,295)	20,971

Operational / Reliability Metrics

Multiple Metrics to Capture Different Aspects of Energy Security

Change in Reliability Metric with ESI compared to CMR Medium Future Case

Scenario Name/Acronym	Operating Reserve Shortages (Hours)	NG Physically Binding (Hours)	Uncovered NG Peakers: NG Physically or Economically Binding (Hours)	Natural Gas Used in Generation When NG Economically Binding (MMBtu)	Daily Available Oil Generation Minimum (MWh)
Medium Future Case - Central Case					
Central Case	0	(4)	(2)	(805,690)	35,413
Medium Future Case - August Scenarios					
ESI Products - RER Plus	0	(6)	(2)	(805,690)	35,413
ESI Products - No EIR/RER	0	(4)	(2)	(805,690)	35,413
Shock HQ 1 Day	0	2	4	(806,483)	34,159
Shock HQ 5 Days	0	2	4	(806,483)	34,159
High Load	0	6	19	(953,917)	34,739
DA Load Adjusted for EIR (50%)	0	(6)	(5)	(854,585)	35,434
Oil Retirements; Renewable Replacement	0	(20)	2	(480,478)	15,474
Oil Retirements; Gas Replacement	0	(36)	(53)	(1,193,094)	19,133
Oil Retirements; Gas / Dual Fuel Replacement	0	6	(29)	(1,184,454)	17,710
High LNG Supply	0	(27)	9	(3,257,563)	34,277

Operational / Reliability Metrics

Multiple Metrics to Capture Different Aspects of Energy Security

Change in Reliability Metric with ESI compared to CMR Low Future Case

Scenario Name/Acronym	Operating Reserve Shortages (Hours)	NG Physically Binding (Hours)	Uncovered NG Peakers: NG Physically or Economically Binding (Hours)	Natural Gas Used in Generation When NG Economically Binding (MMBtu)	Daily Available Oil Generation Minimum (MWh)
Low Future Case - Central Case					
Central Case	0	2	5	0	4,778
Low Future Case - August Scenarios					
ESI Products - RER Plus	0	2	5	0	4,778
ESI Products - No EIR/RER	0	2	5	0	4,778
Shock HQ 1 Day	0	6	8	0	5,202
Shock HQ 5 Days	0	5	7	0	6,700
High Load	0	8	13	0	12,417
DA Load Adjusted for EIR (50%)	0	2	5	0	4,778
Oil Retirements; Renewable Replacement	0	5	7	0	12,077
Oil Retirements; Gas Replacement	0	(8)	2	0	7,209
Oil Retirements; Gas / Dual Fuel Replacement	0	9	15	0	9,074
High LNG Supply	0	(11)	(7)	0	13,078

Next Steps

A Range of Scenarios Will be Evaluated

- September
 - Present further results to MC
 - Draft Report (summarizing presented material)
- October
 - Filing

Appendix

Total Customer Payments – ESI Products - RER Plus

Low, Medium and High Future Cases

Total Payments by Case (\$ Million)

Product / Payment		High Future Case			Medium Future Case			Low Future Case		
		CMR	ESI	Difference	CMR	ESI	Difference	CMR	ESI	Difference
Energy and RT Operating Reserves	[A]	\$4,476	\$4,248	-\$228 (-5.1%)	\$3,186	\$2,835	-\$351 (-11.0%)	\$1,827	\$1,824	-\$3 (-0.2%)
DA Energy Option										
DA Option Payment			\$306			\$188			\$97	
EIR			\$23			\$11			\$6	
RER			\$81			\$52			\$28	
GCR10			\$90			\$55			\$28	
GCR30			\$111			\$70			\$36	
RT Option Settlement			-\$255			(\$152)			(\$59)	
Net DA Ancillary	[B]		\$51			\$36			\$39	
FER Payments	[C]		\$329			\$204			\$112	
Total Payments	[A+B+C]	\$4,476	\$4,628	\$152 (3.4%)	\$3,186	\$3,075	-\$111 (-3.5%)	\$1,827	\$1,975	\$148 (8.1%)

Total Customer Payments – Shock HQ 1 Day

Low, Medium and High Future Cases

Total Payments by Case (\$ Million)

Product / Payment		High Future Case			Medium Future Case			Low Future Case		
		CMR	ESI	Difference	CMR	ESI	Difference	CMR	ESI	Difference
Energy and RT Operating Reserves	[A]	\$4,480	\$4,244	-\$236 (-5.3%)	\$3,307	\$2,931	-\$377 (-11.4%)	\$1,827	\$1,824	-\$3 (-0.2%)
DA Energy Option										
DA Option Payment			\$278			\$176			\$88	
EIR			\$23			\$11			\$6	
RER			\$54			\$35			\$18	
GCR10			\$90			\$57			\$28	
GCR30			\$111			\$73			\$36	
RT Option Settlement			-\$229			(\$137)			(\$53)	
Net DA Ancillary	[B]		\$49			\$39			\$35	
FER Payments	[C]		\$327			\$203			\$112	
Total Payments	[A+B+C]	\$4,480	\$4,620	\$140 (3.1%)	\$3,307	\$3,173	-\$135 (-4.1%)	\$1,827	\$1,971	\$144 (7.9%)

