ISO new england

Executive Summary Preliminary Results for 2012 Economic Study Request Specific Scenario Phase

Analysis Based on Synapse Requested Scenarios

Wayne Coste

PROJECT MANAGER, ECONOMIC PLANNING

Presentation Overview

- Overview
- Framework for evaluation process
 - Review of 2012 Economic Study requests
 - Review overall request framework
- First Phase of 2012 Economic Study
 - Identification of most resilient areas for load changes
 - Changes to the system
- Second Phase: Development of scenarios for 2012 Economic Study
 - Retire oil, coal and natural gas steam units
 - Investigate doubling of energy efficiency growth rates
 - Investigate photovoltaics and combined heat and power / geothermal

2012 Economic Study Scope of Work Three Phases

- Economic study requests provide a forum for stakeholder discussions of alternative future system scenarios
 - Results include production costs, load serving entity expenses, congestion, environmental emissions, and other metrics
 - Show potential effects of alternative resource mixes and relieving transmission constraints
- Three phases
 - First Phase: An incremental / decremental analysis
 - Develop representative load shapes to mimic resource types
 - Illustrates the best locations for resource retirements and additions
 - Second Phase: Limited number of scenarios after discussing the First Phase results
 - Third Phase: Determine capital investment supported by simulated energy revenues

Framework for Analysis

- Build off of the 2011 Economic Study
 - Evaluate New England system 2012 2021
- Replace coal and heavy oil generation as well as natural gas steam generation older than 40 years in 2021 (e.g. older than 30 years in 2011)
- Replacement supply resources considered
 - Energy Efficiency and Active Demand Resources
 - Wind generation
 - Photovoltaics
 - Combined Heat and Power and Geothermal (CHP/G)
 - New generating resources
 - Combined-cycle resources
 - Combustion turbine resources

First Phase

Evaluations Using Load Increments / Decrements

- Sensitivity analyses that quantifies changes in evaluation metrics
 - Load decreases or increases change evaluation metrics:
 - LSE Energy Expense (\$ Million)
 - Production Cost (\$ Million)
 - FTR / ARR Congestion (\$ Million)
 - Environmental emissions (Tons per year)
 - Metrics can be quantified and compared

Load / Resource Additions or Removals Effectiveness Based on Production Cost

				"BASE	" MW A	dded an	d Impact	ction Cost Compared to Unconstrained (\$Million)											
		<= Resource Removals								Resource Additions=>									
			1	<= Loa	d Increa	ses			Load	d Decreases =>									
Sub Area	Most Constraining Interface	-2700	-2100	-1500	-1200	-900	-600	-300	30	0	600	900	1200	1500	2100	2700			
BHE	Orrington South	2	1	1	1	1	1	1	2		4	15	43	143	372	595			
ME	Surowiec South	2	1	1	1	2	1	1	2		3	9	24	73	276	499			
SME	Maine-New Hampshire	2	1	1	1	2	1	1	2		3	3	7	14	65	229			
NH	North/South	2	2	1	1	2	1	1	1		2	2	3	6	18	52			
VT	North/South	2	2	1	1	2	1	1	1		1	2	3	5	14	39			
WMA	N/A	3	2	2	1	2	4	4	1		4	1	1	1	1	1			
CMAN	N/A	3	2	2		ange د	e ot "	bette	r" places			1	1	1	1	1			
BOST	Boston Import	143	24	3		101 ad	ditio	n / re	7 10 mov	aŭ Val		1	1	1	1	1			
SEMA	SEMA/RI	3	2	2	1						I	1	1	1	4	9			
RI	SEMA/RI	3	2	2	1	2	1	1	1		1	1	1	1	4	9			
СТ	N/A	2	2	2	1	2	1	1	1		1	1	1	1	1	1			
SWCT	SWCT Import	104	4	2	1	2	1	1	1		1	1	1	1	1	1			
NOR	Norwalk Import	7828	4675	1549	441	71	5	1	1		1	1	1	1	1	1			
ort Limited >	> \$100 Million	port Limited > \$10 Million				Unconst	rained <	10 \$Millio	on	Bottled-in > \$10 Million						Bottled-in >			

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Load / Resource Additions or Removals Effectiveness Based on LSE Energy Expense

