2006 Marginal Emissions Analysis (MEA)

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Review Process

- This presentation has been reviewed by the Environmental Advisory Group (EAG) and Power Supply Planning Committee (PSPC)
  - Primary recommendation of EAG was to create a broader document based on an hourly analysis, which would include demand response and energy efficiency
  - This recommendation will be considered for future MEA Reports
- Comments received from EAG, PSPC and Planning Advisory Committee (PAC) regarding the 2005 MEA Report were incorporated into the report as appropriate and feasible

MEA Development

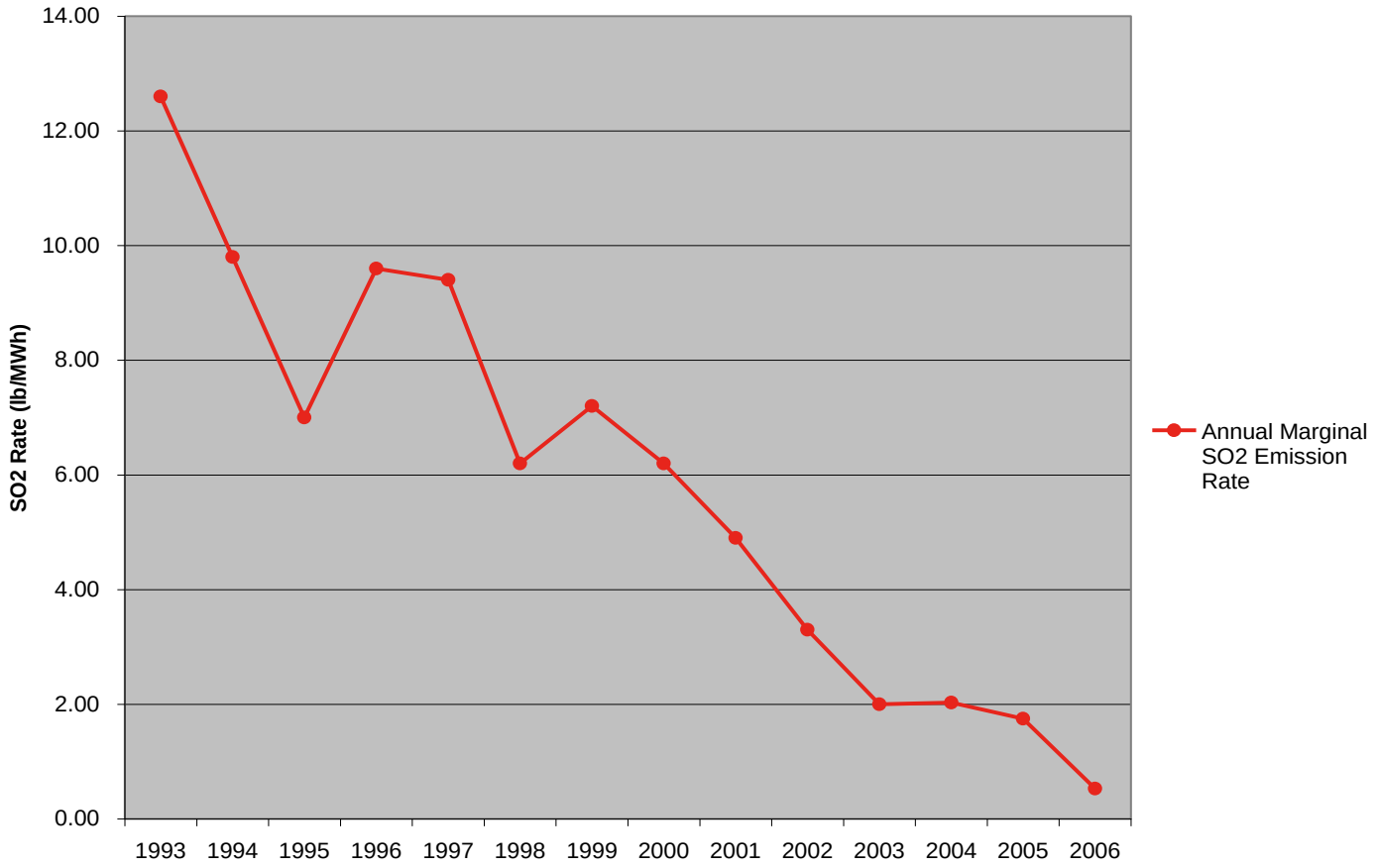
- The marginal emission rates were calculated based on
  - 2006 actual hourly energy production from New England's natural gas and oil units
  - Best available emissions data and/or emission rates for these units
  - Assumes that oil and gas units providing energy are representative of those units that would provide the marginal generation
  - The marginal emission rates calculated are effectively the energy-weighted emission rates for all oil and gas units
- Fossil units not burning gas or oil have *not* been used in calculating the marginal rate
  - Units fueled by coal, wood, biomass and landfill gas are typically dispatched as "baseload" units
  - These units may not operate any differently under the scenario with more electrical demand on the system

See presentation appendix for further details.

