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A Tool for Quantifying the Financial Risks of Environmental Exposures:

An Application to the US Electric Utility Sector

Robert Repetto & James Henderson[1]

I. Analytical Objectives and Approach

The electric utility industry is one of the most environmentally sensitive sectors of the economy. Most companies with generating assets are heavily exposed to the impacts of environmental regulations. Not only have utilities spent heavily to comply with past and current environmental standards, most are faced with the likelihood of significant additional expenditures to meet future environmental standards that are now being considered by Congress and regulatory agencies. Among the most significant of these are additional restrictions on emissions of nitrogen and sulfur oxides, airborne particulates, mercury and other toxic air pollutants, as well as new restrictions on emissions of carbon dioxide, the main greenhouse gas. Depending on the outcomes of legislative and regulatory processes now underway, utilities may be subject to expensive new requirements. Consequently, environmental issues constitute material financial uncertainties for most companies in the utility sector.

The financial risks that result from environmental exposures are highly differentiated across companies in the sector, however. Variability stems from differences in the importance of generating earnings in total earnings, in the mix of fuels used in the portfolio of generating assets, in the location of generating plants, in the environmental controls already in place and the ease of upgrading such controls, and in the regulatory or market situation that would enable or impede cost recovery. Not only are environmental exposures material financial issues for most utilities, they are sources of potential competitive advantage or disadvantage.

A thorough understanding of the financial implications of electric utilities' environmental exposures is necessary if the investment community is to assess accurately the risks and values in utility company securities. Financial impacts can have material effects on credit risks, earnings, asset valuations and fundamental shareholder values. An understanding of the financial implications of environmental exposures is also important for the utilities themselves if they are to manage their environmental risks strategically. Internal and external evaluation of the financial implications of companies' environmental exposures are both important in promoting the transition to sustainable environmental management.

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1. [1] Stratus Environmental Consulting, Inc., Boulder, Colorado. This work was supported by USEPA and USDOE. Authors are solely responsible for analysis and conclusions.

The benchmarking tool described below provides a useful way to compare in financial terms the environmental exposures of leading electric utility holding companies, under a range of plausible future environmental policy scenarios. The tool, or "metric", estimates the discounted present cost of adopting least-cost controls on all generating plants owned by each utility holding company to comply with current and pending air quality regulations, under a range of policy scenarios. The estimated costs, presented here for 47 large utility holding companies, are derived from a detailed analysis of least-cost compliance options for each generating unit operated by each company. The compliance options include a suite of combustion controls, post-combustion pollution controls, and permit trading. Available compliance options and associated costs are tailored to the specific characteristics of each generating unit, including installed pollution control equipment. Least-cost combinations of emissions controls and permit trading are derived by minimizing discounted estimated capital and operating costs over a 25 year horizon.

To demonstrate the use of this tool, the metric is used to analyze the financial impacts of a three-pollutant cap-and-trade bill that imposes stricter future controls on emissions of nitrogen oxides, sulfur oxides, and mercury; also, a four-pollutant cap-and-trade bill that adds restrictions on future emissions of carbon dioxide. These policy scenarios were chosen to resemble proposed legislation submitted to this and the previous Congress. Financial impacts were estimated under the assumption that permits would initially be grandfathered to utilities in proportion to their historical 1998 emissions, and under an alternative assumption that permits would be allocated through an auction among utility bidders.

In addition to these specific policy scenarios, the metric is a tool that permits wide flexibility in the choice of policy assumptions. Users can pre-specify the allowance levels and percentage emission reductions, the compliance deadlines, the amortization period, the permit prices prevailing for each pollutant in each five-year period, and the discount rate to be applied. The transparent spreadsheet format in which the metric was constructed allows users to vary these assumptions to construct a wide variety of policy scenarios.

In order to facilitate comparison of environmental exposures among companies, the present value of future compliance costs in constant year 2000 prices, discounted at 8 percent per year to the year 2000, are benchmarked to each company's revenues and earnings in the year 2000. These benchmarks indicate the financial materiality of the companies' environmental exposures to pending environmental issues and allow their exposures to be compared.

Two limitations of this analysis should be recognized. First, the approach does not allow for adjustments by companies in the dispatch of their various generating units in order to achieve compliance. In reality, companies may reduce the hours operated by particular units rather than installing pollution control equipment if the former is the least-cost option. Second, the metric does not allow for the fact that companies may recover some or all of their environmental costs if market or regulatory processes pass through these cost increases to electricity product prices.

