

# Additional 2013 CARIS 1 Results

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# 2013 CARIS 1 Scenarios

Scenario	Variables
Implementation of Cross-State Air Pollution Rule (CSAPR)	Increases in $NO_x$ and $SO_2$ costs as projected by EPA
Higher Load Forecast	4% higher
Lower Load Forecast	5% lower
Full MainTier RPS and Full EEPS Goals Achievement	Add renewables from Interconnection queue and reduce 2015 coincident peak load to 32147 MW
Athens SPS Out of Service	2013-2022
Higher Natural Gas Prices	One standard deviation
Lower Natural Gas Prices	One standard deviation
Lower CO <sub>2</sub> Emission costs	\$5/ton Ceiling
Higher Natural Gas costs in Midstate	Midstate & New England/ Upstate differential doubled



#### Higher Natural Gas Costs in Midstate: Demand \$ Congestion by Zone

	Projected Changes in Demand \$ Congestion (2013-2022) by Zone (nominal \$M)									
Zone	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
West	7	6	7	7	8	6	7	7	5	6
Genessee	4	3	4	3	4	4	4	4	4	4
Central	5	4	5	4	5	5	6	6	5	4
North	0	0	0	(0)	0	(0)	(0)	(0)	(0)	(0)
Mohawk Valley	2	2	3	2	3	3	3	3	2	2
Capital	47	45	52	49	59	49	51	50	48	52
Hudson Valley	24	24	29	27	34	29	29	27	26	28
Millwood	7	7	8	8	10	8	8	8	8	8
Dunwoodie	14	14	17	16	20	17	17	16	15	16
NY City	125	121	149	144	179	154	152	140	137	142
LongIsland	47	49	59	59	77	70	70	61	60	64
Total-NYCA	284	274	334	320	398	343	345	321	310	327

Note: Individual zone values may not sum to Total-NYCA due to rounding.

## Higher Natural Gas Costs in Midstate: Demand \$ Congestion by Zone



## Higher Natural Gas Costs in Midstate: Demand \$ Congestion by Constraint

	Projected Change in Demand Congestion (2013-2022) by Constraint (nominal \$M)									
Constraints	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
CENTRAL EAST	319	302	355	330	402	334	346	342	327	355
LEEDS PLEASANT VALLEY	(30)	(28)	(27)	(23)	(26)	(18)	(23)	(29)	(24)	(22)
DUNWOODIE SHORE ROAD	(3)	(2)	(2)	(1)	0	3	2	1	0	0
GREENWOOD	(0)	(1)	(1)	(1)	(2)	(1)	(3)	(3)	(4)	(5)
NEW SCOTLAND LEEDS	(16)	(12)	(9)	(5)	(2)	(1)	(4)	(11)	(6)	(17)
MOTTHAVEN RAINEY	0	0	0	0	0	0	0	0	0	0
MOTTHAVEN DUNWOODIE	0	0	0	0	0	0	0	0	0	0
RAINEY VERNON	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
VOLNEY SCRIBA	(5)	(6)	(6)	(7)	(10)	(6)	(4)	(4)	(6)	(7)
HUNTLEY PACKARD	(1)	(1)	(1)	0	(1)	(1)	(0)	(1)	(4)	(6)

