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# Service Report

# An Analysis of FERC's Final Environmental Impact Statement for Electricity Open Access and Recovery of Stranded Costs

**Prepared by**
**Office of Integrated Analysis and Forecasting**
**Energy Information Administration**
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Service Reports are prepared by EIA upon special request and may be based on assumptions specified by the requestor. Information regarding the request for this report is included in the Preface.

## For Further Information

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# Preface

This study was requested by Senator James Jeffords, Vice Chairman, Subcommittee on Energy Production and Regulation, Senate Energy and Natural Resources Committee, U.S. Senate. Senator Jeffords requested that the Energy Information Administration (EIA) review the Final Environmental Impact Statement (FEIS) prepared by the Federal Energy Regulatory Commission for its electricity transmission system open access (RM95-8-000) prepared in April 1996 and use the National Energy Modeling System (NEMS) to analyze the open access rule (Orders 888 and 889), providing written analysis by early September. EIA was also asked to comment on how other competitive issues, outside of open access, might impact the emissions situation.

This report presents the results of the analysis using NEMS. It discusses the methodology used in NEMS, defines the cases reviewed, and describes the results with respect to changes in electricity trade, generation by fuel and emissions of nitrogen oxides (NOx).

The legislation that created EIA vested the organization with an element of statutory independence. The EIA does not take positions on policy questions. The EIA's responsibility is to provide timely high quality information and to perform objective, credible analyses in support of the deliberations by both public and private decisionmakers. Accordingly, this report does not purport to represent the policy positions of the U.S. Department of Energy or the Administration.

# Analysis of the Federal Energy Regulatory Commission's Order 888

## Introduction

The Federal Energy Regulatory Commission (FERC) issued Order 888, which is intended to promote wholesale competition across interstate transmission lines in the electric power industry. Order 888 includes an *open access* rule and a *stranded cost* rule. The open access rule requires public utilities with interstate transmission lines to provide nondiscriminatory transmission services. The stranded cost rule would allow utilities to seek recovery of "legitimate and verifiable" costs that could not be recovered as a result of the transition to competitive markets.

The FERC prepared a final environmental impact statement (FEIS) to estimate the cost savings and environmental impacts that are expected to result from the order. Senator James Jeffords, Vice Chairman of the Subcommittee on Energy Production and Regulation, has requested that the Energy Information Administration (EIA) review the FEIS (Appendix). On July 9, 1996, the EIA delivered an initial report that summarized the purpose, methodology, and results of the FEIS, reviewed the key assumptions and compared them to other forecasts, and discussed the reasonableness of the results.[1]

This report responds to the second part of the request, providing an independent analysis of the impacts of the rule and discussing how growing competition in the electricity business might effect emissions . The analysis focuses on the open access component of the rule, particularly the impact on the emissions of nitrogen oxide ($NO_X$) and carbon dioxide ($CO_2$). Emissions of sulfur dioxide ($SO_2$) are capped by the Clean Air Act Amendments of 1990 and, thus, the impact of the rule on them is not addressed here. Similarly, changes in consumer demand for electricity are expected to be small because the rule calls for utilities to be compensated for investments they made to serve their wholesale customers, making significant price impacts unlikely. The air quality impacts of the emissions changes discussed in this report are not addressed. Regional results concentrate on the Northeast, Midwest, and Southeast.

## Methodology

The analysis was conducted using the EIA's National Energy Modeling System (NEMS). NEMS is an integrated model that represents supply, conversion, and end-use sectors in domestic energy markets. By balancing energy supply and demand, NEMS projects production, imports, consumption, and prices of energy through 2015.[2] The electricity supply component of the NEMS is the Electricity Market Module (EMM). The EMM represents the generation, transmission, and pricing of electricity for 13 regions based on the North American Electric

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[1]Energy Information Administration, "A Review of FERC Final Environmental Impact Statement for Electricity Open Access and Recovery of Stranded Costs", Service Report (Washington, DC, July 9, 1996).

[2]Energy Information Administration, *The National Energy Modeling System: An Overview*, DOE/EIA-0581(96) (Washington, DC, March 1996).

Reliability Council (NERC) Regions and Subregions (Figure 1). The EMM projects operating and planning decisions required to meet demands for electricity, subject to existing Federal and State environmental regulations. With respect to $NO_x$ emissions, Group 1 boiler standards recently specified by the Environmental Protection Agency have been incorporated in the analysis. However, Group 2 boiler standards that have not been finalized are not included in the basic cases developed in this analysis. Two special cases are prepared using the proposed Group 2 boiler $NO_x$ standards and their impacts are discussed. Title 1 (Clean Air Act Amendments of 1990) rules which require plants in non-attainment areas to install reasonably available control technologies (RACT) are included if they have been implemented, but not if they are planned for future years. Similarly, discussions now underway to develop a cap and trading system for $NO_x$ in the Northeast are also not included. These two programs, when finalized, would be expected to significantly reduce the growth in $NO_x$ emissions seen in all of the cases discussed later in this report, but they would not be expected to alter the deltas between the open access and non-open access cases very much. With respect to $CO_2$, various approaches for reducing greenhouse gas emissions that are being discussed internationally are also not represented. Depending on the approach taken $CO_2$ emissions could be reduced from the levels shown in this report. The air quality impacts of the changes in emissions brought on by open access are not addressed in this report, but because the results are similar to FERC's EIS, the impacts would be expected to be similar.

FERC analyzed Order 888 using the Coal and Electric Utilities Model (CEUM). CEUM represents the electricity and coal supply sectors, but excludes other energy markets such as fuel supply (other than coal) and end-use demand. Therefore, factors such as the demand for electricity and prices of natural gas and oil are determined outside of the model. Also, the geographic representation used in the CEUM differs from the EMM in that it consists of subregions of the 9 Census Divisions (Figure 1).

**Definition of Cases**

As in the FERC FEIS, this analysis determines the expected impacts of the Order 888 and addresses the sensitivity of the results to changes in key assumptions by examining a set of alternate cases (Table 1). Given the differences between the EMM and the CEUM, this study uses assumptions that are as consistent as possible with the FEIS Cases.

