

Environmental Issues for NCSP06

Jim Platts – ISO New England

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Presentation Objectives

- Provide an update on environmental regulations and policies affecting air emissions and thermal discharges from electric generating plants in the Northeastern U.S.
- Focus on Regional Greenhouse Gas Initiative (RGGI), mercury and High Electric Demand Days (HEDD) pending regulations
- Present status of renewable resource developments
- Discuss their potential significance on system planning and system reliability

Recent Environmental Developments

- Massachusetts, Rhode Island, and Maryland have joined the Regional Greenhouse Gas Initiative (RGGI)
- States' Mercury Rules are being finalized
- Ozone Transport Commission is selecting policy options to reduce NOx on High Electric Demand Days (HEDD)
- UN's Intergovernmental Panel on Climate Change (IPCC) new report indicates more certainty on human induced climate change: <http://www.ipcc.ch/>
- Canada's revising its approach to its climate change (Kyoto) commitment.

A Refresher: Criteria Air Pollutants

- U.S. EPA determined that Criteria Pollutants (CPs) are harmful to human health and/or property above certain concentrations (in $\mu\text{g}/\text{m}^3$) mostly in urban areas
 - U.S. has six CPs: SO_2 , NO_x , CO, particulates (PM-10 and PM 2.5), ozone (1 and 8 hour) and lead
 - Canada has five Criteria Air Contaminants (CAC): SO_2 , NO_x , CO, particulates and VOCs
- Environmental goal is to move toward meeting the National Ambient Air Quality Standards (NAAQS) concentrations that have been set by the U.S. EPA and Canada's CEPA.
- Many U.S. regions are still in “non-attainment” for many of the CPs, i.e. ozone and particulates
- State Implementation Plans (SIPs) are developed by states and continually revised to inform EPA how attainment of the NAAQS will be met

Power Plant Air Impacts

- “In the United States, power generation is responsible for 63% of sulfur dioxide (SO₂), 22% of nitrogen oxides (NO_x), and 37% of the mercury released to the environment by human activity...”
(Source U.S. EPA)
- According to the U.S. EPA environmental and public health problems resulting from these emissions include:
 - Diseases of the cardiovascular and respiratory systems associated with exposure to fine particles (particulate matter) and ozone;
 - Ozone damage to forests;
 - Acidification of lakes, streams, and forests;
 - Acidic damage and erosion of buildings, statuary, and other materials;
 - Ecosystem and public health effects associated with the accumulation of mercury in fish and other wildlife;
 - Regional haze that impairs visibility in national parks and wilderness areas;
 - Eutrophication (a condition in an aquatic ecosystem where high nutrient concentrations stimulate blooms of algae) in coastal areas”

Principal Regulated Power Plant Air Emissions and Water Discharges

- Air
 - SO₂
 - NO_x (ozone)
 - Particulates
 - Mercury
 - CO₂
- Water
 - Plant water intake and thermal discharge

Matrix of U.S. Air Regulations

Pollutant	Federal	State	Regional
SO ₂	CAAA, CAIR	CT, MA, NH	
NO _x (ozone)	CAAA, CAIR	CT, MA	OTC: CAIR Plus, HEDD
CO ₂		MA, NH	RGGI
Mercury	CAMR	CT, MA, NH	
Particulates	CAIR, CAVR		