## Higher Natural Gas Costs in Midstate: Demand \$ Congestion by Constraint





# **Summary of Scenario Impacts**

		2017 Scenarios: (Change in Demand\$ Congestion from Base Case) (Nominal \$M)							
						Higher	Lower	Capped	Higher Natural
		Higher Load	Lower Load	Full RPS/EEPS	Athens SPS	Natural Gas	Natural Gas	Carbon	Gas Costs in
Constraints	CSAPR	Forecast	Forecast	Achievement	Out of Service	Prices	prices	Prices	Midstate
CENTRAL EAST	(12)	(15)	48	390	(17)	181	(180)	19	402
LEEDS PLEASANT VALLEY	3	17	(28)	(20)	48	15	(21)	11	(26)
DUNWOODIE SHORE ROAD	1	14	(3)	0	(1)	5	(3)	(1)	0
GREENWOOD	(0)	5	(4)	(4)	0	1	(1)	(1)	(2)
NEW SCOTLAND LEEDS	1	1	0	2	(1)	1	5	1	(2)
MOTTHAVEN RAINEY	0	0	0	0	0	0	0	0	0
MOTTHAVEN DUNWOODIE	0	0	0	0	0	0	0	0	0
RAINEY VERNON	0	0	0	0	(0)	0	(0)	(0)	(0)
VOLNEY SCRIBA	3	3	(4)	(9)	1	5	(7)	(0)	(10)
HUNTLEY PACKARD	5	1	1	1	1	(1)	7	3	(1)
Central East – New Scotland – Pleasant Valley	(7)	3	20	372	31	198	(195)	31	374
Central East	(12)	(15)	48	390	(17)	181	(180)	19	402
New Scotland-Pleasant Valley	4	18	(28)	(19)	48	16	(15)	12	(28)



# **Summary of Scenario Impacts**

		202	22 Scenarios:	(Change in Den	nand\$ Congestion	on from Base C	Case) (Nomina	al \$M)	
						Higher	Lower	Capped	Higher Natural
		Higher Load	Lower Load	Full RPS/EEPS	Athens SPS	Natural Gas	Natural Gas	Carbon	Gas Costs in
Constraints	CSAPR	Forecast	Forecast	Achievement	Out of Service	Prices	prices	Prices	Midstate
CENTRAL EAST	(1)	11	19	238	(42)	46	(196)	81	355
LEEDS PLEASANT VALLEY	(8)	22	(39)	(25)	84	12	(30)	13	(22)
DUNWOODIE SHORE ROAD	(1)	67	(13)	(10)	(2)	6	(11)	(1)	0
GREENWOOD	(1)	8	(12)	(12)	1	5	(5)	2	(5)
NEW SCOTLAND LEEDS	0	(2)	(2)	(2)	(7)	(5)	2	(4)	(17)
MOTTHAVEN RAINEY	0	0	0	0	0	0	0	0	0
MOTTHAVEN DUNWOODIE	0	0	0	0	0	0	0	0	0
RAINEY VERNON	(0)	0	(0)	(0)	0	0	(0)	0	(0)
VOLNEY SCRIBA	(0)	(0)	(3)	(9)	1	4	(16)	(4)	(7)
HUNTLEY PACKARD	0	(3)	(3)	(9)	1	(16)	9	(17)	(6)
Central East – New Scotland – Pleasant Valley	(9)	32	(22)	211	35	52	(224)	90	315
Central East	(1)	11	19	238	(42)	46	(196)	81	355



# **Final Benchmarking Case**

- Corrected manner in which controllable tie lines model utilized dispatch hurdle rate for both commitment and dispatch
- Adjusted model for improved tuning
  - Limited IMO-MISO loop-flow to historic limits scheduled in SCUC (+150/-350)
- Above issues surfaced in analysis of model results for study period

# Comparison of Preliminary and Final Benchmark Case (2011)



# Comparison of Preliminary and Final Benchmark Case (2011)





## **Transmission Solutions**

- Transmission Solutions
  - Study # 1: Central East New Scotland Pleasant Valley
    - Edic New Scotland Pleasant Valley
  - Study #2: Central East
    - Edic New Scotland
  - Study #3: New Scotland Pleasant Valley
    - New Scotland-Pleasant Valley



## **Transmission Solutions**

#### Description and Transfer Limit Impact

Line Name	Voltage	Conductor Size	Length in Miles	CE Voltage	UPNY/SENY Thermal Limit (NTC)
Edic - New Scotland- Pleasant Valley	345kV	2 - 1590 ACSR	150	625	1200
Edic - New Scotland	345kV	2 - 1590 ACSR	85	550	-100
New Scotland - Pleasant Valley	345kV	2 - 1590 ACSR	65	75	1200