	"BASE" MW Added and Impacts LSE Enery Expense Compared to Unconstrained (\$Million)																
	<= Resource Removals								Resource Additions=>								
			<= Loa	d Increa	Ses			_	Loa	d Decreases =>							
Most Constraining Interface	-2700	-2100	-1500	-1200	-900	-600	-300	300	600	900	1200	1500	2100	2700			
Orrington South	4	1	1	0	2	0	0	8	70	181	229	282	493	662			
Surowiec South	4	1	1	0	2	0	0	8	63	127	171	122	154	323			
Maine-New Hampshire	4	1	1	0	2	0	0	9	63	103	127	180	178	29			
North/South	6	1	-1	-1	4	-1	0	1	19	45	56	74	146	91			
North/South	6	1	-1	-1	4	-1	0	1	12	33	40	49	119	75			
North/South	12	5	-1	0	5	1			0	-1	-1	-1	-1	-1			
North/South	13	7	1		Range	e of "	bette	er″ pla	aces	-1	-1	-1	-1	-1			
Boston Import	828	56	0	2	ioi ad	resc ditio	n / re	/ IOa	a d	-1	-1	-1	-1	-1			
SEMA/RI	12	6	-1	2	2 1					-1	0	5	51	120			
SEMA/RI	9	5	-1	0	5	-1	0	0	0	-1	0	5	51	120			
N/A	12	4	-1	1	5	-1	0	0	0	-1	-1	-1	-1	-1			
SWCT Import	477	1	-1	1	5	-1	0	0	0	-1	-1	-1	-1	-1			
Norwalk Import	572	1518	2149	1265	317	6	0	0	0	-1	-1	-1	-1	-1			
	Most Constraining Interface Orrington South Surowiec South Maine-New Hampshire North/South North/South North/South North/South Boston Import SEMA/RI SEMA/RI SEMA/RI SWCT Import Norwalk Import	Most Constraining Interface-2700Orrington South4Surowiec South4Maine-New Hampshire4Morth/South6North/South6North/South12North/South13Boston Import828SEMA/RI12SWCT Import477Norwalk Import572	Most Constraining Interface-2700-2100Orrington South41Surowiec South41Maine-New Hampshire41North/South61North/South61North/South125North/South137Boston Import82856SEMA/RI126SWCT Import4771Norwalk Import5721518	Base Base Most Constraining Interface -2700 -2100 -1500 Orrington South 4 1 1 Surowiec South 4 1 1 Maine-New Hampshire 4 1 1 North/South 6 1 -1 North/South 6 1 -1 North/South 12 5 -1 North/South 13 7 1 Boston Import 828 56 0 SEMA/RI 9 5 -1 N/A 12 4 -1 SWCT Import 4777 1 -1 Norwalk Import 572 1518 2149	Most Constraining Interface -2700 -2100 -1500 -1200 Orrington South 4 1 1 0 Surowiec South 4 1 1 0 Maine-New Hampshire 4 1 1 0 North/South 6 1 -1 1 North/South 6 1 -1 1 North/South 12 5 -1 0 North/South 13 7 1 1 Boston Import 828 56 0 2 SEMA/RI 9 5 -1 0 N/A 12 4 -1 1 SWCT Import 477 1 1 1	Most Constraining Interface -2700 -2100 -1500 -1200 -900 Orrington South 4 1 1 0 2 Surowiec South 4 1 1 0 2 Maine-New Hampshire 4 1 1 0 2 North/South 6 1 -1 4 North/South 66 1 -1 4 North/South 66 1 -1 4 North/South 12 5 -1 0 5 North/South 13 7 1 1 -1 Boston Import 828 56 0 2 -3 SEMA/RI 9 5 -1 0 5 N/A 12 4 -1 1 5 SEMA/RI 9 5 -1 0 5 N/A 12 4 -1 1 5 SWCT Import 47	BASE" MW Added and Impact BASE" MW Added and Impact Service Removals Most Constraining Interface -2700 -2100 -1200 -900 -600 Orrington South 4 1 1 0 2 0 Surowiec South 4 1 1 0 2 0 Maine-New Hampshire 4 1 1 0 2 0 North/South 6 1 -1 4 -1 North/South 6 1 -1 4 -1 North/South 12 5 -1 0 5 -4 North/South 13 7 1 -1 4 -1 Boston Import 828 56 0 2 -1 6 -1 2 -1 SEMA/RI 9 5 -1 0 5 -1 N/A 12 4 -1 1 5 -1 SWCT	BASE" MW Added and Impacts LSE E Wost Constraining Interface -2700 -2100 -1500 -1200 -900 -600 -300 Orrington South 4 1 1 0 2 0 0 Surowiec South 4 1 1 0 2 0 0 Maine-New Hampshire 4 1 1 0 2 0 0 North/South 6 1 -1 4 -1 0 2 0 0 North/South 6 1 -1 4 -1 0 0 North/South 12 5 -1 0 5 -1 0 North/South 12 5 -1 0 5 -1 0 Sesson Import 828 56 0 2 3 -1 0 SEMA/RI 9 5 -1 0 5 -1 0 V/A 12	Most Constraining Interface -2700 -2100 -1500 -1200 -900 -600 -300 300 Orrington South 4 1 1 0 2 0 0 8 Surowiec South 4 1 1 0 2 0 0 8 Maine-New Hampshire 4 1 1 0 2 0 0 9 North/South 6 1 -11 4 -11 0 1 North/South 66 1 -11 44 -11 0 1 North/South 12 5 -11 0 5 -1 0 1 North/South 12 5 -1 0 5 -1 0 0 Semantification 12 5 -1 0 5 -1 0 0 Semantification 12 6 -1 2 -1 0 0	Most Constraining Interface -2700 -2100 -1200 -900 -600 -300 300 600 Orrington South 4 1 1 0 2 0 0 4 88 70 Surowiec South 44 1 1 0 2 0 0 4 88 63 Maine-New Hampshire 44 1 1 0 2 0 0 4 88 63 North/South 6 1 -1 44 -1 0 2 0 0 4 19 North/South 6 1 -1 44 -1 0 1 12 North/South 6 1 -1 -1 4 -1 0 1 12 Boston Import 828 56 0 2 -1 0 0 0 0 SEMA/RI 12 6 -1 2 -1 0	"BASE" MW Added and Impacts LSE Ency Expense Compared <= Resource Removals Resource Add Most Constraining -2700 -2100 -1500 -1200 -900 -600 -300 300 600 900 Orrington South 4 11 10 2 0 0 8 63 127 Maine-New Hampshire 44 11 1 0 2 0 0 8 63 127 Maine-New Hampshire 44 11 1 0 2 0 0 8 63 103 North/South 6 1 -1 4 -1 0 9 63 103 North/South 6 1 -1 4 -1 0 1 12 33 North/South 12 5 -1 0 2 0 0 0 1 Boston Import 828 56 0 2 -1 0	"BASE" MV Added and impacts LSE Energy Expense Compared to Uncompared to Uncomp	"BASE" MW Added and Impacts LSE Envery Expense Compared to Unconstraine	North/South 1			

