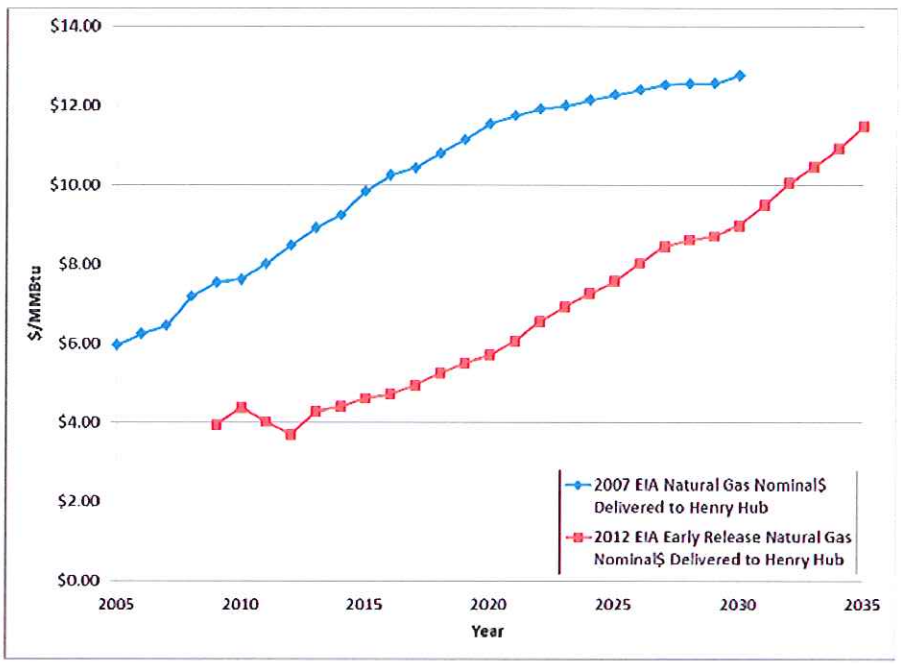
- Prairie State Facility

3.2.2 Natural Gas

The assumption for the cost of natural gas has been one of the most dramatic changes in resource plans developed since 2008. The rapid rise of hydraulic fracturing (fracking) in the drilling process for oil and natural gas in the United States has led to dramatic changes in the amount of natural gas available in the US. This supply glut has created pricing of natural gas well below the projections provided by various sources in the 2008 period. Figure 3-1 provides a comparison of the forecast for natural gas used in the 2008 Study and forecast data used in this 2013 Update. Both of the forecasts were developed using data from the Energy Information Agency.

Figure 3-1: EIA Natural Gas Forecast



As seen, the forecast for the 2008 Study was approximately twice what the current values of natural gas are for 2013. The price of natural gas has caused a significant increase in the amount of electricity produced with natural gas in 2012, displacing electricity produced by coal. Due to the difficulty of permitting new generating units fired by coal, virtually all new generating resources are fired on natural gas.

The traditional resource options available to utilities of all types are being significantly restricted due to environmental regulations. New regulations have essentially removed coal fueled power plants as an option. Essentially all of the traditional resource options are fired by natural gas. CWL has an ongoing review of the use of biomass at the Municipal Plant. Current work on obtaining a fuel supply at a price that would allow ongoing operations of the solid fuel boilers at the plant is being performed by CWL. The results of this effort will have a slight impact on the amount of capacity required. The review of the biomass future at the Municipal Plant was not included within this study. Should the fuel source and combustion economics prove favorable, the need for additional capacity may be delayed from the dates indicated in the following analysis. The following paragraphs describe the traditional resources included in the 2013 Update.

The estimates developed for the CEC expansion and other options considered are based on Burns & McDonnell's experience with other expansion projects. Due to the unique attributes associated with any specific greenfield or expansion project, the assumptions developed herein are considered adequate for use in the 2013 Update, but will require more detailed analysis prior to a final determination of whether or not to actually pursue an option.

3.3.1 CEC Conversion to Combined Cycle

The basic principle of a combined cycle gas turbine (CCGT) plant is to utilize natural gas to produce power in a gas turbine (GT) and also use the hot exhaust gases from the GT to produce steam in a Heat Recovery Steam Generator (HRSG). The use of both gas and steam turbine cycles: Brayton and Rankine, in a single plant to produce electricity results in high conversion efficiencies and low emissions.

