

# The Environmental Impact of Decommissioning in ISO-NE

by

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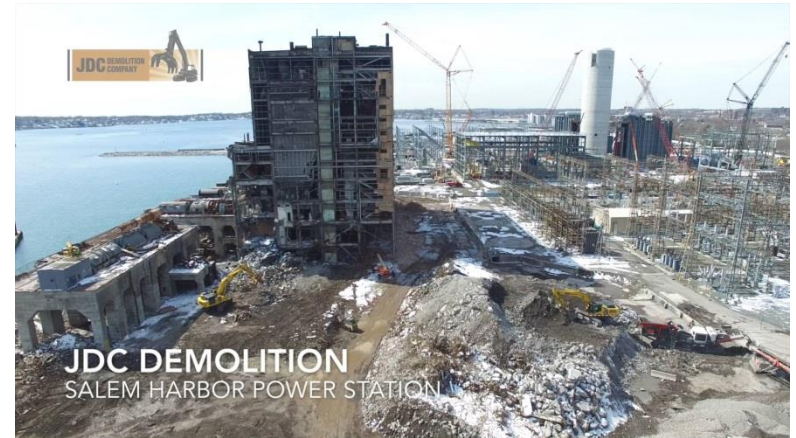
Principal

Epsilon Associates, Inc.

