Appendix I: EVA Modeling Overview

OVERVIEW OF EVA MODELING APPROACH FOR PROJECTING FOSSIL FUEL PRICES AND WHOLESALE MINNESOTA HUB POWER RATES UNDER FUTURE ENVIRONMENTAL REGULATIONS

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Overview

Future environmental regulations will have a significant effect on future fossil fuel prices and emission allowance values. Prior governmental studies have demonstrated that future carbon control regulation will increase electricity prices, reduce electricity demand growth, influence new utility generation technology selection decisions and cause shifts in the utility generation mix. These impacts will cumulatively change fossil fuel demand and price. The extent of these changes will be heavily dependent upon the new environmental program structure, limits and requirements. The purpose of this study is to identify a range of future fossil fuel prices under future carbon regulation possibilities and the associated MISO power prices. These fuel and power prices could be applied to resource modeling to determine their system's lowest cost generation supply alternatives under a future carbon constrained market.

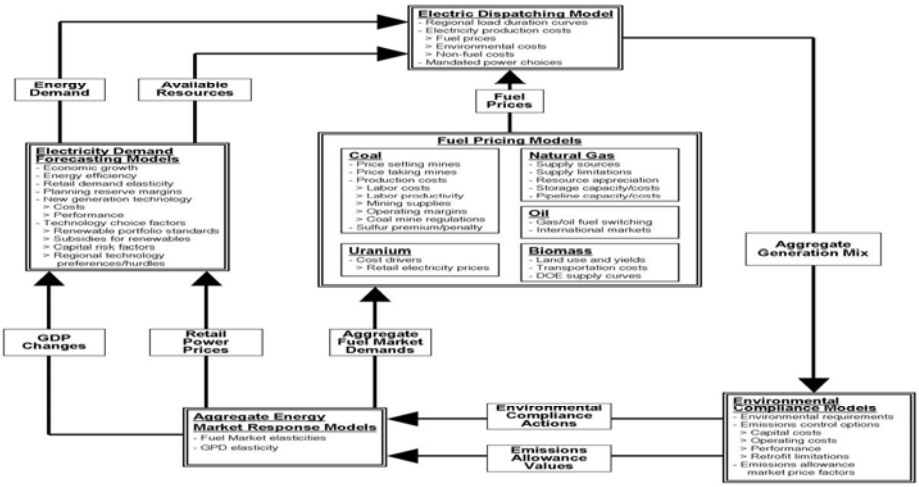
Study Approach

To project future fossil fuel demand and price changes, EVA employs its proprietary Integrated Electricity Model. As illustrated in Exhibit 1, this iterative model calculates the lowest cost power generation mix that meets both future power demand and future governmental requirements. The model incorporates price elasticity effects on the economy and on the demand for electricity and fossil fuels. It utilizes several fuel supply curves to calculate coal prices from major coal producing seams and natural gas commodity prices at projected future demand levels. The model also employs emission reduction cost curves to develop the lowest cost environmental compliance strategies.

The model results can be sensitive to several important model input assumptions. The more influential assumptions include:

- General Economic Assumptions: U.S./state economic growth, cost of capital, inflation rate, electricity price elasticity factors and natural gas price elasticity (outside power industry use).

Exhibit 1. Integrated Electricity Model Overview



- Generation Technology: New generation technology cost and performance, generation selection restrictions (nuclear capacity additions, state permit difficulties/preferences (coal), renewable resources), accelerated unit retirement, energy conservation measures, and future technology improvement rates.

- Environmental Control Technology: Environmental control technology cost and performance (FGD, SCR, and mercury), carbon capture and sequestration technology development schedule and cost, annual technology improvement rates (by pollutant).

- Natural Gas Supply Curves: Domestic resource productivity and appreciation rates, offshore drilling restrictions/moratoria, LNG import terminal capacity changes, non-contracted LNG import supplies, Arctic supply expansion, Canadian imports, regional pipeline delivery costs etc.

- Coal Supply Curves (by major coal producing region/product): Coal mine productivity changes, mine wages, supply/material cost changes, etc.

- Future Governmental Requirements: Environmental requirements (greenhouse gases (GHG), mercury, PM2.5, visibility, ozone), state renewable portfolio standards/incentives, and stricter state environmental limitations.