MEA Development (cont.)

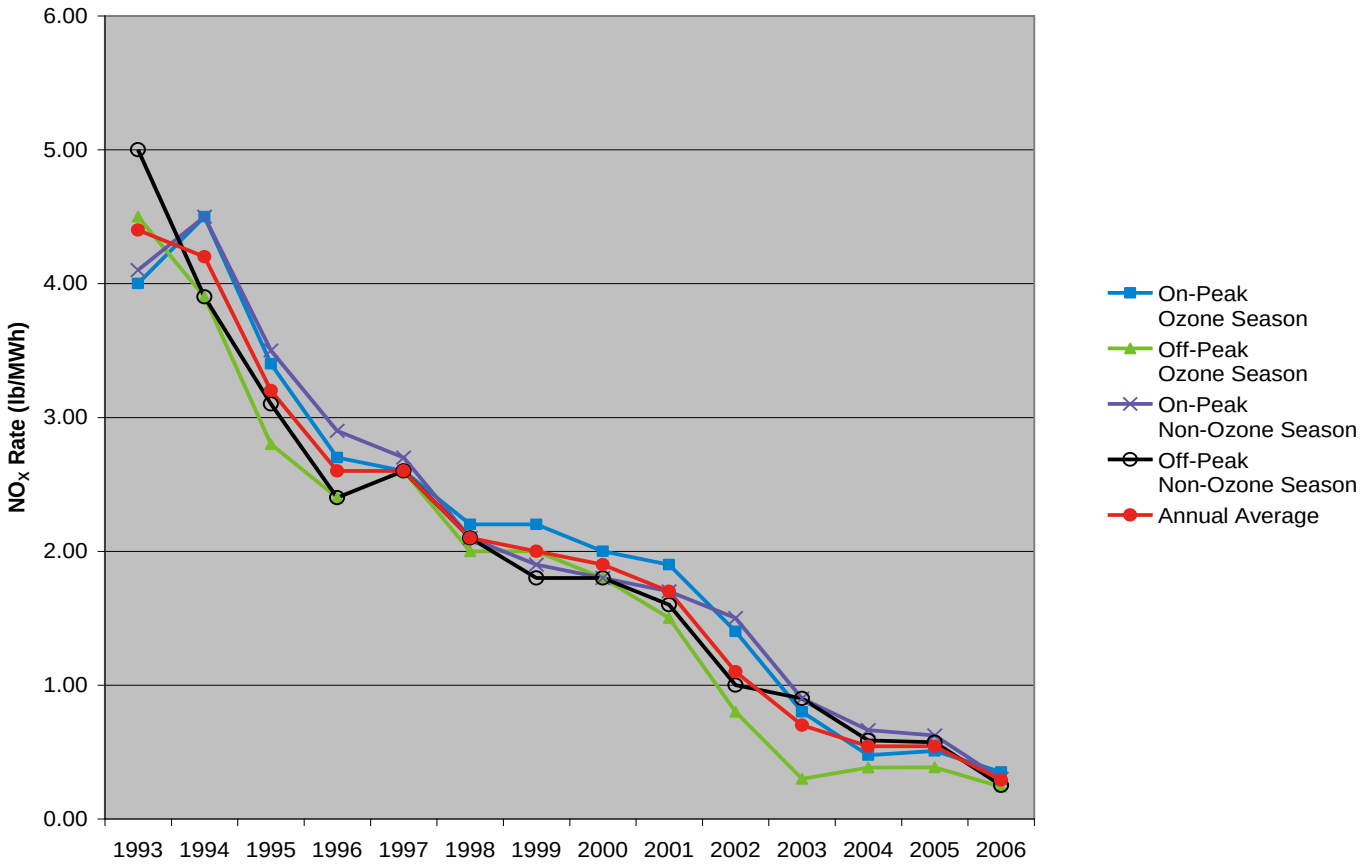
- Sources of Generator Unit Emissions Data
  - Primarily Environmental Protection Agency (EPA) website
    - Clean Air Markets Database for units that are under the Acid Rain and NO_X Budget Programs
  - Generation Information System (GIS) data used to fill in gaps as needed
  - Remaining data from eGRID (2004 emission rates) or historically assumed emission rates

Draft SO_2 MEA Results



- **1993-2003: Production Simulation Method**
- **2004: Intermediate Fossil Method with Annual Rates**
- **2005 & 2006: Intermediate Fossil Method with Monthly and Annual Rates**

