BEFORE THE CORPORATION COMMISSION OF OKLAHOMA

IN THE MATTER OF THE APPLICATION OF OKLAHOMA GAS AND ELECTRIC COMPANY FOR COMMISSION AUTHORIZATION OF A PLAN TO COMPLY WITH THE FEDERAL CLEAN AIR ACT AND COST RECOVERY; AND FOR APPROVAL OF THE MUSTANG MODERNIZATION AND COST RECOVERY	)))))))	CAUSE NO. PUD 201400229

Direct Testimony

of

Leon Howell

on behalf of

Oklahoma Gas and Electric Company

August 6, 2014

I. INTRODUCTION

Q. **Please state your name, your employer, and your business address.**

A. My name is Leon Howell. I am employed by Oklahoma Gas and Electric Company ("OG&E" or "Company") and my business address is 321 N. Harvey, Oklahoma City, Oklahoma 73102.

Q. **What position do you hold with OG&E?**

A. I hold the position of Director, Resource Planning. I am responsible for OG&E's resource planning group and for all of its activities including the preparation of integrated resource plan submittals and frequent resource planning analyses that are performed on an ongoing basis as needs arise. I am also responsible for load forecasting for the Company.

Q. **Please summarize your professional experience and educational background.**

A. I have been employed by OG&E since 1996. I earned a Bachelor of Science Degree in Electrical Engineering from the University of Oklahoma (1985) and a Masters Degree in Business Administration (2000) from Oklahoma City University. I am a registered Professional Engineer (#16018) in the State of Oklahoma. Prior to joining OG&E in 1996, I was employed by Western Farmers Electric Cooperative as a Senior Transmission Planning Engineer. Since joining OG&E, I have held various operations and engineering positions. I have been responsible for leading OG&E's resource planning efforts since 2003.

Q. **Have you previously testified or appeared before the Oklahoma Corporation Commission ("Commission")?**

A. Yes. I have filed testimony at the Commission on two occasions and have appeared before the Commission for numerous IRP public meetings. In 2008, I submitted testimony in OG&E's application to acquire a 51% interest in Redbud (Cause No.

200800086). Later that same year, I submitted testimony in OG&E's application to construct the Windspeed transmission line to deliver wind resources from western Oklahoma to OG&E's load centers (Cause No. PUD 200800148).

Q. **What is the purpose of your testimony in this proceeding?**

A. The purpose of my testimony is to present OG&E's integrated resource planning process that was relied upon to develop OG&E's proposed environmental compliance plan and the replacement of the retiring Mustang generating units. The results of this process are reflected in the 2014 Integrated Resource Plan ("IRP") Update, which OG&E submitted on August 4, 2014. The 2014 IRP Update is attached to my testimony as Exhibit LCH-1. OG&E is required to submit an IRP every three years in Oklahoma and Arkansas and, in addition, is required to submit an out-of-cycle update whenever there is a material change in planning assumptions.

In this instance, the May 27, 2014 United States Supreme Court ruling that established OG&E's deadline for compliance with the Regional Haze requirements of the Clean Air Act ("CAA") and the implementation of the Southwest Power Pool Integrated Marketplace ("SPP IM") represent material changes in planning assumptions. My testimony evaluates alternatives that will bring OG&E into compliance with the environmental requirements that are known as Regional Haze Rule ("RHR") and Mercury and Air Toxics Standards Rule ("MATS") in light of OG&E's future resource needs. I also address the Company's decision to replace the Mustang generating units with combustion turbines.

The RHR and MATS regulations that define the current environmental compliance requirements are addressed in the testimony of OG&E Witness Usha Turner, who will also address the potential of future environmental regulatory risk and the various permitting requirements for the environmental compliance plan. Also, the various technologies for complying with the environmental compliance requirements as well as the modernization of the Mustang plant are addressed in the testimony of OG&E Witness Robert Burch.

Q. **What is the Company's environmental compliance plan to comply with the Regional Haze requirements?**

A. The Supreme Court order, dated May 27, 2014, refused to hear the State's and OG&E's challenges, thereby leaving in place the SO_2 emission limits established by the Environmental Protection Agency's ("EPA") Regional Haze federal implementation plan ("FIP"). The 2014 IRP analysis formed the basis for OG&E's decision to meet the FIP mandate by (1) installing dry scrubbers at Sooner Units 1 and 2, and (2) converting the Muskogee Units 4 and 5 from coal to natural gas. In the IRP, we refer to this plan by the shorthand, "Scrub/Convert".

Q. **Does the 2014 IRP address other environmental compliance mandates?**

A. Yes. The 2014 IRP also includes OG&E's actions to comply with the NO_X emission limits of the Regional Haze State Implementation Plan ("SIP"). The EPA accepted the SIP with regard to the NO_X emission limits. OG&E is currently installing Low NO_X burners on four of its coal and three of its natural gas fired steam units. OG&E is on schedule to meet the NO_X emission limit requirements by the regulatory deadline of January 27, 2017.