Because these adjustment modes are not included in the metric, the resulting cost increases overstate the financial impacts of the environmental scenarios relative to revenues and earnings.[2] However, the metric nevertheless does give a useful comparison of the relative position of the various companies.

II. **The Specific Analytical Simulations**

A. A Three-Pollutant Cap & Trade Policy

The metric analyzes a three pollutant cap-and-trade policy that closely approximates proposed legislation. The hypothesized policy requires utilities to reduce emissions of sulfur oxides, nitrogen oxides, and mercury by 75%, 75%, and 90% respectively below emissions in the baseline year of 1997. The assumed date by which compliance must be achieved is the year 2008. In that year, in the scenario assuming grandfathering of emission allowances and given assumed rates of growth of electricity and fuel use, allowed emissions for generating plants would be 0.190818 lbs of sulfur oxides per million btus of energy consumed, and 0.090248 lbs of nitrogen oxides per million btus of energy. These allowances represent the "caps" in the cap-and-trade regime. In the analysis assuming that emission permits would be auctioned in the year 2008, these allowances can be exceeded by purchasing permits but, in the aggregate, only enough permits are put up for sale to meet the overall emission reduction requirement.

It is assumed in this analysis that all generating plants would be eligible to trade emission allowance for sulfur and nitrogen oxides in a national emission trading market but that an emission trading market for mercury would not exist, due principally to monitoring difficulties. The prices in these permit markets in the period for sulfur oxides and nitrogen oxides are assumed to be $303 per ton and $1619 per ton respectively during the period 2008 to 2014 and

[2] In order to overcome these limitations, a complete model of the demand and supply sides of electricity markets is being constructed, in which environmental cost increases lead companies to alter the quantities and prices at which power from various generating units is bid into the market. This model is applicable to regulated and deregulated electricity markets. In this model, an econometrically estimated bid function aggregates estimated bids into an overall market supply curve. The model simulates the action of an ISO in matching supply with market demand in all periods, thereby determining the market clearing price as well as the electricity supplied by each unit. Simulations run over future time periods yield operating earnings for all units, which vary in each environmental policy scenario.

subsequently in the period 2014-2035. These prices are not estimated within the metric model but are adopted from analyses carried out with the National Energy Modeling System (NEMS).[3]

In addition to allowance trading, the metric analysis assumes that generating plants can draw from an array of internal pollution control options. Choices are assumed to be made to be compatible with existing installed technology in order to achieve technologically possible and cost-effective compliance. The capital and operating costs for each of these options, as applied to plants of given characteristics, were estimated from the literature, as of 1998. The options included in the analysis, including technical options for reducing carbon dioxide emissions, are

- **Combustion controls, such as**
  - Low Nox burner with or without overfire air
  - Low Nox coal-and-air nozzles with close coupled overfire air
  - Low Nox coal-and-air nozzles with separated overfire air
  - Low Nox coal-and-air nozzles with close-coupled and separated overfire air
  - Coal reburning
  - Nox combustion controls for wet bottom boiler types
  - Nox combustion controls for vertically fired boiler types
  - Non plug-in combustion controls;
- **Post-combustion controls, such as**
  - Selective catalytic reduction (SCR) for low or high Nox rate and for coal or gas/oil stream boilers;
  - Selective non-catalytic reduction (SNCR) for low or high Nox rate and for coal or gas/oil stream boilers;

[3] Energy Information Administration, 2000, Analysis of Strategies for Reducing Multiple Emissions from Power Plants: Sulfur Dioxide, Mitrogen Oxides, and Carbon Dioxide, Office of Integrated Analysis and Forecasting, U.S. Dept. of Energy, December.

- **Scrubbers**
  - Scrubbers for 1%, 2%, 3%, or 4% sulfur content in the fuel, by weight;
- **Combined Controls, such as**
  - SCR and scrubber for low or high Nox rate
  - SNCR and scrubber for low Nox rate
- **Maximum Available Control Technologies (MACT) for mercury emission control, according to the particular boiler type**
- **Repowering for carbon dioxide emission control**
  - From coal to coal IGCC
  - From coal to gas combined cycle
  - From oil/gas to gas combined cycle.