Draft NO_X MEA Results



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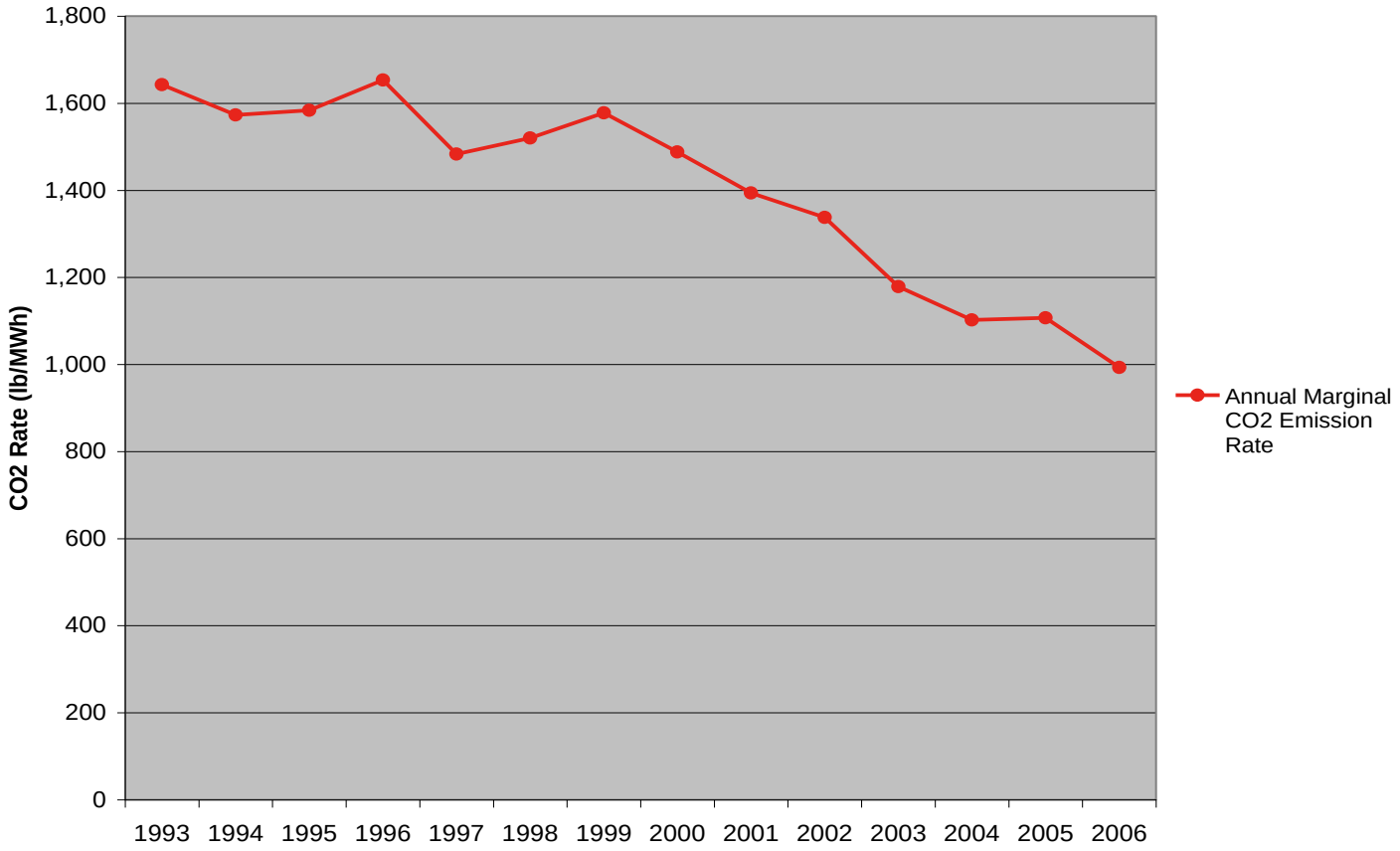