OG&E also is complying with the mercury emissions limits contained in the MATS rule. OG&E will be installing activated carbon injection ("ACI") technology on its five coal fired units. OG&E has until April 16, 2016 to comply with these limits.

Q. **How does the 2014 IRP Update address the retirement and replacement of the Mustang generating units?**

A. The 2014 IRP Update focuses on the resources needed to meet load obligations as specified by the 12% SPP capacity margin requirement. OG&E has determined that its existing Mustang generating units should be retired by the end of 2017, and consequently the capacity must be replaced. OG&E plans to retire the existing Mustang units and, in order to meet the SPP planning capacity margin obligations, replace them with modern combustion turbines.

Q. **Does OG&E identify the need for incremental capacity in the 2014 IRP Update?**

A. Yes, however, OG&E is not projecting a need for new incremental capacity until 2020. The 2014 IRP Update primarily focuses on meeting environmental regulatory requirements and SPP capacity requirements by maintaining the capacity provided by the existing coal-fired steam power plants at Sooner and Muskogee and the Mustang gas-fired steam units. The Company's decision on how it will meet the need that arises in 2020 will be addressed in a future IRP.

Q. **Please briefly describe the Company's approach to the 2014 IRP Update.**

A. The 2014 IRP identifies the resource plan that will allow OG&E to meet its capacity obligations at the lowest reasonable cost. The Company evaluated the best environmental compliance alternatives and generation resource options after performing a comprehensive update of our resource planning assumptions. This included updates to our load forecast, demand-side resource forecast assumptions, existing unit characteristics, retirement plans, new generation unit costs and operating characteristics, emission control costs, fuel prices, and CO_2 cost assumptions.

The 2014 IRP analysis is similar to our prior IRPs with one significant difference: the incorporation of the impact of the SPP IM implementation on net present value of customer cost ("NPVCC"). As I will explain in more detail, OG&E now sells all of its generated energy into the SPP IM and purchases all of its energy requirements from the SPP IM. A forecast of SPP IM energy prices is a critical new step in the IRP process.

Q. **What were the environmental compliance plans you studied in your analysis?**

A. We evaluated five alternative environmental compliance plans that capture the range of possibilities:

Figure 1

Scrub/Convert	• Scrub Sooner 1 by 2018 and Sooner 2 by 2019 • Convert two Muskogee units by 2019
Scrub	• Scrub Muskogee 4 by 2018 and Muskogee 5 by 2019 • Scrub Sooner 1 by 2018 and Sooner 2 by 2019
Convert	• Convert four coal units to gas by 2019
Scrub/Replace	• Scrub Sooner 1 by 2018 and Sooner 2 by 2019 • Replace two Muskogee coal units with new CCs by 2019
Replace	• Replace four coal units with new CCs by 2019

Each of these alternatives has been subjected to scenario and sensitivity analyses to assess the impact of uncertainties associated with key input assumptions, including SPP IM energy pricing, fuel prices and the potential for future carbon regulation. As a final step, the modeling results were evaluated against a set of objectives that included the projected cost to our customers over a 30-year period and other important customer objectives, including reliability, compliance with existing rules, fuel diversity, operational flexibility, portfolio age, demand side management, exposure to fuel and emission prices and future environmental regulation risks.

Q. **Which alternative did the Company select?**

A. After considering the alternatives, OG&E selected the Scrub/Convert alternative because it best addresses the objectives mentioned in the previous answer and produces the lowest reasonable cost with due consideration to the uncertainty associated with the SPP IM energy prices, fuel prices and future regulatory risks. It is the lowest cost alternative in the base case and provides a compromise between the "Scrub" alternative with its CO_2 risk and the "Convert" alternative with its high natural gas price risk. In addition, the Scrub/Convert balances the risk caused by environmental compliance decisions made by other participants in the SPP IM.

II. IRP PROCESS AND OBJECTIVES

Q. **Please describe the process that OG&E uses to develop its resource plan.**

A. OG&E employs a multi-step process that culminates in the development of a draft and final IRP report. The final IRP report reflects input received during meetings with our stakeholders in both Oklahoma and Arkansas.

The modeling process requires an update to all of the model assumptions including the load forecast, fuel prices, and operational attributes for each of OG&E's units and all units across the SPP footprint. We then perform an extensive number of computer simulations using two widely-used industry models. We first use the Ventyx PROMOD IV®, an electric market simulation model, that forecasts SPP IM energy prices. These prices are then input into PCI GenTrader® production cost model. GenTrader is used to calculate the production cost of each of OG&E's units along with the revenue OG&E will be paid for energy produced and sold into the SPP IM.

The modeling process generally takes several months from start to finish, excluding the development of the load forecast, which is performed before the modeling begins. It is necessary to review the results, check and recheck assumptions, and run models several times before we are confident that the base case is verified and reliable to support our decisions. Once the resource planning team is comfortable with the development of a base case, the scenario and sensitivity cases can be defined and run.

The IRP process concludes by applying our set of objectives to the collection of alternative portfolios and developing a specific 5 Year Action Plan.