Each generating plant was assumed to use the most cost-effective combination of internal controls and permit purchases to meet the pollution constraints jointly. In these estimates, capital and operating costs were discounted at an 8 percent annual compound rate. Plants that were able to meet emission caps purely through internal controls at costs per ton less than the assumed market price of emission permits were assumed to generate emission reductions in excess of their requirements for sale in permit markets. Revenues from such sales were netted against compliance costs for such units.

B. A Four-Pollutant Cap & Trade Policy

The metric was also applied to analyze the impacts of a 4-pollutant cap-and-trade policy regime in which generating units are required to reduce carbon dioxide emissions 7 percent below 1990 levels by the year 2015, in addition to the emission reductions for sulfur, nitrogen, and mercury described above. The analysis assumed that the repowering options mentioned above represent the technological options for reducing carbon dioxide emissions, and that the industry would be aware of the future carbon abatement requirement at the same time that the other emission caps were announced. The costs of the four pollutant regime were analyzed both with the assumption that carbon permits would be grandfathered and with the assumption that

they would be distributed by auction. In the former case, the applicable emission cap for each generating unit in 2015 was assumed to be 92.309208 lbs of carbon dioxide per mmbtu.

Adhering to results from the NEMS analysis, it was assumed that over the period 2015-2035 the prevailing price in the carbon dioxide permit market would be $32 per ton. This is consistent with analyses assuming international trading in carbon permits. In addition, it has been assumed in the analysis of the 4-pollutant cap-and-trade policy that prices for sulfur and nitrogen oxide permits would fall to zero in the period after 2015. The reason for this assumption is that so many units would have to repower to gas fuel, reducing sulfur and nitrogen emissions in the process, that the overall emission constraints for sulfur and nitrogen oxides would be met without additional expenditures on combustion or post-combustion controls. For that reason, the demand for permits would fall to negligible levels in those markets. With respect to mercury, the cost-effectiveness analysis estimated the avoided cost of mercury MACT controls to be $72,500 per lb. of mercury when calculating the net cost of repowering to gas, which has a much lower mercury content than coal has.

III. Simulation Results

A. The Three-Pollutant Cap & Trade Policy

If a three-pollutant cap & trade policy similar to that endorsed by the current US administration and submitted in proposed legislation is adopted, many large US electric utility holding companies will face significant financial impacts. This is true whether permits are initially auctioned or distributed (grandfathered) in relation to historical emissions. The required cuts in emissions would be sufficiently large to ensure that utilities would be forced to install expensive internal controls and that permit prices in an allowance trading market would remain high.

As illustrated in Figure 1, even if permits are initially distributed free to companies in proportion to their historical emissions, half of the 48 major utility holding companies included in the study would face compliance costs with a discounted present value greater or equal to 20 percent of their total revenues in the year 2000. Total revenues include not only revenues from sales of generated electricity, but also revenues from distribution, transmission, and unrelated business activities. Some electricity companies would face discounted compliance costs greater than 50% of their year 2000 revenues. To put these magnitudes into perspective, operating profits among these companies averages only 4 or 5 percent of operating revenues.

Figure 2 demonstrates that if permits are not distributed free but are sold to utilities through competitive auctions, then these companies' financial exposures would be even greater.

Still, about half of the companies in the sample would face discounted compliance costs greater than 20 percent of their total year 2000 revenues, but ten percent of the companies would be exposed to the extent of 50 percent or more of those revenues. For all but a few companies, the prospect of a future three-pollutant cap & trade policy represents a significant, financially material, future risk.

The other striking conclusion that emerges from Figures 1 and 2 is the fact that different companies within the electric power sector are exposed in markedly differing degrees to future environmental restrictions of this kind. For a handful of companies, discounted compliance costs would amount to a small percentage of revenues, and for one or two companies, compliance costs would be negligible. At the other extreme, for some companies potential compliance costs would be extremely large relative to annual revenues. The differing environmental exposures of companies within the same sector represent significant sources of competitive advantage or disadvantage.

Differences in exposure to impending environmental restrictions stems from several factors that reflect past investment decisions:

- The importance of generating revenues in total revenues;
- The fuel mix used in generating electricity, especially the degree of reliance on coal;
- The effectiveness of emission controls already in place;
- The efficiency of the company's generating operations in converting fuel to electricity;
- The ease of retrofitting additional emission controls onto existing plants.

In an environmentally sensitive sector such as electricity generation, a company's decisions with respect to environmental performance can put it in a favorable or unfavorable competitive position to face emerging environment issues. These competitive advantages or disadvantages can be significant with respect to a company's overall business position.

