Memorandum

To: Mike Koerber, LADCO

From: Elizabeth David, Lauraine Chestnut, John Cromwell, David Mills, Jim Henderson, Stratus Consulting Inc.

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Subject: Review of the Midwest Ozone Group's Cost Impact Analyses of the Midwest Regional Planning Organization's Candidate Control Measures for SO_2 and NO_x Emissions from Electric Generating Units

This memorandum sets forth Stratus Consulting's review comments on two cost impact analyses produced for the Midwest Ozone Group[1,2] (MOG) in response to candidate control measures for SO_2 and NO_x emissions from electric generating units (EGUs) within the five states belonging to the Midwest Regional Planning Organization (RPO). These candidate control measures, referred to as EGU1 and EGU2, were described in a prior white paper analysis produced by the Lake Michigan Air Director's Consortium (LADCO).[3] At the most general level, we observe that cost impact analysis addresses only half the issue. Public policy regarding air pollution controls intended for public health and environmental protection involves a balancing of costs and benefits. Both sides of this equation require equal attention. A formal benefit-cost analysis is required to assess the merits of the EGU1 and EGU2 control scenarios developed by LADCO. For example, Chestnut and Mills[4] report estimates of benefits that exceed costs by a factor of about 40 for the SO_2 emission caps and NO_x emission controls required under Title IV of the 1990 Clean Air Act Amendments. A formal benefit-cost analysis compares direct costs of the program to direct benefits. Direct costs include the capital and operating costs for emission control equipment, higher costs of cleaner fuel such as low-sulfur coal or natural gas, costs for equipment changes to support fuel switching, and any other costs incurred directly by the electric utilities for the specific purpose of reducing emissions. Direct benefits include the value to the public of the reductions in pollution-related health risks and improvements in environmental quality, such as better visibility and reduced acid deposition. Direct benefits cover the entire geographic area affected by the change in emissions, which would be expected to include areas outside the LADCO boundaries.

1. Marchetti, J., M. Hein, and J.E. Cichanowicz. 2005. Evaluation of the Midwest RPO Interim Measures and EGU1 and EGU2. Submitted on Behalf of Midwest Ozone Group, Submitted to the Midwest Regional Planning Organization. August 1.

2. BBC Research & Consulting. 2005. Midwest Electric Rate Impact Study. Prepared for the Center for Energy and Economic Development, Midwest Ozone Group, and NiSource. August 26.

3. LADCO. 2005. Interim White Paper – Midwest RPO Candidate Control Measures. January 14.

4. Chestnut, L.G. and D.M. Mills. 2005. A fresh look at the benefits and costs of the US Acid Rain Program. *Journal of Environmental Management* 77:252-266.

Secondary economic impacts are not included in an accounting of direct benefits and costs. Secondary economic impacts include employment effects that may result from higher electricity prices, shifts in demand for fuels, or changes in demand for health care. These types of impacts do not add to the total benefits and costs, but instead show how subgroups in the population are affected by the changes in direct costs and benefits. .

Comments on Marchetti et al. paper[1]

The Marchetti et al. paper employs the Emission Economic Modeling System – an optimization model – in evaluating the choices that EGUs might make in arriving at a least cost solution to meeting more stringent emissions caps for SO_2 and NO_x. However, some major caveats associated with such modeling are nowhere stated. The optimization procedure is a static analysis that evaluates a fixed set of objectives and constraints. In reality, markets adapt and change in response to new developments. A fixed optimization therefore yields a "least cost solution" that has an upward bias because it does not predict cost-reducing behaviors that will inevitably emerge. Several points are worth noting in this respect that are all omitted from the analysis in the paper:

- If electricity costs increase due to pollution controls, households and businesses will consume less of it, lessening requirements for generating capacity to meet new growth in electricity demand. Conservation reduces emission loads to varying degrees depending on the existing electricity price level and the associated price elasticity of demand[5], whereas an optimization model seeks to meet the emission load targets with pollution controls alone.

- Plant retirement decisions are based on a wider array of business considerations than just pollution control costs. The optimization modeling approach can apply a hair-trigger to such choices based solely on marginal cost whereas they involve many additional considerations.

- Fuel switching decisions are similarly driven by a wider array of business considerations than pollution control on the part of the EGU. In addition, fuel suppliers – whether in the Powder River Basin, the Midwest, or elsewhere – are market-driven and will respond to changes in ways that will produce different patterns than those that exist currently and are held fixed within a model.

[5] The price elasticity of demand generally increases at higher prices, meaning that at higher prices consumers will have a greater demand reduction response to additional price increases than at lower prices. Recent increases in fuel costs mean that consumers are seeing higher real electricity prices compared to historical levels, and may respond with demand reductions not seen historically since the early 1980's.

- Buying power on the grid or building new generating capacity are options for meeting emission budgets that are driven by non-pollution-related business considerations which are difficult to incorporate accurately in an emissions loading optimization model.

These sources of upward bias in cost estimates resulting from an optimization modeling approach such as that employed in the Marchetti et al. paper must be noted. The paper's conclusions regarding the number of plants "at risk" of retirement, the amount of switching to low sulfur coal, and the ability to meet emissions caps in the region are all subject to this bias.