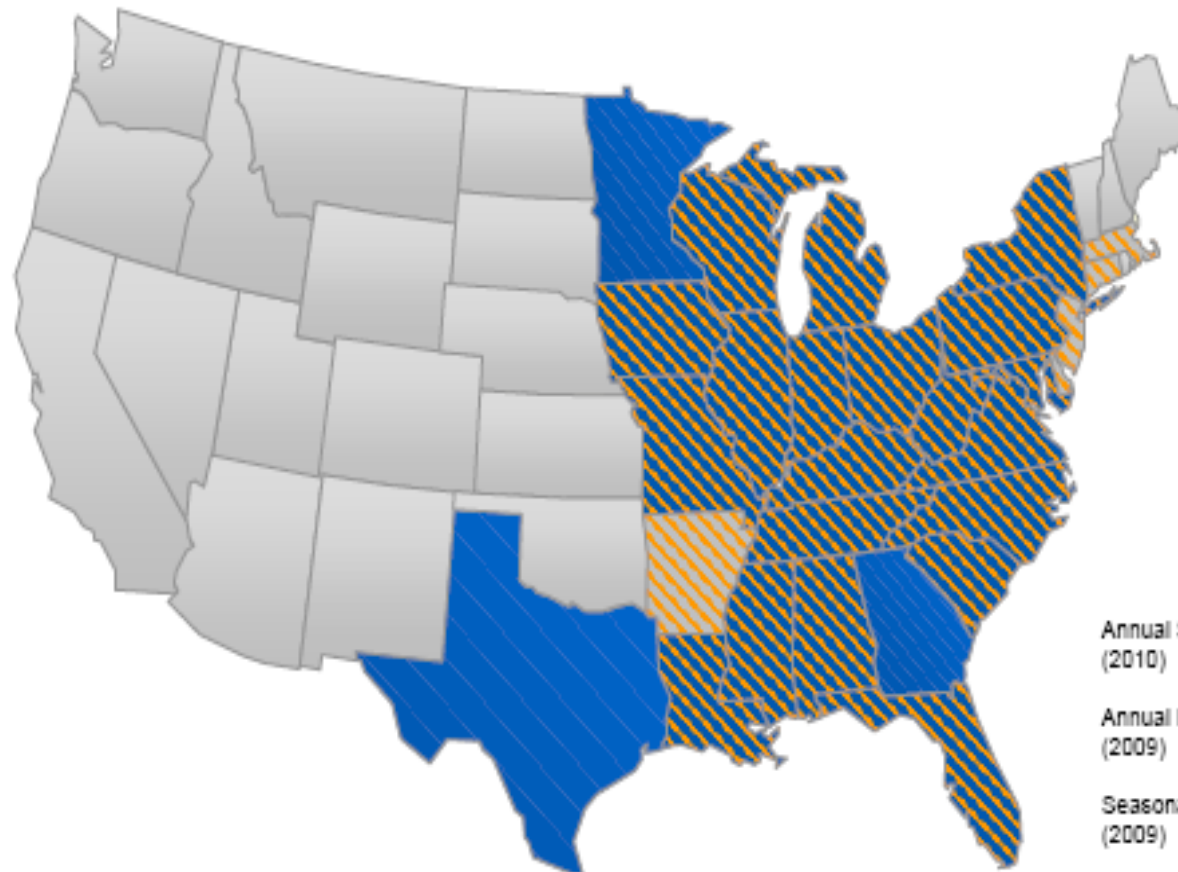
Air Regulations – Federal





- 1990 Clean Air Act Amendments (CAAA)
 - Set SO₂ Caps 1995 and 2000 (9.8 million tons)
 - NO_x Reasonable Available Control Technology (RACT)
 - Established Ozone Transport Region
- Clean Air Interstate Rule (CAIR) EPA 2005
 - Affects Eastern U.S.
 - Sets lower regional SO₂ Caps 2010, 2015
 - Sets lower regional NO_x Caps 2009, 2015
 - Particulates
- Clean Air Mercury Rule (CAMR) EPA 2005
 - Sets caps in 2010 and 2018 for all coal plants
- Clean Air Visibility Rule (CAVR) EPA

EPA Clean Air Interstate Rule (CAIR)

- Covers 28 eastern states plus Washington DC
- Health benefits estimated by EPA by 2015 at \$85 to 100 billion and prevention of 17,000 premature deaths
- SO₂
 - By 2010: reduce 45% from 2003 levels, or by 4.3 million tons
 - By 2015: reduce by another 1.1 million tons to 2.5 million tons
 - Reduces total power plant SO₂ emissions from 77% from 1990 to 2015: 15.7 million tons to 3.5 million tons
- NO_x
 - By 2009: reduce 53% from 2003 levels or 1.7 million tons
 - By 2015: reduce another 0.4 million tons to 1.3 million tons
 - Reduces total power plant emissions 67% from 1990 to 2015: 6.7 million tons to 2.2 million tons
- Establishes federal cap-and-trade framework and states can choose their own cap and trade system

CAIR: Affected Region and Emission Caps



-  States controlled for fine particles (annual SO₂ and NO_x)
-  States controlled for ozone (ozone season NO_x)
-  States controlled for both fine particles (annual SO₂ and NO_x) and ozone (ozone season NO_x)
-  States not covered by CAIR

