

Synapse
Energy Economics, Inc.

Highlights of 2009 AESC Report

Briefing to Vermont Public Service Board
November 3, 2009

AGENDA

- Introduction and General Approach
- Avoided Costs of Electricity (Capacity, Energy, RPS compliance; Demand Reduction Induced Price effect, CO₂ Externalities)
- Avoided Costs of Natural Gas (production; transmission, storage and peaking; distribution)
- Avoided Costs of other fuels

Avoided Cost of Electricity - Components

Avoided energy = (wholesale electric energy price + REC cost (except VT)) adjusted for wholesale risk premium. This is the largest component. Annual values about 5% lower than AESC 2007 due to lower load and more renewable generation

Avoided capacity = revenue from sale into Forward Capacity Market (FCM) OR value of reducing quantity of capacity bought from FCM. Values are about 70% lower than AESC 2007 due to better understand of FCM operation, lower load and capacity from renewable resources

Energy DRIPE = impact of kWh reductions on energy market prices. Values are approximately double AESC 2007, primarily due to longer dissipation, i.e. longer time for market to respond.

Capacity DRIPE = Impact of kW reductions on FCM prices. Values are slightly lower than AESC 2007.

Avoided CO₂ environmental externalities = cost of controlling CO₂ that is not reflected in wholesale energy market prices. Values are approximately 10% lower than AESC 2007 due to more efficient generating units on the margin.

Avoided local T&D infrastructure. These costs are calculated by Program Administrators

Background

AESC 2009 Results (cents/kwh) – Boston zone

Summer 2009 prices for retail electricity supply to residential customers in Northeast Massachusetts zone (NEMA) range from 9.2 cents/kwh to 9.7 cents/kwh (\$2009\$)

Component	AESC 2007 (cents/kWh)	AESC 2009 (cents/kWh)	Difference relative to AESC 2007	
			(cents/kWh)	%
Avoided Energy Costs	10.5	9.6	-0.9	-9%
Avoided Capacity Costs ^a	2.3	0.4	-1.9	-84%
DRIPE				
Energy ^b	1.7	4.3	2.6	156%
Capacity ^c	0.4	0.3	0.2	-39%
CO ₂ Externality	3.2	2.9	-0.3	-10%
TOTAL	18.1	17.5	-0.7	-4%
a) Avoiding costs from purchasing from the Forward Capacity Market b) Values are for total DRIPE (Intrastate and Rest of Pool) c) Assuming a 55% load factor.				

AVOIDED ELECTRICITY COSTS - Energy

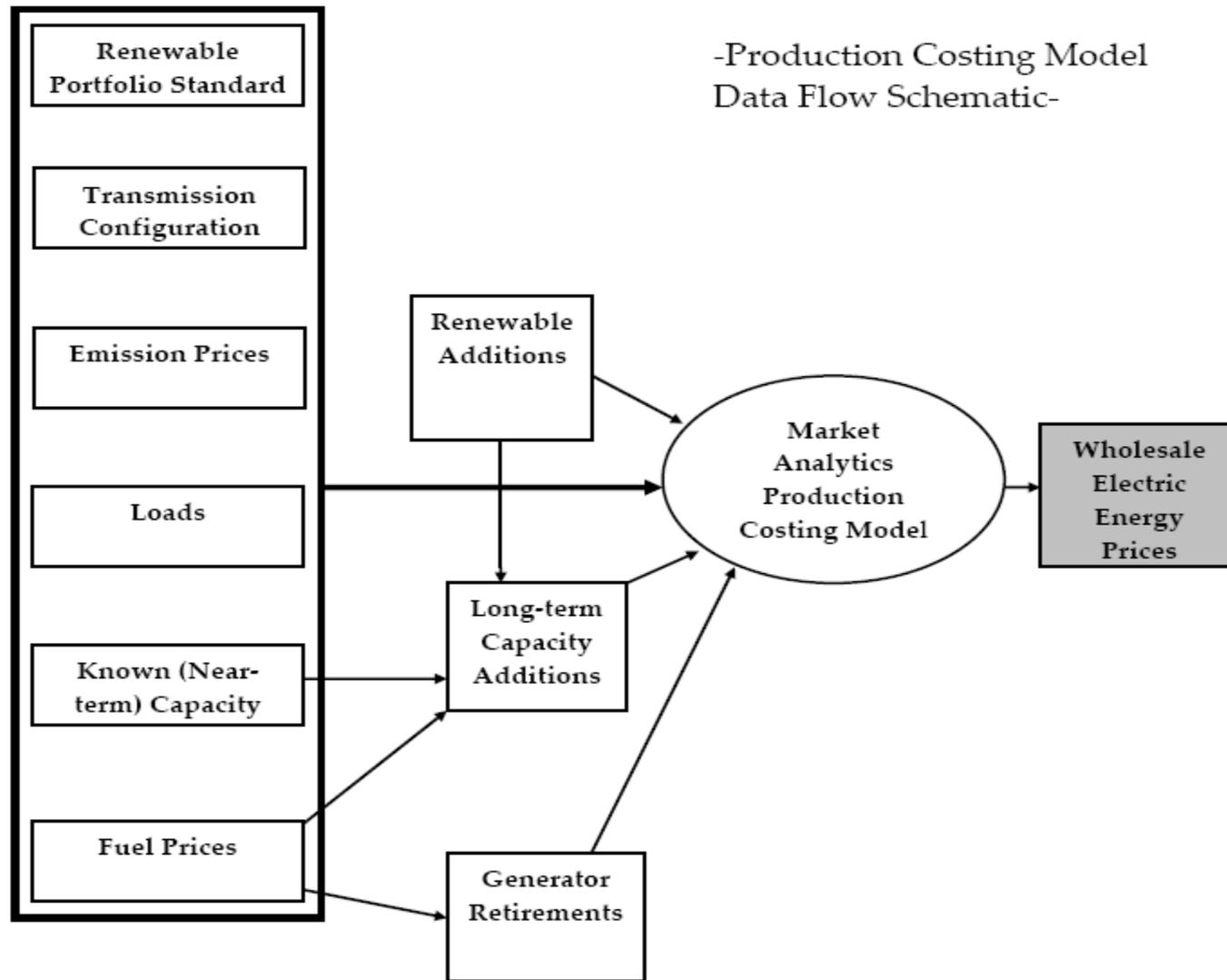
Key Drivers

- *Low load growth*
- *Generation to comply with RPS requirements*
- *Natural gas prices*
- *Carbon emission regulations*

AEESC 2009 results vs AEESC 2007 (state-wide, 15 year levelized)

