**VERIFICATION**

| | | |
|---|---|---|
| **COMMONWEALTH OF KENTUCKY** | ) | |
| | ) | **SS:** |
| **COUNTY OF JEFFERSON** | ) | |

The undersigned, **Shannon L. Charnas**, being duly sworn, deposes and says that she is Director, Accounting and Regulatory Reporting for LG&E and KU Services Company, and that she has personal knowledge of the matters set forth in the responses for which she is identified as the witness, and the answers contained therein are true and correct to the best of her information, knowledge and belief.

Shannon L. Charnas

**Shannon L. Charnas**

Subscribed and sworn to before me, a Notary Public in and before said County and State, this 9th day of August 2012.

Joan A. Henry (SEAL)

Notary Public

My Commission Expires:

July 21, 2015

**LOUISVILLE GAS AND ELECTRIC COMPANY**

**CASE NO. 2012-00222**

**Response to Attorney General's Initial Requests for Information**
**Dated July 31, 2012**

**Supplemental Response filed August 16, 2012**

**Question No. 67**

**Responding Witness: Shannon L. Charnas**

Q-67. Reference the Charnas testimony, p. 3. Provide a copy of the Ventyx report.

A-67. **Original response:**

See attached. The Ventyx report is subject to a confidentiality agreement with the vendor and is being provided under seal pursuant to a petition for confidential treatment. The Company will supplement this response with a public version of the document once the vendor has redacted its proprietary information and given the Company permission to file the report publicly. The Company expects to do so by Wednesday, August 14, 2012.

**Supplemental response:**

See attached. Please note that LG&E is seeking confidential protection for the Ventyx report pursuant to a Petition for Confidential Treatment filed on August 14, 2012.

# An Economic Life Assessment Study of Generating Assets of LG&E and KU

by
Ventyx, An ABB Company

February 2012

## Statement of Confidentiality

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# I. Introduction

In order to determine the effective useful economic life of the LG&E and KU (LG&E-KU) generating assets, Ventyx, an ABB Company (Ventyx), was retained by LG&E-KU to perform a Life Assessment Study of its generating assets. The goal of the analysis was to allow LG&E-KU to more accurately project when a generating asset may reach the end of its effective useful economic life. Ventyx utilized its Strategist® strategic planning model, together with LG&E-KU's data, to perform this analysis. The time horizon examined during this analysis was from 2011 through 2040.

# II. Methodology

The methodology used in LG&E-KU's 2011 Life Assessment Study is consistent with the methodology used in the 2007 Life Assessment Study. Coal fired units in service for less than 30 years were excluded from the evaluation. None of these units will have been in service for more than 60 years at the end of 2040, and current industry practice indicates that it is both reasonable and cost effective to retain properly operated and maintained units for a life of around 60 years. The units excluded on the basis of this criterion were the Trimble County 1 & 2, Ghent 3 & 4, and Mill Creek 4 coal units. Cane Run 4, 5, & 6, Green River 3 & 4, and Tyrone 3 are all scheduled to retire at the end of 2015. LG&E-KU is planning to replace these units with a new 640 MW combined cycle unit at the Cane Run site (Cane Run 7) and three simple-cycle CTs from LS Power's Bluegrass facility (Bluegrass CTs). The coal units scheduled to retire at the end of 2015 and the gas units replacing them are also excluded from this analysis. No other gas fired units were excluded from the study. In the previous Life Assessment Study, it was determined that the projected operating and capital cost streams for both of the hydro plants were sufficiently low such that they should not be retired. Conditions have not changed enough to reconsider them in this analysis.

Figure 1 shows the total MWs for each capacity type considered for retirement in this analysis. The total capacity of the LG&E-KU assets considered for retirement is 4,766 MW (summer). Figure 2 shows all LG&E-KU assets and the total capacity for those considered in the Life Assessment Study. Highlighted assets were not considered in this assessment.