Emission Caps*

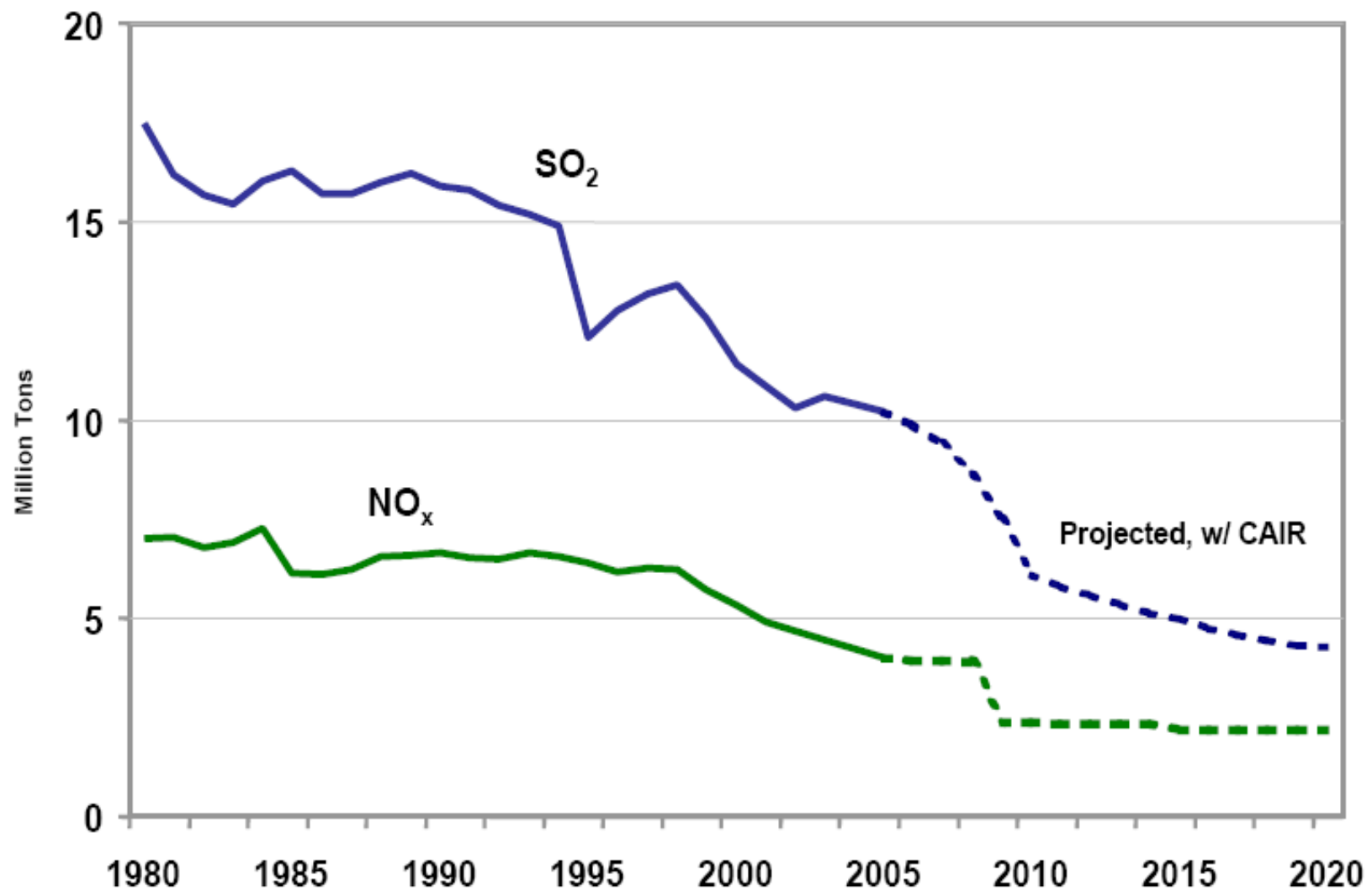
(million tons)

	<u>2009/2010</u>	<u>2015</u>
Annual SO ₂ (2010)	3.6	2.5
Annual NO _x (2009)	1.5	1.3
Seasonal NO _x (2009)	.58	.48

*For the affected region.