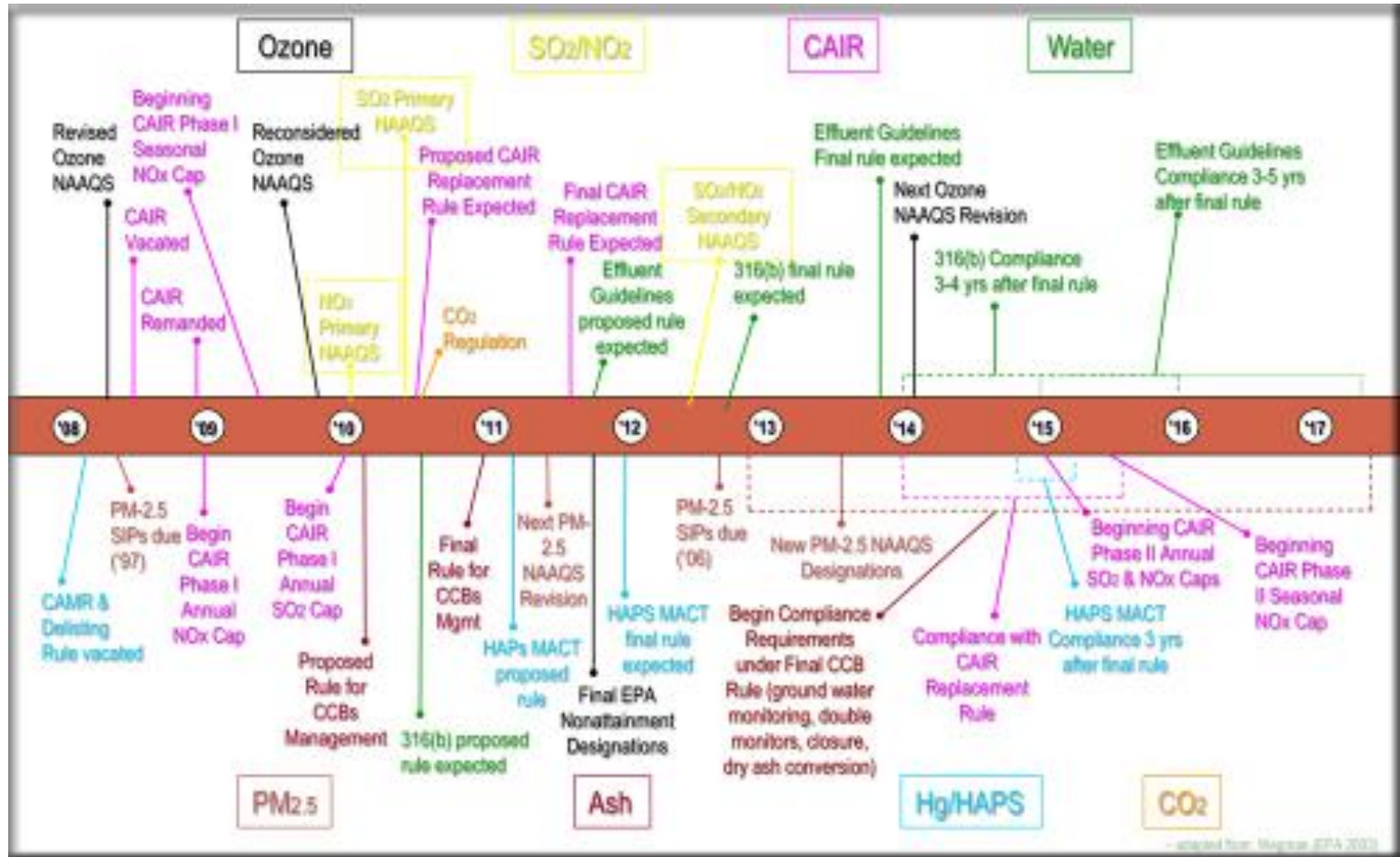
3 Clock Tower Place, Suite 250

Maynard, MA 01754

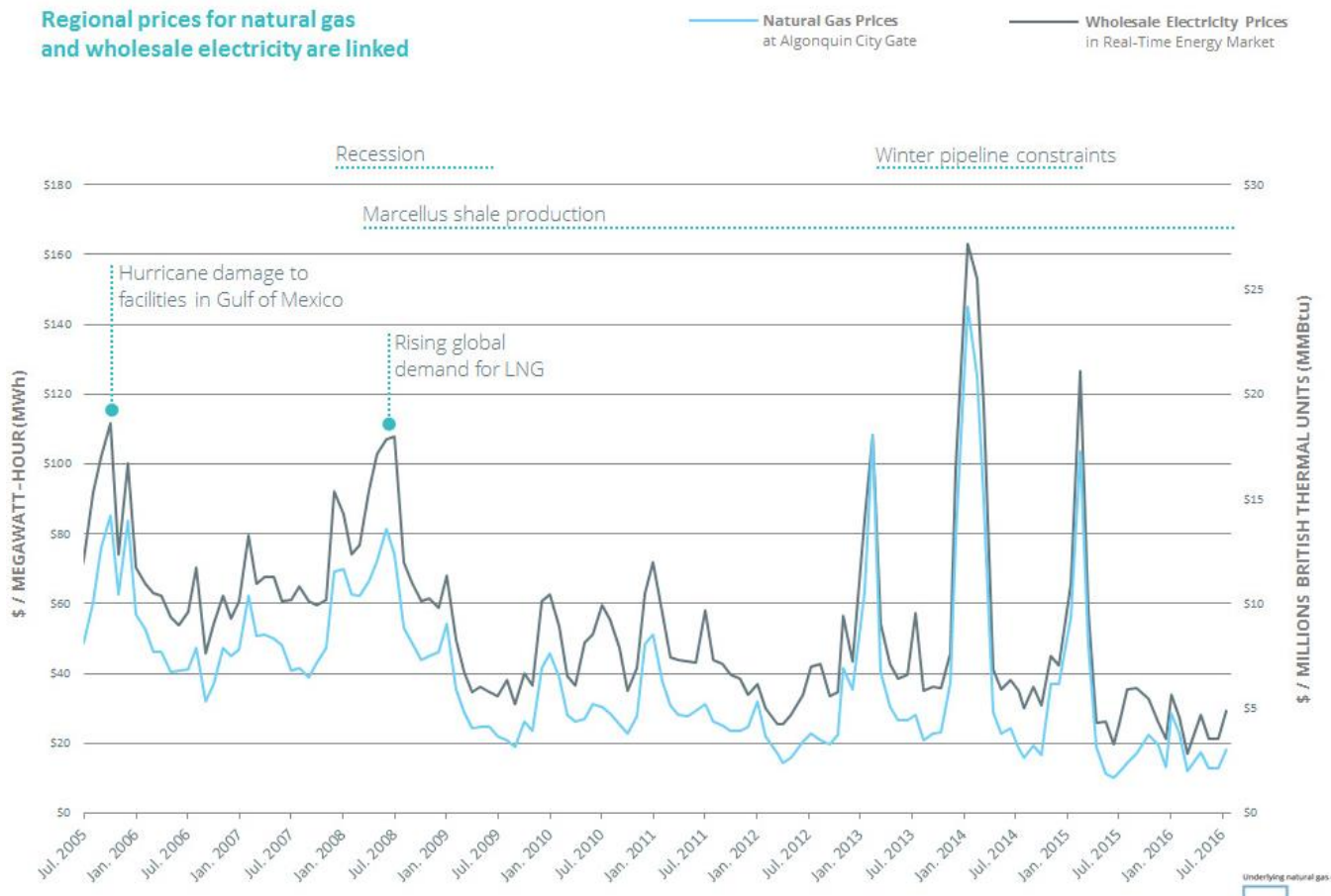
# Why Are Facilities Retiring?



# Why Are Facilities Retiring? Regulations



# Why Are Facilities Retiring? Economics



# ISO-NE Units to be Shutdown

## Imminent retirements

Several of the region's oldest generators – and some of its largest – have already ceased operations or plan to exit the markets by 2018. They take with them over 3,500 MW of regional capacity. Notable exits include:

- ✕ **Brayton Point Station**  
(1,535 MW from oil and coal)
- ✕ **Mount Tom Station**  
(143 MW from coal)
- ✕ **Norwalk Harbor Station**  
(342 MW from oil)
- ✕ **Salem Harbor Station**  
(749 MW from oil and coal)
- ✕ **Vermont Yankee Station**  
(604 MW from nuclear power)

About 6,000 MW more of New England's oil and coal capacity will be over 40 years old in 2020 – some substantially older – and at risk of retirement, according to a 2012 ISO analysis.