## Table 1. Cases Analyzed

EIA Reference Case
EIA Reference Case with Open Access Case
EIA Expanded Transmission Capacity with Open Access
EIA High Fossil-Plant Utilization Rates with Open Access

EIA High Demand Reference Case
EIA Higher Demand with Open Access
EIA High Demand and Fossil-Plant Utilization with Open Access

EIA Reference Case With Lower Gas Prices
EIA Low Gas Prices with Open Access

Similar to the FERC report, this analysis contains a reference case that assumes that open access (Order 888) is not implemented. This is compared to a case that represents the open access rule. The impacts of the rule are highly dependent on the availability of surplus generation and transmission capacity. These factors affect the level of fossil fuel consumption, which is the primary source of $NO_x$, $CO_2$, and $SO_2$ emissions. Therefore, a set of alternative cases was designed to vary the utilization rates for generating plants and the level of transmission capacity. Since the demand for electricity and fuel prices influence emissions levels and are subject to uncertainty, reference cases (i.e., assuming no open access) with higher demands for electricity and lower natural gas prices are also included. Each of these cases is then compared to the comparable case with open access. It should be noted that because it is assumed that most potentially stranded assets resulting from wholesale customers changing suppliers are recovered (as required in the FERC rule), the price impacts of open access are expected to be small and are not addressed here. The impact of the treatment of retail stranded costs on electricity prices, which could be significant, are not addressed in this report because they will depend on the actions of State regulators rather than FERC.

Reference Case (No Open Access). The Reference Case assumes a continuation of previous FERC policies regarding transmission access. This case is based on the Reference Case from the *Annual Energy Outlook 1996 (AEO96)*[3], but has been modified to incorporate regulations on $NO_x$ emissions for Group 1 (tangentially-fired and dry bottom wall-fired) boilers for electricity generation that were developed by the Environmental Protection Agency (EPA) after the AEO96 was completed. The proposed Group 2 standards are not included in the Reference Case, but they are analyzed in two cases discussed later.

The primary differences between the EIA and the FERC No Open Access Cases involve electricity sales and fuel prices. In the AEO96 Reference Case, the EIA projects that electricity sales grow at an average annual rate of 1.4 percent between 1994 and 2015. In the FEIS, electricity sales were assumed to grow at a rate of 1.8 percent per year between 1994 and 2010. Consequently, electricity sales in the FERC study are about 7 percent higher in 2010 than in the EIA analysis. To address this difference, a higher demand case, in which the demand for electricity in 2010 is slightly higher than in the FERC Cases, is included and discussed below (Figure 2). This higher demand growth rate is similar to that of other forecasters such as DRI, GRI and WEFA.

Given the uncertainty about fuel prices, the FEIS contained two sets of assumptions for natural gas prices relative to the coal prices determined by the CEUM (all of these prices represent prices as delivered to electric utilities). In FERC's Constant-Gas/Coal-Price-Differential Cases, coal

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[3]Energy Information Administration, *Annual Energy Outlook 1996*, DOE/EIA-0383(96) (Washington, DC, January 1996).

prices to electricity generators decline at a rate of 1.9 percent per year between 1994 and 2010 and natural gas prices decrease by an average of 2.1 percent per year. In FERC's High-Gas/Coal-Price-Differential Cases, the coal prices decline by 1.4 percent per year while natural gas prices increase by 1.7 percent per year. In the EIA Reference Case, coal prices are projected to decrease at a rate of 0.2 percent per year between 1994 and 2010 while natural gas prices are expected to increase by 0.7 percent per year. Therefore, EIA's coal prices are higher than the coal prices in both FERC cases (Figure 3). EIA's reference case natural gas prices fall between the two FERC price paths for natural gas (Figure 4). This analysis also includes a set of EIA cases with lower natural gas prices (with and without open access), although the price does not decline as assumed in the FERC Constant-Gas/Coal-Price-Differential Case. In FERC's Constant-Gas/Coal-Price-Differential cases the ratio of delivered gas prices to delivered coal prices remains around 1.5, while in the High-Gas/Coal-Price-Differential cases it grows from 2.1 in 2000 to 2.7 in 2010. In EIA's Reference Case the ratio of delivered gas prices to delivered coal prices grows from 1.8 in 2000 to 1.9 in 2010 and 2.3 in 2015 (the ratio is 1.6 in 1994 in all EIA cases). In EIA's High Demand Case discussed below the ratio grows from 2.0 in 2000 to 2.3 in 2010 and 2.8 in 2015. Similarly, in EIA's Low Gas Price Case the ratio is constant at 1.7 between 2000 and 2010, and grows to 1.9 in 2015.

In the FEIS, FERC assumes that certain efficiency improvements will occur in the electric power industry even without the open access rule. FERC assumes that reserve margins, which currently range from 17 percent to 24 percent depending on the region, will fall to 15 percent by 2005. The reserve margins, which are based on NERC reliability criteria, are determined by dividing the capacity requirement by the peak demand (less interruptible loads). In this analysis, NERC data are also used to determine minimum reserve margins; however, interruptible demands (all or a portion of which can be treated as available capacity) are not represented in the NEMS. After adjusting for the impact of interruptible demand EIA uses lower reserve margin assumptions (generally 13 to 15 percent) to achieve capacity requirements similar to FERC.

In the FERC FEIS, availability rates for generating units are assumed to attain a level of 85 percent by 2005 and remain constant thereafter.[4] As a result, utilization rates for all coal-fired units increase to about 80 percent in FERC's High-Gas/Coal-Price-Differential Cases. A review of currently operating coal plants shows only a small number operating at utilization rates over 80 percent and, as a result, EIA considers the FERC average coal plant utilization rates to be somewhat optimistic[5]. In the AEO96 Reference Case, the maximum utilization rate is assumed to increase to 75 percent by 2003 due to improvements in availability rates. However, to evaluate

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[4]The availability rate describes the percent of time a generating plant is not out-of-service due to planned and unplanned maintenance. Usually, the average utilization rate is lower than the availability rate because the demand for electricity is insufficient to require continuous operation. Also, some units are occasionally operated at less than full capacity so that other units do not have to be shut down completely and later incur costly startup expenses.

[5]Energy Information Administration, "A Review of FERC's Final Environmental Impact Statement for Electricity Open Access and Recovery of Stranded Costs", Service Report (Washington, DC, July 9, 1996).

the sensitivity of the open access rule to assumptions about availability rates, this analysis includes a case in which maximum utilization rates increase to 80 percent in 2005, which is comparable to the assumption used in the FERC Base Cases.