#### Cost Data

#### 2011 Generic cost data reviewed and confirmed by National Grid

Cost Range	Line System Voltage (kV)	Construction Type	Transmission Cost (\$M/Mile)	Line Terminal Addition per Substation (\$M)	System Upgrade Facilities(\$M)
High	345	Overhead	\$7.30	\$9	\$9
Mid	345	Overhead	\$5	\$6	\$6
Low	345	Overhead	\$2	\$3	\$3



## **Generation Solutions**

- Combined-Cycle Unit
  - 1 x 1 x 1 SGT6-5000F(5)
    - 1x1x1 refers to one combustion turbine exhausting into one heat recovery steam generator supplying steam to one steam turbine generator.
  - 330 MW

## Operating characteristics and cost data presented in 2013 Demand Curve Reset report<sup>1</sup>

<sup>1</sup>Independent Study to Establish Parameters of the ICAP Demand Curve for the New York Independent System Operator, August 2, 2013, NERA



# **Generation Solutions**

#### Description

Line Name	Size	Location
Edic - New Scotland- Pleasant Valley	4 - 330 MW	Pleasant Valley
Edic - New Scotland	2 - 330 MW	New Scotland
New Scotland - Pleasant Valley	4 - 330 MW	Pleasant Valley

#### Cost Data

Generation Solution	Cost Range	\$/KW
New Scotland (Capital)	High	\$1,732
	Mid	\$1,413
	Low	\$1,094
Pleasant Valley (Hudson Valley/Dutchess County)	High	\$1,912
	Mid	\$1,560
	Low	\$1,208

#### High/low cost estimates derived from 2011 CARIS ranges



### Energy Efficiency / Demand Response Solutions

- Energy Efficiency (EE)
  - Followed procedure for siting EE solutions in load zones with goal of 50% reduction in demand congestion
  - Adjusted load shapes to reflect EE implementation
- Demand Response (DR)
  - DR solutions match EE solutions (MWs, zones)
  - Peak 100 hours reduced to reflect DR implementation



### Energy Efficiency/ Demand Response Solutions

Study Case	Load Zone	EE-MW
Central East-New Scotland-Pleasant Valley	F	200
	G	200
	Н	0
	I	0
	J	1000
	К	400
Central East	F	200
	G	200
	Н	0
	I	0
	J	1000
	К	400
New Scotland - Pleasant Valley	G	200
	Н	0
	I	0
	J	1000
	К	400



# **Energy Efficiency Solutions**

- Generic cost estimates derived from EEPS budget (October 2011) on a zonal basis.
- High/low based on approximately +/- 25%

	Energy Efficiency Implementation Costs (\$M/100 MW) by Zone							
Range	F	G	J	К				
Low	\$90	\$130	\$240	\$130				
Mid	\$120	\$170	\$320	\$180				
High	\$150	\$210	\$400	\$230				



# **Demand Response Solutions**

- Generic cost estimates derived from KEMA study of Advanced Metering costs
- Mid-level costs calculated as average of low and high cost estimates
- No zonal differentiation