Figure 1:
Retirement Candidates by Type

| | 2011 Net MW | |
|---|---|---|
| | Winter | Summer |
| Coal Units | 2,644 | 2,652 |
| Primary CTs | 2,266 | 2,015 |
| Secondary CTs | 112 | 99 |
| Total Capacity | 5,022 | 4,766 |

Figure 2:

# Kentucky Utilities' Company / Louisville Gas and Electric Company

## 2011 Generator Ratings (MW)

| Plant Name | Owner | In-Service Date | Net Winter 2011 | Net Summer 2011 | Planned Retirement | Unit Type | Fuel Type | Age as of 12/31/2010 | Age as of 12/31/2040 |
|---|---|---|---|---|---|---|---|---|---|
| Brown 1 | KU | 05/01/1957 | 107 | 106 | | Steam | Coal | 53 | 83 |
| Brown 2 | KU | 06/01/1963 | 168 | 166 | | Steam | Coal | 47 | 77 |
| Brown 3 | KU | 07/19/1971 | 416 | 412 | | Steam | Coal | 39 | 69 |
| **Total Brown Coal** | | | **690** | **683** | | | | | |
| Ghent 1 | KU | 02/19/1974 | 481 | 479 | | Steam | Coal | 36 | 66 |
| Ghent 2 | KU | 04/20/1977 | 477 | 495 | | Steam | Coal | 33 | 63 |
| **Total Ghent Coal** | | | **958** | **974** | | | | | |
| Mill Creek 1 | LGE | 08/01/1972 | 303 | 303 | | Steam | Coal | 38 | 68 |
| Mill Creek 2 | LGE | 07/01/1974 | 299 | 301 | | Steam | Coal | 36 | 66 |
| Mill Creek 3 | LGE | 08/01/1978 | 394 | 391 | | Steam | Coal | 32 | 62 |
| **Total Mill Creek Coal** | | | **996** | **995** | | | | | |
| **Total Coal** | | | **2,644** | **2,652** | | | | | |
| Brown 5 | Joint | 06/09/2001 | 130 | 133 | | CT | Gas | 9 | 39 |
| Brown 6 | Joint | 08/11/1999 | 171 | 146 | | CT | Gas | 11 | 41 |
| Brown 7 | Joint | 08/08/1999 | 171 | 146 | | CT | Gas | 11 | 41 |
| Brown 8 | Joint | 02/23/1995 | 128 | 121 | | CT | Gas | 15 | 45 |
| Brown 9 | KU | 01/24/1995 | 138 | 121 | | CT | Gas | 15 | 45 |
| Brown 10 | KU | 12/22/1995 | 138 | 121 | | CT | Gas | 15 | 45 |
| Brown 11 | KU | 05/08/1996 | 128 | 121 | | CT | Gas | 14 | 44 |
| **Total Brown CT** | | | **1,003** | **908** | | | | | |
| Paddy's Run 13 | Joint | 06/27/2001 | 183 | 147 | | CT | Gas | 9 | 39 |
| **Total Paddy's Run CT** | | | **183** | **147** | | | | | |
| Trimble County 5 | Joint | 05/14/2002 | 180 | 160 | | CT | Gas | 8 | 38 |
| Trimble County 6 | Joint | 05/14/2002 | 180 | 160 | | CT | Gas | 8 | 38 |
| Trimble County 7 | Joint | 06/01/2004 | 180 | 160 | | CT | Gas | 6 | 36 |
| Trimble County 8 | Joint | 06/01/2004 | 180 | 160 | | CT | Gas | 6 | 36 |
| Trimble County 9 | Joint | 07/01/2004 | 180 | 160 | | CT | Gas | 6 | 36 |
| Trimble County 10 | Joint | 07/01/2004 | 180 | 160 | | CT | Gas | 6 | 36 |
| **Total Trimble County CT** | | | **1,080** | **960** | | | | | |
| **Total Primary CT** | | | **2,266** | **2,015** | | | | | |
| Cane Run 11 | LGE | 06/01/1968 | 14 | 14 | | CT | Gas | 42 | 72 |
| **Total Cane Run CT** | | | **14** | **14** | | | | | |
| Haefling 1-3 | KU | 10/23/1970 | 42 | 36 | | CT | Gas | 40 | 70 |
| **Total Haefling 1-3 CT** | | | **42** | **36** | | | | | |
| Paddy's Run 11 | LGE | 06/10/1968 | 13 | 12 | | CT | Gas | 42 | 72 |
| Paddy's Run 12 | LGE | 07/16/1968 | 28 | 23 | | CT | Gas | 42 | 72 |
| **Total Paddy's Run CT** | | | **40** | **35** | | | | | |
| Zorn 1 | LGE | 05/23/1969 | 16 | 14 | | CT | Gas | 41 | 71 |
| **Total Zorn** | | | **16** | **14** | | | | | |
| **Total Secondary CT** | | | **112** | **99** | | Weighted Average | | 25 | 55 |
| **Total Units Considered** | | | **5,022** | **4,766** | | | | | |
| Cane Run 4 | LGE | 05/04/1962 | 155 | 155 | 12/31/2015 | Steam | Coal | 48 | 78 |
| Cane Run 5 | LGE | 05/13/1966 | 168 | 168 | 12/31/2015 | Steam | Coal | 44 | 74 |
| Cane Run 6 | LGE | 05/12/1969 | 240 | 240 | 12/31/2015 | Steam | Coal | 41 | 71 |
| Ghent 3 | KU | 05/31/1981 | 494 | 477 | | Steam | Coal | 29 | 59 |
| Ghent 4 | KU | 08/18/1984 | 491 | 469 | | Steam | Coal | 26 | 56 |
| Green River 3 | KU | 04/06/1954 | 71 | 68 | 12/31/2015 | Steam | Coal | 56 | 86 |
| Green River 4 | KU | 07/08/1959 | 100 | 95 | 12/31/2015 | Steam | Coal | 51 | 81 |
| Dix Dam 1-3 | KU | 11/24/1925 | 26 | 26 | | Hydro | Water | 85 | 115 |
| Mill Creek 4 | LGE | 09/01/1982 | 486 | 477 | | Steam | Coal | 28 | 58 |
| Ohio Falls 1-8 | LGE | 01/01/1928 | 34 | 52 | | Hydro | Water | 82 | 112 |
| Trimble County 1 | | 12/23/1990 | 386 | 383 | | Steam | Coal | 20 | 50 |
| Trimble County 2 | | 01/22/2011 | 571 | 549 | | Steam | Coal | -1 | 29 |
| Tyrone 3 | KU | 07/21/1953 | 73 | 71 | 12/31/2015 | Steam | Coal | 57 | 87 |
| **Total Units Not Considered** | | | **3,295** | **3,230** | | | | | |
| **Total Units** | | | **8,317** | **7,996** | | | | | |