- *Annual values about 5% lower*
- *Peak period values 6% to 12% lower*

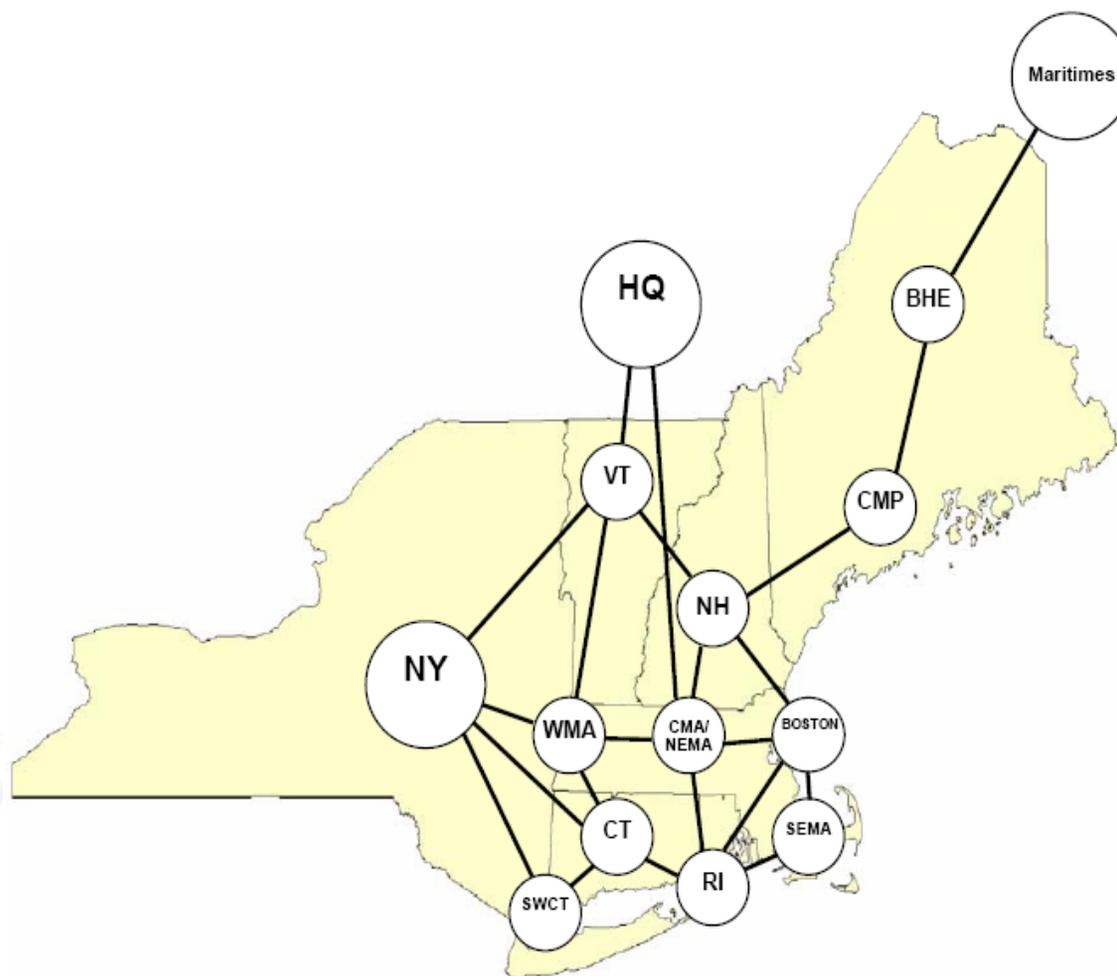
AVOIDED ELECTRICITY COSTS - Energy



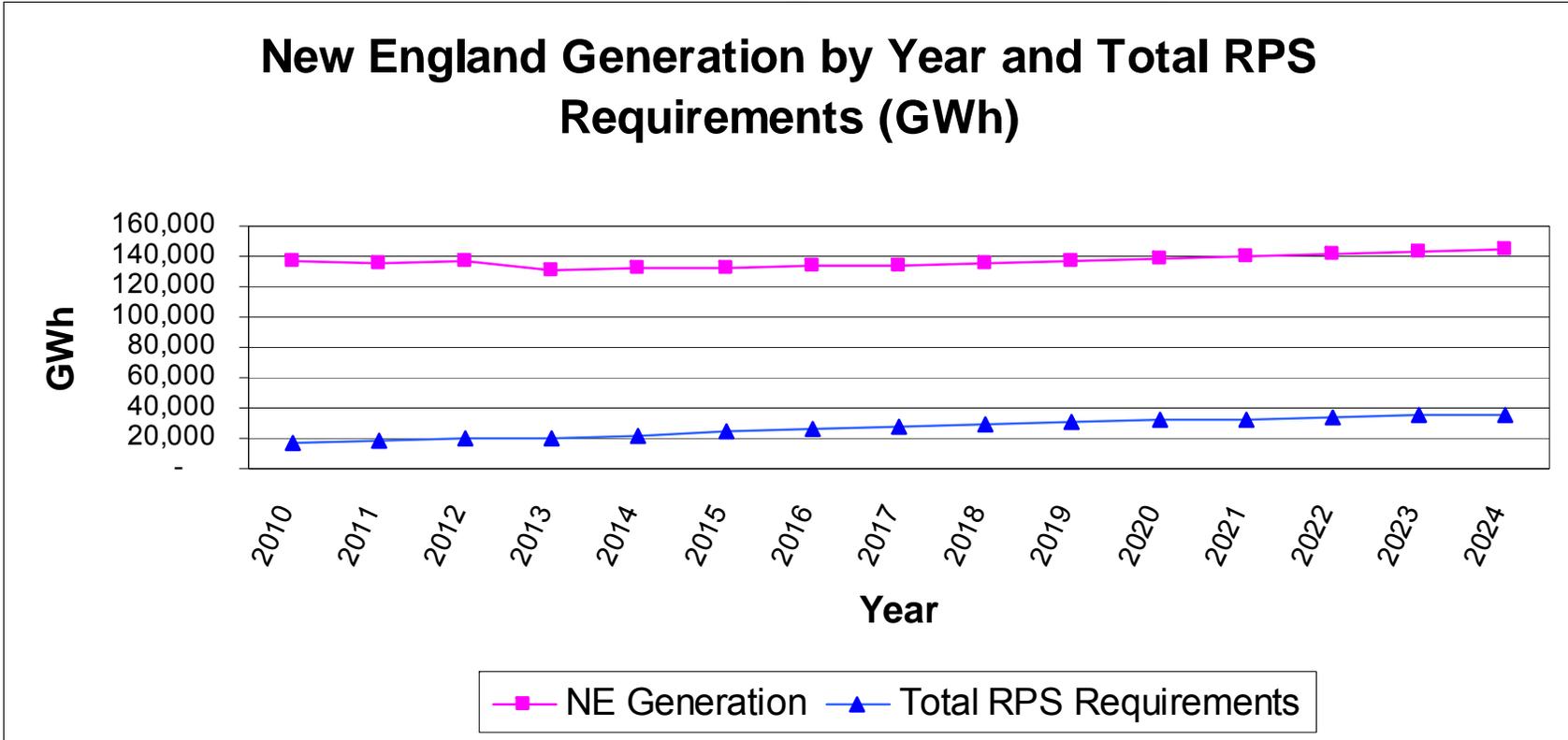
AVOIDED ELECTRICITY COSTS - Energy

Based on the topology used for ISO-NE RSP 2006 with two exceptions:

1. SME and ME combined to form CMP
2. Norwalk included in the rest of SWCT



New England Generation and RPS Requirements



AVOIDED ELECTRICITY COSTS - Energy

Price of Gas For Electric Generation = Henry Hub + cost of delivery to generating units

Henry Hub prices

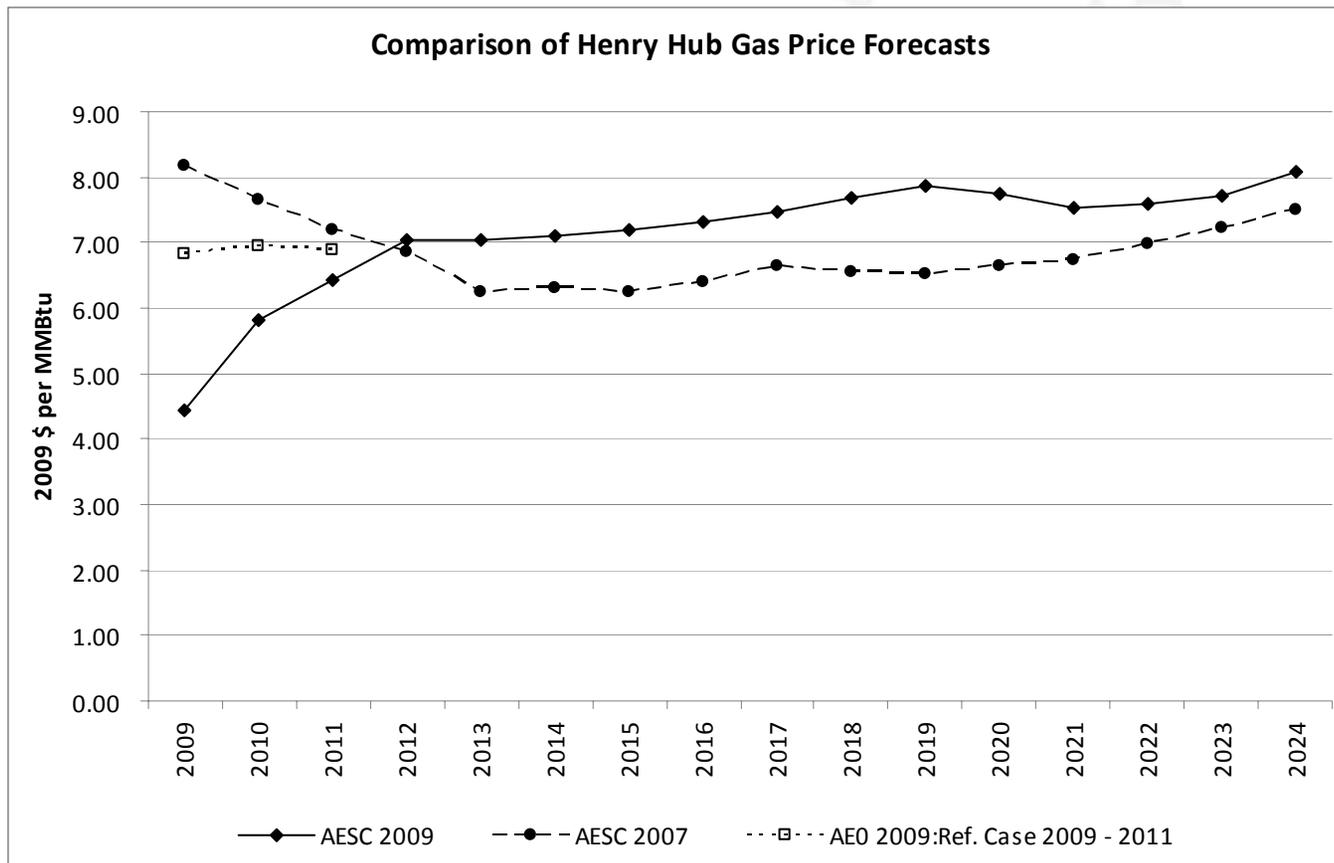
- 2009 to 2011 per NYMEX monthly (as of March 31, 2009)
- 2012 to 2024 per AEO 2009 annual prices and AESC 2009 monthly coefficients from analysis of NYMEX

Cost of delivery to generating units

- Forecast based on analysis of historical differential between monthly average unit costs reported to EIA by generating units and HH prices

AVOIDED ELECTRICITY COSTS - Energy

Exhibit 4- 10



- Emission Allowance Prices
 - Emission allowance price forecasts for SO₂, NO_x, and CO₂
 - Price forecasts for SO₂ and NO_x based upon values from allowance futures markets and experience with existing regulations
 - Price forecast for CO₂ assumes Regional Greenhouse Gas Initiative (RGGI) will be in effect in 2009 and will be replaced by national regulations for CO₂ in 2013.

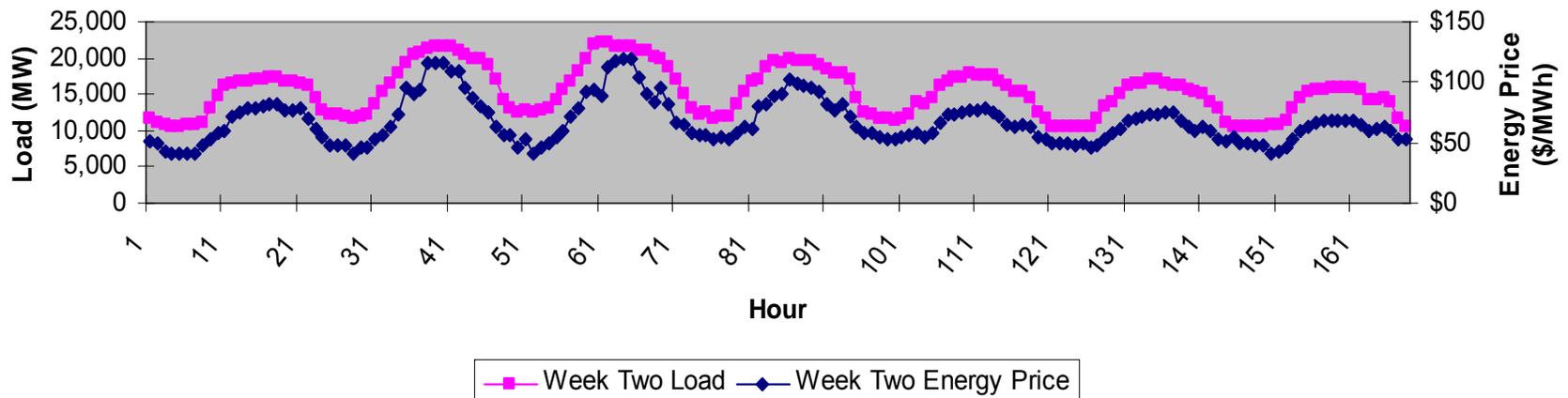
AVOIDED ELECTRICITY COSTS - Energy

Exhibit 3-3 Allowance Price Summary

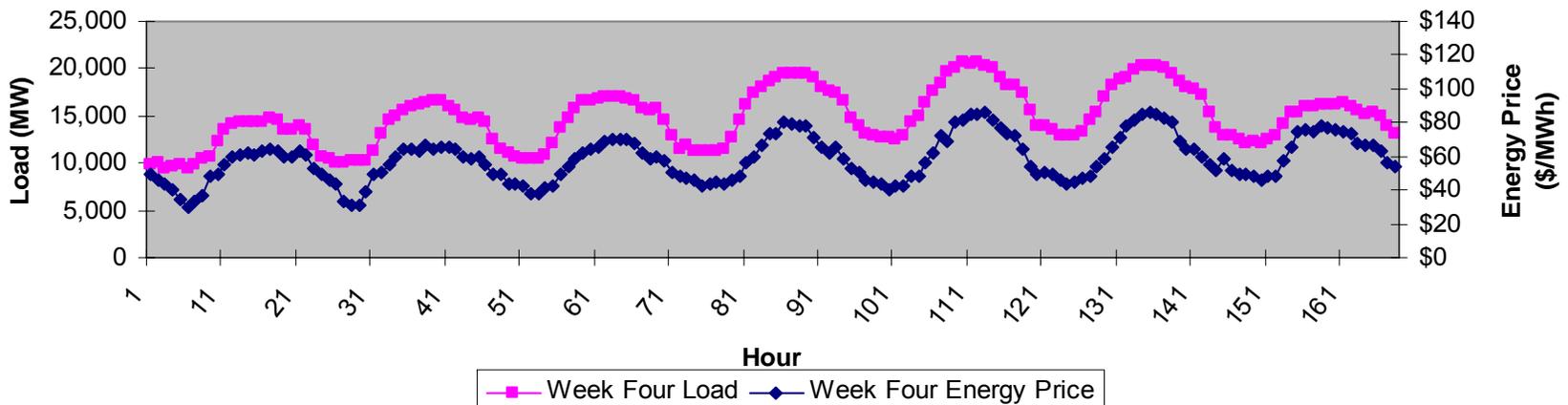
Emission Allowance Prices per short ton (nominal\$ and \$2009)								
Year	NO ₂		SO ₂		CO ₂		RGGI Scenario CO ₂	
	nominal	2009\$	nominal	2009\$	nominal	2009\$	nominal	2009\$
2009	\$2,075	\$2,075	\$61	\$61	\$3.85	\$3.85	\$3.85	\$3.85
2010	\$1,550	\$1,520	\$34.90	\$34.22	\$3.99	\$3.91	\$3.99	\$3.91
2011	\$785	\$755	\$33.90	\$32.58	\$4.18	\$4.02	\$4.18	\$4.02
2012	\$494	\$466	\$32.40	\$30.53	\$4.25	\$4.00	\$4.25	\$4.00
2013	\$623	\$576	\$31.50	\$29.10	\$15.00	\$15.63	\$4.34	\$4.00
2014	\$311	\$282	\$27.50	\$24.91	\$17.30	\$18.03	\$4.42	\$4.00
2015	\$317	\$282	\$18.10	\$16.07	\$19.50	\$20.32	\$4.51	\$4.00
2016	\$326	\$284	\$8.40	\$7.31	\$21.80	\$22.72	\$4.60	\$4.00
2017	\$333	\$284	\$7.80	\$6.66	\$24.00	\$25.01	\$4.69	\$4.00
2018	\$339	\$284	\$7.20	\$6.02	\$26.30	\$27.41	\$4.79	\$4.00
2019	\$346	\$284	\$6.60	\$5.41	\$28.50	\$29.70	\$4.88	\$4.00
2020	\$353	\$284	\$6.00	\$4.83	\$30.80	\$32.10	\$4.98	\$4.00