In the FEIS, FERC assumes that the limit on sustainable power flows is 75 percent of the average Summer and Winter transfer capability reported by NERC.[6] The limit is less than the maximum capacity due to a variety of reasons as discussed in the FEIS. EIA considers this to be a reasonable assumption and uses the same rate in its analysis. However, EIA uses FERC data, because they are available at a lower level of aggregation than the NERC data.[7] The net result is that the limits used in this analysis are slightly higher than the NERC data used in the FEIS.

High Demand Reference Case. Since fossil fuel consumption, and the resulting pollutant emissions, are sensitive to the demand for electricity, a second reference case with higher growth in demand is included. This case is based on the High Electricity Demand Case from the Annual Energy Outlook 1996, in which electricity sales are projected to grow at an average annual rate of 1.8 percent between 1994 and 2015. Between 1994 and 2010, demand grows at a slightly higher rate of 2.0 percent per year. In this case, the electricity demand in 2010 is about 4 percent higher than in the FERC cases. In 2015, the corresponding demand is 9 percent higher than in the Reference Case (Figure 2). Except for the difference in electricity sales, this case uses the same assumptions as the Reference Case in the AEO96.

Reference Case With Lower Natural Gas Prices. The projected price path for natural gas is subject to considerable uncertainty. In order to examine the sensitivity of the results to variations in natural gas prices, this case assumes that technological improvements will lead to lower prices. This case is based on the High Technology (Oil and Gas Supply) Case from the AEO96. Compared to the Reference Case, delivered natural gas prices to utilities in 2015 are 20 percent lower in this case. In 2010, the natural gas price in this case is 29 percent lower than the assumed price in the High-Gas/Coal-Price Differential Case and 36 percent higher than the corresponding price in the FERC Constant-Gas/Coal-Price-Differential Case (Figure 4).

Open Access Case. The open access rule is expected to increase market opportunities for generators with excess capacity. It will also provide greater access to information about transmission services and should lower transactions costs associated with electricity trade. In the Open Access Case, the maximum utilization rate for plants is 75 percent, but it is assumed that this rate is achievable by 2000, or three years earlier than in the Reference Case. In comparison, FERC assumes that increases in availability rates through 2005 could result in utilization rates as high as 80 percent, except for the Competition-Favors-Coal Case, in which these improvements

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[6]Federal Energy Regulatory Commission, *Promoting Wholesale Competition Through Open Access Non-Discriminatory Transmission Services by Public Utilities (RM95-8-000) and Recovery of Stranded Costs by Public Utilities and Transmitting Utilities (RM94-7-0001)*, FERC/EIS-0096 (Washington, DC, April 1996), p. 3-9 -- 3-11.

[7]EIA uses estimates of transmission capability from FERC Form-714, "Annual Electric Control and Planning Area Report".

occur by 2000.

In this analysis, the transaction cost for bulk power purchases, which is 1 mill (one-tenth of a cent) per kilowatt-hour in the Reference Case, is assumed to fall to 0.5 mills per kilowatt-hour as a result of the open access rule. This cost is similar to FERC's transmission usage charge, which is assumed to fall from 1 to 3 mills per kilowatt-hour to 0.5 mills per kilowatt-hour as a result of the rule.

Expanded Transmission Capacity with Open Access Case. Compared to the Reference Case, this case assumes an increase in the interregional transmission capacity. Higher transmission capacity could occur as a result of improvements at existing lines or the construction of new facilities, although new interregional transmission lines are considered less likely due to siting difficulties. The EMM does not construct new transmission capacity endogenously, so transmission capacity expansion is input to the model. In this Case, the existing transmission limits, expressed as a percentage of the maximum capability (current capacity plus planned increases), are assumed to increase to 95 percent in 2000, 100 percent in 2005, 105 percent in 2010, and 110 percent in 2015. In the Reference Case, the corresponding percentage was 75 percent throughout the forecast horizon, so this represents an increase of more than 25 percent in 2000 and almost 50 percent by 2015. These are the same percentages used in the Base and Expanded Transmission Cases in the FEIS, except that the FERC study did not include projections beyond 2010. Except for the increase in transmission capacity, all other assumptions are the same as those used in the Open Access Case.

Higher Fossil-Plant Utilization Rates with Open Access Case. This case assumes that the open access rule encourages suppliers to achieve higher availability and utilization factors than expected in the Reference Case. It is assumed that the maximum utilization rate of 80 percent is achieved in 2005, compared to 75 percent in 2003 in the Reference Case. This is similar to the assumption in the FERC cases, in which availability rates are allowed to rise to 85 percent in 2005 and utilization rates approach 80 percent. Except for the higher utilization rate, this case is identical to the Open Access Case.

Higher Demand with Open Access Case. This case evaluates the sensitivity of the results to growth in the demand for electricity. It combines the assumptions of the Open Access Case and the higher growth rate for electricity sales. That is, demand is projected to grow at about 1.8 percent per year, plants can achieve maximum utilization rates of 75 percent by 2000, and transaction costs for power purchases are assumed to decrease by 50 percent (from 1 mill per kilowatt-hour to 0.5 mills per kilowatt-hour) as a result of the open access rule.

Lower Natural Gas Prices with Open Access Case. This case combines the assumptions of the Open Access Case and the technology improvements that result in lower natural gas prices. The assumed increases in utilization rates and lower transaction costs associated with open access will increase potential for bulk power sales. However, electricity trade, which can result in the displacement of indigenous gas-fired generation with imported coal-fired supplies when excess capacity exists, will be less economical with lower gas prices.

High Demand and Fossil-Plant Utilization with Open Access Case. This case combines the assumptions from the High Fossil-Plant Utilization Rates with Open Access Case with those from the Higher Demand with Open Access Case. This is meant to serve as a worst case, assuming that the open access rule leads to stronger demand growth and provides utilities with an incentive to improve the performance of their plants beyond what they otherwise would have.