Q. **How does OG&E evaluate resource planning options?**

A. The fundamental objective is to develop a resource plan that meets our capacity obligations and complies with applicable laws at the lowest reasonable cost. The "reasonable" qualifier refers to the fact that there are many other factors that need to be considered, many of which relate to the cost and performance risk of the portfolio. Those factors are embodied in the list of nine objectives as presented in the 2014 IRP Update:

(1) Reliability: satisfy SPP's planning capacity margin requirements throughout the 30-year planning horizon;

(2) Compliance with Existing Environmental Rules: satisfy the requirements of MATS and the Regional Haze FIP;

(3) Expected Cost to Consumers: lowest reasonable NPVCC subject to satisfying other IRP objectives;

(4) Fuel Diversity: maintain a reasonable balance among natural gas, coal, and wind, and other economically viable renewable resources;

(5) Operational Flexibility: maintain or increase the ability of OG&E's portfolio to respond at SPP's direction to localized reliability issues (through quick-start peaking units, for example);

(6) Portfolio Age: maintain a reasonable balance of capacity as measured by expected remaining asset life;

(7) Demand-Side Resources: maximize the reliance on economic demand-side resources;

(8) Exposure to Fuel and Emissions Prices: consider the sensitivity of NPVCC based on different assumptions regarding fuel and emissions prices;

(9) Exposure to Future Environmental Regulation: consider the potential that future environmental regulations (particularly regulations intended to address greenhouse gases) may result in costly environmental compliance solutions.

Developing a plan that meets our capacity obligations satisfies our first objective: reliability. Compliance with existing environmental rules is the second objective, and refers specifically to the requirements of MATS and Regional Haze in this IRP. The third objective focuses on the cost of the resource plan to our customers as represented by a 30-year NPVCC, and includes monetized environmental costs.

Q. **What components contribute to the calculation of NPVCC?**

A. Customer costs are comprised of three components: the return on rate base, expenses, and production costs with market impact. The return on rate base is calculated in a spreadsheet model that applies the overall rate of return to the future capital expenditures. The expenses, such as estimated O&M, ad valorem tax and depreciation, are then added to the spreadsheet model. Lastly, the *production costs with market impact*, consisting of

the fuel and other variable costs for OG&E's units plus the energy purchases from the SPP IM for OG&E's load, less sales revenues from the SPP IM, are added to the spreadsheet model. This calculation is performed for alternative portfolios in all scenarios and sensitivities that are analyzed in the IRP process.

Q. **Why is fuel diversity important?**

A. Fuel diversity, as an objective, is closely related to the concepts of lowest reasonable cost and portfolio risk. For example, the NPVCC of a portfolio that is heavily weighted toward natural gas plants will be relatively insulated from the impact of carbon prices but will swing widely in response to volatility in natural gas prices. Similarly, the NPVCC of a portfolio that is heavily dependent on coal resources will be relatively sensitive to the risk of carbon prices and also be at risk should regulation of CO_2 take a less flexible form than a market-based approach. In our view, relying predominantly on a single technology or a single fuel is a risky strategy. That is why OG&E has developed an existing portfolio which has a mix of fossil-fuel generation (both coal and natural gas-fired) and wind energy. We also have diversity of fossil fuel generation types that meet differing duty cycles such as baseload, intermediate, and peaking generation.

Q. **Why is it important to consider the risk associated with fuel and emission price uncertainty?**

A. Any 30-year analysis depends on many assumptions that are uncertain. Two of the biggest sources of uncertainty are the assumptions regarding fuel prices and environmental policies. Fuel and environmental costs are impacted by fundamental supply and demand circumstances as well as by government policies that shift the supply or demand curves and thus affect fuels prices and electricity prices. OG&E relies on sensitivity analyses to evaluate the impact of changes in these assumptions. A new source of uncertainty in this IRP relates to a new and important input variable, SPP IM energy prices. As I noted earlier, SPP IM prices vary depending on many factors, including the resource planning decisions of all other SPP members. We have evaluated the impact of variations in market prices by developing scenarios and sensitivities that are intended to capture the range of SPP IM energy prices.

It is important to run sensitivities and scenarios to get a sense of the impact on the NPVCC under alternative and plausible assumptions. OG&E believes that an alternative portfolio that limits the risks attributable to uncertainty about future prices and policies is preferable to a portfolio that has moderately lower NPVCC but exposes customers to higher levels of risks.

III. IRP INPUTS AND ASSUMPTIONS

Q. **How did OG&E approach the task of updating assumptions for this particular IRP?**

A. We reviewed and updated every assumption that is relied upon to produce an IRP. These assumptions are discussed in detail in Section IV of the 2014 IRP Update, supplemented by the schedules as required by the Commission's IRP rules.

The IRP assumptions specify the load forecast, demand-side resources, the operating costs of OG&E's existing generation resources and contracts, capital costs and operating costs of environmental compliance options, capital costs, operating costs and operating characteristics of potential new generation, siting and transmission costs necessary to develop and interconnect new generation to the SPP transmission grid, planned additions to the regional transmission network, fuel and emissions costs (scenarios and sensitivities), and SPP IM energy price forecasts (scenarios and sensitivities).