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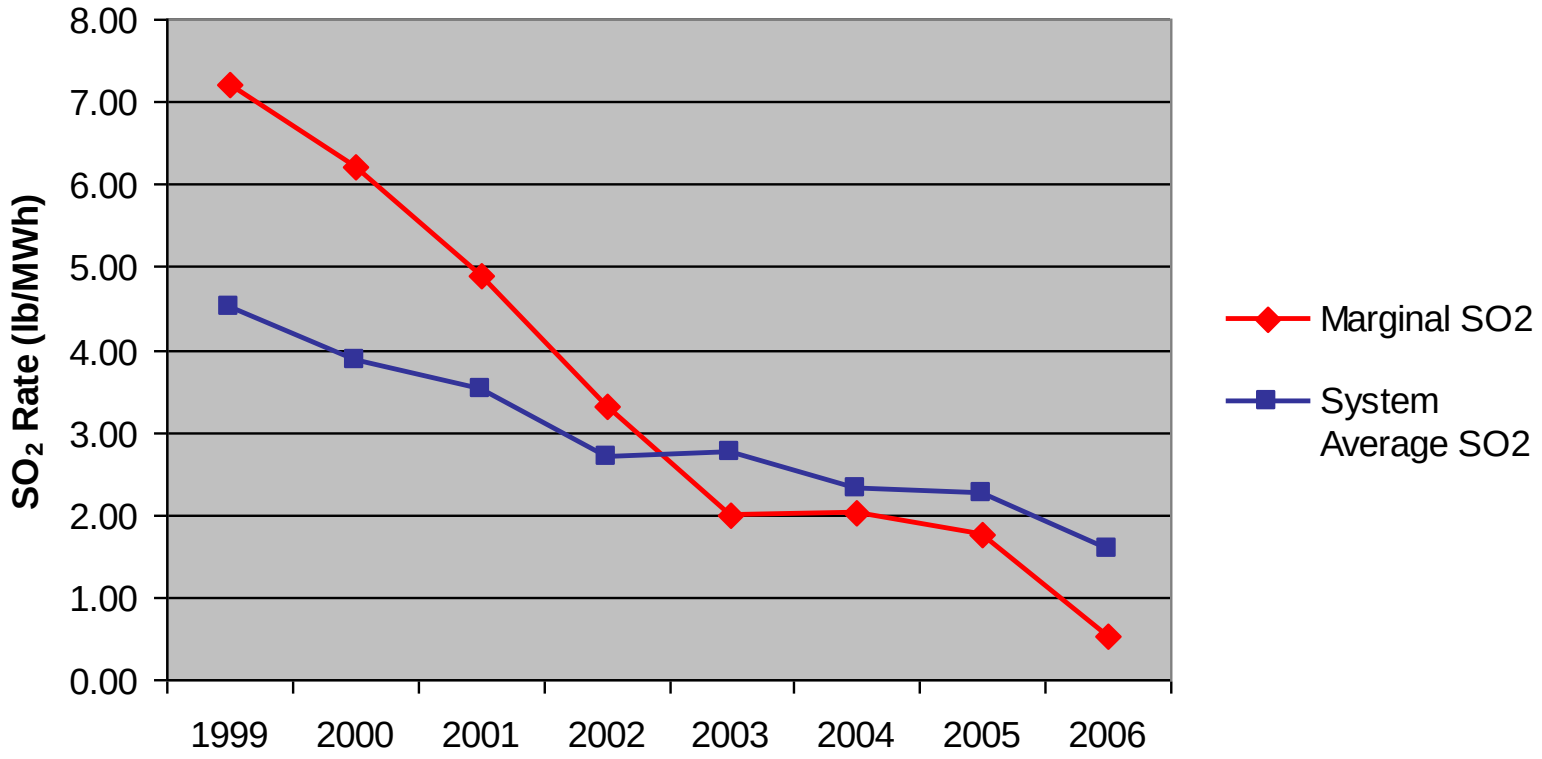
2001 – 2006 New England Generation System Annual Aggregate Emissions (kTons)

Year	SO_2	NO_X	CO_2
2001	200.01	59.73	52,991
2002	161.10	56.40	54,497
2003	159.41	54.23	56,278
2004	149.75	50.64	56,723
2005	150.00	58.01	60,580
2006	101.78	42.86	51,649