**Results**

In this section, the results for the three Reference Cases are presented. Trends in emissions, utility fuel use, and electricity trade are the primary focus. Each of the Open Access Cases are then compared to the corresponding Reference Case. That is, the Open Access, Expanded Transmission Capacity with Open Access, and the High Fossil-Plant Utilization Rates with Open Access Cases are compared to the Reference Case. The High Demand with Open Access Case and the High Demand and Fossil-Plant Utilization with Open Access Case are evaluated using the High Demand Reference Case. The Low Gas Prices with Open Access Case is compared to the Reference Case With Lower Gas Prices. Also discussed are the potential impacts of the Group 2 boiler $NO_x$ standards and how growing competition in the electricity business might effect emissions. In all cases significant trends and patterns are discussed. One point should be noted about historical $NO_x$ emissions values. All historical $NO_x$ emissions are estimated using fuel consumption data and plant configuration data reported to EIA, and emission factors developed by the Environmental Protection Agency. These factors are likely to be revised in the next few years as data from the continuous emissions monitoring systems required by the Clean Air Act Amendments of 1990 becomes available. As a result, the historical values given in this report could also be revised.[8] It should also be noted, that in the later years of the EIA analysis, after 2005, the differences between the open access cases and the corresponding reference cases get very small and are effectively zero (excluding the high utilization cases discussed below). The extremely small changes seen in those years should not be seen as significant.

Reference Case. Even without the open access rule, $NO_x$ emissions will increase over the next 20 years, although the implementation of the EPA regulations for Group 1 boilers will offset this growth over the next decade. Compared to 1994, $NO_x$ emissions are expected to be 15 percent lower in 2000 and 6 percent lower in 2005 in EIA's Reference Case. However, $NO_x$ emissions are expected to continue to increase and are projected to be 3 percent higher than 1994 levels by 2015 (Figure 5). $CO_2$ emissions are also expected to increase over the forecast horizon. They are expected to be 5 percent and 33 percent higher than in 1994 in 2000 and 2015, respectively (Figure 6).

Increases in utility fossil fuel consumption accounts for the higher level of emissions. Due to low operating costs, coal-fired plants remain an economical choice compared to other alternatives, particularly oil and gas capacity. Most coal plants generate power for less than 3 cents per

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[8]The EIA revised its historical $NO_x$ emissions estimates on August 30, 1996 due to methodological changes. This revision resulted in a revised estimate of 1994 emissions of just over 7 million tons. These new estimates are included in this report, but were not available to FERC for use in its EIS.

kilowatthour (Figure 7). Coal-fired generation, which accounted for 55 percent of total supply in 1994, is expected to increase by 26 percent between 1994 and 2015 in order to satisfy increases in demand and to replace supplies from retiring units (Figure 8). Increases in utility coal consumption occur primarily as a result of higher utilization rates for existing capacity as relatively few new coal-fired facilities are expected to be built (Figure 9). Oil and gas-fired generation, which accounted for 13 percent of total generation in 1994, is projected to increase by about 170 percent by 2015 (Figure 8). Most of this increase is provided by new gas-fired combined cycle facilities.

Interregional trade represented only 8 percent of total generation in 1994. It will decline by 24 percent over the forecast horizon as increases in the demand for electricity within regions reduce the amount of surplus generating capacity. ECAR (Midwest) and STV (Southeast) are the largest domestic exporters. New England and New York are the largest importers, but most bulk power purchases by utilities in the Northeast are supplied by international sources.

Historically, ECAR and STV have relied heavily on coal-fired capacity and have consequently had the highest levels of $NO_x$ emissions. Together, these two regions produced more than 40 percent of coal-fired generation and electric utility $NO_x$ emissions in 1994. Compared to 1994 levels, $NO_x$ emissions are expected to increase slightly in both ECAR and STV. Electric utilities in New England and New York generate comparatively little coal-fired electricity and combined to account for only 3 percent of utility $NO_x$ emissions in 1994. Between 1994 and 2015, $NO_x$ emissions are expected to increase slightly due to higher fossil fuel consumption. $CO_2$ emissions are expected to increase substantially in each of these regions.

High Demand Reference Case. Compared to the Reference Case, demand for electricity is 9 percent higher in 2015 in the High Demand Reference Case (Figure 2). With higher demand for electricity, more of the available capacity is required to meet internal demand and the transmission facilities are more heavily utilized. The higher utilization rates not only increase fossil fuel consumption and emissions, but also reduce opportunities for trade.

Compared to the Reference Case, $NO_x$ emissions in 2015 are 2 percent higher in the High Demand Reference Case due to higher fossil fuel consumption although the impact is reduced by the EPA regulations for Group 1 boilers (Figure 5). This represents an increase of 5 percent compared to 1994 levels. Similarly, higher demands lead to higher $CO_2$ emissions. By 2015, $CO_2$ emissions are 5 percent higher than in the Reference Case and 39 percent above 1994 levels (Figure 6).

In the High Demand Reference Case, coal-fired generation increases by 31 percent between 1994 and 2015. Gas- and oil-fired generation is expected to more than double over the corresponding period. Compared to the Reference Case, coal-fired and gas/oil-fired generation in 2015 is projected to be 4 percent and 19 percent higher in the High Demand Reference Case (Figure 8 and Figure 10).

In the High Demand Reference Case, interregional bulk power purchases are expected to be lower than in the Reference Case. The increased demand reduces the availability of surplus generating

capacity so there are fewer opportunities to displace less economical supplies with imported power. Compared to the Reference Case, domestic economy power sales through 2010 are lower in the High Demand Reference Case. Stronger demand growth reduces the availability of excess capacity, because it is needed to meet intra regional requirements. In 2015, economy trades increase slightly due to additions of new plants, which increase capacity available for export.

Reference Case With Lower Gas Prices. In this case, the technological assumptions resulting in lower production costs for oil and gas supply result in delivered natural gas prices in 2015 that are 20 percent lower than in the Reference Case (Figure 4). Consequently, gas-fired generation is more competitive with coal-fired generation. By 2015, oil/gas-fired generation is 6 percent higher and coal-fired generation 2 percent lower than in the Reference Case (Figure 10). Since gas plants have lower emission rates than coal plants, $NO_x$ and $CO_2$ emissions are slightly lower than in the Reference Case. Through 2010, lower natural gas prices also reduce economy trades in which coal-fired generation displaces gas-fired supplies. However, in 2015 interregional sales are essentially unchanged because in both cases most capacity is needed to meet intra regional demand and not available for trade.

Reference Case with Open Access. In the Reference Case with Open Access, which assumes that Order 888 encourages utilities to accelerate improvements in utilization rates for existing capacity and results in lower transaction costs for bulk power purchases, most of the impacts of the rule are observed during the next 5 to 10 years. Compared to the Reference Case, $NO_x$ and $CO_2$ emissions in 2000 are about 1 percent higher in the Reference Case with Open Access (Figures 11 and 12, and Tables 2 and 3). By 2005 and thereafter, the corresponding differences in both emissions are negligible.