- ✕ Closed or retiring
- Generation at risk





# ISO-NE Units Shutdown

70 units have shutdown or have announced they will be shutdown

Through 2014, 55 units shutdown

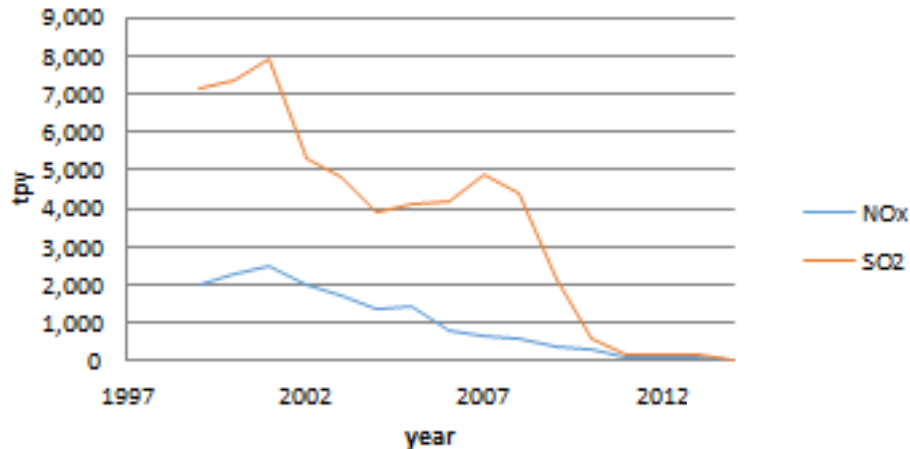
- 38 utility boilers with an average vintage of 1962
- Most units firing residual oil or coal
- the other units were turbines
  - four GTCC – average vintage of 1986
  - 13 GTSC – average vintage of 1979

Units of note included:

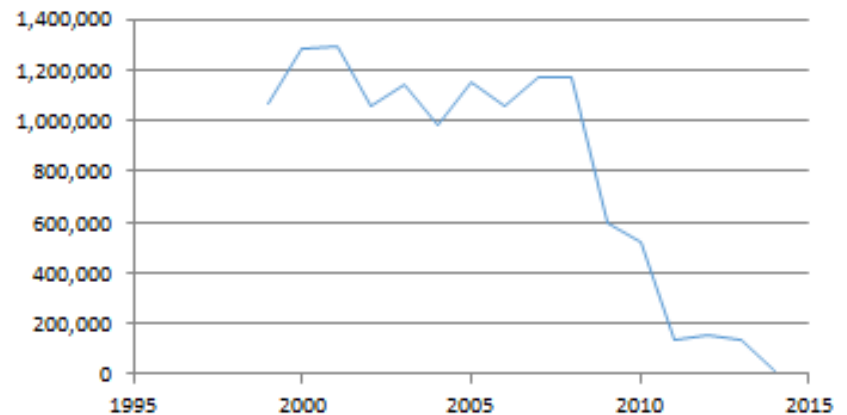
- AES Thames in 2011
- Salem Harbor in 2014
- Mount Tom in 2014
- Mason Steam units in 2003
- smaller units at Devon and Mystic