AVOIDED ELECTRICITY COSTS - Energy

July 2007: Hourly Load and Energy Price for July 8-14th (High Load)

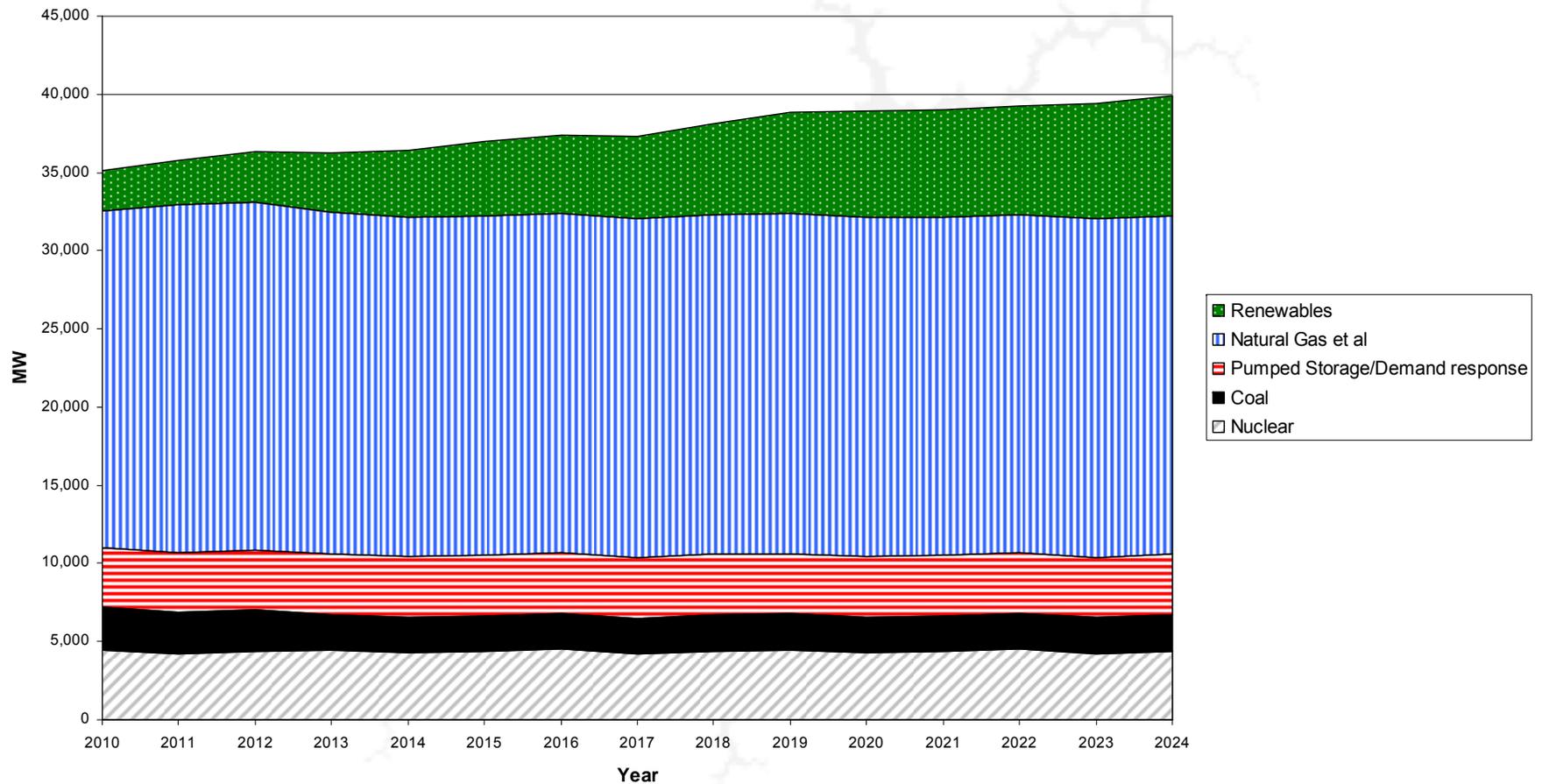


July 2007: Hourly Load and Energy Price from July 22-28th (Low Load)



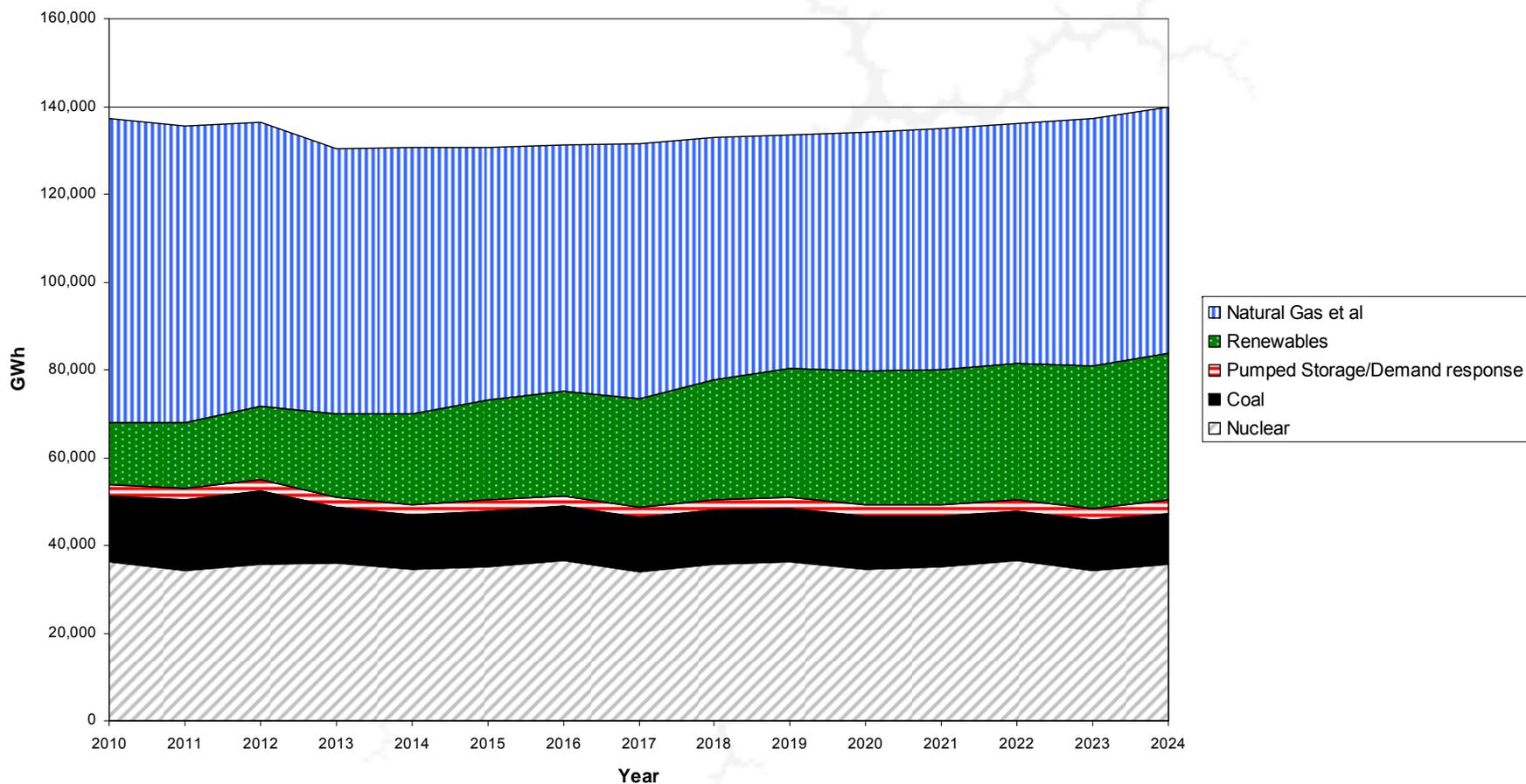
AVOIDED ELECTRICITY COSTS – Capacity in energy market

AESC 2009 Reference Case - Capacity by source (MW)



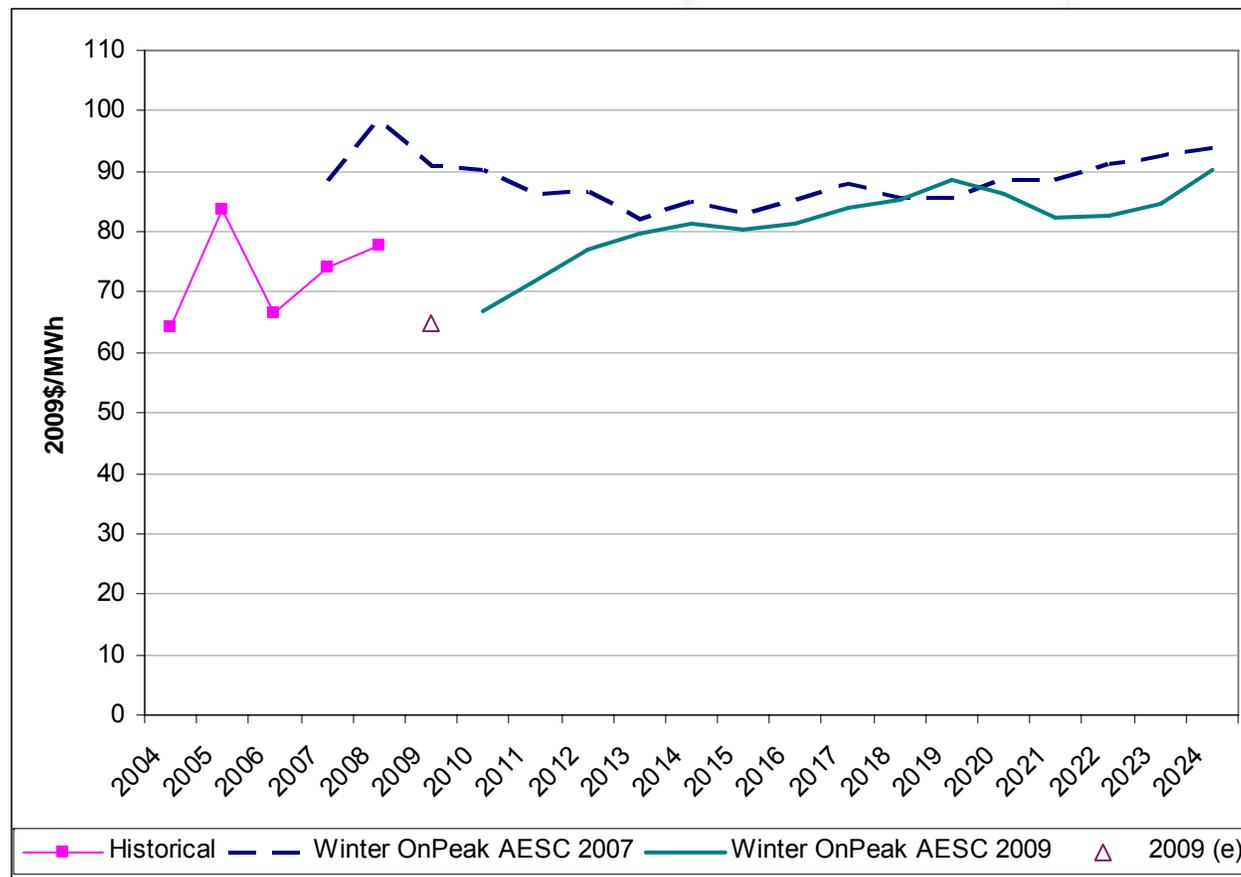
AVOIDED ELECTRICITY COSTS – Wholesale Energy Market Generation