1999 – 2006 Marginal and System Average SO_2 Emission Rates in lb/MWh



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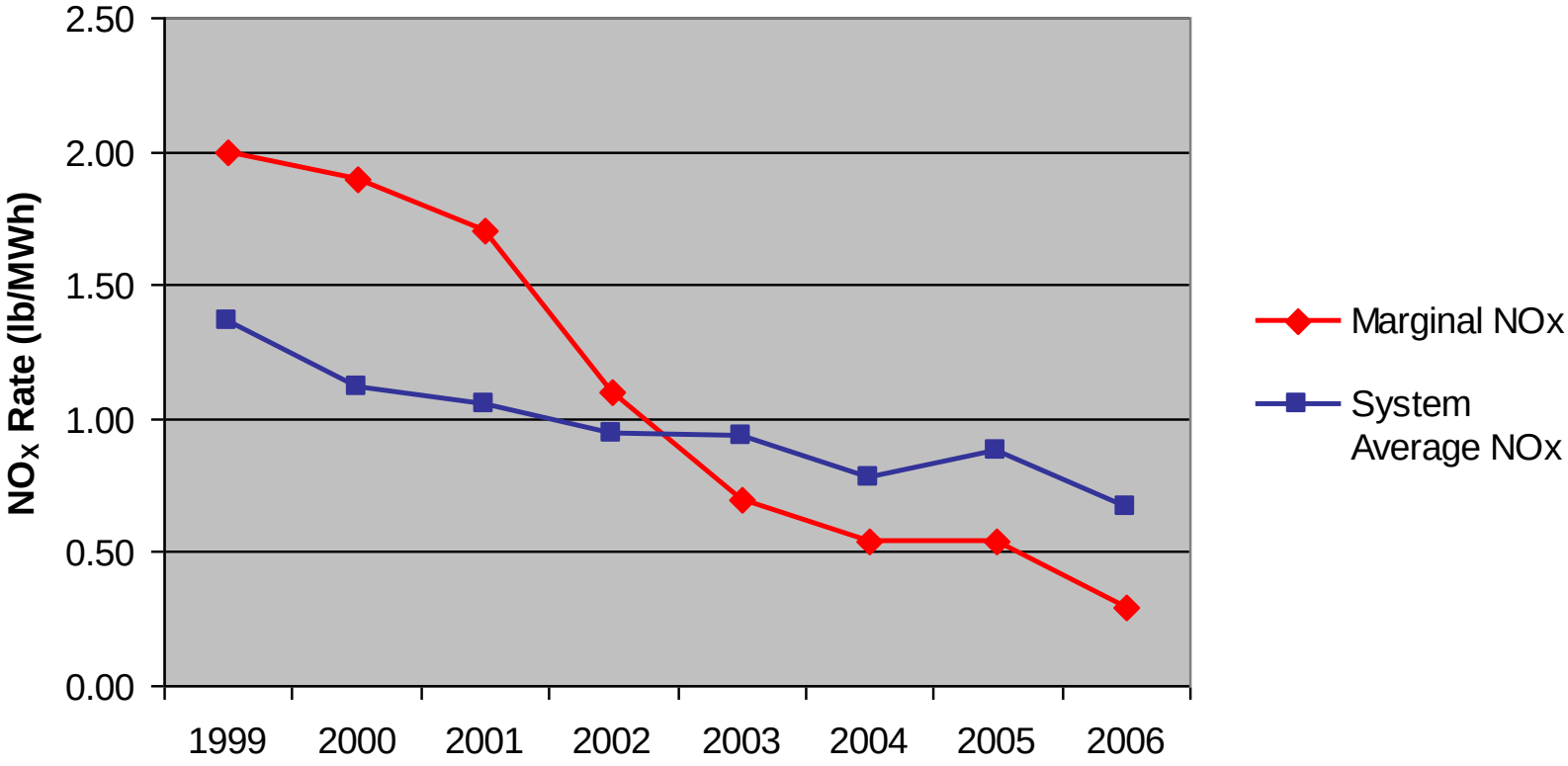