# Impact of Shutdowns – Mt. Tom

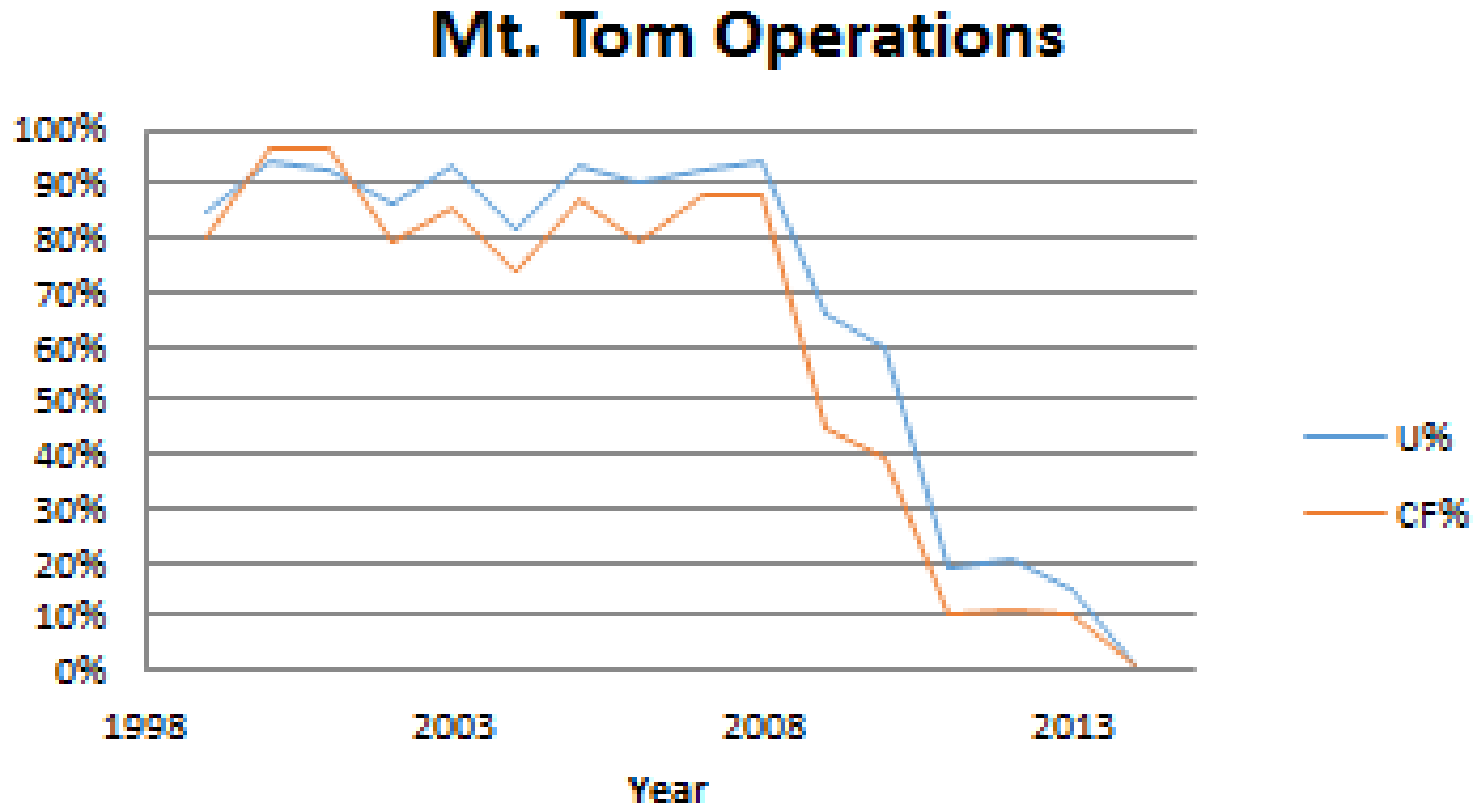
## Mt. Tom Emissions



## Mt Tom CO2



# Impact of Shutdowns – Mt. Tom



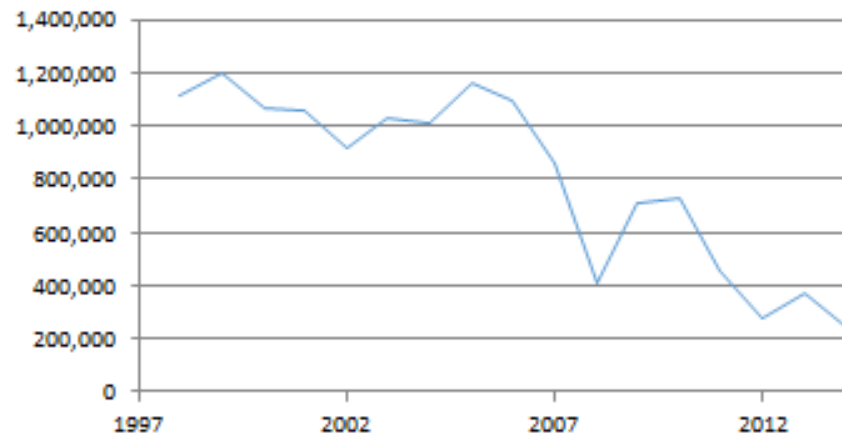


# Impact of Shutdowns – Salem Harbor

## Salem Harbor Unit 3

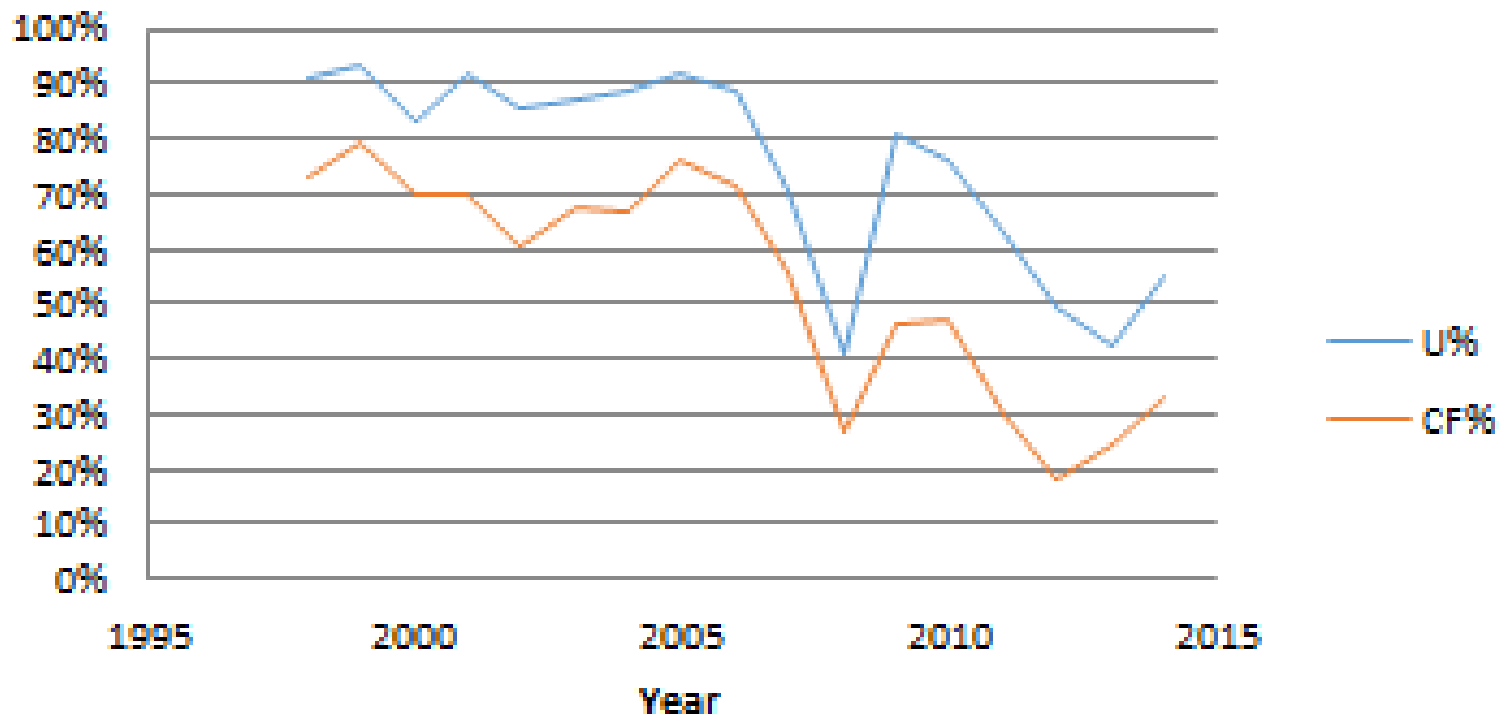


## Salem Harbor Unit 3 CO2



# Impact of Shutdowns – Salem Harbor

## Salem Harbor Unit 3



# Future Units to be Shutdown – Brayton Pt

Another ~ 3,000 MW have announced they will be shutting down