Source: http://www.dnr.mo.gov/env/apcp/cair_camr/8-17-05mtg/epa_mdnr_cair_camr_ii.pdf

National NO_x and SO₂ Power Plant Emissions: Historic and Projected with CAIR



Source: EPA

EPA Clean Air Mercury Rule (CAMR)

- Applies “standards of performance” for mercury emissions from all existing and new coal plants
- Creates a market based cap-and-trade program to reduce mercury emissions in two steps
 - By 2010 reduce total U.S. emissions from 48 to 38 tons. Will be achieved by the “co-benefits” of CAIR’s SO₂ and NO_x reductions
 - By 2018 reduce to 15 tons
 - New coal plants (starting construction after 1/30/04) will have stringent new mercury emission standards in addition to cap
 - States allowed flexibility on how to implement rule
- U.S. coal plants contribute about 1% to worldwide mercury emissions (Source: EPA)

Regional Haze Rule

- EPA Regional Haze Rule requires Best Available Retrofit Technology (BART) to reduce haze in national parks and wilderness areas
- Could affect 13 New York plants and require controls by 2013. These could include
 - SO₂ scrubbers
 - Selective Catalytic Reduction (SCR) for NO_x
 - Fabric filters for particulates
- Maine, NH and VT have affected areas. SIPs are due 2008
- States opting for CAIR Rule will get a waiver from BART, i.e. CAIR achieves better results

State Air Regulations

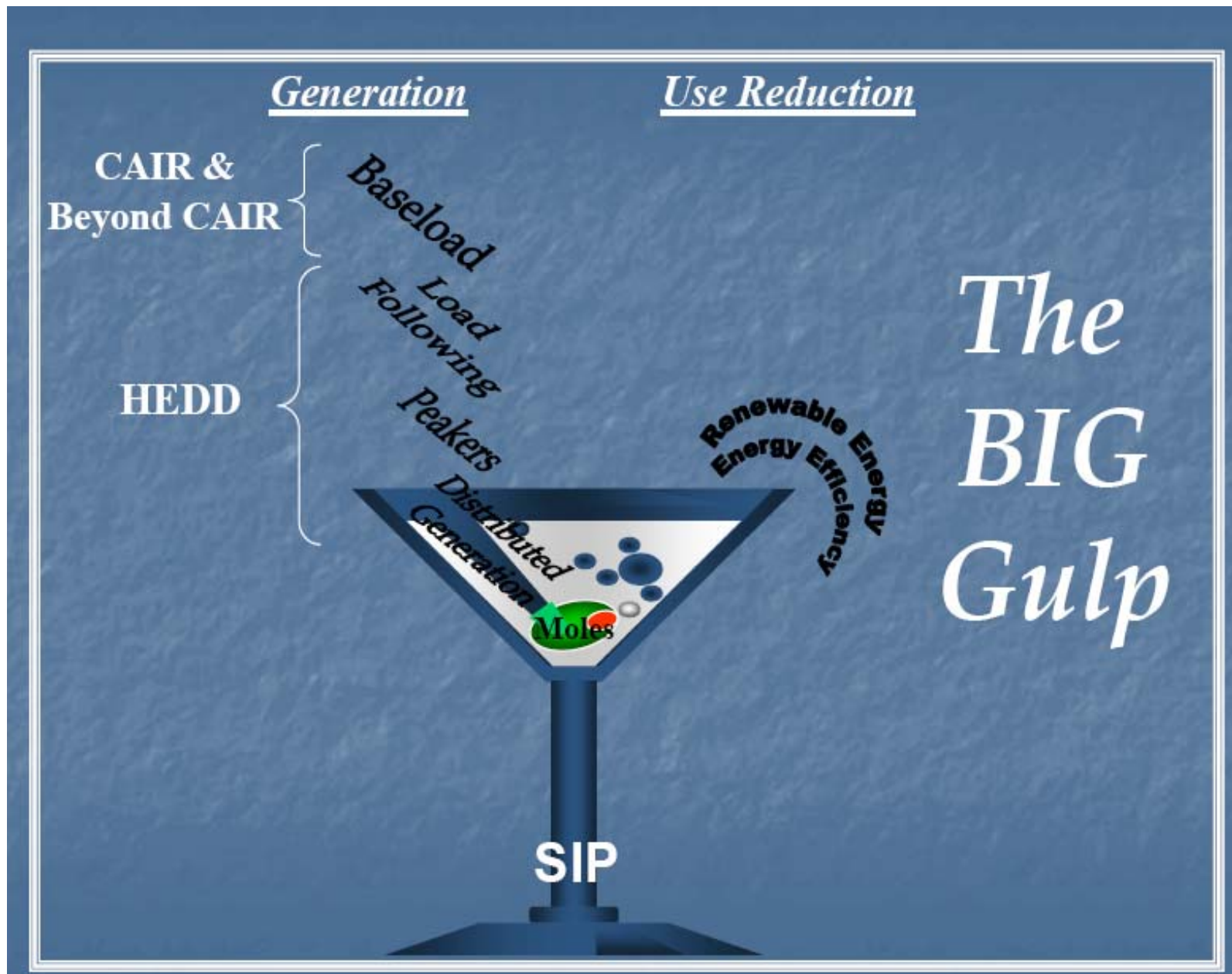
- SO₂ and NO_x
 - DE and MD are proposing reduction targets or rate limits for SO₂ and NO_x from existing plants
- Mercury
 - Most states in the three ISO/RTOs are proposing mercury reductions or rate limits
 - Reductions are typically 80 to 90% and are required earlier than CAMR deadlines or
 - A rate limit of 0.6lb/trillion Btu or less and
 - Emission credit trading is usually prohibited