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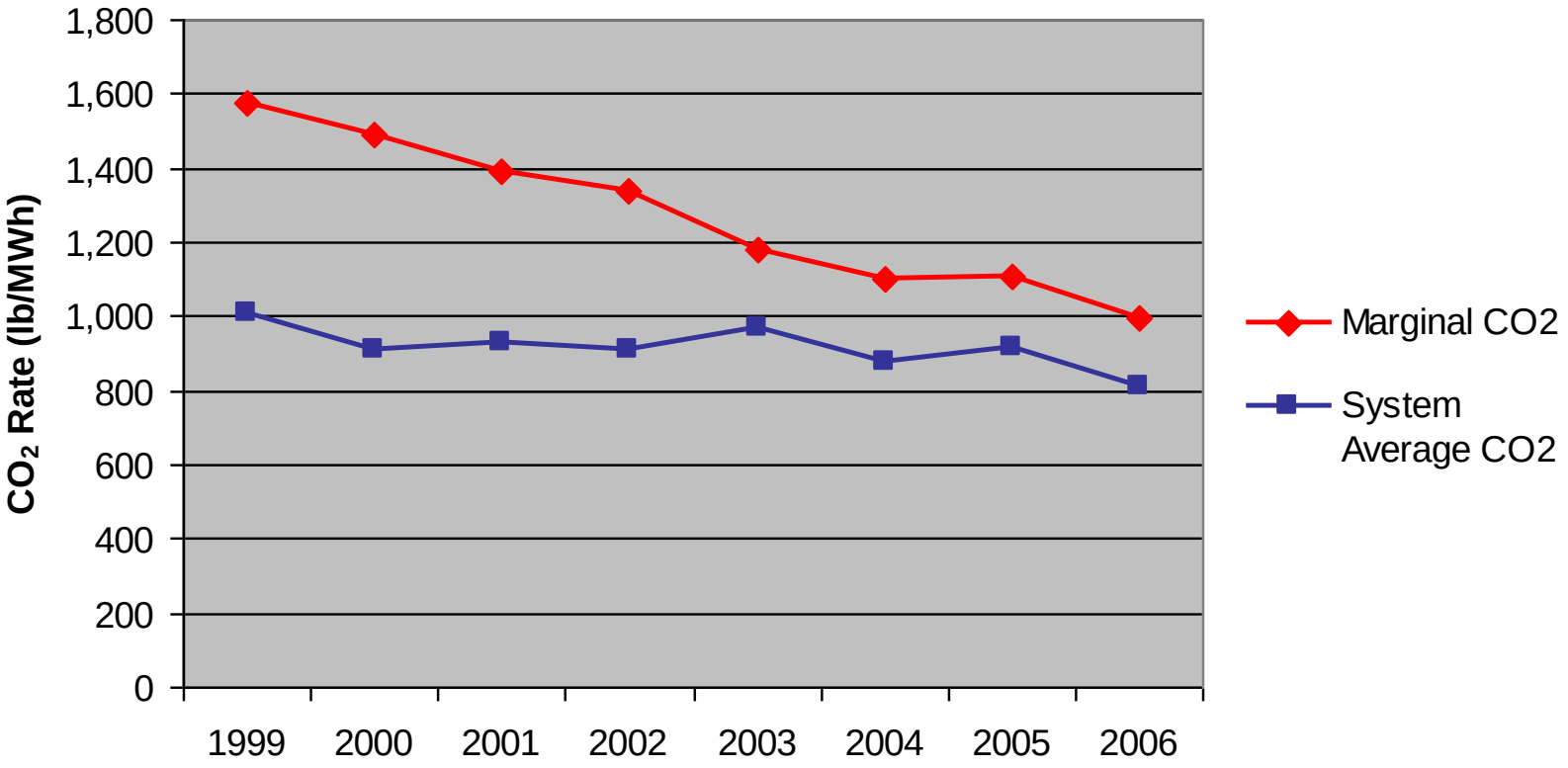
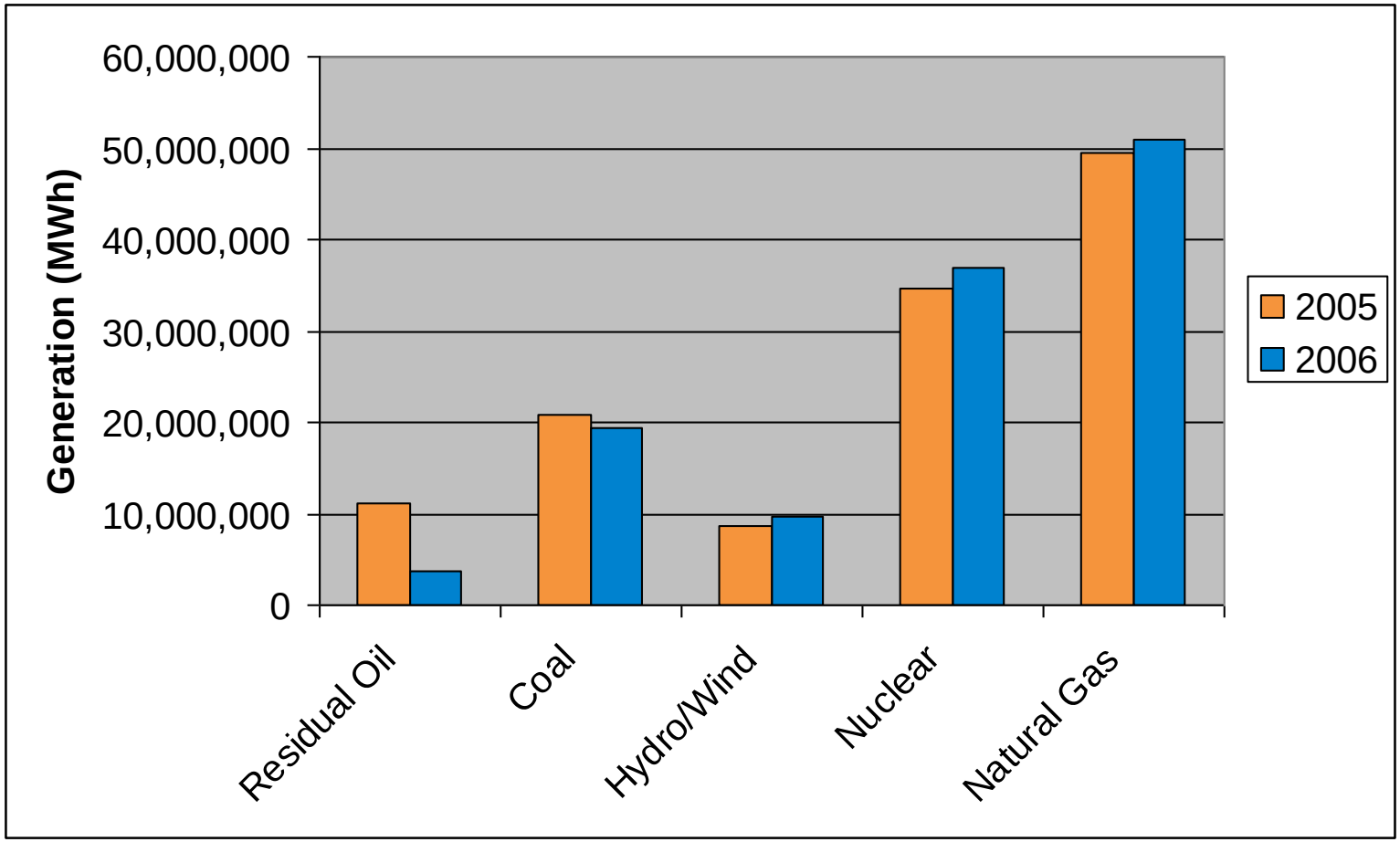