Units that will be less than 60 years of age in 2040

Hydro units

Units already scheduled for retirement.

Ventyx employed a *differential annual revenue requirements* methodology to determine the appropriate effective useful economic life for each unit. The first step involves assuming all the candidate units are "retired" in a specific year. For the life assessment candidates, gas fired combustion turbines (CTs) were "retired" at the end of 2016 and coal fired steam units were "retired" at the end of 2021. These dates were chosen to correspond to the earliest dates when equivalent replacement capacity could be installed. Then, a Reference Plan of replacement capacity was selected by Strategist's PROVIEW resource optimization module. This Reference Plan contains an appropriate mix of peaking, mid-range, and baseload capacity to meet future demand and energy requirements in a least-cost method. These capacity types are represented by gas fired simple cycle combustion turbines, gas fired combined cycle combustion turbines, and coal fired steam generators, respectively.

The alternative resources available for developing the Reference Plan are summarized in Figure 3. The simple cycle CT and two combined cycle CT options were included because they were found to be the most economical capacity expansion options in LG&E-KU's 2011 Integrated Resource Plan (IRP) process. That process considered a wide array of capacity options and included renewable resources. The supercritical pulverized coal (PC) option was included to ensure that the coal assets considered for retirement could be replaced with like kind, if the model found that to be most economical. The target minimum reserve margin constraint for the model optimization runs to develop the Reference Plan was set to 10% through 2016, and to 14% thereafter. The low reserve margin target before 2017 reflects an inability to build any new capacity prior to that time. The 14% reserve margin minimum target used in the model beyond 2016 was selected so that the reserve margin resulting after resource additions more closely aligned with the desired long term minimum reserve margin target of 15-17% for the system.

Figure 3:
Replacement Capacity Alternatives

| Name | Description | Book Dep. Life (Years) | Summer Capacity (MW) | Capital Cost (2010 $M)[1] | Capital Cost (2010 $/kW) | First Year Avail. | Max Per Year |
|---|---|---|---|---|---|---|---|
| LGSC | Supercritical PC | 50 | 789 | 2,016 | 2,555 | 2022 | 2 |
| SCCT | Simple Cycle CT | 30 | 194 | 164 | 847 | 2017 | 4 |
| 2x1C | Two Unit Combined Cycle | 40 | 640 | 573 | 895 | 2017 | 3 |
| 3x1C | Three Unit Combined Cycle | 40 | 962 | 818 | 851 | 2017 | 2 |

Once the Reference Plan is developed, the replacement capacity is converted automatically within the Strategist model to "deferral capacity" [redacted]

[1] Capital costs for the LGSC and SCCT are from the 2011 IRP. Capital costs for the 2x1C and 3x1C are LG&E-KU's most recent estimates for those units.