Air Regulations – Regional

- Ozone Transport Commission (OTC)
 - **CAIR Plus** seeks further SO₂ and NO_x reductions in the Northeast corridor for ozone attainment
 - **High Electric Demand Days (HEDD)**: OTC is proposing multiple strategies for ozone reductions on peak electric demand days in Northeast Corridor
- Regional Greenhouse Gas Initiative (RGGI)

OTC Proposed Regulations

- CAIR Plus
 - Go beyond EPA's CAIR to obtain additional SO₂ and NO_x reductions in the Northeast Corridor to reach ozone attainment
 - Proposed removal of NO_x allowances from budget before allocating
 - Set declining rate caps: 2015 NO_x: 0.07lb/MBtu, SO₂: 0.21 lb/MBtu
 - Various ratios suggested
- HEDD: Multi-strategies being considered for NO_x Reductions
 - Energy Efficiency
 - Economic Incentives
 - Voluntary controls
 - DG regulation



Source: OTC Newark Meeting, 1/11/07, Anne Gobin, CT DEP

RGGI Update

- RGGI is a regional CO₂ cap and trade program starting in 2009
- Ten Northeastern States will be participating
 - MA joined Jan 07
 - RI announced it is joining
 - MD joining in June 07
- CO₂ Cap
 - Total 181.6 million tons
 - New England 55.8 million tons
 - Starts 1/1/2009
- First compliance period ends 12/31/11
- Compliance means: a generator must hold sufficient allowances plus offsets to cover its CO₂ emissions for 2009-2011

RGGI State Caps (Allowances)

State	CO ₂ Cap Million (Short*) Tons
Connecticut	10.70
Maine	5.95
Massachusetts	26.66
New Hampshire	8.62
Rhode Island	2.66
Vermont	1.23
New York	64.31
New Jersey	22.89
Delaware	7.56
Maryland	31.0
Total (10 States)	181.57

*short ton = 2200 lbs

RGGI Update (Continued)

- States setting up regulations or passing legislation to implement RGGI
- Allowances
 - VT, NY and CT may auction 100% of state's allocation
 - Minimum auction amount is 25% of states allocation. Remaining amount would be allocated free to generators
- Offsets can be used for 3.3 % of compliance needs
- Higher CO₂ allowance price triggers allow use of offsets for 5% (\$7) and 10% (\$10) of compliance needs

RGGI Update (Continued)

- Offset projects can be created as follows
 - Reduce methane from landfill gas
 - Reduce SF6 leaks on T&D systems
 - Reduce CO₂ from improved gas and propane end use efficiency
 - Take up CO₂ through afforestation
 - Reduce methane from agricultural wastes