In this section of my testimony I will focus on the assumptions that are particularly important for purposes of evaluating environmental compliance plan alternatives.

Q. **What alternatives has OG&E considered to address the SO_2 emission limits of the Regional Haze FIP at the affected coal units?**

A. OG&E has three basic alternatives to meet the SO_2 emission limits and preserve capacity at the Sooner and Muskogee plants. First, OG&E can install dry scrubber technology at the four regional haze affected coal units (Sooner 1 and 2 and Muskogee 4 and 5). The second option is to convert the existing coal boilers to burn natural gas. The final option is to retire the units and replace them with natural gas combined cycle units. Each of

these alternatives and various combinations, which are described above in Figure 1, have their own capital and operating costs that are presented in the 2014 IRP Update.

Q. **How did OG&E decide which units to scrub and which to convert or replace?**

A. The Sooner units have a better design efficiency and have historically performed better than the Muskogee units. We determined that the Sooner units should be scrubbed if only two units were to be scrubbed, and that the Muskogee units would be either converted to natural gas or replaced by natural gas. OG&E Witness Burch elaborates on the rationale for scrubbing the Sooner units in his testimony.

Q. **What actions is OG&E taking to address the NO_X requirements of Regional Haze?**

A. OG&E is installing low NO_X burners as required in the Regional Haze SIP. OG&E Witness Burch discusses in his testimony the reason OG&E selected low NO_X burners as the technology for meeting those requirements at its four Regional Haze affected coal units and at its three Seminole gas-fired steam units. The installation of the low NO_X burners will be completed by January of 2017.

Q. **Will OG&E take any action to address MATS?**

A. Yes. The compliance date for MATS is April 16, 2016 and OG&E will have to take action in order to meet that deadline. OG&E will install Activated Carbon Injection ("ACI") on its coal units in order to meet this requirement and allow these units to continue running until the Regional Haze compliance date (and beyond if they remain coal-fired). Installation of ACI on Muskogee 4 and 5 allows those coal units to remain operational until they are converted to natural gas. This is a lower cost option for customers than converting or shutting down those units in 2016. OG&E Witness Burch discusses the selection of the ACI technology in his testimony.

Q. **Did OG&E include any generating unit retirements in the 2014 IRP?**

A. Yes. The retirement dates for OG&E's gas steam generation units are reflected in Figure 5 in the attached LCH-1. As discussed in the testimony of Witness Burch, the Mustang units will be retired by the end of 2017. In order to continue to meet its capacity planning

margin, OG&E will need to replace approximately 280 MW of the 460 MW currently at the Mustang facility by the summer of 2018 and an additional 120 MW by the summer of 2019. OG&E utilized the cost data from Sargent & Lundy ("S&L") in determining the appropriate replacement assets.

Q. **When is OG&E expected to need new capacity for reliability purposes?**

A. The termination of OG&E's final wholesale contracts in June 2015 coupled with OG&E's demand side management programs should defer OG&E's need for incremental capacity until 2020. Future IRPs will focus on how best to meet this incremental capacity need in 2020.

Q. **Does the 2014 IRP Update analyze the options for new generation?**

A. Yes. OG&E considered multiple options for new generation. The process began by performing an initial screen of all generation technologies to identify technologies that represent a proven technology and are economically viable (established for our purposes as less than $2,500/kW). The screening analysis is based on generic estimates of capital costs that are published annually by Energy Information Administration ("EIA"). The screening results are presented in Table 11 of the 2014 IRP Update.

Q. **Which technologies passed this screening analysis?**

A. Natural gas-fired technologies, including combined cycle and combustion turbine technologies, passed the initial screen. Wind energy and solar technologies also passed the screening analysis.

Q. **Did OG&E rely on the EIA capital costs to perform its analyses?**

A. No. For the next step in the analysis, OG&E retained S&L to provide cost and unit characteristic assumptions for the combined cycle and combustion turbine options. Also, OG&E developed solar assumptions based on a recent regulatory filing in Arizona and wind energy assumptions based on OG&E's 2013 RFI (request for information).

Q. **What did OG&E assume with respect to fuel prices?**

A. The forecast of coal and natural gas prices are based on the EIA's 2014 Annual Energy Outlook and are specified by delivery area. Thus, deliveries to OG&E's coal and natural gas plants reflect a forecast of the price index for coal and natural gas delivered to the "SPP South" pricing point. The same approach is taken in the Ventyx PROMOD IV® model for coal and natural gas delivered prices to other SPP generation plants in their respective regions.

Q. **Did OG&E consider some form of carbon regulation in its analysis?**

A. Yes, OG&E considered two separate ways of capturing the impacts of carbon regulation. First, we ran a sensitivity analysis that assumes that there will be carbon regulation that can be represented by a tax on carbon emissions. However, OG&E, consistent with the approach taken by EIA in its Annual Energy Outlook, did not assume a carbon tax in the base case. Instead, OG&E decided to evaluate the risk of carbon regulation in a sensitivity analysis because of the uncertainty around the potential carbon regulation. Second, the scenarios consider various levels of conversions of coal plants in the SPP and, therefore, various levels of reduction in CO_2 emissions. The level of conversions in the SPP affects market prices and, therefore, has an impact on each of the alternative portfolios.