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

The basic system modeling was supplemented with specific cost data for each of the candidate units, including projections of their O&M costs and capital expenditures (CapEx). These are discussed in more detail below. It is widely recognized that operating parameters such as EFOR, maintenance outage requirements, and heat rates may, depending on operating and maintenance practices, increase (degrade) over the lifetime of an asset and that operating capacity (MW) declines. Projections of future performance for aging generators would, ideally, be based on detailed data reflecting the way similar units' performance degraded as the end of their operating life approached. However, no reliable source of such detailed data to project this performance degradation exists. Thus, Ventyx instead adopted the assumption that operating cost would increase and maximum operating capacity would decrease as an asset approaches the end of its life according to a [redacted]. With one exception (Brown 1), a unit's performance was assumed to begin degrading at the end of its nominal life (60 years for coal fired units and 30 years for gas units). The [redacted] is described in detail in Appendix A.

For several reasons, the degradation of performance for Brown 1 was assumed to occur at the same time as Brown 2. Brown 1 is 54 years old. Despite its age, its current operating performance is better than industry averages. Brown 1 and 2 are somewhat unique in the fact that they operate at a lower pressure than other units in the LG&E-KU fleet not scheduled for retirement by 2015, which serves to increase the life expectancy of these units (all other things equal). In addition, new operating controls were recently installed at Brown 1 and 2 to improve monitoring and help ensure that these units are operated within their design parameters. Based on these facts, it is not reasonable to assume that the performance of Brown 1 will begin to degrade in six years.

Fixed O&M (FOM) costs and capital costs [redacted] of the deferrable resources are also modified such that they can adjust automatically to reflect the varying capacities for the deferral units as each candidate retirement unit is overlaid on the Reference Plan (as described above and illustrated in Figure 4b). The model is then run to determine the capital and production costs for this adjusted system. A discussion of the [redacted] and its applicability to this type of analysis can be found in Appendix B.

The next step involves developing plans where each of the candidate units is assumed to continue operation for the full study period (through 2040) and further assumes that each unit will then remain in service through at least 2042. For this part of the analysis, the candidate units are individually overlaid on the Reference Plan such that each resultant plan contains only the deferral units from the Reference Plan, the units not considered for retirement in this study, and one candidate unit. The present value (PV) of utility cost, which is the annual incremental revenue requirements including operating and incremental capital cost, is extracted from the model for each plan retaining one of the candidate units. The difference between these PV annual revenue requirements and the PV annual revenue requirements of the Reference Plan is then computed. The first year the difference is negative (retaining the candidate unit costs more than allowing it to retire) is determined and this indicates the earliest potential date for the end of the asset's effective useful economic life. The PV annual revenue requirements differentials are then accumulated from that year forward, and the point where the sum turns negative and remains negative is the latest potential date for the end of the asset's effective useful economic life. This is shown in the example in Figure 5; the earliest year that the example unit would reach the end of its effective useful economic life in this case is 2014, with the latest economic retirement in 2018.

Figure 5:

**Illustration of the Determination of the Effective Useful Economic Life For a Life Assessment Candidate Unit**

| Year | Differential Annual Revenue Requirements | Cumulative NPV of Differential Annual Revenue Requirements (2014 and beyond) |
|---|---|---|
| 2010 | $1.00 | |
| 2011 | $1.50 | |
| 2012 | $0.80 | |
| 2013 | $0.60 | |
| 2014 | ($0.03) | ($0.03) |
| 2015 | ($0.50) | ($0.53) |
| 2016 | $0.40 | ($0.13) |
| 2017 | $0.30 | $0.17 |
| 2018 | ($0.50) | ($0.33) |
| 2019 | ($0.70) | ($1.03) |
| 2020 | ($1.00) | ($2.03) |
| 2021 | ($0.60) | ($2.63) |
| 2022 | ($0.20) | ($2.83) |
| 2023 | $0.20 | ($2.63) |
| 2024 | $0.50 | ($2.13) |
| 2025 | ($0.80) | ($2.93) |
| 2026 | ($0.10) | ($3.03) |
| 2027 | $0.05 | ($2.98) |
| 2028 | $0.01 | ($2.97) |
| 2029 | ($0.40) | ($3.37) |
| 2030 | ($0.10) | ($3.47) |
| 2031 | ($0.50) | ($3.97) |
| 2032 | $0.30 | ($3.67) |
| 2033 | $0.50 | ($3.17) |
| 2034 | ($0.30) | ($3.47) |
| 2035 | ($0.10) | ($3.57) |