RGGI Fossil Generator Emission Cost Adders: SO₂, NO_x and CO₂

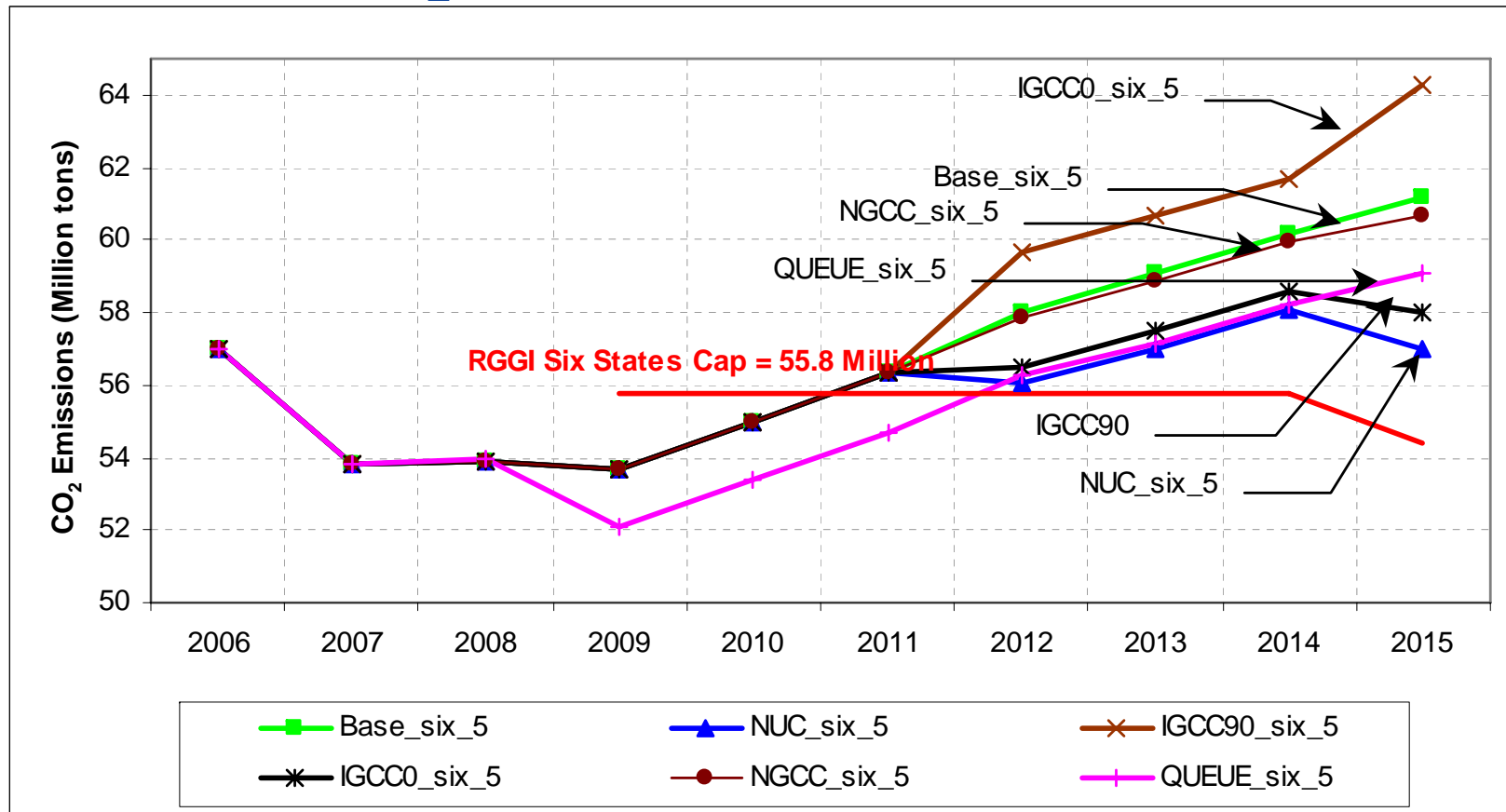
For illustrative purposes only

CO₂ allowance cost does not appear to change relative dispatch order of fossil plants

Typical Plant	Fuel \$/MBtu	Fuel \$/MWh	Allowances \$/ton	SO ₂ \$/MWh	NO _x \$/MWh	CO ₂ \$/MWh	Total \$/MWh
Gas combined cycle	7	49	1085	0	0.1	2.1	51
Oil peaking steam plant	7	73.5	2800	11.5	4.4	5.4	95
Coal base load steam plant	2.25	20	5	4.7	4.4	4.4	34