B. The Four-Pollutant Cap and Trade Policy

The simulation results representing the impacts of a four-pollutant cap & trade policy show interesting similarities and differences compared to the three-pollutant results. If permits are distributed free to utilities in proportion to historical emissions, then the financial impacts differ only slightly if carbon controls are added to the requirements. This can be verified by comparing Figure 3 with Figures 1 and 2. The distribution of compliance costs does not differ

greatly, through individual companies change places in the ranking. Overall, the general conclusions remain the same. Companies differ greatly in their financial exposures and for most companies, the prospect of a four-pollutant cap & trade policy that includes carbon constrains represents a material financial risk.

The reason why adding a carbon constraint does not greatly increase companies' compliance costs is essentially that in reducing carbon dioxide emissions by switching plants to run on natural gas, companies will avoid the need to install expensive equipment to control emissions of mercury, sulfur, and (to some extent) nitrogen emissions. Since the natural sulfur or mercury content of natural gas used as power plant fuel is low, switching to natural gas not only reduces carbon dioxide emissions, it also -- as a side benefit -- helps meet other emission constraints.

However, Figure 4 shows that if carbon permits are sold by auction, then these conclusions must be revised. Though the permit price per ton of carbon dioxide is estimated to be a relatively modest $32/ton, power plants produce such prodigious amounts of carbon dioxide that the total costs of acquiring the necessary permits would be very large. For more than a quarter of the companies, the discounted compliance cost would exceed a year's revenues. For almost two-thirds of the companies, the costs would exceed half a year's revenues. At the extreme, for the most exposed companies, discounted compliance costs would be nearer to two years' revenues.

Again, not only do these exposures create material financial risks, they also create powerful potential competitive advantages and disadvantages. One or two companies face negative compliance costs in some scenarios, because of their potential revenue gains in selling permits. More broadly, for some companies with relatively small compliance burdens, profits would likely increase as electricity prices rose in response to higher industry operating costs. This price response is not captured in the current metric but will be reflected in the results of the complete model.

IV. Implications for Financial Analysts and Investors

The environmental policy scenarios used in this application of the metric tool are neither implausible nor remote. Legislation enacting both three-pollutant and four-pollutant cap & trade policies have been introduced in the current and previous Congressional sessions. The three-pollutant approach has the endorsement of the current administration.

Because companies' financial exposures to these policies are so significant and so different, potential investors and financial analysts should be aware of the potential implications.

Enactment of such policies could materially affect companies; earnings, liquidity, debt-servicing capacity, required capital expenditures, and other financial characteristics.

At this point few companies in the sample have disclosed in their financial reports the implications of proposed three-pollutant or four-pollutant cap & trade policies, particularly in any quantitative detail. A perusal of SEC filings would be of little help to investors and analysts in understanding the exposures of electric utility companies to these environmental risks. This lack of information exists despite current SEC regulations requiring companies to disclose "material events and uncertainties known to management that would cause reported financial information not to be necessarily indicative of future operating results or future financial condition." (Item 303, Regulation S-K, 17CFR229.303) Instructions to firms in complying with this regulation in providing Management Discussion and Analysis in its financial reports specifies that registered companies shall disclose "where a trend, demand, commitment, event, or uncertainty is both presently known to management and reasonably likely to have material effects on the registrant's financial condition or results of operation." (SEC Release 33-6835, May 24, 1989; 54FR22427).

In the case of a proposed government regulation, the registrant is required to make two determinations in deciding what to disclose. First, it must determine that there is not a reasonable likelihood that the regulation or provision will be enacted. If it cannot make that determination, it must disclose the impacts on the firm's financial conditions under the assumption that the law or regulation will be adopted, unless it can make a second determination that, if enacted, the provisions will not have a material financial effect. In the case of the three-pollutant or four-pollutant policies, most firms in the electric utility sector would find it difficult to reach the latter conclusion. Nonetheless, there is currently little information in companies' financial reports regarding these issues.