By 2005, capacity utilization rates are expected to increase substantially due to increases in demand, even without the open access rule. As a result, opportunities for increased trade are reduced. Also, the interregional transmission system is already heavily utilized, so the effects of lower transaction charges for bulk power purchases are limited.

Compared to the Reference Case, interregional economy power sales in 2000 are 27 percent higher in the Reference Case with Open Access. By 2005, the corresponding difference is 9 percent. Most of the increased exports are provided by ECAR, STV, and MAIN but imports to the Northeast are virtually unchanged due to limits in interregional transmission capacity (Figures 13 and 14). In 2010 and 2015, interregional economy sales are essentially the same in both the Reference Case and the Reference Case with Open Access.

In the Reference Case with Open Access, coal-fired generation in 2000 is about 3 percent higher than in the Reference Case, whereas gas- and oil-fired electricity production is about 12 percent lower (Figures 15 and 16). By 2005, little difference in fossil fuel consumption is observed between the two cases since the current surplus of generating capacity in some regions is mostly required to meet internal demands and not available for trade.

In the short-term, most of the increased coal-fired generation and electricity exports occur in ECAR. Compared to the Reference Case, $NO_x$ emissions in 2000 are expected to be 2 percent

higher (Figure 17). $NO_x$ emissions in STV are 2 percent lower in 2000 due to an increase in imported power. In the Northeast, there is comparatively little interregional transmission capacity, so operating decisions and emissions are not expected to differ much as a result of the open access rule. By 2005, increased demand has reduced the surplus generation and transmission capacity and the corresponding differences are usually smaller. In general, $CO_2$ emissions are expected to increase over time in all regions.

Expanded Transmission Capacity with Open Access. Increasing the interregional transmission capacity provides more opportunities for utilities with excess generating capacity to seek markets in other service areas. This will result in additional displacement of gas- and oil-fired generation and higher coal consumption, which will increase emissions. The impacts are expected to be greater in the earlier part of the forecast horizon when more excess generating capacity is available.

Compared to the Reference Case, $NO_x$ emissions in 2000 are 1 percent higher as a result of the assumed expansion in transmission capacity (Figure 11 and Table 2). The corresponding increase in $CO_2$ emissions is less than 1 percent. By 2005, emissions of both $NO_x$ and $CO_2$ are essentially unaffected by the increase in transmission capacity. These results are similar to the trends observed in the Reference Case with Open Access.

Interregional economy trades in 2000 are 33 percent higher than in the Reference Case as a result of the assumption of expanded transmission capacity. However, these purchases are only 4 percent higher than in the Reference Case with Open Access. This implies that it is the availability of generating capacity more than transmission limits that determines the impacts of the open access rule. The increase in bulk power purchases resulting from higher transmission limits declines over time as less excess capacity is available for export due to increases in demand.

High Fossil-Plant Utilization Rates with Open Access Case. If the open access rule encourages improvements to availability factors, then the resulting higher utilization rates will increase the amount of capacity available for trade. In this case, the maximum utilization rate for power plants

## Table 2. Changes in NOx Emissions Resulting From Open Access

| Case | 2000 Change 1000 Tons | 2000 Change Percent | 2005 Change 1000 Tons | 2005 Change Percent | 2010 Change 1000 Tons | 2010 Change Percent |
|---|---|---|---|---|---|---|
| EIA Open Access | 90 | 1.49% | 0 | 0.00% | -10 | -0.14% |
| EIA Open Access with Higher Utilization | 90 | 1.49% | 140 | 2.10% | 50 | 0.71% |
| EIA Open Access with High Transmission | 70 | 1.32% | -40 | -0.60% | -20 | -0.28% |
| EIA Open Access with High Demand | 130 | 2.00% | -30 | -0.41% | 10 | 0.14% |
| EIA Open Access with Low Gas Prices | 90 | 1.49% | 40 | 0.60% | 10 | 0.14% |
| EIA Open Access with Higher Demand/Utilization | 130 | 2.00% | 160 | 2.21% | 250 | 3.39% |
| FERC Constant Price Differential with Open Access | -107 | -2.00% | -91 | -1.63% | -203 | -3.52% |
| FERC High Price Differential with Open Access | 92 | 1.62% | 55 | 0.91% | 97 | 1.51% |

Source: EIA, National Energy Modeling System runs, noopen.d082796a, opnacc.d082796a, oat100.d082896a, oahiav.d082896a, nohdem.d082796a, oahde
oalgpr.d082996a and oahdut.d082896a. FERC, Federal Energy Regulatory Commission/Environmental Impact Statement, tables 4-20, 5-18, and 5-19.

## Table 3. Changes in CO2 Emissions Resulting From Open Access

| Case | 2000 Change 1,000,000 Tons | 2000 Change Percent | 2005 Change 1,000,000 Tons | 2005 Change Percent | 2010 Change 1,000,000 Tons | 2010 Change Percent |
|---|---|---|---|---|---|---|
| EIA Open Access | 11 | 0.57% | 2 | 0.10% | 2 | 0.09% |
| EIA Open Access with Higher Utilization | 11 | 0.57% | 23 | 1.09% | 16 | 0.71% |
| EIA Open Access with High Transmission | 12 | 0.63% | 5 | 0.24% | -1 | -0.04% |
| EIA Open Access with High Demand | 17 | 0.81% | 2 | 0.08% | 11 | 0.45% |
| EIA Open Access with Low Gas Prices | 10 | 0.52% | 4 | 0.19% | -16 | -0.71% |
| EIA Open Access with Higher Demand/Utilization | 17 | 0.81% | 29 | 1.23% | 56 | 2.30% |
| FERC Constant Price Differential with Open Access | -41 | -1.94% | -49.3 | -2.17% | -81 | -3.27% |
| FERC High Price Differential with Open Access | 14 | 0.63% | 6 | 0.25% | 9 | 0.34% |

Source: EIA, National Energy Modeling System runs, noopen.d082796a, opnacc.d082796a, oat100.d082896a, oahiav.d082896a, nohdem.d082796a, oahde
oalgpr.d082996a and oahdut.d082896a. FERC, Federal Energy Regulatory Commission/Environmental Impact Statement, tables 4-14 and 4-18.

is assumed to be 80 percent, compared to 75 percent in the Reference Case. The higher utilization rate will increase the amount of excess capacity that can be marketed to customers.