Approximately ~ 40 other units to be retired

Technologies varied among the following (with their average vintage):

Boilers 1964

Refuse 1998

Nuclear 1972

Hydro 1962

Engines 1984

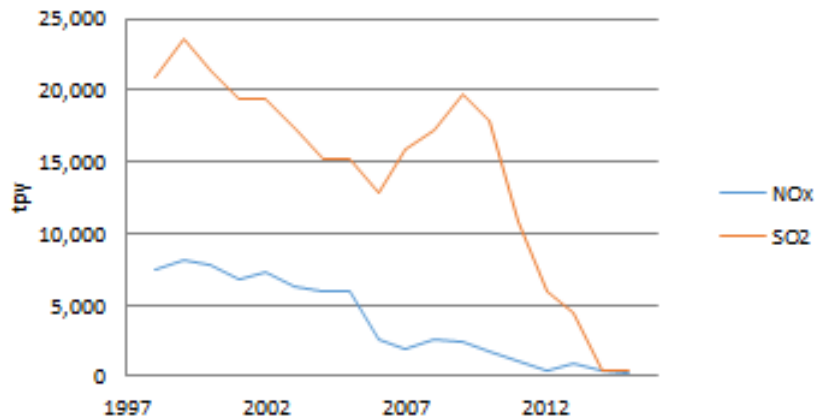
Units of note include:

- Pilgrim and VT Yankee

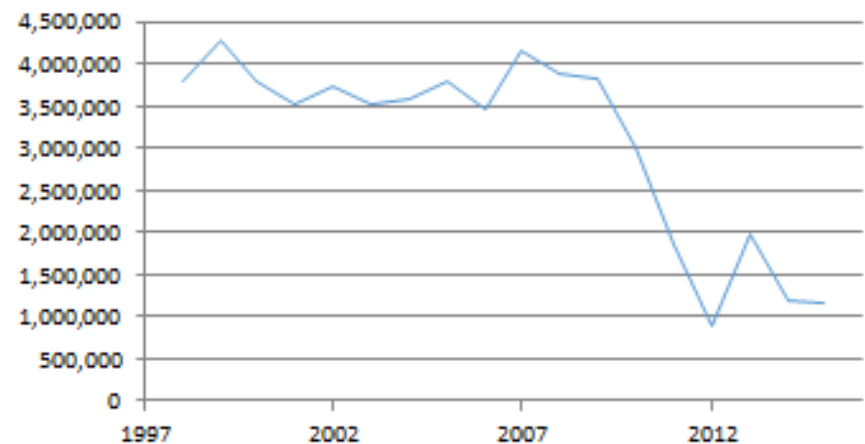
- Brayton Point, largest fossil fuel plant in ISO-NE