AESC 2009 Reference Case - Generation by source (GWh)



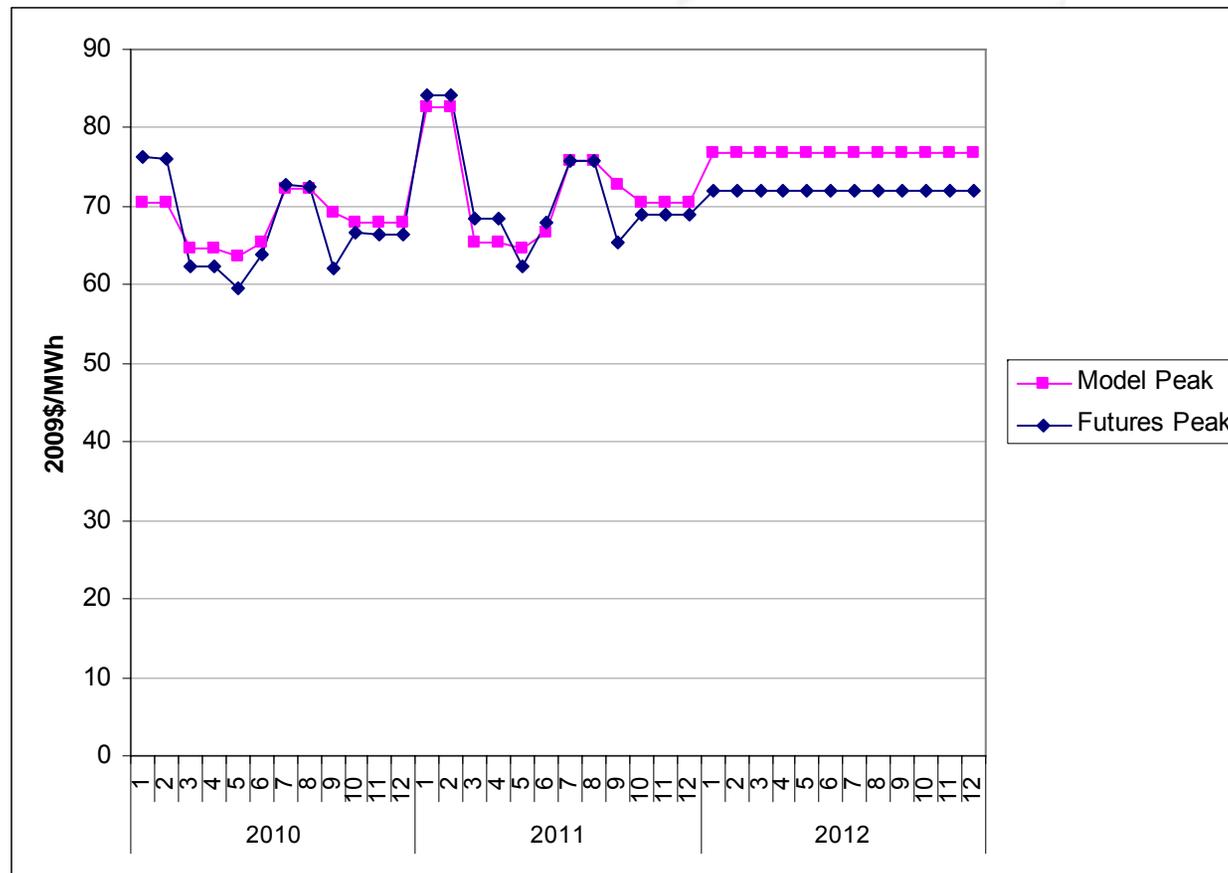
AVOIDED ELECTRICITY COSTS - ENERGY

Exhibit 7- 9: Historical and AESC Forecasts – Winter On-Peak Prices

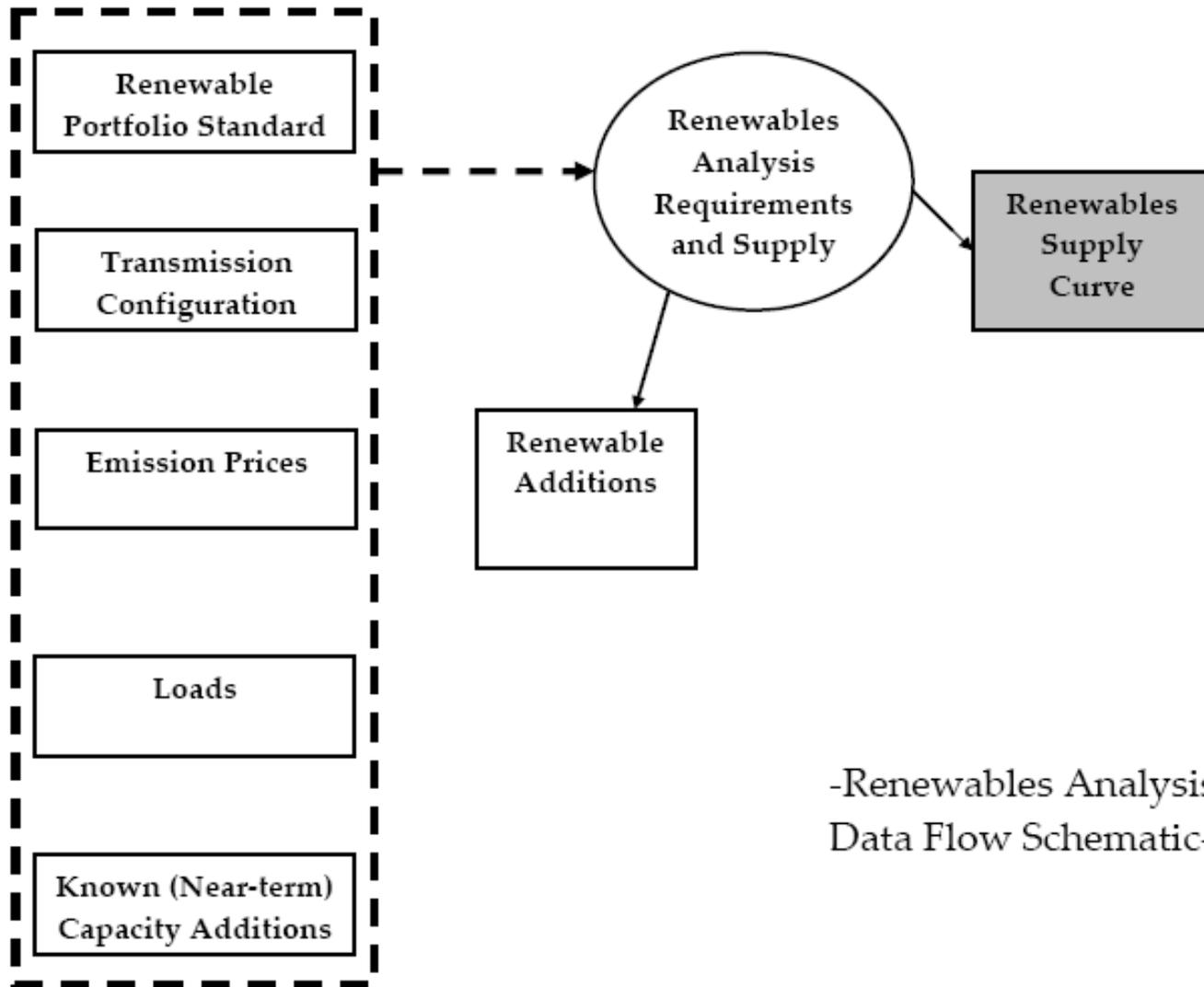


AVOIDED ELECTRICITY COSTS - ENERGY

Exhibit 7- 13: AESC Peak Forecast vs. NYMEX New Eng Futures



AVOIDED ELECTRICITY COSTS – Class I Renewable Energy Certificates



-Renewables Analysis
Data Flow Schematic-

AVOIDED ELECTRICITY COSTS – Class I Renewable Energy Certificates

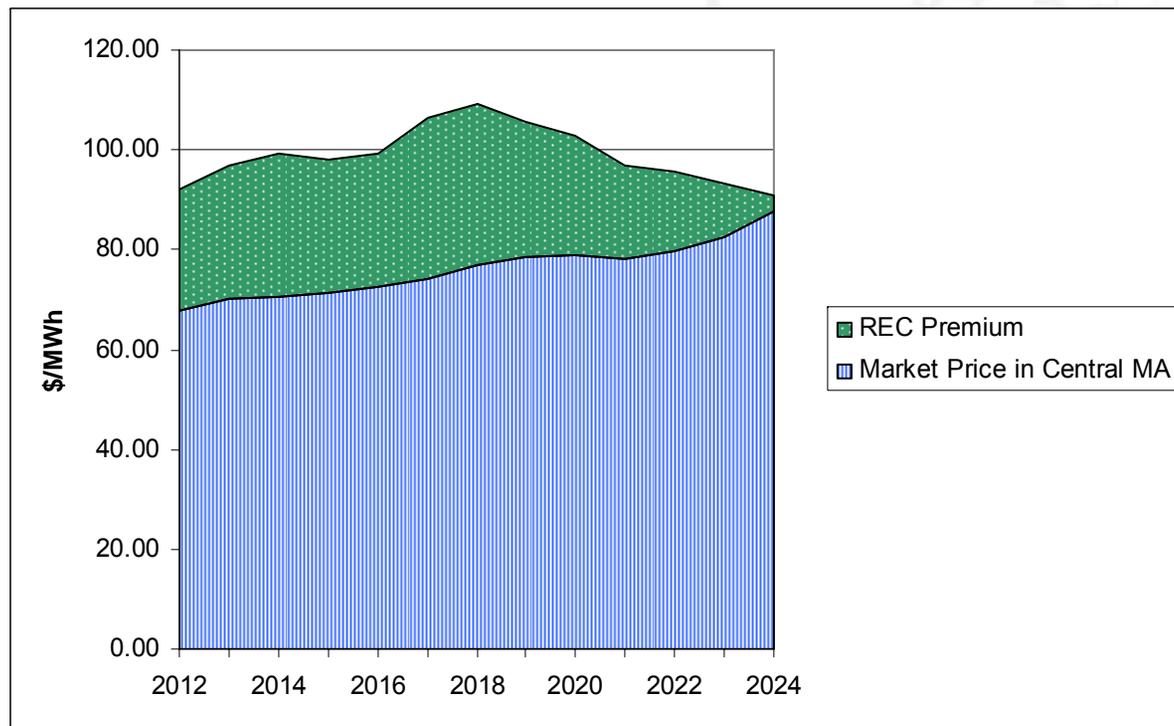
Exhibit 7C- 1

New England Annual RPS Requirements			
Year	Class I (GWh)	Other Classes (GWh)	Total (GWh)
2009	4,566	10,396	14,962
2010	5,628	10,821	16,449
2011	6,856	10,989	17,844
2012	8,120	11,118	19,237
2013	9,494	11,133	20,627
2014	10,951	11,215	22,167
2015	12,645	11,275	23,919
2016	14,344	11,365	25,709
2017	16,105	11,434	27,539
2018	17,651	11,500	29,151
2019	19,156	11,510	30,666
2020	20,606	11,462	32,068
2021	21,523	11,487	33,010
2022	22,460	11,510	33,970
2023	23,416	11,534	34,950
2024	24,392	11,557	35,949