For some of the units, the first year with a negative PV annual revenue requirements differential occurs relatively early, and then several years with positive PV annual revenue requirements follow before the annual PV differential values become negative again. In these cases, accumulating the annual PVs from the year with the first negative differential would result in pushing the end of the asset's effective useful economic life out by several years while an accumulated positive differential sum is eliminated by the subsequent accumulation of negative differentials. It is not reasonable to wait until all the benefits accumulated during the intervening positive differential years are eliminated by retaining the unit for several years of negatives. In these cases, it is sensible to ignore the early occurrences of a negative differential, and to wait for the differential series to show stable negatives before beginning the summation.

It is possible for the methodology to indicate *no* end of effective useful economic life for a particular unit in the time frame of the study; in this case through 2040. This means that, based upon the assumptions used for this analysis, the actual end of the asset's effective useful economic life is beyond 2040. The cost assumptions in this analysis are taken from the company's most recent long-term plan and do not include costs potentially associated with low-probability outage events. In some instances, the costs associated with low-probability outage events could accelerate the end of the useful economic life of the generating assets.

The assessment is performed in three steps to ensure that the units under consideration displace units in the Reference Plan that are like kind. The first step is to develop a Reference Plan, in which the model retires all candidate units and replaces the capacity with the most economical set of expansion resource options (see Figure 3 for all options considered). Once the Reference Plan deferral capacity units have been established, the CT units are turned off as deferral units and the candidate coal units are run through the process thereby ensuring that they are being replaced by like coal units. This process is repeated for candidate gas units by turning off the coal units and allowing the candidate gas units to be replaced by like gas units.

# III. Model Data and Assumptions

LG&E-KU provided Ventyx with their latest Strategist database, translated from a PowerBase database. This basic data included all operating parameters and costs for the existing generation units in the LG&E and KU system. This includes EFOR, scheduled outage requirements, heat rates, variable and fixed operating and maintenance costs for all the generating assets, as well as load and fuel cost forecasts over the study horizon (2011 to 2040). A loads and resources summary report from the Strategist model reflecting only the existing system with no new capacity additions and including all potential unit retirements analyzed in this study is shown for selected years over the study horizon in Figure 6. In developing the reference case, 797 MW of coal-fired capacity (coal units at the Cane Run, Green River, and Tyrone stations) are retired at the end of 2015, 2,015 MW of gas-fired capacity is retired at the end of 2016, and 2,652 MW of coal-fired capacity is retired at the end of 2021. 3,490 MW of capacity, the sum of capacities at Trimble County 1 & 2, Ghent 3 & 4, Mill Creek 4, Cane Run 7, and the Bluegrass CTs, is not retired.

Figure 6:

Loads and Resources 2011 - 2040

| | 2011 | 2015 | 2020 | 2025 | 2030 | 2035 | 2040 |
|---|---|---|---|---|---|---|---|
| LOADS | | | | | | | |
| ===== | | | | | | | |
| PEAK DEMAND AFTER DSM | 6,757 | 7,165 | 7,498 | 7,836 | 8,268 | 8,807 | 9,340 |
| | | | | | | | |
| | | | | | | | |
| RESOURCES | | | | | | | |
| ========= | | | | | | | |
| TOTAL HYDRO | 78 | 94 | 94 | 94 | 94 | 94 | 94 |
| | | | | | | | |
| TOTAL THERMAL | 8,160 | 8,641 | 6,339 | 3,729 | 3,729 | 3,729 | 3,729 |
| | | | | | | | |
| TOTAL CAPACITY | 8,238 | 8,735 | 6,433 | 3,823 | 3,823 | 3,823 | 3,823 |
| | | | | | | | |
| | | | | | | | |
| RESERVES | | | | | | | |
| ======== | | | | | | | |
| RESERVE (MW) | 1,481 | 1,570 | (1,065) | (4,013) | (4,445) | (4,984) | (5,517) |
| RESERVE MARGIN PERCENT | 22 | 22 | (14) | (51) | (54) | (57) | (59) |
| | | | | | | | |
| Note: In addition to the units in Figure 2, the resource totals include the capacities of the Cane Run 7, the Bluegrass CTs, OVEC, and Curtailable Customers. | | | | | | | |

Historical O&M costs and capital expenditure streams for individual units are volatile with large expenditures in some years and very little expenditures in others. This creates problems in projecting the forward trajectory for these costs. Furthermore, each year's capital expenditures should be amortized over the remaining life of the asset using the [redacted] methodology. The O&M cost stream adjusted for degradation using the [redacted] and the capital expenditures spread out over the remaining life using the [redacted] methodology are then overlaid on the FOM costs within the Strategist model's database for each candidate unit.