# Future Units to be Shutdown – Brayton Pt

**Brayton Pt Unit 3**

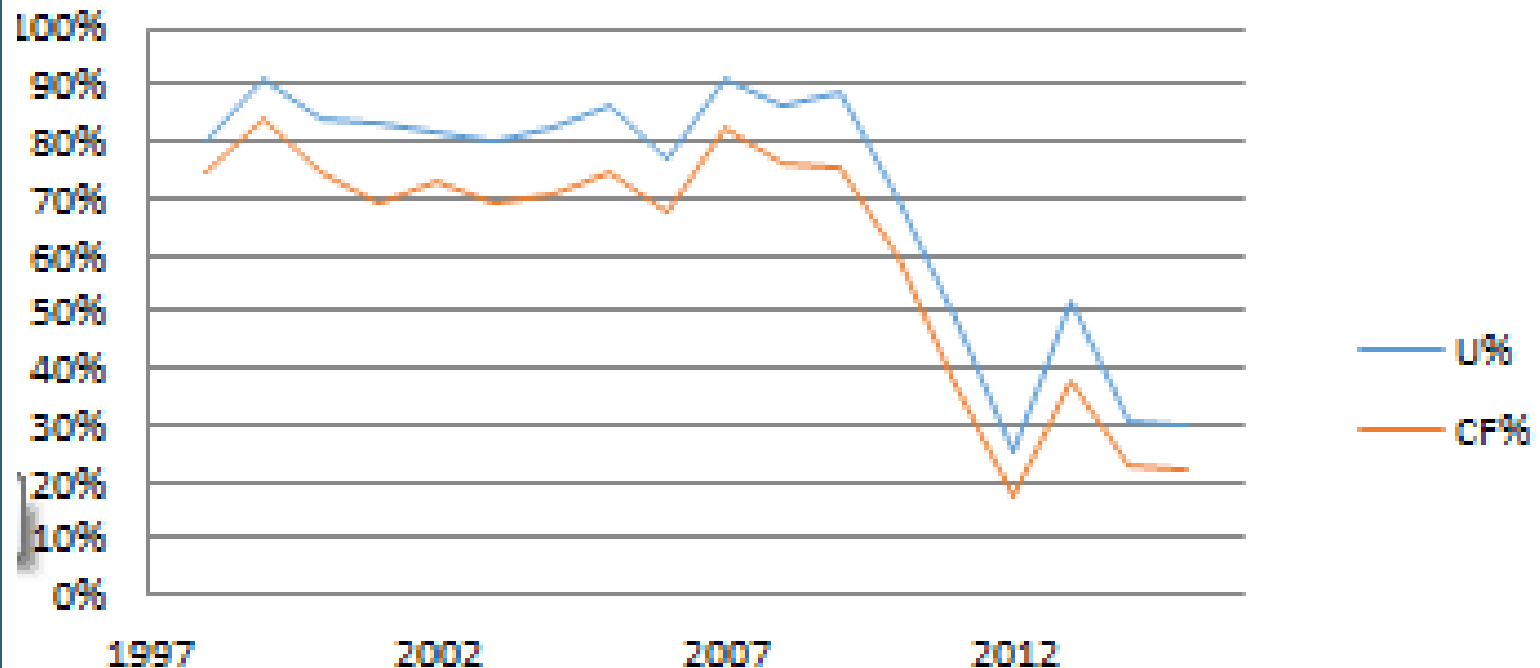


**Brayton Pt Unit 3 CO2**



# Future Units to be Shutdown – Brayton Pt

## Brayton Pt Unit 3



# Units Added During this Period

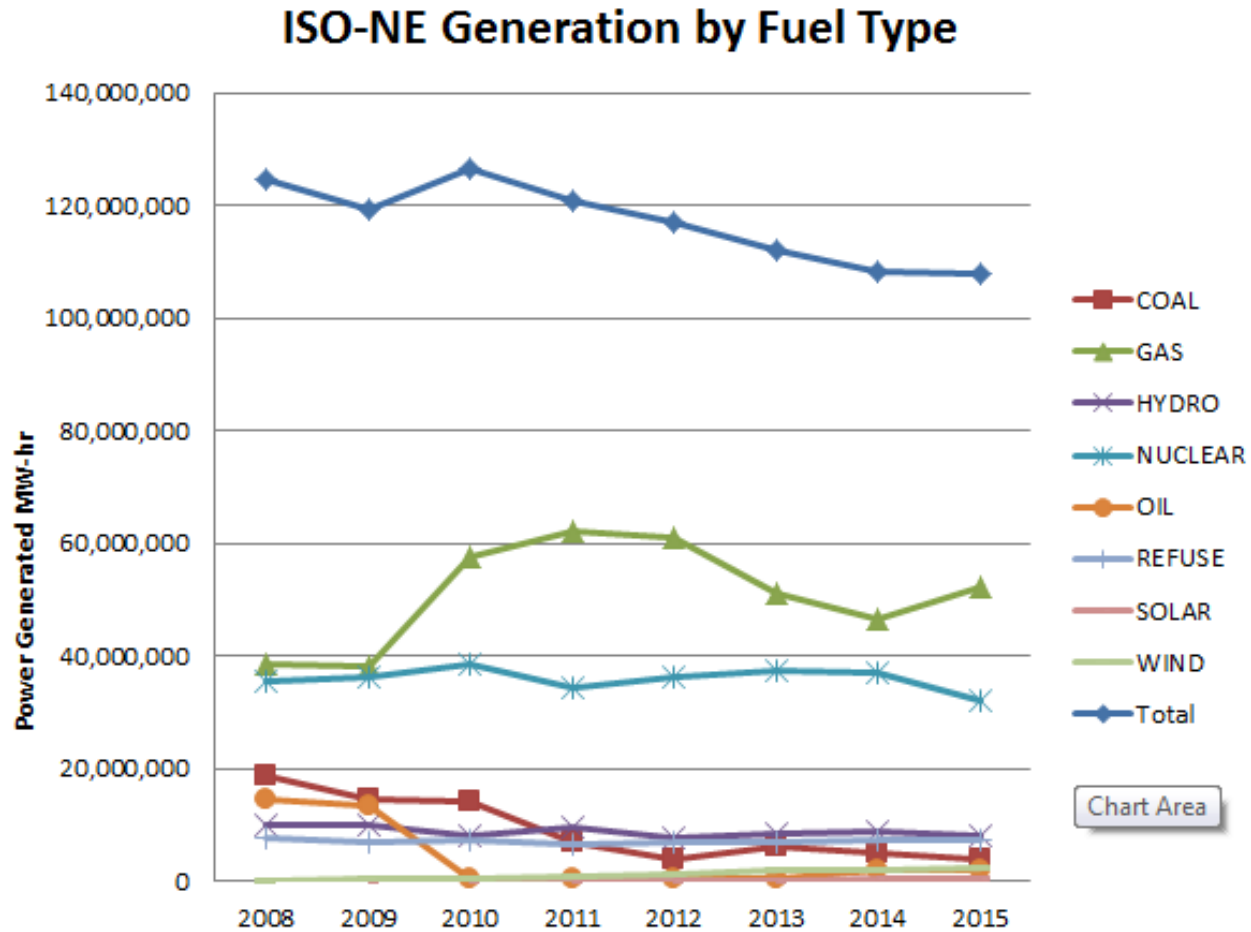
There were many GTCCs added during this period  
30 facilities, ~ 10,000 MW added, ~ 300 MW  
Vastly reduced emissions

On a much smaller scale, there were substantial number of renewable facilities (solar and wind) – although small in size and low in capacity factor

Wind – 65 units, 92 MW, average of 6 years old