The CEC consists of four existing simple cycle combustion turbines rated 36MW. The addition of the steam portion of the combined cycle expansion would require the addition of a heat recovery steam generator, the steam turbine and the electric generator. It was assumed for purposes of this analysis that the site had sufficient clearances to allow construction of the combined cycle expansion. It was further assumed that a separate HRSG would be provided for each CT which would then feed a header system to supply steam to a single steam turbine/generator. The net electrical output was assumed to be 206MW in total, base loaded (with duct firing capability the total output would be 294MW). One fourth of this capacity could be obtained with dispatch of each CT. An additional transformer and switchyard connection would also be required.

3.3.1.1 Constructability and Permitting

For purposes of this study, construction of the CEC expansion would have a Commercial Operating Date (COD) of no earlier than 2016. A general review of site plans was performed by Burns & McDonnell of the CEC. Although it appears there is sufficient space to add the combined cycle portion described above, no site verification has been performed. Also, it appears that permitting of the existing turbines allows 400 hours of operation per turbine during the period from May through September. This would limit the utilization of a combined cycle asset constructed at the site unless the permit was revised.

Natural gas-fired generation resources would be equipped with emission control technology to meet currently required emission regulations. The following are the assumed emission rates of criteria pollutants for this supply alternative:

- NO_X: 0.009 lbs/MMBtu
- CO: 0.006 lbs/MMBtu
- CO_2: 120 lbs/MMBtu

3.3.1.2 Performance and Cost Assumptions

The expansion of the CEC with a natural gas-fired CCGT option was assumed to have a net electrical increase in the CEC output of approximately 62MW (to a total net plant capacity of 206MW) and an operational heat rate of 8,140 Btu/kWh. In 2012$, variable and fixed O&M for this alternative was assumed to be $4.40/MWh and $12.00/kW-yr, respectively for the total net plant capacity. Assuming a 2016 COD and 2016$, the total project costs, including Owner's and Interest During Construction (IDC), was an estimated $2,417/kW (based on the full baseload plant output of 206MW). Please refer to Appendix A for a complete summary of assumptions used for all of the supply options considered in this study.

3.3.2 Local Simple Cycle

Typically, simple cycle generation options are used to provide peaking power due to their fast load ramp rates and relatively low capital costs. Simple cycle generation based on gas turbine and reciprocating engine technologies is a widely used and mature technology. These units are typically fired using natural gas as the primary fuel. Some units are provided with oil as a backup to interruption of the natural gas. The gas turbine (Brayton) cycle is one of the most efficient cycles for conversion of gaseous fuels to mechanical power or electricity. However, the units typically have higher dispatch costs when compared with combined cycle and coal-fired technologies. Gas turbines can have capacity ratings of kW for micro-turbines to units of 200MW nominal. Reciprocating engines can have capacities of watts up to approximately 20MW. The larger reciprocating engines typically have better heat rates than the combustion turbines. Peaking resources offering dispatch flexibility and capacities at or below 50MW were considered the best alternatives for peaking resources to be evaluated in this study.

3.3.2.1 Constructability and Permitting

It was assumed that any simple cycle capacity constructed would be located at a site within the CWL service territory. For purposes of this study, construction of a simple cycle resource would have a COD of no earlier than 2015. For purposes of this analysis, MW scale reciprocating engines were considered due to the flexibility of being able to add relatively small MW quantities to better match expected load growth, their dispatch attractiveness in the MISO market and their efficiency advantage over combustion turbines.

Natural gas-fired generation resources would be equipped with emission control technology to meet currently required emission regulations. The following are the assumed emission rates of criteria pollutants for the reciprocating engine supply alternatives:

Assumed reciprocating engine emission rates:

- NO_X: 0.018 lbs/MMBtu
- CO: 0.034 lbs/MMBtu
- CO_2: 120 lbs/MMBtu

3.3.2.2 Performance and Cost Assumptions

A local natural gas-fired simple cycle option within the CWL service territory was assumed to have a net electrical output of 9.14MW per engine for the reciprocating engine option. This alternative assumed a block of six reciprocating engines was installed for a total capacity of 54.6MW. The operational heat rates of the units are 8,780 Btu/kWh. In 2012$, variable and fixed O&M for the reciprocating engine alternative was assumed to be $6.10/MWh and $16.17/kW-yr, respectively. Assuming a 2015 COD and 2015$, the total project costs, including Owner's and IDC, was an estimated $1,660/kW for the reciprocating engine alternative based on 54.6MW. Please refer to Appendix A for a complete summary of assumptions used for all of the supply options considered in this study.