Total Customer Payments – DA Load Adjusted for EIR (50%)

Low, Medium and High Future Cases

Total Payments by Case (\$ Million)

Product / Payment		High Future Case			Medium Future Case			Low Future Case		
		CMR	ESI	Difference	CMR	ESI	Difference	CMR	ESI	Difference
Energy and RT Operating Reserves	[A]	\$4,346	\$4,153	-\$193 (-4.4%)	\$3,019	\$2,714	-\$305 (-10.1%)	\$1,758	\$1,758	\$0 (-0.0%)
DA Energy Option										
DA Option Payment			\$262			\$158			\$84	
EIR			\$9			\$4			\$2	
RER			\$53			\$35			\$18	
GCR10			\$90			\$52			\$27	
GCR30			\$110			\$67			\$36	
RT Option Settlement			-\$215			(\$131)			(\$49)	
Net DA Ancillary	[B]		\$47			\$27			\$34	
FER Payments	[C]		\$328			\$181			\$96	
Total Payments	[A+B+C]	\$4,346	\$4,528	\$182 (4.2%)	\$3,019	\$2,922	-\$97 (-3.2%)	\$1,758	\$1,888	\$130 (7.4%)

Total Customer Payments – Oil Retirements, Renewable Replacement

Low, Medium and High Future Cases

Total Payments by Case (\$ Million)

Product / Payment		High Future Case			Medium Future Case			Low Future Case		
		CMR	ESI	Difference	CMR	ESI	Difference	CMR	ESI	Difference
Energy and RT Operating Reserves	[A]	\$3,466	\$3,385	-\$82 (-2.4%)	\$2,249	\$2,176	-\$73 (-3.2%)	\$1,468	\$1,469	\$1 (0.1%)
DA Energy Option										
DA Option Payment			\$265			\$156			\$88	
EIR			\$21			\$10			\$6	
RER			\$52			\$33			\$18	
GCR10			\$86			\$50			\$27	
GCR30			\$106			\$64			\$36	
RT Option Settlement			-\$229			(\$137)			(\$53)	
Net DA Ancillary	[B]		\$36			\$20			\$35	
FER Payments	[C]		\$314			\$191			\$111	
Total Payments	[A+B+C]	\$3,466	\$3,735	\$269 (7.8%)	\$2,249	\$2,387	\$138 (6.1%)	\$1,468	\$1,616	\$147 (10.0%)

Total Customer Payments – Oil Retirements, Gas Replacement

Low, Medium and High Future Cases

Total Payments by Case (\$ Million)

Product / Payment		High Future Case			Medium Future Case			Low Future Case		
		CMR	ESI	Difference	CMR	ESI	Difference	CMR	ESI	Difference
Energy and RT Operating Reserves	[A]	\$5,696	\$5,371	-\$325 (-5.7%)	\$6,918	\$4,366	-\$2,552 (-36.9%)	\$1,799	\$1,792	-\$7 (-0.4%)
DA Energy Option										
DA Option Payment			\$423			\$345			\$88	
EIR			\$23			\$11			\$6	
RER			\$54			\$35			\$18	
GCR10			\$156			\$135			\$28	
GCR30			\$191			\$164			\$36	
RT Option Settlement			-\$229			(\$137)			(\$53)	
Net DA Ancillary	[B]		\$195			\$208			\$35	
FER Payments	[C]		\$328			\$203			\$111	
Total Payments	[A+B+C]	\$5,696	\$5,893	\$197 (3.5%)	\$6,918	\$4,777	-\$2,141 (-30.9%)	\$1,799	\$1,938	\$140 (7.8%)

Total Customer Payments – High LNG Supply

Low, Medium and High Future Cases

Total Payments by Case (\$ Million)

Product / Payment		High Future Case			Medium Future Case			Low Future Case		
		CMR	ESI	Difference	CMR	ESI	Difference	CMR	ESI	Difference
Energy and RT Operating Reserves	[A]	\$4,298	\$4,067	-\$231 (-5.4%)	\$2,693	\$2,406	-\$286 (-10.6%)	\$1,603	\$1,603	\$0 (0.0%)
DA Energy Option										
DA Option Payment			\$278			\$160			\$88	
EIR			\$23			\$10			\$6	
RER			\$53			\$34			\$18	
GCR10			\$91			\$51			\$27	
GCR30			\$111			\$65			\$36	
RT Option Settlement			-\$229			(\$137)			(\$53)	
Net DA Ancillary	[B]		\$49			\$23			\$35	
FER Payments	[C]		\$325			\$197			\$112	
Total Payments	[A+B+C]	\$4,298	\$4,441	\$143 (3.3%)	\$2,693	\$2,627	-\$66 (-2.4%)	\$1,603	\$1,750	\$148 (9.2%)

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