DR Costs: \$M per 100 MW	Total
Low	\$16.6
Medium	\$23.2
High	\$32.8



## Cost Summary (across all solution types)

	Generic Solution	n Cost Summary (\$M)			
Studies	Study 1: Central East-New Scotland-Pleasant Valley	Study 2: Central East	Study 3: New Scotland - Pleasant Valley		
	Tran	smission			
5. C	Edic to New Scotland to		New Scotland to Pleasant		
Substation Terminals	Pleasant Valley	Edic to New Scotland	Valley		
Miles (# of terminals)	150 (3)	85 (2)	65(2)		
High	1,131	648	502		
Mid	774	443	343		
Low	312	179	139		
	Ger	neration			
Substation Terminal	Pleasant Valley	New Scotland	PleasantValley		
# of 330 Blocks	4	2	4		
High	2,524	2,286	2,524		
Mid	2,059	1,865	2,059		
Low	1,595	1,444	1,595		
		DR			
Zone	F , G, J, and K	F , G, J, and K	G, J, and K		
# of 200 MW Blocks	9	9	8		
High	590	590	525		
Mid	418	418	371		
Low	299	299	266		
		EE			
Zone	F , G, J, and K	F , G, J, and K	G, J, and K		
# of 200 MW Blocks	9	9	8		
High	5,640	5,640	5,340		
Mid	4,500	4,500	4,260		
Low	3,360	3,360	3,180		



## **Congestion Relief Comparability**





## **Congestion Relief Comparability**





## **Congestion Relief Comparability**





## Production Cost Savings Comparability









## Transfer Limit Comparable MW





### Production Cost Savings (2013-2022, \$2013M)<sup>1</sup>

	Ten-Year Production Cost Savings (\$M)						
Study	Transmission	Generation	Demand Response	Energy Efficiency			
	Solution	Solution	Solution	Solution			
Study 1: Central East-New Scotland-Pleasant Valley	217	231	29	3,315			
Study 2: Central East	116	57	29	3,315			
Study 3: New Scotland-Pleasant Valley	72	231	25	2,918			

<sup>1</sup> Energy Efficiency and Demand Response impacts include Production Cost Savings due to load reductions.



# Additional Metrics (2013-2022, \$2013M)<sup>1</sup>

	3		IMPORT PAYMENT	GENERATOR + IMPORT PAYMENT			
	TRANSMISSION SOL	UTIONS					
Study 1: CE-NS-PV	1: CE-NS-PV Edic-New Scotland-Pleasant Valley \$1,251 \$15						
Study 2: CE	Edic-New Scotland	\$608	\$136	\$744			
Study 3: NS-PV	New Scotland-Pleasant Valley	\$291	\$25	\$316			
	GENERATION SOLU	TIONS					
Study 1: CE-NS-PV	Pleasant Valley	\$407	(\$402)	\$5			
Study 2: CE	New Scotland	(\$214)	(\$153)	(\$367)			
Study 3: NS-PV	Pleasant Valley	\$407	(\$402)	\$5			
	DEMAND RESPONSE S	OLUTIONS					
Study 1: CE-NS-PV	F (200), G(200), J(1,000), K(400)	(\$92)	(\$48)	(\$140)			
Study 2: CE	F (200), G(200), J(1,000), K(400)	(\$92)	(\$48)	(\$140)			
Study 3: NS-PV	G(200), J(1,000), K(400)	(\$90)	(\$50)	(\$140)			
	ENERGY EFFICIENCY S	OLUTIONS					
Study 1: CE-NS-PV	F (200), G(200), J(1,000), K(400)	(\$2,749)	(\$787)	(\$3,536)			
Study 2: CE	F (200), G(200), J(1,000), K(400)	(\$2,749)	(\$787)	(\$3,536)			
Study 3: NS-PV	G(200), J(1,000), K(400)	(\$2,399)	(\$799)	(\$3,198)			

<sup>1</sup> Energy Efficiency and Demand Response impacts include Payments reduced due to load reductions.