Q. **Please briefly describe the SPP IM.**

A. The SPP IM was launched on March 1, 2014 after a decade-long planning and development effort. OG&E, as a member of SPP, participated in these discussions. The IM has five primary elements:

(1) a day-ahead energy market with transmission congestion rights;

(2) a reliability unit commitment process;

(3) a real-time balancing market that supplants SPP's Energy Imbalance Services ("EIS") market;

(4) a price-driven operating reserve market; and

(5) a single SPP-wide balancing authority.

The establishment of a single SPP-wide balancing authority replaces sixteen distinct balancing authorities, including one that was defined as OG&E's load area. This is particularly relevant for resource planning analyses because OG&E previously determined which of its generation units would be committed and dispatched to meet its own load. Now, the SPP determines which of OG&E's generating units will be committed and dispatched, along with the generation resources of all other SPP members, to meet SPP system load.

Q. **What does this change to a single system-wide balancing authority mean for purposes of OG&E's resource planning efforts?**

A. The change is quite significant. While OG&E must continue to maintain its generating capacity margin requirements, it now offers all of its generation units' energy into the SPP IM and receives revenue for energy that is committed and dispatched to serve SPP system load. This revenue is established at a market-clearing price that is based on security-constrained locational marginal energy costs at different nodes on the SPP system. OG&E must also purchase all of its load requirements from the SPP IM at the market price. This is relevant for resource planning purposes because the evaluation of alternative generation technologies will depend on forecasts of (1) the hourly dispatch of OG&E units by SPP, and (2) market prices for every hour of the year.

Adding to this new complexity, the forecast of each of these key variables will be influenced by the resource planning decisions (unit retirements and additions) of all of the other SPP members. In prior IRPs, OG&E could focus only on its own resource planning decisions to develop its production cost models. In utilizing an SPP wide production cost model, OG&E's older, less efficient generation may be dispatched less throughout the year, and this translates into a customer cost savings through lower production costs with market impact.

Q. **Can OG&E rely on the SPP IM to cover its capacity needs?**

A. No. The SPP IM is an energy market only and not a capacity market. Thus, OG&E cannot rely on the SPP IM to cover its capacity needs should it fall short in any year. OG&E remains responsible for ensuring that it has adequate capacity either from OG&E

units or from firm contracts for capacity to meet its projected peak load requirements, including a capacity margin reserve of 12%.

The coal units that are subject to Regional Haze requirements provide approximately 2,000 MW of capacity, which is necessary for OG&E's ability to meet its annual capacity requirement. This 2,000 MW of capacity must be maintained by either controlling emissions from the existing units, converting existing units to natural gas or by replacing those units with other capacity.

Q. **How did OG&E forecast SPP IM prices?**

A. OG&E used the Ventyx PROMOD IV® model to produce hourly SPP IM energy prices over the 30-year forecast period. Forecasting SPP IM energy prices is a new element in this IRP. SPP IM energy prices are the basis for calculating costs for all purchases of energy by OG&E to meet its load and are also the basis for calculating revenue for all OG&E energy that is sold into the SPP IM.

Q. **How did OG&E assess the risk associated with key assumptions in the IRP analysis?**

A. OG&E performed both scenario and sensitivity analyses to consider the uncertainties around the key assumptions of SPP market prices, natural gas prices, load, CO_2 costs and capital costs. OG&E created three scenarios to assess varying SPP IM price forecasts and also considered six sensitivity cases. Seven different market prices were calculated to capture a range of future outcomes (this excludes the capital cost sensitivities).

Q. **Please describe the scenarios that OG&E used to determine alternative SPP IM price forecasts.**

A. In order to evaluate the impact of alternative SPP IM prices, OG&E created scenarios around a key driver of future SPP IM prices: the extent to which SPP generation owners will convert their existing coal units to natural gas. The Low Conversion Case looks at what SPP IM prices would look like if it is assumed that the owners of all generating units in the SPP that have publicly announced plans to (1) install SO_2 emission controls, (2) convert coal units to natural gas or (3) replace coal plants with new combined cycles