Harrington et al.[6] compared estimates of actual costs of many large regulatory programs to predictions of those costs made while the regulatory programs were being developed and found a tendency for predicted costs to overstate the actual implementation costs, especially for market-based programs such as the SO_2 trading program. Actual costs of the SO_2 trading program under Title IV of the Clean Air Act Amendments of 1990 have been about half of the typical estimates predicted before the program began. Factors contributing to the lower costs include lower transportation costs for low-sulfur coal (attributed to railroad deregulation), productivity increases in coal production leading to favorable prices for low-sulfur and mid-sulfur coal, cheaper than expected installation and operation costs for smokestack scrubbers, and new boiler adaptations that allow use of different types of coal. These are examples of responses to market forces that were not predicted by the least cost optimization models used to estimate expected costs of the program. Some of these factors may have been one-time opportunities for cost savings, so there is no guarantee that current cost estimates are overstated by a factor of two or more. However, Harrington et al. report for all programs with market-based incentives, technological innovations and unexpected efficiencies emerge because producers have flexibility in where and how to make emissions reductions and incentives to find cost savings.

An additional reason to question Marchetti et al.'s conclusions arises from the fact that the analysis assumes emissions budgets for the EGU1 and EGU2 scenarios that are much more restrictive than those proposed by LADCO. The NO_x caps evaluated by Marchetti et al. (Appendix A, Table 3) are only 83% of the caps proposed by LADCO (White Paper, Table 2). The SO_2 caps evaluated by Marchetti et al. (Appendix A, Table 4) are only 80% of the caps proposed by LADCO (White Paper, Table 2). This requirement for additional emissions reductions beyond those proposed by LADCO will cause the optimization model to assign a more costly mix of strategies to attain compliance. Because the last increments of pollution control are often the most expensive ones, modeling emissions caps that are 80% to 83% of those proposed by LADCO will greatly increase the resulting cost estimates. All of Marchetti et al.'s quantitative conclusions regarding the extent of plant retirements, the extent of switching to low sulfur coal, the extent of compliance with emission caps, and the cost of the pollution controls

6. Harrington, W., R.D. Morgenstern, and P. Nelson. 2000. On the accuracy of regulatory cost estimates. *Journal of Policy Analysis and Management* 19(2):297-322.

are negated by this discrepancy; they cannot be regarded as accurate estimates of the cost impacts of the EGU1 and EGU2 scenarios proposed in the LADCO White Paper.

Comments on BBC Research & Consulting paper[2]

The BBC paper employs regional economic input-output (I/O) analysis to assess cost impacts of the EGU1 and EGU2 emission control scenarios. I/O models, such as IMPLAN used by BBC, track the ripple effects of the financial implications of a policy through the economy and estimate employment, income, and economic growth impacts in various sectors. The results do not represent additional net costs or benefits of the policy, but rather they articulate how individual sectors of the economy are expected to be affected. There may be shifts in employment or income from one location to another, but as adjustments to the changes in prices are made, losses in one area are offset by gains in another as various sectors adjust to the initial impact of the policy. The regional economic analysis thus tracks how the direct costs and benefits of a policy ripple through the economy.

The BBC analysis of the regional economic impacts of the EGU1 and EGU2 options for alternative emissions caps beyond the Clean Air Interstate Rule requirements in the Midwest RPO states looks at only part of the expected impacts. Their focus is on the costs to the power generation sector and they track only the effects on selected industries of the potentially higher electricity prices that might be expected as a result of higher pollution control costs. They do not consider the benefits of improved air quality. Thus, their results do not provide a balanced view of regional impacts.

The South Coast Air Quality Management District (2003) in southern California conducted an assessment of the expected employment impacts of their air quality management plan using the REMI model.[7] They found an expected growth of about 42,000 jobs as a result of the improvements in air quality. These stem from several factors including reductions in medical expenditures and lost income (from less pollution-induced illness) that translate to greater consumer spending, improved yields of ozone sensitive commercial crops, and increases in demand for production and installation of pollution control equipment. This assessment also found expected job losses in some sectors, but the results demonstrate that by focusing only on job losses the BBC report overstates the negative impacts of the proposed LADCO emissions caps.

Even as a measure of the job losses, the BBC analysis overstates the effects of the proposed emissions caps. As they acknowledge, they presume no adjustment in electricity demand as a

7. South Coast Air Quality Management District. 2003. Final Socioeconomic Report for the 2003 Air Quality Management Plan. Diamond Bar, CA. August. Available at http://www.aqmd.gov/aqmp/AQMD03AQMP.htm.

result of the expected higher prices for electricity. In reality, consumers can be expected to reduce demand in the face of higher prices. This means that the amount of income that is diverted to paying more for electricity is not as large, leaving less of a reduction in expenditures on other things. The BBC analysis also presumes that the entire cost of the emission controls is passed on as higher electricity prices. Some of this cost may be reflected in lower profits rather than being entirely passed on as higher prices.

In the final analysis, all of the quantitative conclusions of the BBC paper are negated by the fact that their analysis uses the cost estimates produced in the Marchetti et al. paper as input assumptions to their I/O model. Their results cannot therefore be regarded as accurate estimates of the impacts of the EGU1 and EGU2 scenarios proposed in the LADCO White Paper.