Solar – 600 units, 167 MW, average of 3 years old

# ISO-NE by Generation Type





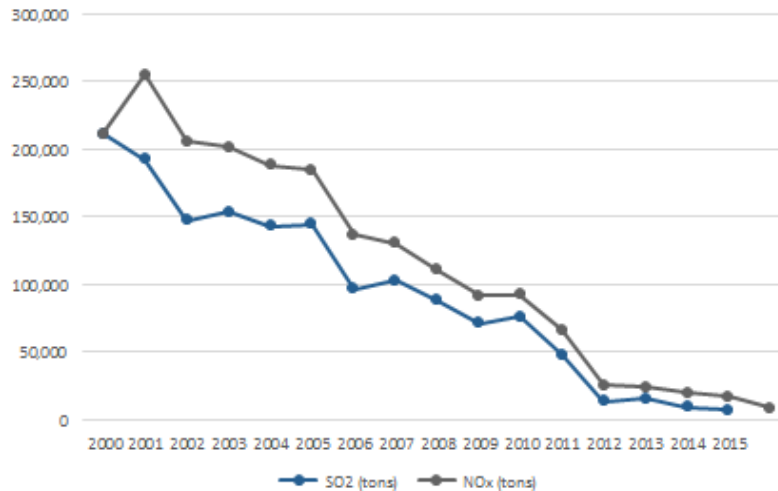
# Change in the ISO-NE Fleet

## Dramatic shift

The mix of fuels used to produce New England's electricity have changed markedly in a relatively short period of time.



# Overall ISO-NE Reduction Emissions

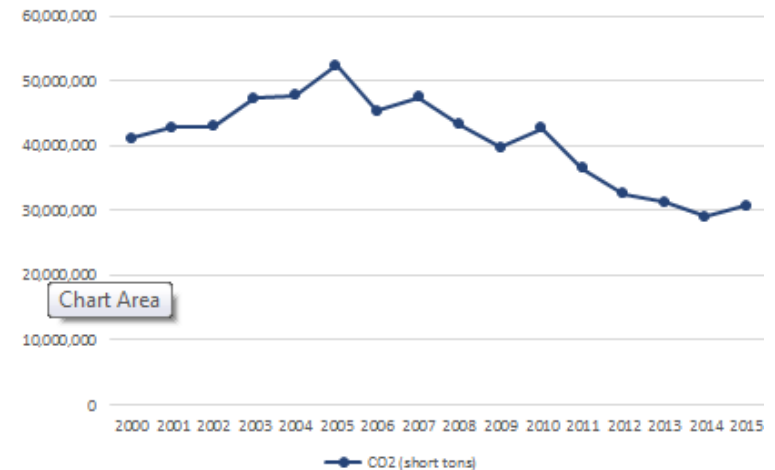


**Emission Rates**  
NOx 0.20 to 0.04 lb/MMBtu

NOx 1.5 to 0.3 lb/MW-hr

SO2 0.69 to 0.031 lb/MMBtu

SO2 5.1 to 0.3 lb/MW-hr



# Future Units to be Shutdown?

ISO-NE has substantial capacity classified as “at risk”