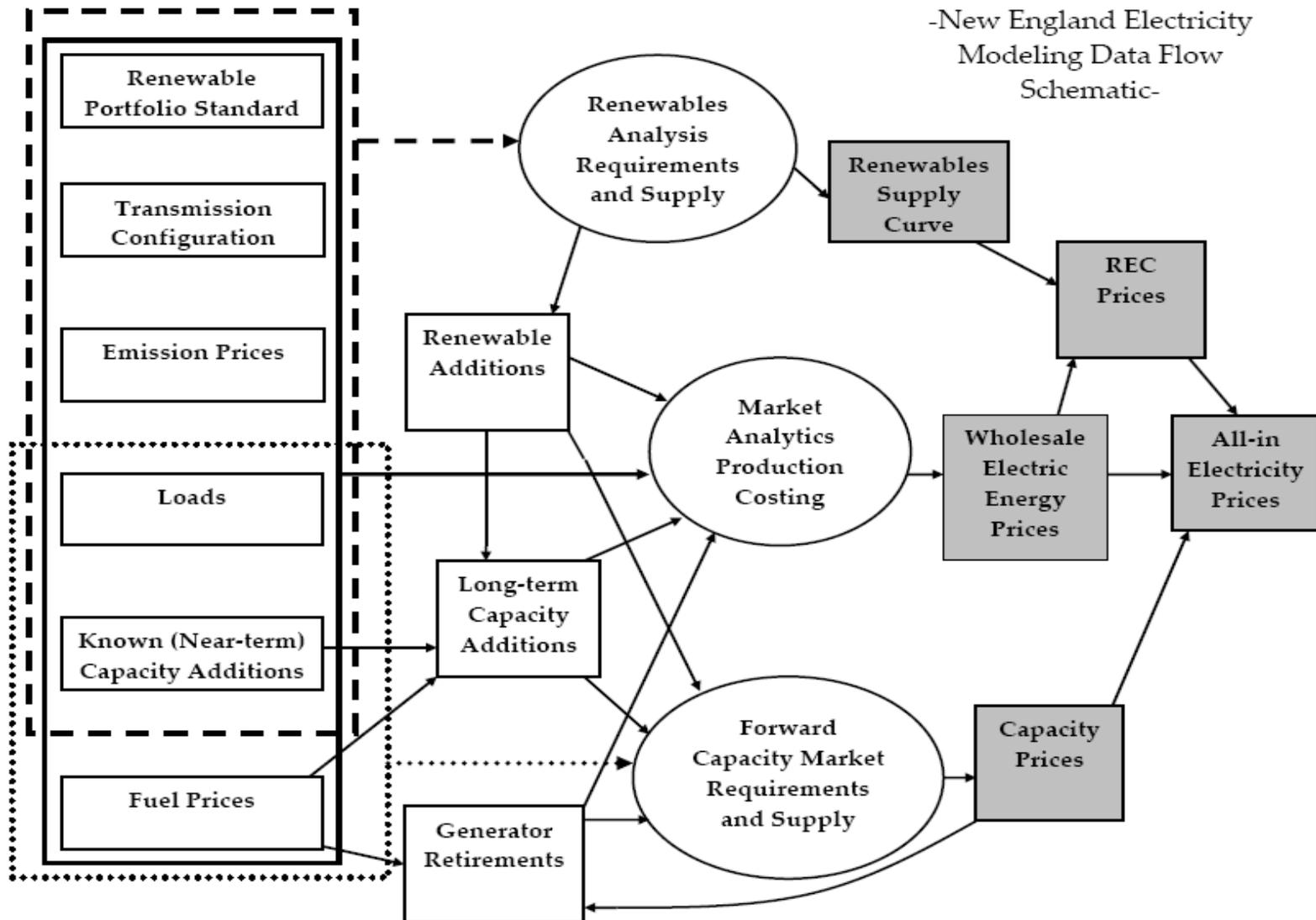
Notes
Class I also include voluntary demand
Calculations based on CELT forecast and RPS requirements summarized in Task 3

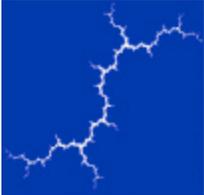
AVOIDED ELECTRICITY COSTS – Class I Renewable Energy Certificates

Wholesale Energy Market Price and REC Premium (\$/MWh)



AVOIDED ELECTRICITY COSTS – Capacity, Energy and RECs





AVOIDED ELECTRICITY COSTS – Wholesale Risk Premium

- reflects the difference between the prices for electricity supply charged to retail customers under full-requirements fixed-price contracts during a given time period and the wholesale market prices for electric energy and capacity during the corresponding time period.
- primarily attributable to the costs marketers incur to mitigate their exposure to risk. Risks arise from the potential for costs to exceed revenues due to unexpected levels of consumption due to factors such as unexpected variations in weather, economic activity and and/or customer migration
- no utility sponsor of this project was able to provide public information on the retail adders implicit in the prices bid by suppliers
- The experience of members of the Study Group and the Project Team with confidential data on prices bid by suppliers into standard offer service auctions suggests that 9% is realistic to apply to wholesale energy and capacity prices
- Study Group members have flexibility to apply a different percentage

AVOIDED ELECTRICITY COSTS - Capacity

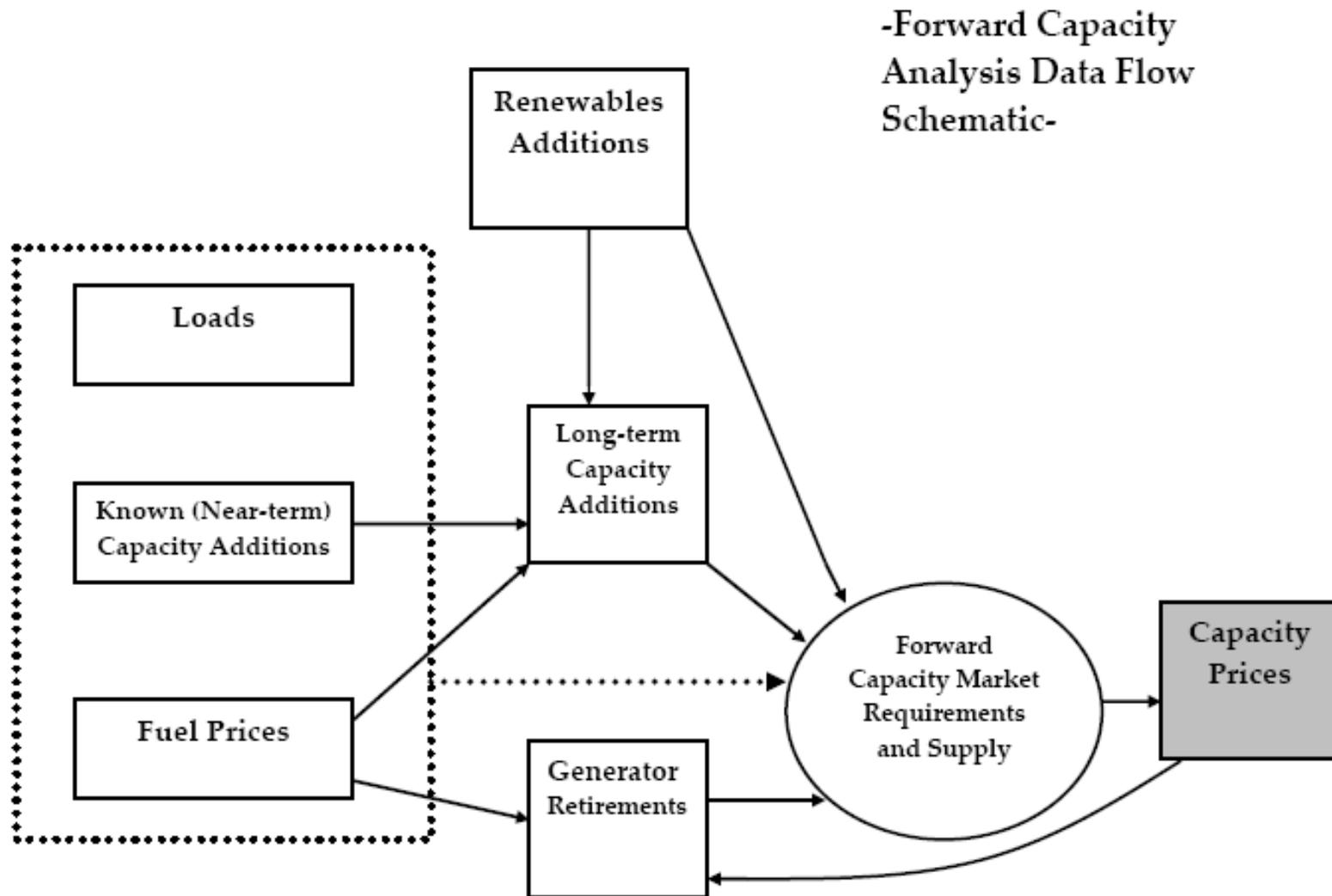
Key Drivers

- *Low load growth*
- *Ample existing capacity*
- *Capacity from resources added to comply with RPS requirements*
- *Limited expected retirements*