Compared to the Reference Case, $NO_x$ emissions in 2000 are expected to be 1 percent higher in the High Fossil-Plant Utilization Rates with Open Access Case (Figure 11 and Table 2). In contrast to the Reference Case with Open Access, in which the increase in $NO_x$ emissions resulting from open access eventually disappeared, the assumption of higher utilization rates results in some excess capacity available throughout the forecast period. In this case, increases in economy trades and coal-fired generation continue to occur throughout the forecast period as a result of the open access rule. Therefore, $NO_x$ emissions in 2015 are 2 percent higher than in the Reference Case and the other Open Access Cases. The differential from the reference case is actually higher in 2015 than in 2010. This occurs because, in the later years of the projections, a small number of new coal plants are added and allowed to operate at an 80 percent utilization rate, 5 percentage points higher than in the reference case.

Higher Demand with Open Access Case. With higher demands for electricity, the open access rule increases $NO_x$ and $CO_2$ emissions in 2000 by 2 percent and 1 percent, respectively. This is slightly higher than the corresponding impacts observed with the lower demand growth in the Reference Case. With the higher demand for electricity, fossil fuel consumption increases more rapidly, particularly for natural gas, which is usually the marginal source of supply. This leads to increases in the price of natural gas and imports of coal-fired generation are more economical. In 2000, surplus generating capacity is still available, even with higher demand, and the open access rule results in more trades than was observed with the demand growth from the Reference Case. Although the short-term effects of the open access rule are slightly higher in this case, opportunities for trade decrease over time since the higher demand growth increases utilization rates for plants, which reduces the capacity available for export. Consequently, the impacts of the open access rule decline more rapidly compared to the Reference Case with Open Access Case, which has lower demand growth.[9] In addition, the higher fossil fuel prices in this case make renewables, particularly wind power, attractive reducing the impact of the higher demand for electricity on emissions.

Low Gas Prices with Open Access Case. If natural gas prices are lower than projected in the Reference Case, electricity trade will be less economical since gas-fired plants are more competitive with coal-fired plants and there is less of a cost difference to exploit. Fewer trades will result in lower coal-fired generation and higher gas-fired generation.

In the short-term, the gas prices in this case are not substantially lower than projected in the Reference Case, though they are approximately 20 percent lower in 2015.. With the lower price path for natural gas, the open access rule is expected to increase $NO_x$ and $CO_2$ emissions in 2000 by slightly over 1 percent. By 2005, the differences are less than 0.5 percent. These results are

[9]Each region is assumed to build capacity to meet its own peak demand, the demands in other regions are not considered. Thus, no new capacity is built in a region until its existing capacity is insufficient to meet peak demand.

similar to the impacts observed in the Reference Case with Open Access, but less dramatic then projected in the FERC Constant-Gas/Coal-Price-Differential Case, which incorporated considerably lower natural gas price assumptions.

High Demand and Fossil-Plant Utilization with Open Access. The results in this case are similar to those in the High Fossil-Plant Utilization Rates with Open Access Case. Relative to the High Demand Reference Case, $NO_x$ emissions are 2-3 percent higher through 2015. The assumption of average utilization rates reaching 80 percent increases the use of coal leading to stronger growth in $NO_x$ and $CO_2$ emissions.

Impact of Group 2 Boiler $NO_x$ Standards. The implementation of Group 1 boiler $NO_x$ standards is expected to keep $NO_x$ emissions below 1994 levels through 2010, except in the higher demand cases. However, the implementation of these standards is not sufficient to offset expected growth in $NO_x$ emissions much beyond 2010. EPA is currently in the process of finalizing Group 2 boiler standards and expects to issue them later this year or early next year. Two cases, one with the reference case electricity growth and one with the high electricity demand growth assumptions, were run with the proposed Group 2 standards (Figure 18). Implementation of these standards will have a significant impact, reducing $NO_x$ emissions approximately 800,000 tons. This reduction will keep $NO_x$ emissions below 1994 levels through 2015 and beyond. However, in later years or with higher growth in electricity demand than expected in EIA's cases, additional efforts will be needed to keep $NO_x$ emissions from exceeding current levels. Also, though the new emissions standards do offset $NO_x$ emissions growth for some time, emissions do increase substantially after the standards are implemented in 2000. Between 2000 and 2015, $NO_x$ emissions increase between 18 and 24 percent in the cases with the proposed group 2 boiler standards.

Competition and Emissions.

The key to understanding the potential impacts of growing competitive pressures in the electricity business on emissions will likely lie in determining what happens to the demand for electricity. Efforts to reduce $NO_x$ and $CO_2$ emissions may be complicated by State and local electricity restructuring efforts. One of the major goals of these programs is to reduce electricity prices. If these efforts result in lower electricity prices it is likely that consumers will respond by increasing their use of electricity. While EIA does not believe that the open access rule by itself will lead to widespread declines in the price of electricity, the efforts underway in many States to make the electricity industry more competitive could have a more significant impact. It is currently unclear to what degree prices might change, but employment and production cost trends in recent years suggest that they could fall significantly. Between 1990 and 1994, the number of employees at major electric utilities has fallen by nearly 65,000 or 13 percent (Figure 19). Utilities are clearly making efforts to prepare for a more competitive future. On a similar note, operations and maintenance costs at fossil plants have also been falling (Figure 20). Between 1990 and 1994, they fell over 12 percent. Depending on the impact these and future cost reductions have on electricity prices the demand for electricity and the emissions associated with it will be somewhat higher than shown in the reference case.

**Summary**

Because of uncertainties associated with projecting fuel prices, electricity demand, the economics of increasing transmission capacity, and the potential for increased performance from older fossil plants (particularly older coal plants), both EIA and FERC used a number of alternate cases to examine the impact of the open access rule.

The key result in all of the cases is that emissions are expected to increase between now and 2015, with or without open access (Figure 21). In most cases, between now and 2010 $NO_x$ emissions will stay below current levels because of the imposition of Group 1 boiler $NO_x$ standards. However, by the end of the forecast horizon they will exceed 1994 levels. $CO_2$ emissions will increase throughout the next 20 years. These higher emissions levels result from increased fossil fuel consumption, which occurs because of continued increases in demand for electricity and the expected retirements of existing capacity, particularly nuclear plants whose 40-year operating licenses are scheduled to expire. Through 2010, the imposition of Group 1 boiler $NO_x$ standards offsets the increase in $NO_x$ emissions that would have resulted from demand growth, but emissions continue to grow after the new standards are implemented.