(all percentages are % of total MW)

5% (170 MW) of hydro  $\geq$  100 years old

23% (733 MW) of hydro  $\geq$  70 years old

26% (1,142 MW) of IC engines  $\geq$  60 years old

4% (273 MW) of steam  $\geq$  60 years old

20% (1,418 MW) of steam  $\geq$  50 years old

92% (6,470 MW) of steam  $\geq$  40 years old

39% (1,545 MW) of the nuclear  $\geq$  40 years old

31% (773 MW) of GTSC  $\geq$  40 years old

39% (11,939 MW) of ISO-NE fleet  $\geq$  40 years old

48% (14,498 MW) of ISO-NE fleet  $\geq$  30 years old

# What Happens Next

In its future planning, ISO is relying on these steam cycle power plants:

- assumes 5,600 MW steam units to remain in operation from 2019-2025
- approximately 18% of the ISO-NE installed capacity of 31,441 MW and total of 34,277 MW – 2746 DR and 90 imports (down from 1,337 in 2015)
- also assumes ~8,000 MW nuclear, GTSC, IC and bio/refuse all unchanged in operation from 2019-2025
- In 2025, the Summer Peak will be 31,794 MW – it is offset by Behind the Meter Solar and Demand Response (31,794-828 BTM – 3844 PDR) = 27,122
- Worst case, there is up to 13,641 MW of potentially at risk generation
  - 8,890 MW  $\geq$  40 years old
  - 11,042 MW  $\geq$  30 years old
- Average Operational Statistics of the Steam Cycle Facilities
  - $\geq$  60 years old – 70 MW, 13,000 Btu/kW-hr, 7% CF
  - $\geq$  50 years old – 89 MW, 11,900 Btu/kW-hr, 10% CF
  - $\geq$  40 years old – 451 MW, 11,600 Btu/kW-hr, 7% CF

# Units at Risk

Age	Unit	HR	U%	CF%	NOx	SOx	CO2	MW	risk/sd
60 yrs	Schiller 4	12,260	34%	22%	162	632	119,486	48	risk
60 yrs	Montville 5	12,117	4%	2%	15	19	15,188	82	risk
60 yrs	West Springfield 3	14,396	10%	3%	14	36	19,971	100	risk
60 yrs	Yarmouth 1	13,754	10%	3%	14	44	10,492	50	risk
50 yrs	Schiller 6	11,619	30%	20%	146	560	109,822	48	risk
50 yrs	Middletown 2	12,375	15%	9%	70	26	65,168	120	risk
50 yrs	Yarmouth 2	12,435	10%	2%	17	47	11,679	53	risk
50 yrs	Norwalk Harbor 1	sd						0	sd
50 yrs	Mt Tom	sd						0	sd
50 yrs	Merrimack 1	10,348	45%	34%	624	1,871	433,215	108	risk
50 yrs	Norwalk Harbor 2	11,928	4%	1%	13	22	13,085	0	risk
50 yrs	Brayton Pt 1	sd						241	sd
50 yrs	Middletown 3	10,785	10%	5%	149	30	73,499	244	risk
50 yrs	Brayton Pt 2	sd						242	sd
50 yrs	Yarmouth 3	10,966	9%	3%	27	123	31,124	114	risk
50 yrs	Cleary 8	15,070	3%	2%	8	24	4,880	22	risk
40 yrs	Merrimack 2	10,100	38%	27%	1,299	3,430	1,004,194	331	
40 yrs	Canal 1	10,453	4%	2%	63	204	90,411	562	
40 yrs	Bridgeport Harbor 3	10,422	24%	16%	402	614	615,640	385	
40 yrs	Brayton Pt 3	sd						599	sd
40 yrs	Montville 6	13,648	2%	1%	34	33	25,994	407	
40 yrs	Middletown 4	14,468	2%	1%	42	50	28,518	402	
40 yrs	Newington 1	12,902	9%	3%	122	267	110,456	400	
40 yrs	Brayton Pt 4	sd						446	sd
40 yrs	Mystic 7	11,273	14%	4%	167	491	170,290	560	
40 yrs	New Haven Harbor	10,407	11%	4%	89	137	116,131	453	
40 yrs	Canal 2	11,104	5%	2%	61	89	61,465	559	

# Conclusions

For many reasons, older facilities are being decommissioned

These decommissioned facilities have substantially reduced emissions fleet-wide

There is now a substantial overreliance on GTCC

We need to permit new facilities, preferably not just natural gas

Based on passed permitting experience, repowering existing facilities is much more optimal than greenfield development

Most development has ground to a halt, limited to expansion at existing facilities

ISO-NE needs to incentivize developers to be able to replace these older units