AESC 2009 results vs AESC 2007

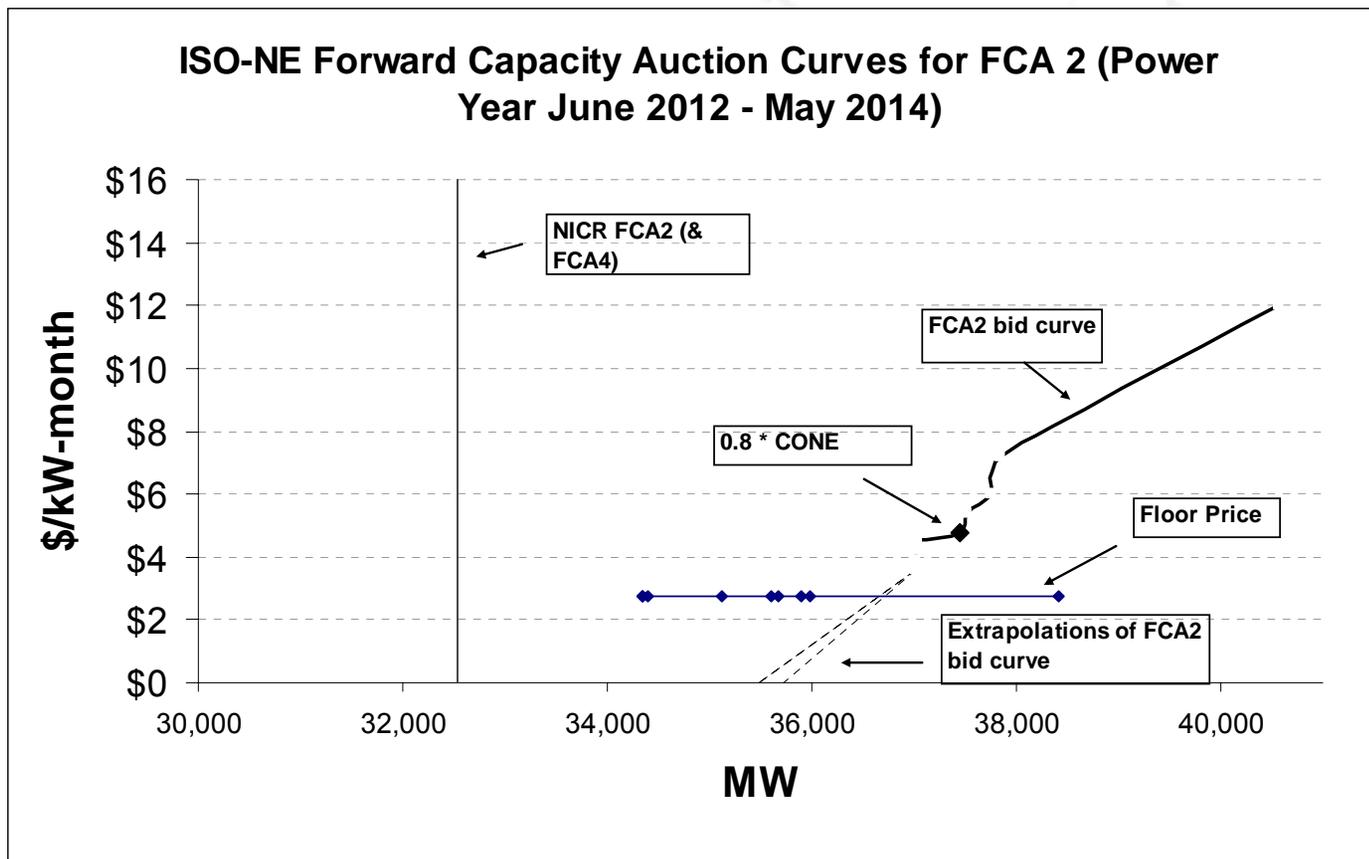
- *About 70% lower*

AVOIDED ELECTRICITY COSTS - Capacity



AVOIDED ELECTRICITY COSTS - Capacity

Exhibit 7-2.



AVOIDED ELECTRICITY COSTS - Capacity

Exhibit 7-4. Capacity Requirements, Supply and Price

Capacity Year Starting	FCA	Peak Demand	Reserve Req Inc. HQ	Net Installed Capacity Req	Annual Resource Adjustments					FCM Price	
					Adds	Retires	delists	renews	DR	Floor Prices Nominal\$	2009\$
		a	b	c	d	e	f	g	h	i	j
6/1/2010	1	28,160								\$4.50	\$4.38
6/1/2011	2	28,575	13.7%	32,528						\$3.60	\$3.43
6/1/2012	3	29,020	14.4%	32,276	156	-10	-753	159	-1050	\$2.95	\$2.76
6/1/2013	4	29,365	14.6%	32,731	125	-10	-3,117	216			\$1.30
6/1/2014	5	29,750	14.6%	33,183		-10	275	187			\$1.40
6/1/2015	6	30,115	14.7%	33,628		-10	218	237			\$1.50
6/1/2016	7	30,415	14.9%	34,027		-10	229	180			\$1.60
6/1/2017	8	30,695	15.0%	34,374		-10	184	173			\$1.70
6/1/2018	9	30,960	15.1%	34,709		-10	139	207			\$1.80
6/1/2019	10	31,270	15.2%	35,097		-10	189	209			\$1.90
6/1/2020	11	31,566	15.3%	35,469		-10	229	152			\$2.00

AVOIDED ELECTRICITY COSTS - Capacity

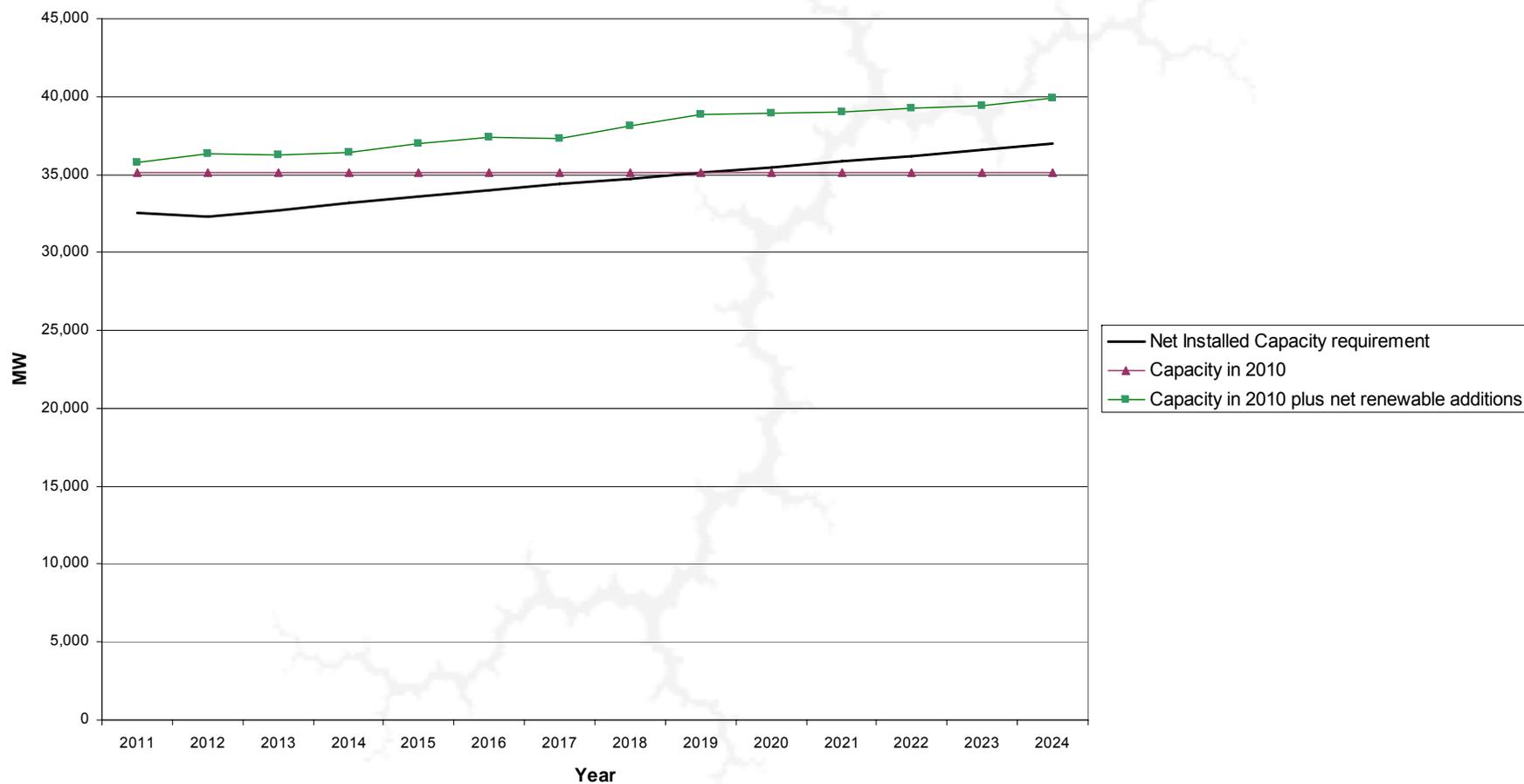
Value of Illustrative Alternative Approaches to Avoiding Capacity Costs via Efficiency Measure Reductions in Peak Demand

Hypothetical measure assumptions - Installation in 2010, peak reduction of 100 kw, 5 year measure life													
	Values per ISO-NE NICR and FCA			Example 1 - PA bids 100% of expected demand reduction into each corresponding FCA			Example 2 - PA bids zero expected demand reduction into each corresponding FCA			Example 3 - PA bids 50% of expected demand reduction into each corresponding FCA			
	FCA #	FCA Price(1)	Avoided Capacity Cost to Load(2)	Reduction Bid into FCA	Impact of Reduction on NICR set for power year	Value of Reduction in Peak demand	Reduction Bid into FCA	Impact of Reduction on NICR set for power year	Value of Reduction in Peak demand	Reduction Bid into FCA	Impact of Reduction on NICR set for power year	Value of Reduction in Peak demand	
Units		\$ per kw-yr	\$ per kw-yr	kw	kw		kw	kw		kw	kw		
Year		a	b	c	d	$e = (a * c) + (b * d)$	f	g	$h = (a * f) + (b * g)$	i	j	$k = (a * i) + (b * j)$	
2010	1	\$65.84	\$67.71	100	0	\$ 6,584	0	0	\$ -	50	0	\$ 3,292	
2011	2	\$50.58	\$52.02	100	0	\$ 5,058	0	0	\$ -	50	0	\$ 2,529	
2012	3	\$35.74	\$42.03	100	0	\$ 3,574	0	0	\$ -	50	0	\$ 1,787	
2013	4	\$16.85	\$19.85	100	0	\$ 1,685	0	0	\$ -	50	0	\$ 842	
2014	5	\$16.85	\$19.86	100	0	\$ 1,685	0	100	\$ 1,986	50	50	\$ 1,835	
Net Present Value @ 2.2% discount rate						\$ 17,688				\$ 1,781			\$ 9,734

(1) FCA Price Reflects ISO NE 1.08% loss factor and reserve margins for 2010 and 2011 only
(2) Includes wholesale risk premium of 9.0%

AVOIDED ELECTRICITY COSTS – energy DRIPE

AESC 2009 Reference Case - Capacity Requirements vs Resources(MW)



AVOIDED ELECTRICITY COSTS – capacity DRIPE

- *FCM generally expected to clear at very low prices from FCA4 onward.*
- *Impact of DSM on FCM market price is \$0.0005/kW-year (\$0.70/kw-yr per 100 MW of load reduction)*
- *We assume no impact 2010 to 2012 with full dissipation by 2016 (Exhibit 7C-7)*

	Installations in		
	2010	2011	Average
2010	\$ -	\$ -	\$ -
2011	\$ -	\$ -	\$ -
2012	\$ -	\$ -	\$ -
2013	\$0.41	\$0.41	\$0.41
2014	\$0.50	\$0.70	\$0.60
2015	\$0.30	\$0.50	\$0.40
2016	\$ -	\$0.30	\$0.15

Environmental Effects – CO2 Externality Value

CO2 identified as the one major emission associated with electricity usage whose **internalized cost**, as reflected in compliance prices, most significantly understates the externality value supported by current science.