3.3.3 Large Combined Cycle

The basic principle of a combined cycle gas turbine (CCGT) plant is to utilize natural gas to produce power in a gas turbine (GT) and also use the hot exhaust gases from the GT to produce steam in a Heat Recovery Steam Generator (HRSG). The use of both gas and steam turbine cycles: Brayton and Rankine, in a single plant to produce electricity results in high conversion efficiencies and low emissions. For this evaluation, a large 1x1 CCGT plant was considered with a total plant output near 300MW baseload.

In order to be able to use the advantages of a large combined cycle unit, CWL would have to share in a joint owned project, similar to the joint participation in units such as Sikeston and Iatan II. It is likely that such a unit would not be located within the service area of CWL.

3.3.3.1 Constructability and Permitting

It was assumed that large combined cycle capacity constructed would be located outside of CWL service territory. For purposes of this study, construction of a combined cycle resource would have a COD of no earlier than 2016 and would likely require another utility to take the lead on the development and construction of the unit due to the unit's large size. CWL could potentially purchase capacity and energy from a percentage of the unit.

Natural gas-fired generation resources would be equipped with emission control technology to meet currently required emission regulations. The following are the assumed emission rates of criteria pollutants for the combined cycle supply alternatives:

Assumed CCGT emission rates

- NO_X: 0.009 lbs/MMBtu
- CO: 0.006 lbs/MMBtu
- CO_2: 120 lbs/MMBtu

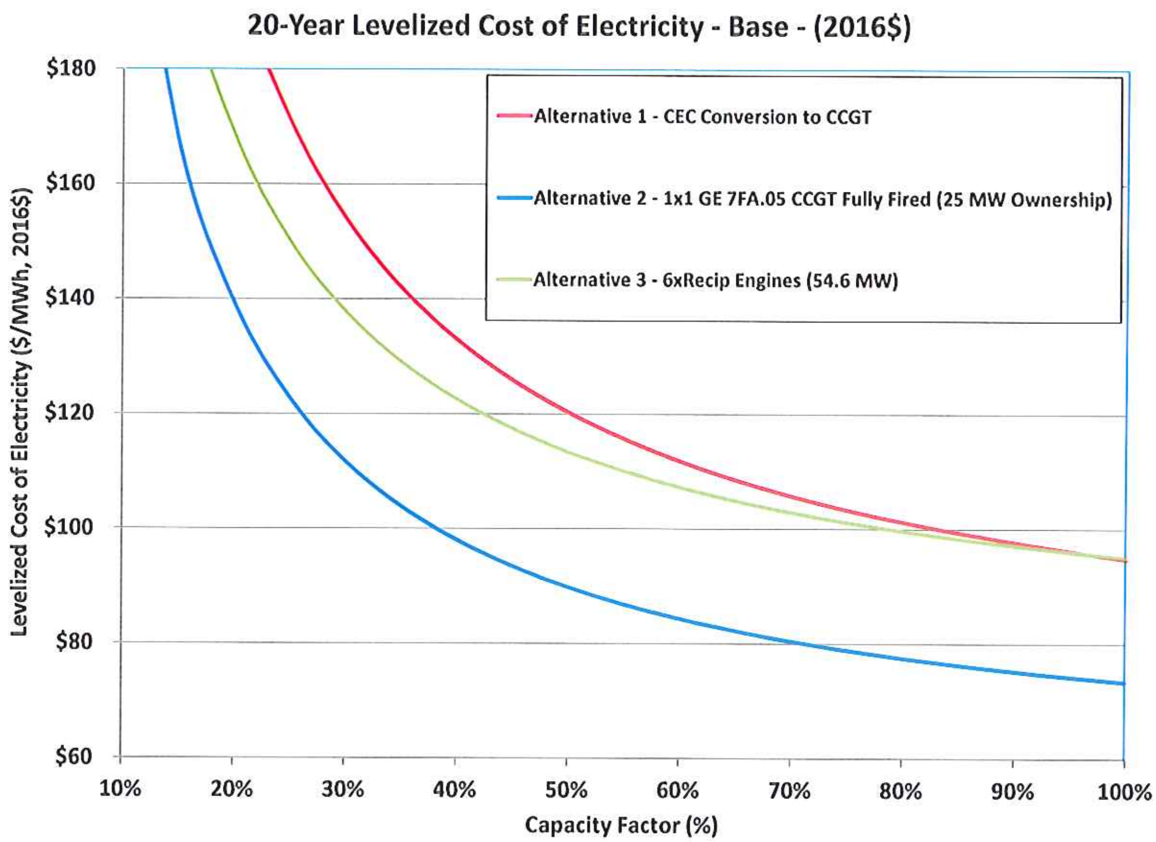
3.3.3.2 Performance and Cost Assumptions