# Additional Metrics (2013-2022, \$2013M)<sup>1</sup>

			EXPORT PAYMENT	LOAD + EXPORT PAYMENT	
	TRANSMISSION SOL	JTIONS			
Study 1: CE-NS-PV	Edic-New Scotland-Pleasant Valley	\$93	\$134	\$227	
Study 2: CE	Edic-New Scotland	\$75	\$194	\$269	
Study 3: NS-PV	New Scotland-Pleasant Valley	\$14	(\$52)	(\$38)	
	GENERATION SOLU	TIONS			
Study 1: CE-NS-PV	Pleasant Valley	(\$1,023)	\$750	(\$273)	
Study 2: CE	New Scotland	(\$406)	\$324	(\$81)	
Study 3: NS-PV	Pleasant Valley	(\$1,023)	\$750	(\$273)	
	DEMAND RESPONSE SO	OLUTIONS			
Study 1: CE-NS-PV	F (200), G(200), J(1,000), K(400)	(\$208)	\$43	(\$166)	
Study 2: CE	F (200), G(200), J(1,000), K(400)	(\$208)	\$43	(\$166)	
Study 3: NS-PV	G(200), J(1,000), K(400)	(\$196)	\$40	(\$155)	
	ENERGY EFFICIENCY SO	LUTIONS			
Study 1: CE-NS-PV	F (200), G(200), J(1,000), K(400)	(\$4,576)	\$588	(\$3,988)	
Study 2: CE	F (200), G(200), J(1,000), K(400)	(\$4,576)	\$588	(\$3,988)	
Study 3: NS-PV	G(200), J(1,000), K(400)	(\$4,106)	\$414	(\$3,692)	

<sup>1</sup> Energy Efficiency and Demand Response impacts include Payments reduced due to load reductions.



# Additional Metrics (2013-2022, \$2013M)<sup>1</sup>

		SO2			CO2			NOx		
Study	Generic Solutions	Tons	% Change	Cost (\$M)	1000 Tons	% Change	Cost (\$M)	Tons	% Change	Cost (\$M)
Transmission										
Study 1: CE-NS-PV	Edic-New Scotland-Pleasant Valley	8,485	7.0%	\$5.4	-404	-0.1%	\$1.9	1,460	0.7%	\$0.1
Study 2: CE	Edic-New Scotland	5,245	4.3%	\$3.6	734	0.2%	\$5.3	2,211	1.1%	\$0.1
Study 3: NS-PV	New Scotland-Pleasant Valley	1,158	1.0%	\$0.9	-1,575	-0.5%	-\$6.8	-1,333	-0.6%	-\$0.1
	Generation									
Study 1: CE-NS-PV	Pleasant Valley	-6,445	-5.3%	-\$3.6	9,463	2.8%	\$68.4	-6,558	-3.1%	-\$0.4
Study 2: CE	New Scotland	-3,895	-3.2%	-\$2.2	4,223	1.3%	\$27.9	-2,198	-1.1%	-\$0.2
Study 3: NS-PV	Pleasant Valley	-6,445	-5.3%	-\$3.6	9,463	2.8%	\$68.4	-6,558	-3.1%	-\$0.4
	Demand Response									
Study 1: CE-NS-PV	F (200), G (200), J (1000), K (400)	-622	-0.5%	-\$0.5	644	0.2%	\$3.6	-61	0.0%	\$0.0
Study 2: CE	F (200), G (200), J (1000), K (400)	-622	-0.5%	-\$0.5	644	0.2%	\$3.6	-61	0.0%	\$0.0
Study 3: NS-PV	G (200),J (1000), K (400)	-289	-0.2%	-\$0.2	738	0.2%	\$4.3	36	0.0%	\$0.0
	Energy Efficiency									
Study 1: CE-NS-PV	F (200), G (200), J (1000), K (400)	-8,191	-6.8%	-\$5.2	-23,674	-7.1%	-\$131.4	-10,535	-5.0%	-\$0.7
Study 2: CE	F (200), G (200), J (1000), K (400)	-8,191	-6.8%	-\$5.2	-23,674	-7.1%	-\$131.4	-10,535	-5.0%	-\$0.7
Study 3: NS-PV	G (200),J (1000), K (400)	-6,228	-5.1%	-\$3.9	-20,395	-6.1%	-\$112.4	-8,931	-4.3%	-\$0.6

#### <sup>1</sup> Energy Efficiency and Demand Response impacts include Emissions reduced due to load reductions.



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