The near-term **internalized cost** of carbon dioxide emissions will be driven by RGGI and proposed federal CO2 regulations. These regulations will only internalize a portion of the "greenhouse gas externality"

Environmental Effects – CO₂ externality value

Exhibit 7-13. Determination of the Additional Cost of CO₂ Emissions



Environmental Effects – CO2 Externality Value

	LT MAC (\$/short ton)	2009 AESC Reference Allowance Price (\$/short ton)	2009 AESC Reference Externality (\$/short ton)	RGGI Only Scenario Allowance Price (\$/short ton)	RGGI Only Scenario Externality (\$/short ton)
	a	b	c=a-b	d	e=a-d
2009	\$80	\$3.85	\$76.15	\$3.85	\$76.15
2010	\$80	\$3.91	\$76.09	\$3.91	\$76.09
2011	\$80	\$4.02	\$75.98	\$4.02	\$75.98
2012	\$80	\$4.00	\$76.00	\$4.00	\$76.00
2013	\$80	\$15.63	\$64.37	\$4.00	\$76.00
2014	\$80	\$18.03	\$61.97	\$4.00	\$76.00
2015	\$80	\$20.32	\$59.68	\$4.00	\$76.00
2016	\$80	\$22.72	\$57.28	\$4.00	\$76.00
2017	\$80	\$25.01	\$54.99	\$4.00	\$76.00
2018	\$80	\$27.41	\$52.59	\$4.00	\$76.00
2019	\$80	\$29.70	\$50.30	\$4.00	\$76.00
2020	\$80	\$32.10	\$47.90	\$4.00	\$76.00
2021	\$80	\$34.49	\$45.51	\$4.00	\$76.00
2022	\$80	\$36.79	\$43.21	\$4.00	\$76.00
2023	\$80	\$39.18	\$40.82	\$4.00	\$76.00
2024	\$80	\$41.48	\$38.52	\$4.00	\$76.00
Notes					
Values expressed in 2009 Dollars					
Allowance Prices from Exhibit 2-4					
Inflation rate of 2%					

Avoided Natural Gas Costs

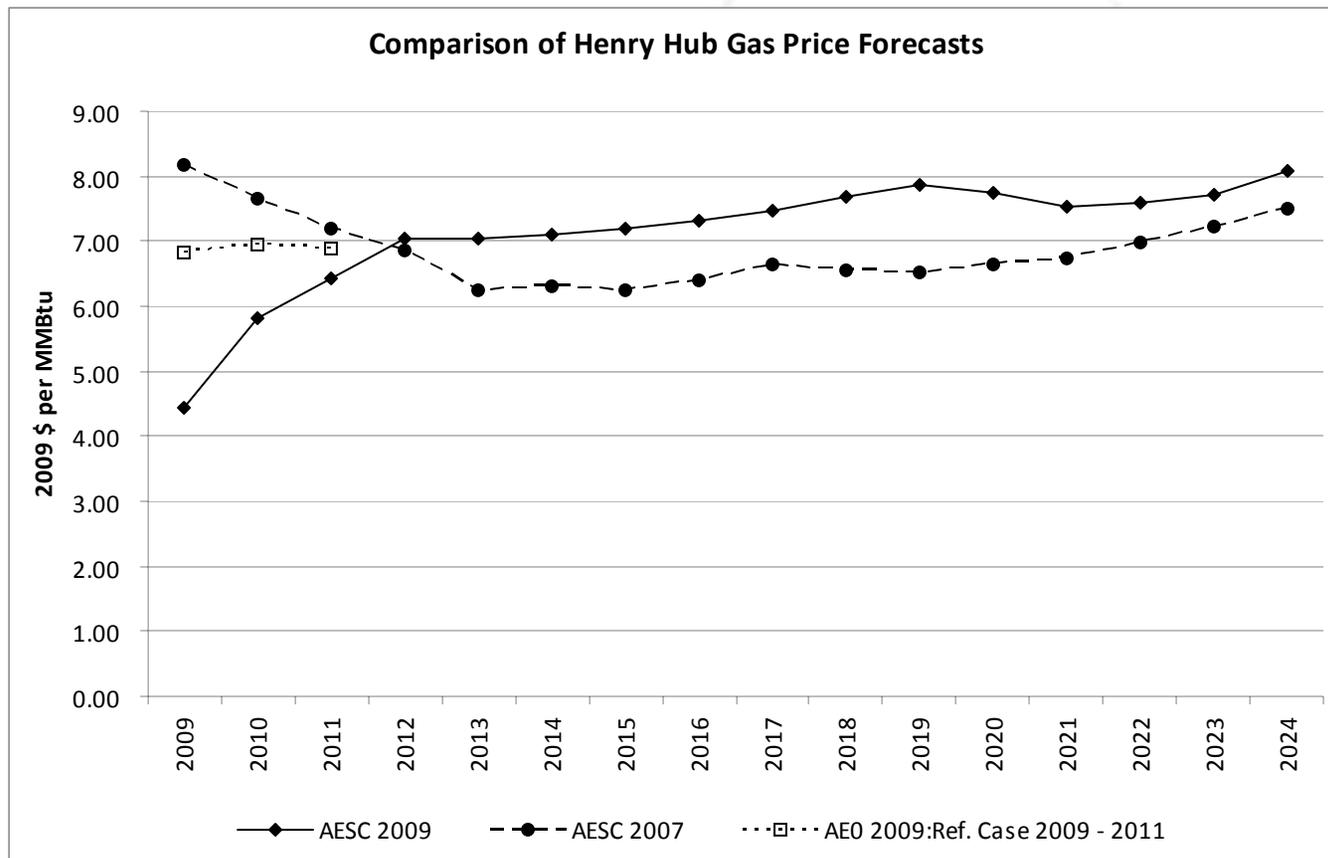
Key Drivers

- *limited load growth*
- *shale gas as major new marginal resource*
- *more accurate estimates of end use profiles*