A large combined cycle unit was assumed to have a net electrical output of 289.8MW based loaded. The operational heat rate of the unit is approximately 6,850 Btu/kWh (base loaded). Combined cycle units also have the ability to increase output through duct burning. The addition of duct burner capability would increase the capacity by another 91.7MW with an incremental heat rate of 8,310 Btu/kWh. In 2012$, variable and fixed O&M for the lager CCGT alternative was assumed to be $2.60/MWh and $15.00/kW-yr, respectively. Assuming a 2016 COD and 2016$, the total project costs, including Owner's and IDC, was an estimated $1,520/kW for the large CCGT alternative (based on base load output of 289.8MW). Please refer to Appendix A for a complete summary of assumptions used for all of the supply options considered in this study.

3.3.4 Alternative Levelized Cost of Electricity Evaluation

To provide a preliminary screening analysis of the supply side alternatives, Burns & McDonnell performed a levelized cost of electricity (LCOE) evaluation. Burns & McDonnell determined the 20-year LCOE across varying capacity factors for each alternative including debt service costs, variable and fixed O&M costs, and fuel costs. Figured 3-2 presents the LCOE for each of the alternatives.

Figure 3-2: Levelized Cost of Electricity Evaluation



As presented in Figure 3-2, the large CCGT alternative provides a lower LCOE for all capacity factors between 10 to 100 percent compared to the CEC conversion to CCGT and the reciprocating engines based on the assumptions used herein. The large CCGT alternative is estimated to be lower cost due to its lower heat rate and lower capital cost investment due to the large economies of scale. However, CWL would not be able to develop and construct a large CCGT option solely on its own and would be dependent on participation from other utilities. The CEC conversion to CCGT operation is slightly higher in cost than the reciprocating engine alternatives across the varying capacity factors.

3.4 POWER PURCHASE AGREEMENTS

Utilities can purchase capacity and energy in firm and non-firm contracts or purchase long-term capacity in generation facilities, similar to CWL contracts for several existing resources. Both of these options depend on the availability of excess capacity in the area. For CWL, capacity should be located within the CWL or MISO market to reduce the costs of delivery and potential for system constraints. Under the proposed MISO capacity construct, capacity would preferably be located in MISO Resource Zone 5.

Please refer to Appendix A for a complete summary of assumptions used for all of the supply options considered in this study.

3.5 STRATEGIST ANALYSIS

This part of the report addresses the various resource planning scenarios that were developed and analyzed using Strategist and describes the results of the analysis. The Strategist model is a resource portfolio optimization model that allows an analysis of several different resources with a variety of characteristics. The model selects the lowest cost combination of capacity amounts and in-service dates based on the performance and construction costs provided. In developing the scenarios, consideration was given to the existing resources discussed in Section 2 as well as various new resource options discussed previously in this section.

3.5.1 Portfolio Selection

The resource scenarios were modeled and simulated using the Strategist resource optimization software. The model used the assumptions of the resources as described previously in this section to determine the optimal portfolio of resources to meet the energy needed. In addition to the supply resources outlined previously in this section, when the supply resources were not available or economical, a market capacity resource was used to maintain reserve margins throughout the study period. This market capacity resource was modeled as a temporary supply resource, expiring at the end of each year. The model provided a net present value of costs for thousands of portfolio options.

In order to evaluate the economic impacts of certain resources, Burns & McDonnell forced the model to accept certain generating resources in some scenarios. There were essentially two futures considered with