Note: Unlike the Adjusted Production Cost metric, the LSE Energy Expense metric may not be monotonic. The shape of the curve depends on the relative size of the import constrained area to the entire New England area and the relative effect on prices in the unconstrained area.

Second Phase

- Developed in discussions with Synapse Energy Economics
 - Primary advocate for this phase of the project
 - Requested that specific renewable technologies be evaluated
- Focused on growth in resources complying with Renewable Portfolio Standards (RPS)
 - Existing RPS resources
 - Inventory of existing RPS resources not available
 - Focused on growth of RPS after 2011
 - Based on 2012 Regional System Plan information
 - Assume
 - Existing RPS resources is sufficient to cover existing RPS requirements
 - Flexibility assumed so that
 - State level requirements
 - Can be summed to estimate an aggregate New England requirement

Second Phase Resource Expansion Plan

- Resource retirement assumptions
 - Retired resources partially replaced by:
 - Wind
 - Solar PV
 - Combined Heat and Power / Geothermal
 - Created expansion case assuming a 15 percent reserve margin
 - Retired resources replaced with Natural Gas technologies
 - Added 1000 MW of single cycle gas turbine with heat rate of 8600 Btu/kWh
 - Advanced Combined Cycle (ACC) with a heat rate of 6000 Btu/kWh
 - Assume capacity values based on:
 - Full "nameplate" credit for
 - New combined cycle and new simple cycle natural gas technology units
 - Steam / CHP / Geothermal units
 - 39.4% for solar photovoltaic (based on reliability hour calculation)
 - 27.6% for composite wind (based on reliability hour calculation)

Gross Annual Energy Forecast and Net Energy after Passive Demand Resources



Scenarios to be Analyzed

• Four cases to be analyzed

Case 1) Base Energy Efficiency with no additional renewables Case 2) Base Energy Efficiency with:

- 3000 MW of Photovoltaics
- 340 MW of Combined Heat and Power / Geothermal

Case 3) Double Energy Efficiency Growth with no additional renewables Case 4) Double Energy Efficiency Growth with

- 3000 MW of Photovoltaics
- 340 MW of Combined Heat and Power / Geothermal

Metrics and Sensitivities

- Metrics
 - Economic (Production Cost, LSE Energy Expense)

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- Fuel consumption/energy by fuel type
- Environmental

Economic Metric Load Serving Entity Energy Expense (Million 2008\$)



Economic Metric Production Cost (Million 2008\$)



Fuel Consumption Metric Case 1: Base EE No PV or CHP/G



Fuel Consumption Metric Case 2: Base EE with PV and CHP/G



Fuel Consumption Metric Case 3: Double EE Growth No PV or CHP/G



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Fuel Consumption Metric Case 4: Double EE Growth with PV and CHP/G



Environmental Emissions Metric Annual CO2 Emissions



Environmental Emissions Metric Annual NOx Emissions



Environmental Emissions Metric Annual SO2 Emissions



Questions





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