Generation Changes in MWh
2005 vs. 2006



Observations

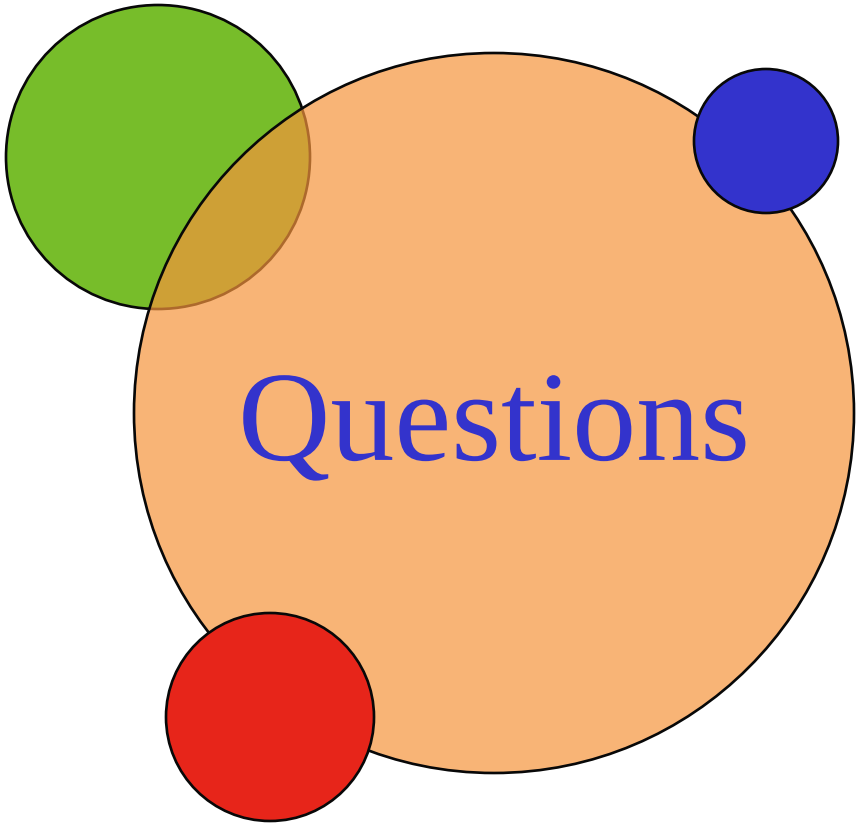
- The significant change in marginal and total system emissions can be explained by these factors
  - System energy production was lower in 2006
  - Oil unit generation decreased significantly
  - Coal generation decreased slightly
  - Hydro, nuclear and natural gas generation increased slightly
  - System load decreased in 2006
    - Net interchange did not change significantly
    - Higher energy prices in 2006 impacted demand

Conclusions

- Marginal emission rates have decreased significantly between 1993 and 2006
  - Over 93% reduction in SO_2 and NO_X
  - Nearly 40% reduction in CO_2
- Significant reductions in all three marginal emissions occurred between 2005 and 2006

2006 Marginal and System Annual Emission Rates

	Marginal Emissions		System Emissions	
	Annual Rate (lb/MWh)	Percent Change 2005 to 2006	Annual Rate (lb/MWh)	Percent Change 2005 to 2006
SO_2	0.53	-70%	1.59	-30%
NO_X	0.29	-46%	0.67	-24%
CO_2	993	-10%	808	-12%



Appendix

MEA Development and Calculation Details and Emission Rate Graph Details

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What is the MEA?