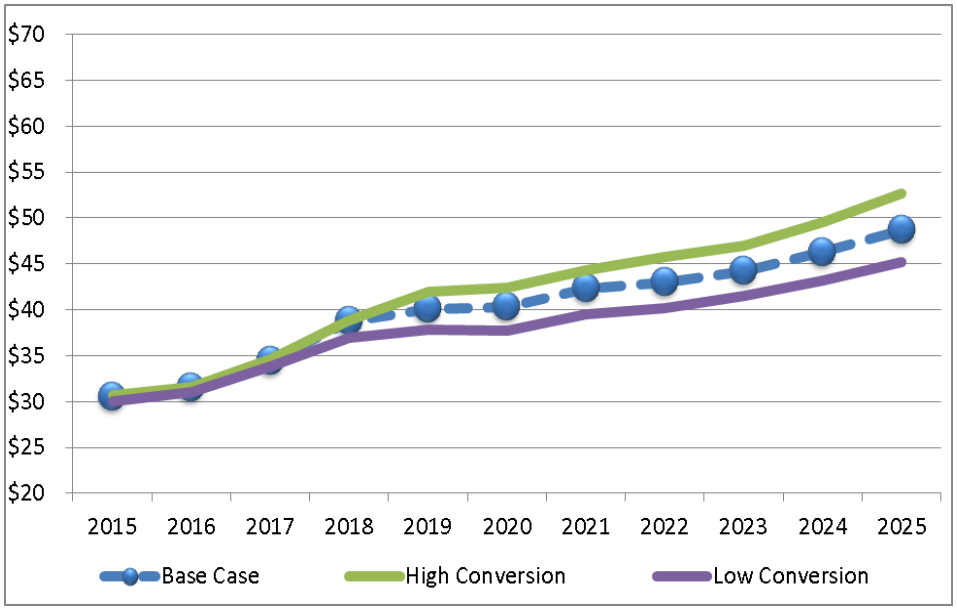
executed on their plans. All other coal plants, including OG&E's own coal units, remain coal-fired and are assumed to be available in the SPP IM as they are today.

The Base Case starts with the Low Conversion Case, but also assumes that coal units smaller than 200 MW and all coal units that were placed in service before 1977 and have not already had SO_2 emission controls installed are converted to natural gas. In addition, OG&E's Muskogee 4 and 5 units are assumed to be converted in this case.

The High Conversion Case starts with the Base Case and assumes that all other coal units in SPP that have not announced plans to control SO_2 emissions or already have SO_2 emission controls installed are assumed to be converted to natural gas. OG&E's Sooner 1 and 2 and Muskogee 6 units are not assumed to be converted to natural gas.

These scenarios produced the SPP IM price forecast as represented in Chart 1 below.

Chart 1: SPP Market Scenarios (Annual Average $/MWh)



Q. Please describe the sensitivity analyses that OG&E performed.

A. OG&E performed six sensitivity analyses by changing a single input assumption of the Base Case and measuring the impact on the NPVCC of each portfolio. The variables changed in the sensitivity analyses are: (i) high natural gas prices, (ii) low natural gas prices, (iii) the addition of CO_2 costs, (iv) low load in the SPP footprint, (v) higher capital

costs of emission control technologies and (vi) lower capital costs of emission control technologies. The first four of these impact SPP IM energy prices.

First, OG&E looked at a sensitivity of natural gas prices that was defined by increasing the base case natural gas prices by 50% on the high side and reducing them by 25% on the low side. These asymmetric adjustments reflect the fact that, since natural gas prices are currently at historically low levels, it is more likely that prices will increase than that they will decrease.

Next, OG&E assumed that there would be a carbon price beginning in 2020. OG&E developed its own CO_2 forecast as explained in the 2014 IRP Update Appendix D in Exhibit LCH-1. This CO_2 price forecast was developed to create price parity between efficient gas generation and emission controlled coal generation. Then, OG&E created a low SPP load forecast sensitivity that is representative of a situation in which distributed generation could be more widely adopted across the SPP footprint. This case was developed by lowering the forecast for the SPP load by 10%. Finally, OG&E created capital cost sensitivity cases by assuming that the capital costs required to implement each of the five environmental compliance plan portfolios are either 30% higher or 30% lower than estimated.

IV. IRP ANALYSIS

Q. **Please provide an overview of the IRP analysis.**

A. OG&E first creates portfolios to be analyzed in the IRP process. These portfolios are a combination of environmental compliance alternatives and generation expansion options designed for OG&E to meet its capacity requirements. For each portfolio, we calculated NPVCC under the scenario and sensitivity assumptions to consider the risk of each portfolio. Finally, we consider how each of the alternative portfolios meets our objectives.

Q. **How did OG&E develop portfolios for analysis?**

A. The focus of this IRP is to help OG&E make the best possible decisions with respect to its environmental compliance plan. Thus, we focused on developing portfolios that

would satisfy our capacity obligation and Regional Haze FIP requirements. Each portfolio therefore combines an environmental compliance alternative with a generation expansion option. Then each portfolio is evaluated through scenario and sensitivity analysis. This produces over 100 combinations.