The implementation of Group 2 boiler standards (Figure 21), expected to be issued in late-1996, is expected to offset the growth shown in $NO_x$ emissions. If the proposed standards that EPA now has out for comment are implemented $NO_x$ emissions are likely to stay below 1994 levels through 2015. However, $NO_x$ emissions are expected to continue to grow after the new standards are implemented and they could eventually surpass current levels. It is possible that emissions trading programs under consideration by the Environmental Protection Agency and States in the Northeast and Midwest will further lower $NO_x$ emissions. The impacts of these programs were not addressed in this report because they are still being negotiated. In addition, the agreement between FERC and EPA to monitor $NO_x$ emissions and review the need for mitigation, as well as, the work at OTAG may also reduce or offset the growth seen in this analysis.

The impact of the open access rule on emissions is small relative to the change in emissions resulting from growth in the demand for electricity. Absent the new boiler standards, $NO_x$ emissions would grow substantially. The effects of the open access rule depend to a large extent on the availability of excess generation and transmission capacity, which determine how much surplus power exists and how much and where the electricity can be delivered. However, the results appear more sensitive to changes in available generating capacity than transmission capacity. Thus, as demand grows over the next few years, the amount of excess economical capacity available for trade declines and the impact of open access on emissions becomes very small. In most regions of the country, reserve margins are expected to decline as demand grows over the next few years (Figure 22). In response to changing demands and the completion of plants currently under construction reserve margins in ECAR and STV, two coal dependent regions, varied significantly between 1990 and 1995, but the trend shows a gradual decline with eventual stabilization between 12 and 16 percent.

In the cases examined, the increases in $NO_x$ emissions resulting from open access range from 1 to 3 percent. Except for the cases which assume higher fossil-steam plant utilization the change in $NO_x$ emissions are less than 120,000 tons per year (Table 2). The projected impacts on emissions are greater in the next 5 to 10 years. In this time frame, there is excess generation and transmission capacity, so that there is considerable potential to increase bulk power transfers due to the open access rule. In later years, power plants and transmission facilities are more heavily utilized due to increases in the demand for electricity, so opportunities for trade are more limited. Except for the High Fossil-Plant Utilization Rate cases, the impact on emissions in 2005 and beyond are negligible. If higher utilization rates occur as a result of Order 888, $NO_x$ and $CO_2$ emissions could increase by more than 2 percent through 2015 compared to the Reference Case.

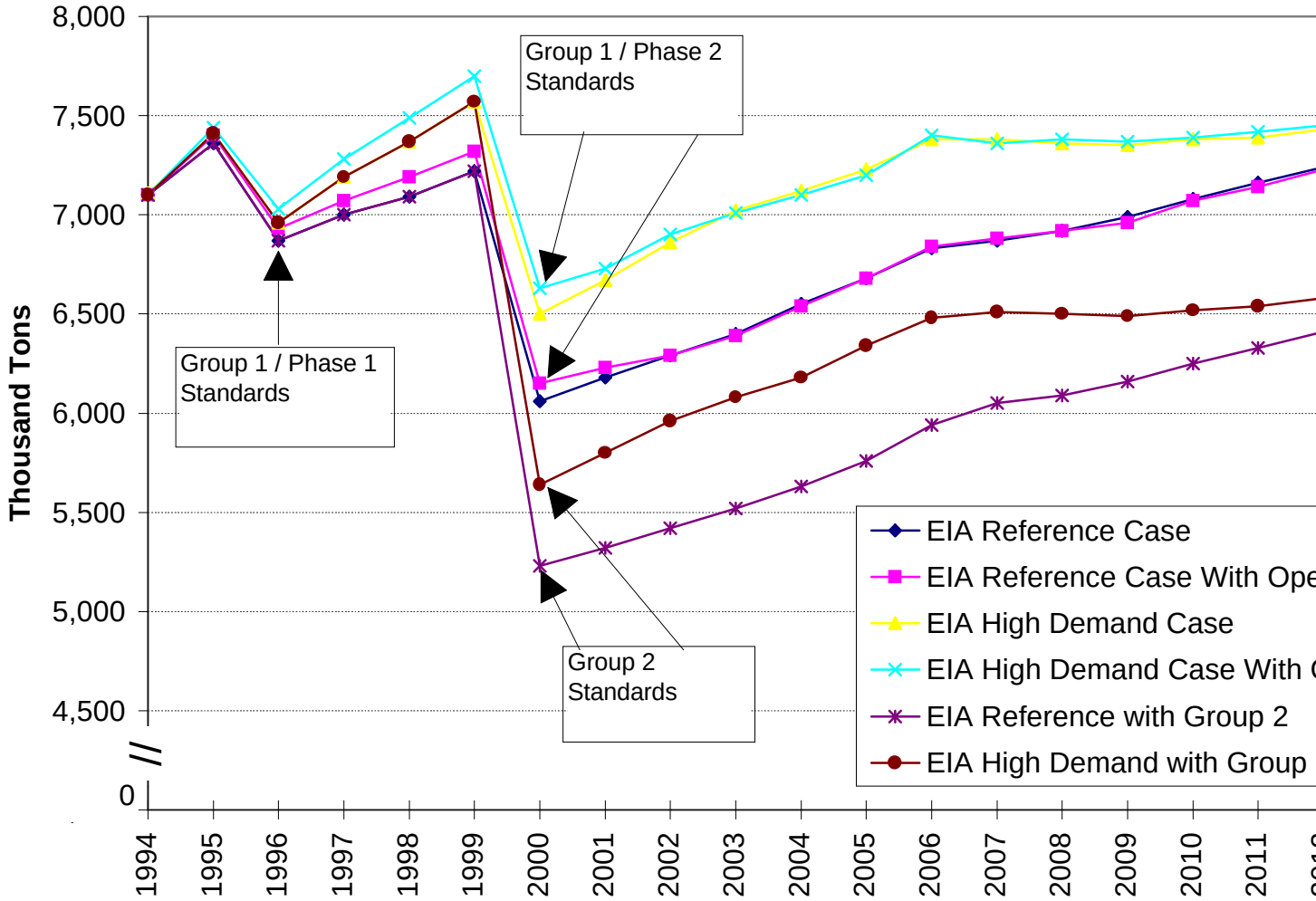
These results are similar to the impacts determined in the FEIS. Both the EIA and FERC analyses indicate that increases in emissions resulting from Order 888 are expected to be larger in the next five to ten years. Thereafter, the impacts in the EIA study were usually negligible, whereas the FERC cases typically resulted in declining, but observable, increases in emissions. This is primarily due to FERC's assumptions for efficiency improvements (e.g., heatrates and plant availability) throughout the forecast horizon. In the EIA cases, these improvements were not assumed to occur, so opportunities for trade declined over time as utilization rates for plants increased to meet new demands for electricity. EIA does not believe that is reasonable to assume that all of the older fossil steam plants will be able to operate at utilization rates of over 80 percent, and, as a result, limited the regional averages to 75 percent in all cases other than the higher utilization cases. A case, the Higher Demand and Fossil Plant Utilization with Open Access case, was prepared to look at the impact and $NO_x$ emissions are 2 to 3 percent higher throughout the projection period as a result of open access.