To establish a range of future fossil fuel prices, six different scenarios were evaluated. Of the model input factors, the future GHG regulatory requirements were believed to have the greatest uncertainty and addressed through running four different cases. In addition, two cases evaluated the potential range in natural gas prices from changes in industry cost and productivity. A brief description of the five cases is provided below.

- Case 1 - Baseline Forecast- $15/ton CO2: The baseline forecast incorporated EVA's most probable future regulatory outlook as of June 2009 that is outlined in Exhibit 2. In this scenario, the existing governmental requirements included the stricter SO_2/NOx requirements contained in the Clean Air Interstate Rule[1]. In addition to these existing environmental regulations, the EPA was assumed to adopt additional new mercury MACT standards for coal-fired power plants, to set stricter national SO_2 cap limits to address visibility, and to incorporate an allowance cost on all fossil fuel CO_2 emissions starting in 2015. In lieu of a carbon emission cap, a carbon fee was selected to allow utilities more certainty in their generation planning and its value was set close to the safety value CO2 price incorporated in the 2007 Senator Bingaman proposal. The case sets CO2 allowance values of $15/ton (2009$) plus 5 percent real escalation.

- Case 2 – Low Carbon- $10/Ton CO2: This case incorporates the base case regulatory requirements except that it assumes Congress will authorize a much lower carbon price cap in an effort to reduce its impact on the national economy. The case sets CO2 allowance values of $10/ton (2009$) plus 5 percent real escalation starting in 2015.

- Case 3 – High Carbon Case- $20/ton CO2: This case assumes that Congress will adopt a higher carbon price cap of $20/ton CO2 plus 5 percent real escalation starting in 2015.

- Case 4- Highest Carbon Case: This case incorporated MRES Christenson CO2 Price Forecast for the Boxer Saunders *Global Warming Pollution Reduction Act of 2007* that had a 2012 start date.

- Case 5 Low Natural Gas Industry Price Fundamentals: Key assumption for this case is that the significant contribution from unconventional resources continues and, in particular, the shales turn out to be a very prolific resource. A key factor in the shales becoming a very prolific resource will be the industry's ability to increase the average recovery rate from the typical 10 to 20 percent to about 45 percent, which already has started to occur in some plays due to

[1] In July 2008, the US Court of Appeals overturned the EPA Clean Air Interstate Rule (CAIR). In December 2008, the Court temporarily reinstated the CAIR until EPA could develop a new replacement program to meet PM2.5 air quality standards. EPA expects that this replacement program will take two years to complete. It is believed that a similar level of SO2/NOx reductions as outlined in the CAIR program will be required.

improvements in technology. This result would provide an adequate long-term supply to meet demand.[2]

Both the improvements in technology and general industry efforts to secure cost reductions result in overall lower finding and development costs. Concerning the former a recent example is the use of longer laterals in Woodford shale play, which has increased production levels and reduced costs to the point where the breakeven Henry Hub gas price is close to $4.00 per MMBTU. Previously this figure for the Woodford shale had been close to $7.00 per MMBTU. With respect to overall industry cost reductions, with the recent decline in activity and overall decline in material prices (e.g., steel prices) many members of the industry are seeking to achieve cost reductions of 25 percent and thus, undo the impact of hyper-inflation in E&P costs over the last several years. If a significant part of these cost reductions become permanent, then the outlook for long-term gas prices would drift towards the lower end of the band.

- Case 6: High Natural Gas Price Fundamentals: This case assumes that while the shales are a prolific resource, they have longer term limitations. Among these limitations are limited improvements in technology and governmental restrictions at both the state and federal level on the access to acreage. In addition, the power industry becomes overly reliant on gas-fired generation, which results in runaway gas demand in the long term. Coal and nuclear capacity additions are at minimal levels. Higher gas demand eventually results in gas prices increasing sharply over the longer term and relinking with oil prices.

EVA also provided Minnesota Hub wholesale power prices for peak and offpeak periods. Historically there has been a strong correlation between Minnesota Hub wholesale electricity prices and Western delivered coal prices with added environmental penalties during off-peak periods and natural gas prices (and some coal during some hours) during on-peak periods. For this project, EVA incorporated the combination of projected changes in coal, natural gas, CO2, SO2 and NOx market prices in combination with changes in coal transportation and natural gas pipeline rates for each case to calculate the anticipated Minnesota Hub wholesale power rates.

[2] By some estimates the U.S. reserve base with the addition of the recently found shales would be enough to supply the U.S. for 100 years at 2007 demand levels.