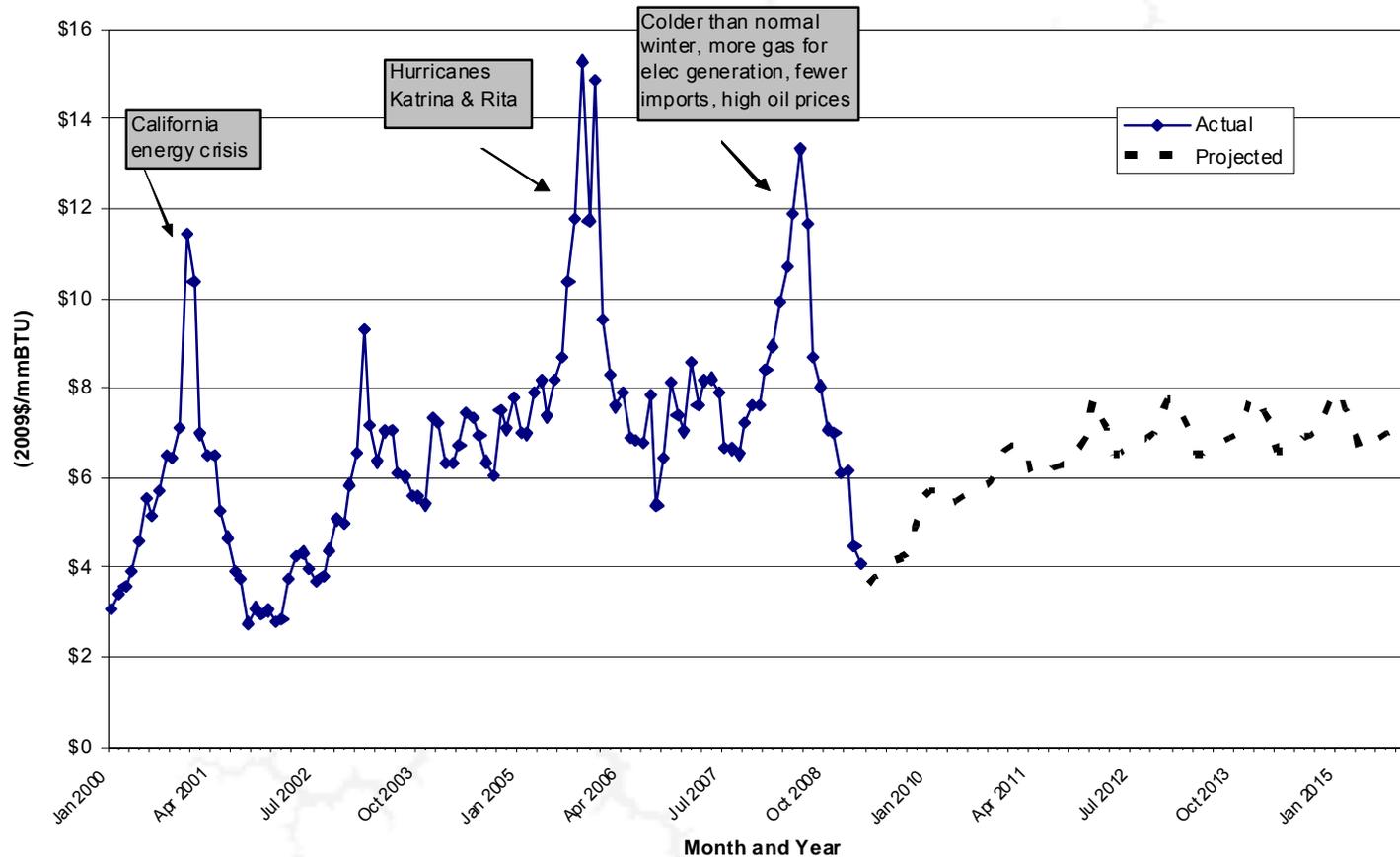
AESC 2009 results vs AESC 2007

- *Henry Hub prices approximately the same*

Avoided Natural Gas Costs – Henry Hub Prices

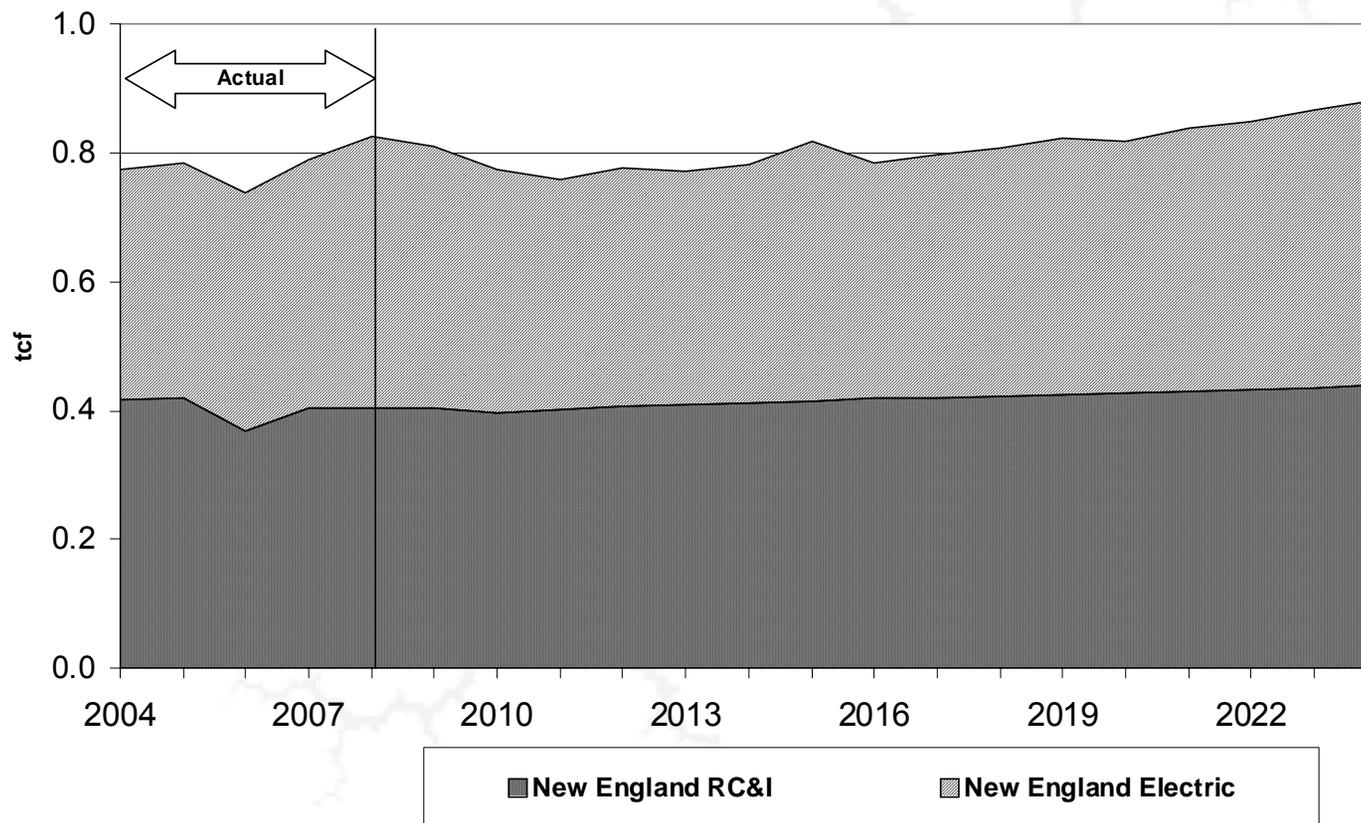


Avoided Natural Gas Costs – Volatility of HH Prices

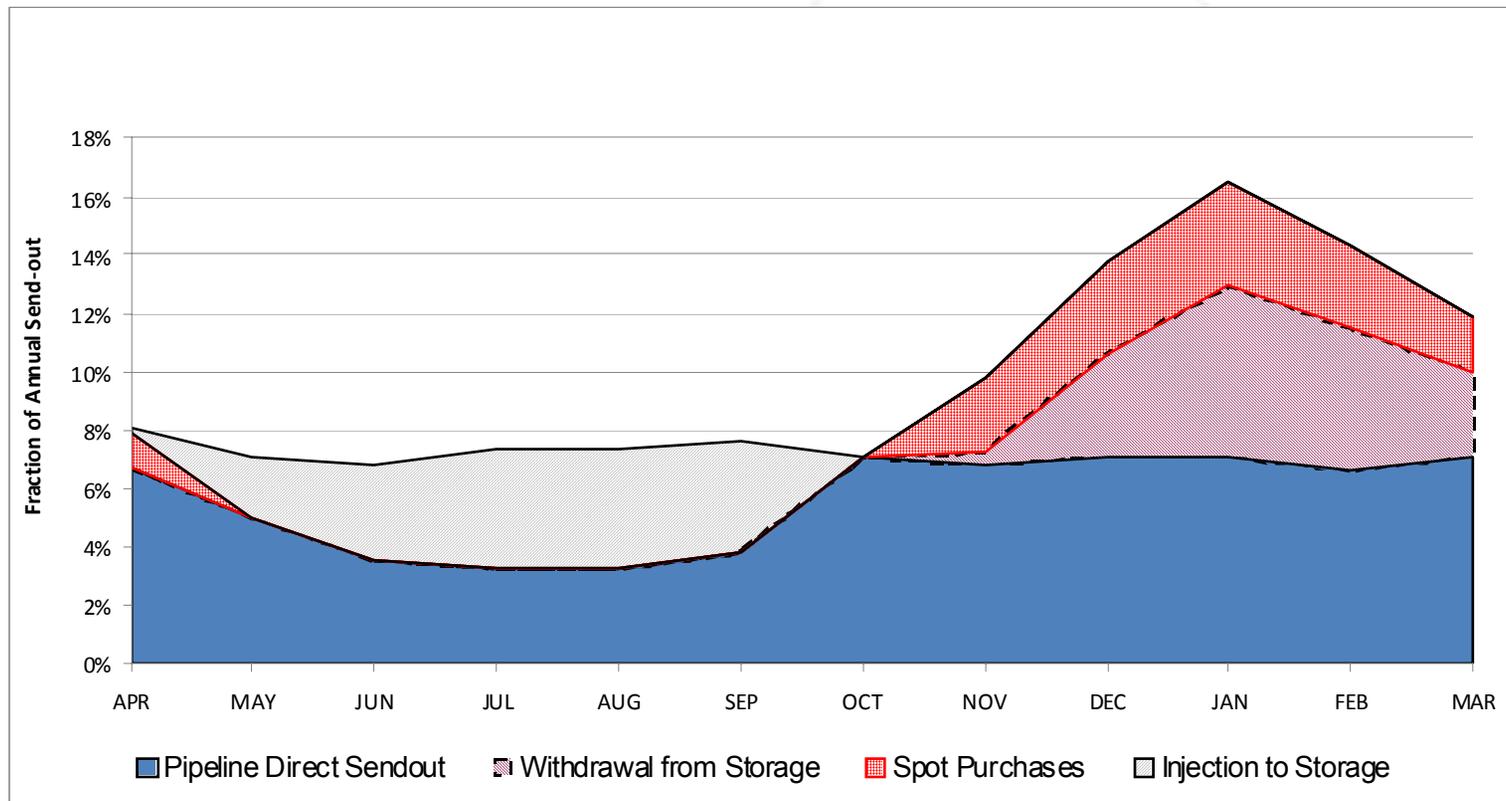


Avoided Gas Costs

Annual Gas Use (tcf) in New England Actual and AEO 2009 Reference Case projection



Avoided Gas Costs – Send out of Gas by source in Vermont



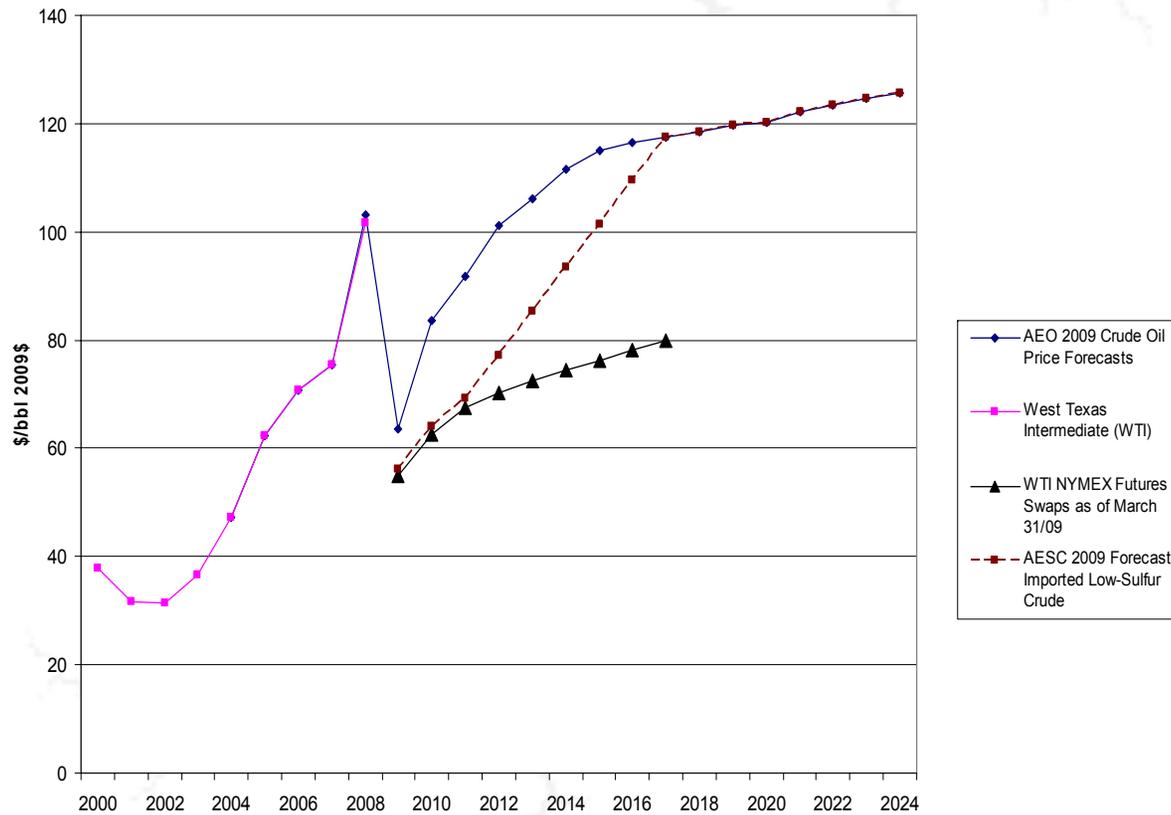
Avoided Natural Gas Costs

Exhibit 4-1 Summary Table

Summary of Levelized Avoided Cost Of Gas Delivered To Retail Customers AESC 2009 versus AESC 2007 (2009\$/Dekatherm)									
	RESIDENTIAL				COMMERCIAL & INDUSTRIAL			ALL RETAIL	
	Non Heating	Hot Water	Heating	All	Non Heating	Heating	All		
AESC 2007 end-use period (a)	annual	5-month	6-month		annual	5-month	6-month	5-month	
Southern New England									
AESC 2009	11.42	11.42	14.52	13.52	9.88	11.83	11.21	12.26	
AESC 2007		11.62	12.84	12.48	9.50	10.72	10.36	11.65	
2007 to 2009 change		-1.71%	13.09%	8.33%	4.04%	10.36%	8.25%	5.25%	
Northern & Central New England									
AESC 2009	10.87	10.87	13.54	12.67	10.02	12.05	11.40	12.03	
AESC 2007		11.32	12.35	12.04	10.19	11.23	10.92	11.74	
2007 to 2009 change		-3.96%	9.61%	5.27%	-1.66%	7.30%	4.39%	2.43%	
Vermont									
AESC 2009	9.72	9.72	12.43	11.56	8.01	9.44	9.00	9.93	
AESC 2007		10.43	11.67	11.31	8.34	9.58	9.21	10.37	
2007 to 2009 change		-6.84%	6.49%	2.21%	-3.89%	-1.37%	-2.31%	-4.20%	
<p>(a) In AESC 2007 the end-use profiles was defined as a certain number of months in the winter period; e.g. 5-months is Nov. - March.</p> <p>(b) Factor to convert 2005\$ to 2007 \$ 1.0420</p> <p>Note: AESC 2007 levelized costs for 16 years, 2007 - 2022 at a discount rate of 2.2165%.</p> <p>AESC 2009 levelized costs for 15 years 2010 - 2024 at a discount rate of 2.22%.</p>									

Avoided Costs of Other Fuels

Low Sulfur Crude Actual and AESC 2009 Forecast (\$2009/bbl)



Avoided Costs of Other Fuels

Exhibit 5-1 Summary of Other Fuel Prices: AESC 2009 versus AESC 2007

Sector	No. 2 Distillate	No. 2 Distillate	No. 6 Residual Fuel (low sulfur)	Propane	Kerosene	BioFuel	BioFuel	Wood
	Res	Com	Com	Res	Res & Com	B5 Blend	B20 Blend	Res
AESC 2009 Levelized Values (2009\$/MMBtu)								
2010-2024	22.82	21.68	17.52	34.01	22.17	22.82	22.82	8.22
AESC 2007 Levelized Values (2009\$/MMBtu)								
2010-2024	15.31	13.50	9.15	30.99	15.92	15.31	15.31	5.48
Percent Difference from AESC 2007								
2010-2024	49.1%	60.6%	91.6%	9.8%	39.2%	49.1%	49.1%	49.9%
Notes								
Res	Residential Sector							
Com	Commercial Sector							
AESC 2007 values from Exhibit 4-6 New England Average Price Forecast of Other Fuel Prices by Sector (AESC 2007)								

AVOIDED ELECTRICITY and Natural Gas COSTS – Economic Development Impacts

Economic Development Impacts of Massachusetts Electric and Gas Energy Efficiency (EE) (Net Impact Multipliers per \$1 million)

	Electric EE Net Impact	Gas EE Net Impact
MULTIPLIERS (per \$1 million, 2009 \$)		
Employment (job-years)	22.9	19.1
Earnings	\$1,126,900	\$885,200
Value-Added	\$1,478,300	\$891,500

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