Q. **What generation expansion options did OG&E consider in its portfolios?**

A. Although the focus of this IRP is the environmental compliance plan, we still need to provide the model with resources that would keep OG&E in compliance with SPP capacity margin requirements. While the actions taken to achieve the 2020 goal allows OG&E to defer new incremental generation until the year 2020, the retirement of the Mustang generating units requires OG&E to begin replacing the capacity by 2018. To that end, we evaluated the following three expansion options for these purposes as shown in Chart 2:

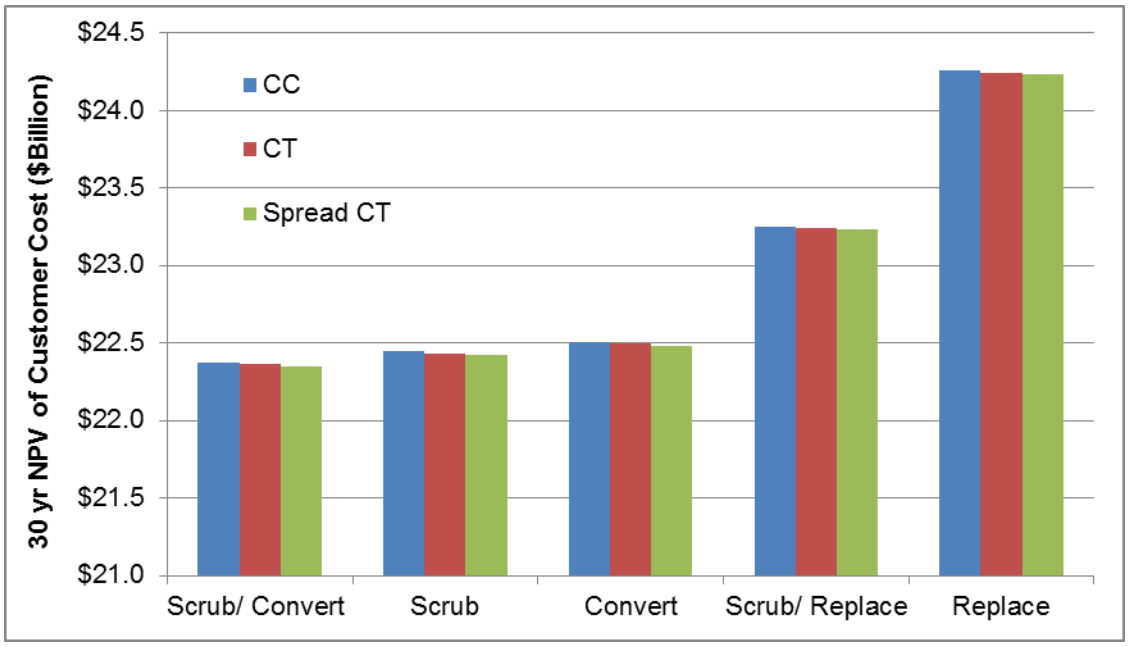
Chart 2

	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2031
CC	560 MW CC					560 MW CC		560 MW CC					560 MW CC
CT	400 MW CTs		560 MW CC				560 MW CC					560 MW CC	
Spread CT	280 MW CTs	120 MW CTs	560 MW CC				560 MW CC					560 MW CC	

Q. **Do these expansion options have any material impact on the selection of the environmental compliance plan?**

A. No. As you can see in Chart 3 below, the expansion options had very little impact on the evaluation of the cost of the environmental compliance alternatives. There is very little difference in NPVCC among the three expansion plans when they are included with each of the five environmental compliance plan portfolios.

Chart 3



Q. **Does Chart 3 illustrate that the Scrub/Convert plan is the lowest cost environmental compliance plan?**

A. Yes, in the base case it's the lowest cost alternative. However, OG&E also performed scenario and sensitivity analysis to probe the risk of each of these alternatives. We evaluated each of the five environmental compliance plans through three SPP market scenarios and by performing the six sensitivities discussed above.

Q. **Please describe the results of the SPP IM energy price scenarios.**

A. First, the Scrub alternative is the most favorable in the High Conversion Case scenario. This is because OG&E's coal units would be compensated at SPP IM prices based on a natural gas unit being on the margin with such frequency that the four scrubbed units generate considerable margins that would be flowed back to OG&E's customers.

Second, the Convert alternative is the most favorable in the Low Conversion scenario. This is because OG&E's capital costs are lower in this alternative and OG&E has the ability to purchase low cost energy in the SPP IM. OG&E's customers benefit in this scenario when purchasing energy in the SPP IM rather than running higher cost gas-fired generation. In the Low Conversion scenario, the Scrub and Scrub/Convert

alternatives for comparison are not as favorable because the margin from the SPP IM prices are not high enough to offset the higher capital costs associated with scrubbing.

The Scrub/Convert alternative is the most favorable in the Base Case scenario. Additionally, it is the second most favorable in the Low Conversion and High Conversion scenarios.

Q. **Did the sensitivity cases yield any surprising results?**

A. No, and this is consistent with the results of past IRPs. The environmental compliance plans that rely more on natural gas (i.e., the plans that include convert and replace options) are more sensitive to changes in natural gas prices. The plans that rely more on coal are more sensitive to the establishment of a CO_2 price. Not surprisingly, the environmental compliance plans with greater capital costs are more sensitive to the capital cost sensitivity cases. Finally, the low load forecast had very little impact on the results.