Figure 1: 3 Pollutant Cap&Trade, Permits Grandfathered

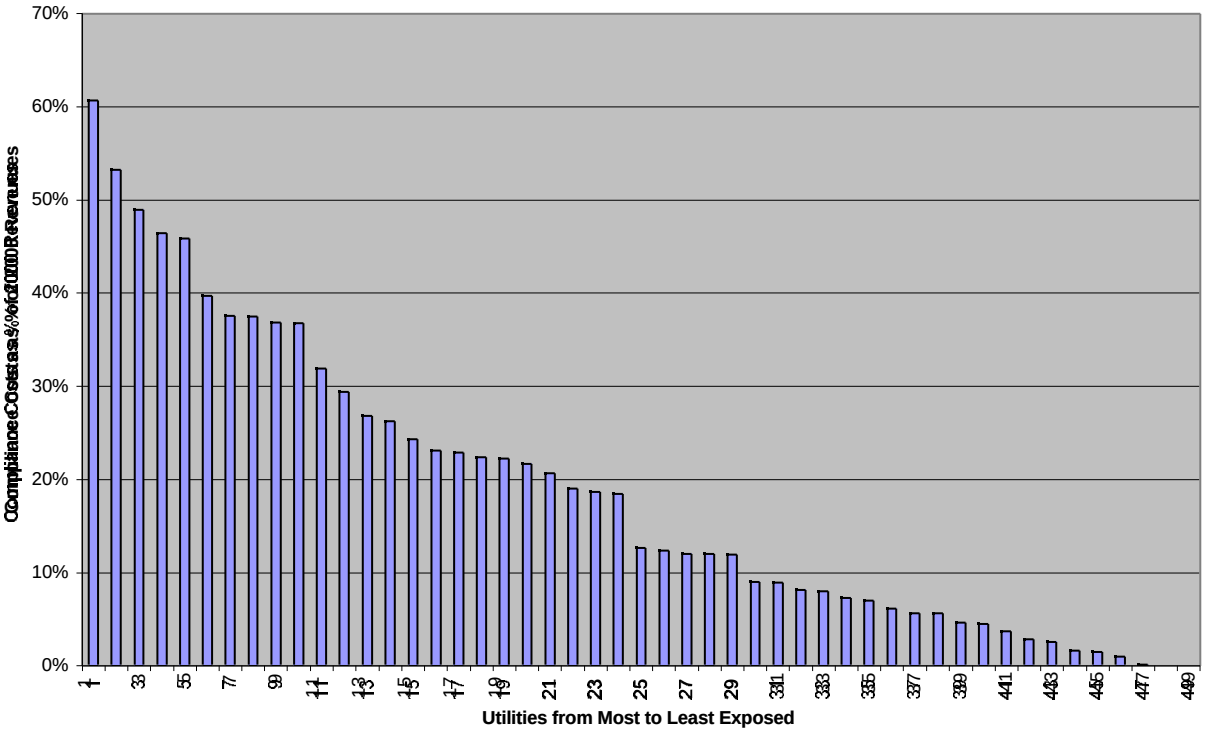


Figure 2: 3 Pollutant Cap&Trade, Permits Auctioned

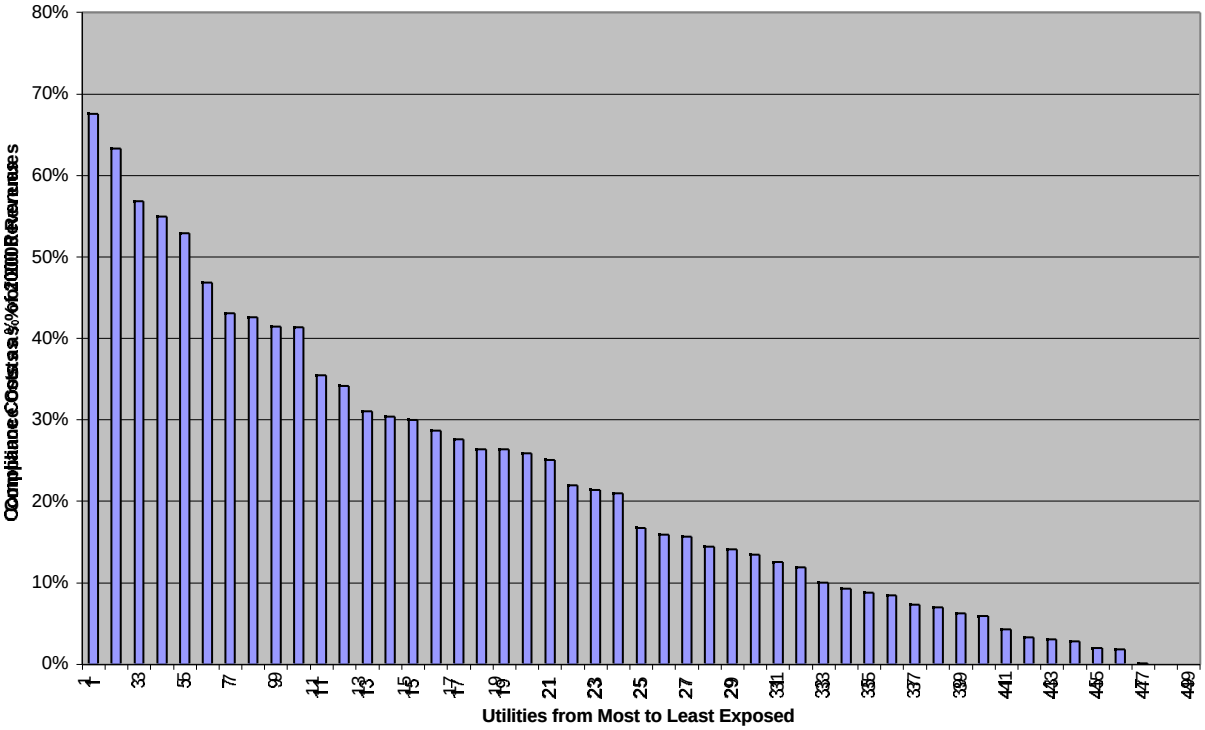


Figure 3: 4 Pollutant Cap&Trade, Permits Grandfathered

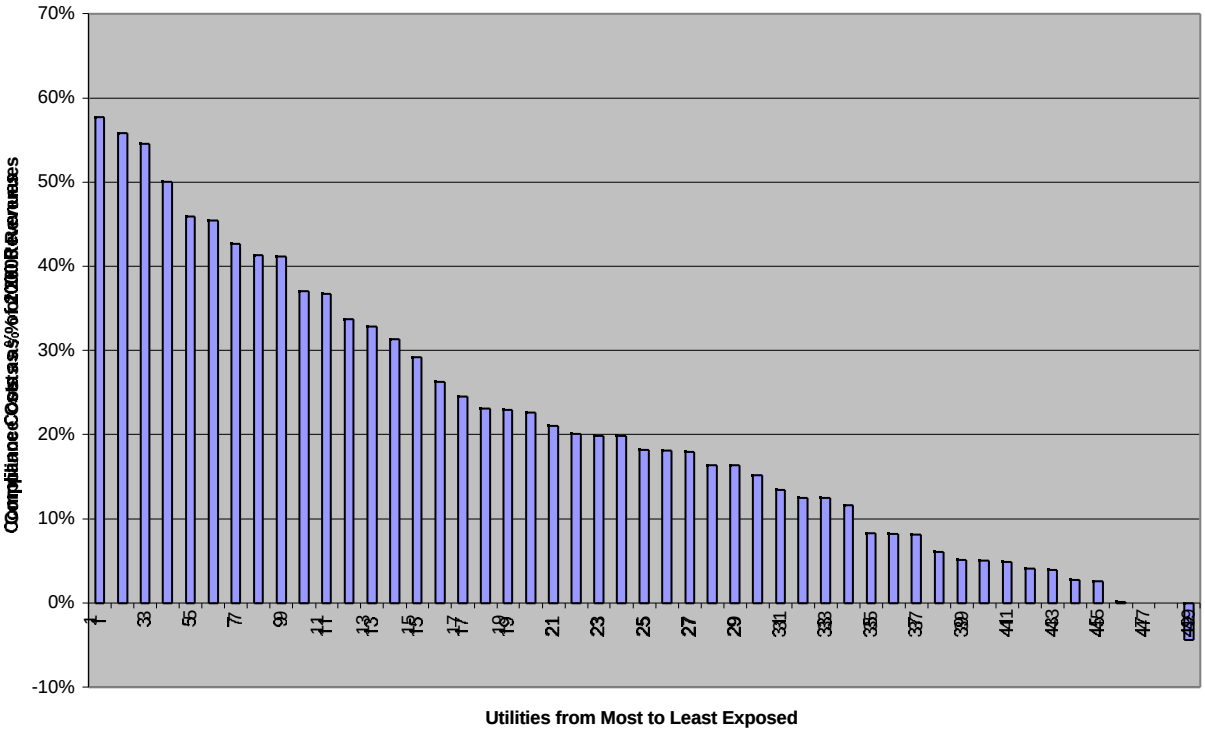
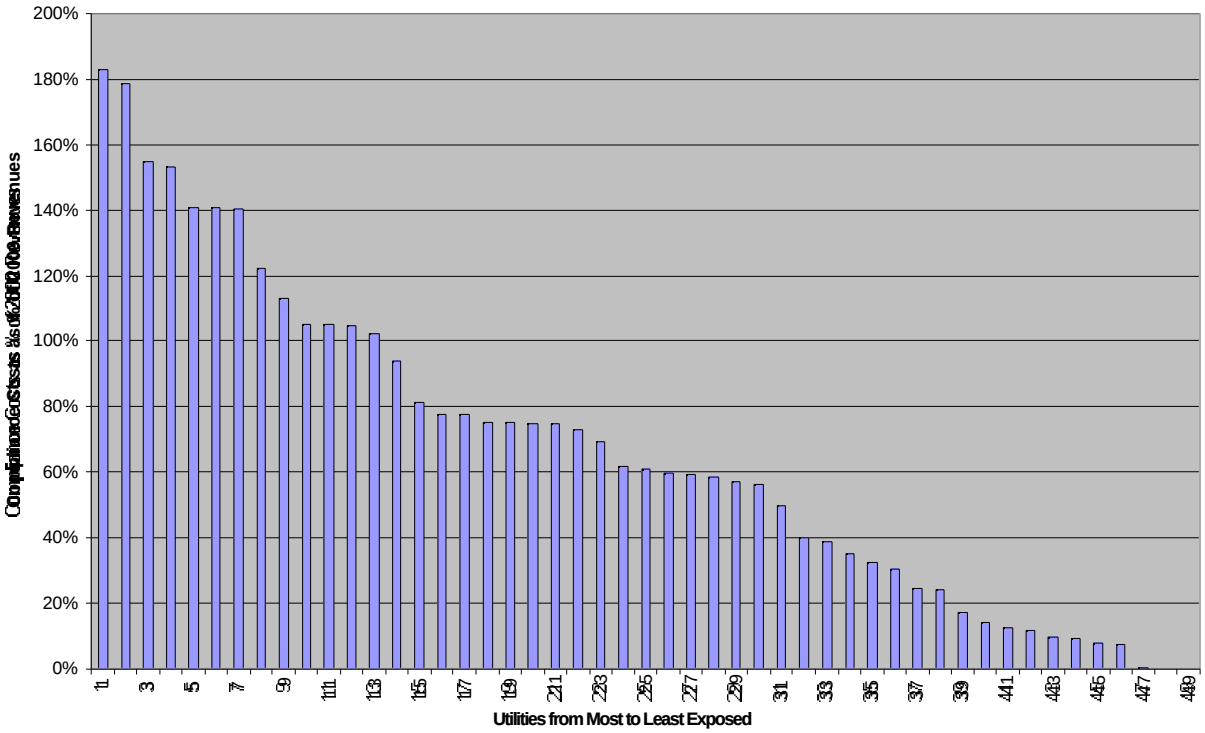


Figure 4: 4 Pollutant Cap&Trade: Permits Auctioned



Appendix: Electric Utility Holding Companies Included in the Study

Holding Company
Allegheny Energy, Inc
Progress Energy
American Electric Power Co Inc
DPL Inc
Ameren Corp
Southern Company, The
DTE Energy Company
Alliant Energy Corp
Cinergy Corp
TECO Energy, Inc
FirstEnergy Corporation
Wisconsin Energy Corporation
PPL Corp
LG&E Energy Corporation
Vectren Corporation
AES Corp
WPS Resources Corporation
CLECO Corporation
CH Energy Group, Inc
Dominion Resources, Inc
SCANA Corporation
Constellation Energy Group, Inc
RGS Energy Group Inc
NiSource, Inc
Pinnacle West Capital Corporation
Entergy Corporation
UniSource Energy Corporation
Conectiv
FPL Group, Inc
ALLETE
OGE Energy Corporation
Reliant Energy, Inc
Great River Energy
CMS Energy Corporation
Northeast Utilities
Sierra Pacific Resources
TXU Corporation
Duke Energy Corporation
Public Service Enterprise Group, Inc
Xcel Energy Inc
Exelon Corporation
PG&E Corporation
KeySpan Corp
Dynegy Inc
Niagara Mohawk Holdings Inc
IDACORP Inc