Making Clean Air Markets Work

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Some Fundamental Questions of Interest

1. How can we improve the environmental footprint of the energy sector?

2. How can we markets and ecosystems be most effectively linked?

3. What is the success of Cap and trade vs. command and control?

4. What role does a national environmental strategy play in the success of the outcome?

Summary of Research

Research Method

A comparative case study of the current Acid Rain regulatory regimes in the United States and the European Union

Research Question	**Variables Studied**
1. Method of Emission Reduction	•Type of Regulation •Level of Reduction
2. Utility Compliance Strategy	•Type of Compliance Strategies •Cost of Compliance
3. Measurement of Environmental Improvement	•Change in Acidification •Change in Ecological Activity

Comparison of US and EU Emission Reduction Methods

Comparison of US and EU Emission Reduction Methods		
	United States	**European Union**
Type of regulation		
SO2	Market-based cap and trade program	CAC / national emission ceilings
NOX	CAC, emission averaging	CAC / national emission ceilings
How limits were determined?	No clear scientific basis, political compromise	Based on critical loads and ecosystem level data, use of RAINS model analysis
Regional focus	National	Member state based on ecosystem grids
Level of Reduction		
SO2	40% based on 1980 baseline, phased to an 8.95 million ton cap	Varies by member state based on need to meet target ecosystem improvement
NOX	10% based on 1980 baseline, no cap thus emissions can increase from increased utilization and new construction	Varies by member state based on need to meet target ecosystem improvement
Emission Trends	1981 – 2000	1980 – 97
SO2	50% decrease	67% decrease
NOX	14% decrease	47% decrease

Comparison of US and EU Compliance Methods

Comparison of US and EU Compliance Methods		
	United States	**European Union**
Compliance Requirements		
SO2	Must have allowances to cover annual emissions, flexibility to choose best compliance strategy	Member states must come into compliance with Emission ceiling by 2010 and meet minimum CAC requirements
NOX	CAC, but allowed to average emission rates, CAC level set based on available technology	Member states must come into compliance with Emission ceiling by 2010 and meet minimum CAC requirements
Compliance Method Selected	➢ 37% of reductions from scrubbing; ➢ 63% fuel switching, mostly to lower sulfur coal; ➢ Allowances available for trading - 57% from over-compliance and 43% form excess allocations	Individual member states have varying laws and thus varying options for compliance. In Germany scrubbers must be installed on units above 300 MW and implied SCR standard for NOX. Old units must now comply with same standards as new facilities.

Comparison of US and EU Compliance Methods (Continued)

Comparison of US and EU Compliance Methods (Continued)		
	United States	**European Union**
Cost of Compliance		
Cost per ton of SO2 reductions	$130 to $155 per ton in 2000	Actual abatement cost not available. NECs developed in RAINS based on country specific abatement cost curves. FGD costs of $300 to $600 per ton estimated.
Cost vs. Alternative	➢ $525 million annually estimated for CAC in Phase I versus $167 million with Title IV ➢ $4.0 billion annually for CAC in Phase II versus$1.9 billion	NEC cost $860 million euro per year for SO2 reductions. Flat rate reductions estimated to be 50% more costly.
Individual Compliance		
	Southern Company relied almost entirely on switching to lower sulfur coal and accounted for 30% of the over-compliance by fuel switching. Southern was the largest source of banked allowances in Phase I.	RWE Energy coal-fired stations equipped with FGD with average emission reduction of 90%. Reconstruction and use of catalysts (SCRs) have reduced NOX emissions by >70%.

Comparison of US and EU Ecosystem Recovery

	United States	**European Union**
Reduction in Deposition	1996-2000 over 1990-1994	
Sulfate	10% reduction in sulfate deposition nationwide; 15% reduction in the eastern US	Sulfate concentrations decreased with almost all cases decrease in 1990s greater than in 1980s.
Nitrate	3% increase in nitrate deposition	After increases in 1980s there is a slight decline in 1990s exception for the UK.

Comparison of US and EU Ecosystem Recovery (Continued)

Ecosystem Recovery	United States	European Union
Current Outlook	Adirondacks and Midwest show no improvement in alkalinity (increasing acidification or no improvement). Improvement in lakes and streams in the Northeast have been limited; 41% of the lakes in the Adirondacks are still acidic or subject to short-term pulses in acidity and in Catskills and New England 15% of the lakes are similarly affected.	In Nordic countries and many European sites alkalinity increased (demonstrating recovery). With existing rules implemented the unprotected ecosystem area will decline from 24.7% in 1990 to 4.3% in 2010. Unprotected areas range by member state from 0% to 60.4%.
Long-term Outlook	% of target waters in the Adirondacks projected to be acidic in 2040 with CAAA implemented from 11% to 43%.	With NEC in 2010 the unprotected ecosystem area will decline to 2.9% (all member states < 10% except Netherlands, 23.7%).
	If Adirondack nitrogen saturation <=100 years, sulfur and nitrogen deposition may need to be reduced 40 - 50% more to maintain the proportion of chronically acidic target surface waters in 2040 at 1984 levels (19%).	
Ecosystem Protection Standards	While Congress asked EPA to propose acid deposition standards to protect sensitive ecosystems and NAPAP to propose reductions in deposition rates needed to prevent “adverse ecological effects” they did not do so, citing remaining scientific uncertainties.	Fifth EAP objective of no exceedance of critical loads for acidification. The EU defines critical loads for regions and tracks exceedance of critical loads by EMEP grid cells. NECs developed to reduce exeedance in each grid cell by at least 50% compared to 1990.

Some Observations from the Research

- U.S. Cap and trade approach has been effective in meeting the emission reductions required by statute and in terms of economic effectiveness compares favorably to the EU approach
  - The total cost of compliance and the marginal cost of abatement have proven to be significantly lower than expected under the 1990 CAAA.
- When considering ecosystem recovery it is not possible to conclude that the 1990 CAAA have achieved this goal
  - Ecosystem recovery has begun to occur throughout the EU while the evidence is less clear in the US
- The EPA and NAPAP processes have not developed clear ecosystem improvement standards similar to what has been developed in the EU as part of the Environmental Action Plans and Acidification Strategy
- How to integrate a US strategy for adequately resolving acidification with our cap and trade approach is an open question.

Questions and Further Information

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