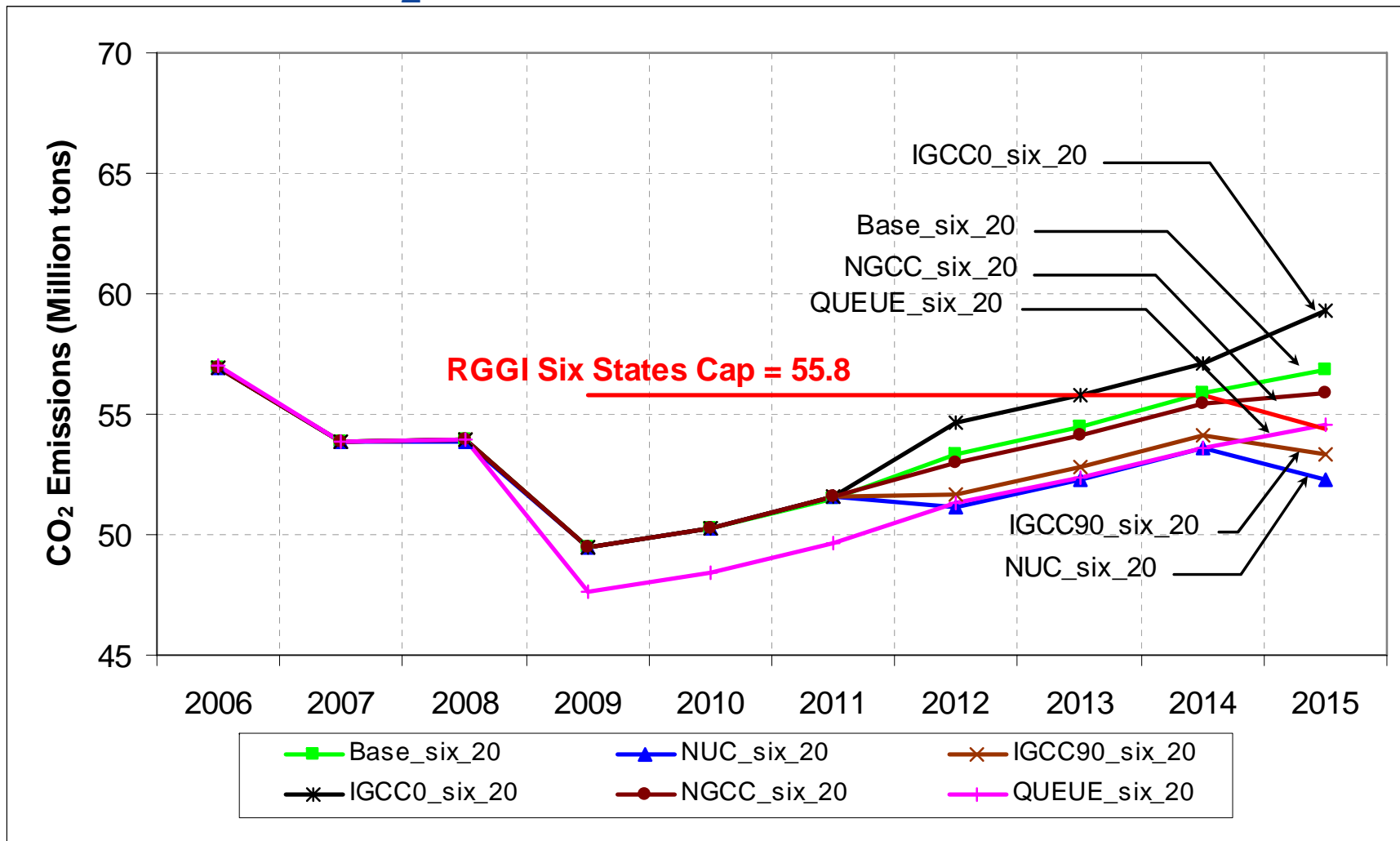
ISO RGGI Study Results – 6 NE States 1,000 MW Alternative Resource Additions

CO₂ Allowance Price: \$5/ton



ISO RGGI Study Results – 6 NE States 1,000 MW Alternative Resource Additions

CO₂ Allowance Price: \$20/ton



RGGI Implications for Generators and Market

- RGGI plants will have an additional dispatch cost adder in 2009
- Coal and oil plants will have higher CO₂ adders than gas plants due to their higher CO₂ emission rates (lbs/MWh)
- RGGI rules will increase operation of non or low CO₂ emitting plants, e.g. hydro, nuclear, wind, gas fired combined-cycle
- May increase imports from non-RGGI regions (leakage)
- Costs of CO₂ allowances would have to be recovered in the wholesale power markets similar to SO₂ and NO_x allowances today

Water Regulations

- Clean Water Act Section 316b
 - Requires EPA to insure BACT for cooling intake structures
 - 3 Phase implementation
 - Phase I applies to new facilities
 - Phase II applies to large existing plants > 50 Million gallons per day (MGD)
 - Phase III applies power plants < 50 MGD and other facilities
 - Site by site determination of Phases I and II
 - Implication is cooling towers may need to be installed on existing plants..
- In New York some merchant plants have dry cooling