Q. **What do these IRP analyses imply for the lowest reasonable cost environmental compliance plan?**

A. The Scrub/Convert environmental compliance plan is the least cost option in the Base Case and performs well under all scenarios. It also provides some stability against two important sources of risk: high natural gas prices and carbon regulation. The Scrub plan exposes OG&E and its customers to future carbon regulations in a way that is moderated under the Scrub/Convert plan. The Convert plan exposes OG&E and its customers to high and volatile natural gas prices, which is also moderated by the Scrub/Convert plan. While natural gas prices have been relatively low and stable over the past few years, it has not been that many years since gas prices spiked to historically high levels. Finally, the plans that include replacement of coal with new gas-fired combined cycle plants are consistently the highest cost cases and also expose OG&E to high and volatile natural gas prices.

Q. **Did you consider wind resources as a solution to Regional Haze and MATS?**

A. Yes. However, wind generation does not serve as an effective resource to address the planning capacity needs in OG&E's environmental compliance plan. Wind energy has a very low capacity value under SPP rules. SPP only allows OG&E to count approximately 5% of the nameplate capacity towards its planning capacity margin requirements. If OG&E retires one 500 MW coal unit, we would need to install approximately 10,000 MW of nameplate wind capacity to satisfy the SPP planning capacity margin requirements.

Q. **Did OG&E consider adding additional wind energy for any other purposes?**

A. Yes. OG&E has been utilizing wind as a source of generation for a decade now. The Company keenly understands the value of wind energy and is always looking at wind as a way to create customer savings. However, we have concerns about the low SPP IM prices in areas where the addition of wind generation has caused those prices to be depressed due to congestion charges. Transmission lines are under construction that may relieve the congestion on the transmission system. If congestion on the system is relieved, the impact should be higher market prices for wind generation. However, with over 2,000 MW of nameplate wind generation currently under contract to be constructed, the new wind generation could use up the new transmission capacity and congestion could continue to occur.

Q. **Does this mean OG&E will not add wind energy in the future?**

A. No. It is very possible, if not likely, that OG&E will increase its reliance on wind energy over the coming decade, if the transmission constraints are addressed and if the cost of wind offers our customers savings. OG&E will offer an RFI in the Spring of 2015 to gather market intelligence that will be considered in the 2015 IRP submittal.

VI. OG&E'S ACTION PLAN

Q. **Please summarize OG&E's 5 Year Action Plan as described in the 2014 IRP Update.**

A. OG&E will implement the Scrub/Convert environmental compliance plan discussed above and move expediently in order to meet the EPA compliance deadlines. This Scrub/Convert plan includes the installation of dry scrubber technology on the Sooner units, the conversion of Muskogee units 4 and 5 to natural gas, the installation of low NO_X burners on four of its coal and three of its natural gas-fired steam units , and installation of ACI on all five OG&E coal units. We expect the development effort to take four years or longer and it is always possible that major construction projects will experience unanticipated delays. OG&E will plan the construction projects to minimize the unavailability of any of its coal units and continue to meet its SPP capacity margin requirements.

OG&E will retire all the existing Mustang units by the end of 2017 and replace at least 280 MW of this capacity by the summer of 2018 and the balance of the 400 MW of CTs by the Summer of 2019 in order to remain in compliance with its SPP capacity margin requirements.

OG&E will also continue to invest in demand side management during the five year period. In addition, the 5 Year Action Plan calls for OG&E to issue RFIs for wind energy and solar energy in the Spring of 2015.

Q. **Does the 5 Year Action Plan meet OG&E's resource planning objectives?**

A. Yes. This Action Plan performs well when considered against this comprehensive set of objectives:

(1) Reliability: OG&E will remain in compliance with SPP capacity margin requirements throughout the forecast period; in addition, replacing the capacity of the retired Mustang units with CTs at the same location helps maintain reliability in the Oklahoma City load center;

(2) Compliance with Existing Environmental Rules: the proposed environmental compliance plan complies with the MATS and Regional Haze requirements;

(3) Expected Cost to Customers: the Scrub/Convert performs well under almost all cases, including the sensitivity and market price scenario cases;

(4) Fuel Diversity: the Scrub/Convert preserves OG&E's fuel diversity as compared to alternative environmental compliance plans that expose the Company to dependence on either natural gas or coal as the predominant fuel;

(5) Operational Flexibility: the quick start CTs on the Mustang Plant site provide operational flexibility to respond to intermittent wind and solar generation, fluctuating load due to distributive generation and reliability issues that may arise;

(6) Portfolio Age: we are retiring our oldest units and replacing the capacity that they have provided with new CTs;

(7) Demand-Side Resources: OG&E's unwavering commitment to demand-side resources will continue under the proposed Action Plan;

(8) Exposure to Fuel and Emissions Prices: the Scrub/Convert environmental compliance plan strikes an appropriate balance between exposure to natural gas prices and exposure to coal and CO_2 prices; and

(9) Exposure to Future Environmental Regulation: while it can be extremely difficult to plan for future environmental regulation, OG&E's pursuit of the 2020 goal and commitment to wind energy have helped provide a hedge against future environmental regulation; the Scrub/Convert will continue this progress in a responsible way.

Q. **Does this conclude your prepared direct testimony?**

A. Yes, it does.