Several uncertainties beyond the alternative electricity demand and fuel prices reviewed in this report should be mentioned. First, it is possible that the more open access to transmission capacity resulting from the rule will lead to increasing pressure on relatively high cost utilities to lower rates to keep their large wholesale customers. Even though the rule calls for recovery of investments made to serve these customers, utilities may be willing to forego some portion of these investments to keep them. The resulting lower electricity prices could result in increased demand for electricity and a higher level of emissions. Second, in the cases presented here it assumed that the excess generating capacity seen today will decline over time as demand grows, reducing the opportunities for increased interregional trade. However, many new players (nonutility generators, cogenerators, power brokers, etc.) are entering the electricity supply business. These entrepreneurs may continue to seek out competitive opportunities in the market, slowing the decline in excess capacity and leading to more opportunities for trade. However, most of the plants added have been natural gas-fired, so their emissions impacts would be expected to be small.

# APPENDIX

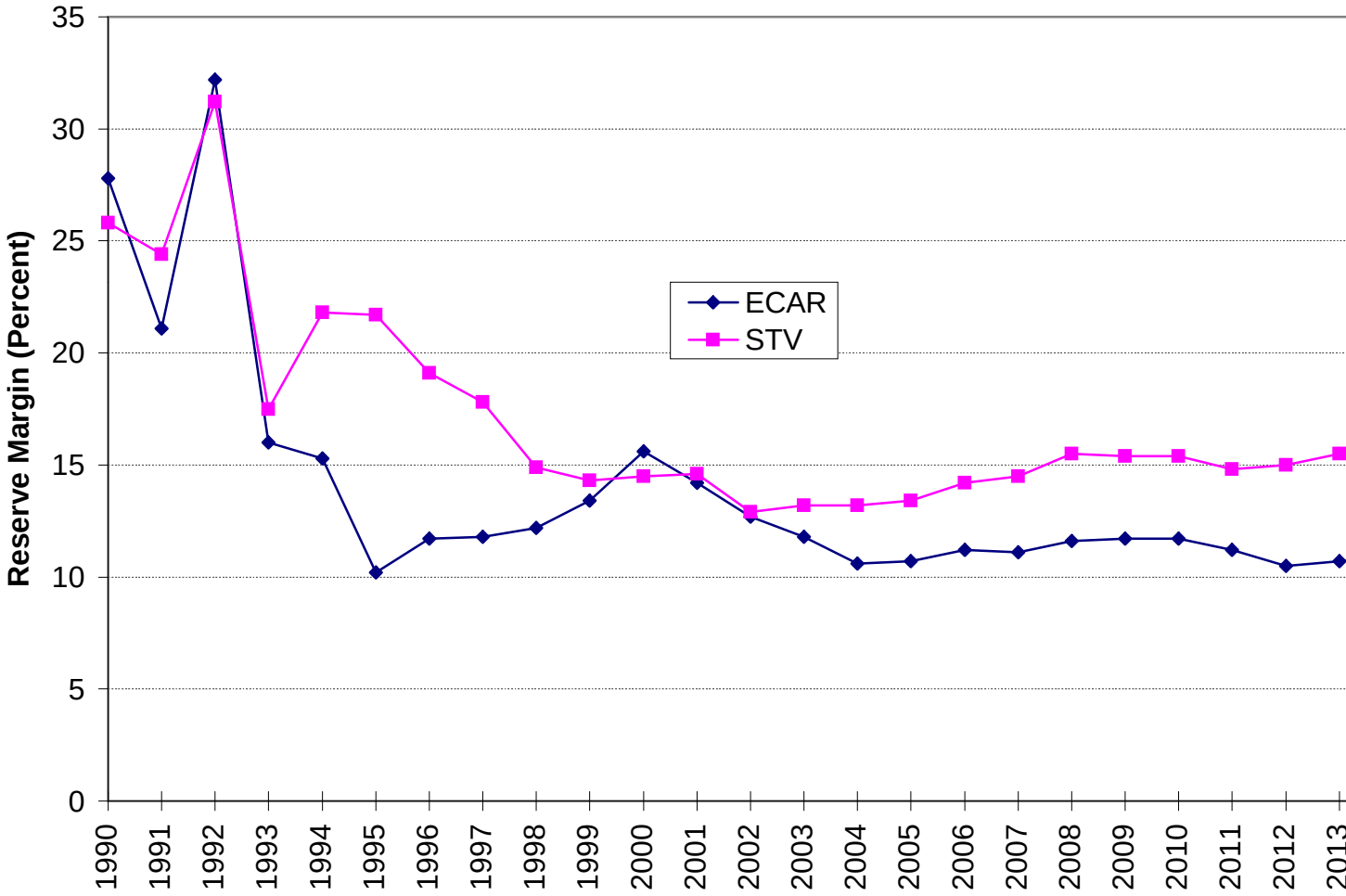
Requests for Analysis of Federal Energy Regulatory Commission Order 888

## Figure 21. NOx Emissions With and Without Open Access




Source: EIA, National Energy Modeling System runs, noopen.d082796a, opnacc.d082796a, nohdem.d082796a and oahde

## Figure 22. Reserve Margins in Selected Regions




Source: EIA, National Energy Modeling System runs, noopen.d082796a.

# Figure 1. NEMS Electricity Supply Regions and Census Divisions