Canadian Regulations



Canadian Air Regulations

- SO_2 , NO_x
 - Eastern Canadian Provinces had SO_2 annual cap of 2.3 million tonnes 1994-2000
 - National cap of 3.2 million tonnes established starting in 2000
 - Ontario
 - Caps for SO_2 and NO_x since 2000
 - Reductions by 2007: SO_2 (25%), NO_x (53%)
 - Emissions trading allowed
 - Planned Retirement of 6,500 MW of coal plants by 2009.
Replace with mix of various zero and low emitting resources

Canadian Air Regulations (continued)

- Mercury Emissions
 - National cap (6 Provinces): 1,130 kg by 2010 (58% reduction)
 - Ontario's cap from 495 to 0 kg
 - New Brunswick's cap 140 to 25 kg
- CO₂
 - Canada signed the Kyoto Agreement and committed to a 6% reduction in GHG
 - No implementing legislation has been passed

Renewable Resources – Development Outlook vs. Requirements

Northeastern U.S. Renewable Resources

- Many states have Renewable Portfolio Standards (RPS)
- Generally they specify a growth rate for specific types of renewables, but the maximum percent targets and horizon years vary.
- RPS requires load serving entities to meet targets or, alternatively, make payments to a renewable fund
- The intent is to encourage development of new renewable resources for a cleaner and more diversified energy portfolio

Northeastern U.S. Renewables

- Will the RPS be achieved?
- A look at what's in the ISO/RTOs interconnection queue can give some clue and assuming all projects are built
- ISO New England
 - RSP06 indicated over a 50% shortfall by 2015 based on the ISO 6/4/06 queue
 - The current queue has more renewable resources but the outlook still appears around 30% deficient
- NYISO
 - If the queue resources were built, they could essentially meet the RPS requirements by 2013
- PJM
 - Given the existing level of operating renewable resources, as well as those under construction, and assuming the resources currently being studied in the interconnection queues are built, the PJM state RPS targets are achievable.

Canadian Renewable Resource Targets

- **Ontario**

- RPS target of 5% (1,350 MW) by 2007 and 10% (2,700 MW) by 2010
- The IESO Ontario Reliability Outlook (6/1/06) shows proposed projects of 1104 MW of wind, 43 MW of hydro and 2 MW of biomass

- **Quebec (94% Hydro)**

- **Hydro:** 1,054 MW of hydro under construction; 4,500 MW planned by 2010
- **Wind:** Commitment of 4,000 MW by 2015. 10% thereafter

- **Maritimes**

- New Brunswick Commitment: By 2016 10% of electric sales to be from low-impact renewables
- Nova Scotia Target: By 2010 5% of new capacity to be from renewables
- PEI RPS: By 2010 15% of electric sales to be from renewables

Environmental Issues: What do they mean for Inter-regional Planning?

What impacts will air regulations have on power plants?

- Will increase the costs of fossil power plants
- Fossil generating plants will have increased emission constraints from new air regulations. This translates to
 - More complex plant operation
 - Economic bidding must recognize costs of new emission allowances
 - Can affect startup/shutdown
 - Compliance strategy may limit energy from plants
 - Higher costs for emissions compliance
- Regulations will have little or no impact on costs of non- and low-emitting power plants e.g. nuclear, hydro and fuel cells

What impacts will these regulations have on power plants? (continued)

- Coal plants are more vulnerable than gas/oil-fired units:
 - Higher CO₂ emissions
 - Mercury emissions
 - Gas/oil price differential with coal may still give coal an economic advantage even with added CO₂ costs
 - Potential for added costs for cooling towers.
- May cause earlier plant retirements due to changing economics or inability to comply
 - ISOs concern for generating unit attrition when outlook shows need for more capacity with the 5-10 year planning horizon.
- Overlapping maintenance or refurbishing scheduling for compliance

What Impacts on System Reliability?

- Meeting resource adequacy requirements may encourage shift to low or non-CO₂ emitting generating options
 - Ontario's plan for replacement of coal fired units
 - RGGI regional economic expansion modeling yielded
 - Mostly wind and new combined cycle with low natural gas prices...
 - Mostly clean coal, more wind and some combined cycle with high gas prices
 - Potentially can change transmission flow patterns and this may require additional system improvements

Summary

- Leading environmental issues are global warming, ozone attainment, mercury reductions and water discharge
- Addressing these issues leads to very complex policy evaluations and decisions e.g. HEDD
- In response to regulations, costs for generators will likely increase and therefore energy costs will likely increase
- Region's response to these issues needs to be flexible to not impair electric system reliability