- MEA provides calculated marginal emission rates that can be used to estimate the impact of load reduction, such as would result from DSM programs, on New England's SO_2, NO_X, and CO_2 generating unit emissions
- Currently, the MEA is based on emissions from all New England gas and oil-fired generation

MEA Development

- Marginal emission rates for NO_X calculated for five defined time-periods
  - On-Peak Ozone
  - On-Peak Non-Ozone
  - Off-Peak Ozone
  - Off-Peak Non-Ozone
  - Annual
- SO_2 and CO_2 emissions calculated for on- and off-peak periods on an annual basis
- Time Period Definitions
  - Ozone = May through September
  - Non-Ozone = October through April
  - On-Peak = Hour Ending 9 AM through Hour Ending 10 PM
  - Off-Peak = Hour Ending 11 PM through Hour Ending 8 AM

Calculation Method

- Establish emission rates for units with monthly emission totals
  - lb/MWh = monthly emissions (lb) / monthly total generation (MWh)
- For each unit
  - With monthly emission rates
    - Unit monthly emission rate (lb/MWh) x monthly gen. during on-peak or off-peak hours (MWh) = monthly emissions (lb) for on- or off-peak
  - With annual emission rates
    - Unit annual emission rate (lb/MWh) x monthly gen. during on-peak or off-peak hours (MWh) = monthly emissions (lb) for on- or off-peak

Calculation Method (cont.)

- Group monthly on-peak and off-peak emissions into ozone or non-ozone time periods
  → Total lbs. in time period
- Total lbs. in time period / MWh in time period
  = emission rate for time period

Draft SO_2 MEA Results – Historical Details (lb/MWh)

Year	Annual Rate
1993	12.60
1994	9.80
1995	7.00
1996	9.60
1997	9.40
1998	6.20
1999	7.20
2000	6.20
2001	4.90
2002	3.30
2003	2.00
2004	2.03
2005	1.75
2006	0.53

Draft SO_2 MEA Results – State Details (lb/MWh)

State	On-Peak	Off-Peak	Annual
Connecticut	0.45	0.29	0.38
Maine	0.13	0.05	0.09
New Hampshire	1.11	0.21	0.66
Rhode Island	0.01	0.01	0.01
Vermont	4.72	4.43	4.63
Massachusetts	0.84	0.79	0.82
New England Total	0.60	0.47	0.53

Draft NO_X MEA Results – Historical Details (lb/MWh)

	Ozone Season		Non-Ozone Season		
Year	**On-Peak**	**Off-Peak**	**On-Peak**	**Off-Peak**	**Annual**
1993	4.00	4.50	4.10	5.00	4.40
1994	4.50	3.90	4.50	3.90	4.20
1995	3.40	2.80	3.50	3.10	3.20
1996	2.70	2.40	2.90	2.40	2.60
1997	2.60	2.60	2.70	2.60	2.60
1998	2.20	2.00	2.10	2.10	2.10
1999	2.20	2.00	1.90	1.80	2.00
2000	2.00	1.80	1.80	1.80	1.90
2001	1.90	1.50	1.70	1.60	1.70
2002	1.40	0.80	1.50	1.00	1.10
2003	0.80	0.30	0.90	0.90	0.70
2004	0.48	0.38	0.66	0.59	0.54
2005	0.51	0.39	0.62	0.57	0.54
2006	0.35	0.24	0.30	0.25	0.29

Draft NO_X MEA Results – State Details (lb/MWh)

	Ozone Season		Non-Ozone Season		
State	On-Peak	Off-Peak	On-Peak	Off-Peak	Annual
Connecticut	0.56	0.36	0.42	0.35	0.43
Maine	0.17	0.14	0.15	0.15	0.16
New Hampshire	0.26	0.09	0.25	0.10	0.18
Rhode Island	0.14	0.10	0.16	0.14	0.14
Vermont	5.76	4.91	5.45	4.81	5.37
Massachusetts	0.39	0.26	0.33	0.30	0.32
New England Total	0.35	0.24	0.30	0.25	0.29

Draft CO_2 MEA Results – Historical Details (lb/MWh)

Year	Annual Rate
1993	1,643
1994	1,573
1995	1,584
1996	1,653
1997	1,484
1998	1,520
1999	1,578
2000	1,488
2001	1,394
2002	1,338
2003	1,179
2004	1,102
2005	1,107
2006	993

Draft CO_2 MEA Results – State Details (lb/MWh)

State	On-Peak	Off-Peak	Annual
Connecticut	1,062	994	1,030
Maine	968	981	975
New Hampshire	952	882	917
Rhode Island	933	910	925
Vermont	2,258	2,196	2,238
Massachusetts	1,027	1,003	1,015
New England Total	1,106	977	993