Finally, the candidate units were overlaid on the Reference Plan one at a time, the present value of each year's revenue requirements (equivalent to the PV Utility Cost model output from PROVIEW) was extracted from the model, and the differentials with the Reference Plan were calculated.

# IV. Results – Reference Plan

The Life Assessment Reference Plan developed using Strategist PROVIEW is shown below in Figure 7. Please note that the large number of units added in 2017 for the Reference Plan is the result of "replacing" the large amount of capacity that the candidate gas units represent. Likewise, two coal units and three gas-fired simple cycle combustion turbines were the most economical resources for replacing the candidate coal units "retired" in 2022.

Figure 7:

Life Assessment Reference Plan

| | Reference Plan |
|---|---|
| 2011 | |
| 2012 | |
| 2013 | |
| 2014 | |
| 2015 | |
| 2016 | |
| 2017 | SCCT(2) |
| | 2x1C(3) |
| 2018 | SCCT(1) |
| 2019 | |
| 2020 | SCCT(1) |
| 2021 | SCCT(1) |
| 2022 | SCCT(3) |
| | LGSC(2) |
| 2023 | |
| 2024 | |
| 2025 | LGSC(1) |
| 2026 | |
| 2027 | |
| 2028 | |
| 2029 | |
| 2030 | |
| 2031 | |
| 2032 | |
| 2033 | LGSC(1) |
| 2034 | |
| 2035 | |
| 2036 | |
| 2037 | |
| 2038 | |
| 2039 | 2x1C(1) |
| 2040 | |

# V. Results – Coal Units

The results of the life assessment of the coal fired units are presented in Figures 8, 9, and 10. Figure 8 shows the annual nominal utility cost differential between the Reference Plan and each alternative. Figure 9 shows the present values of the same annual differentials. Figure 10 shows the present value sums accumulated from when the values become negative. The results show that Ghent 1 & 2, Mill Creek 1, 2 & 3, and Brown 3 are not candidates for retirement prior to 2040. In each year of the study horizon, the differentials are greater than zero, which indicates that these units will not reach the end of their economic lives until after 2040.

The results show that Brown 1 and 2 are candidates for retirement prior to the end of 2040. As shown in Figures 8 and 9, the first year the Brown 1 differentials are negative is 2028. For the next several years, the differentials alternate between negative and positive before becoming permanently negative in 2032. An examination of the accumulated present value differentials in Figure 10 shows that the positive differentials in 2029 and 2031 do not overcome the negative differentials in 2028 and 2030; based on this analysis, Brown 1 could reach the end of its economic life in 2028. Beginning in 2029, Brown 2 shows a similar pattern to Brown 1 except that the positive differentials in the years 2031 through 2033 do overcome the initial negative in 2029; the analysis indicates that Brown 2 could reach the end of its economic life in 2034, after the differentials become permanently negative.

A review of the input assumptions for both Brown 1 and 2 shows that the drivers for their potential retirement dates are found in the FOM and CapEx [redacted] streams. Figure 11 shows the assumed total fixed costs (the sum of FOM and CapEx [redacted]) for both of these units, which include CapEx [redacted] for new environmental controls in 2012 through 2014. For Brown 1, there are CapEx costs that cause increases in the total fixed cost stream which correspond with the years that the differentials go negative. Although Brown 2 has the same expenditures shifted a year later, it can also be seen that there are very large expenses assumed in the next to last year of the study. These expenses cause Brown 1 and 2 to potentially reach the end of their economic lives before the end of study period.

Figure 8:
Coal Units
Nominal Utility Cost Differentials vs. All New Build Plan
(Nominal New Build - Nominal Existing Unit)

| | Nom,inal Utility Cost Differential with All New Build Plan (PVUC New Build - PVUC Existing Unit) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | GH2 | MC3 | GH1 | BR3 | MC2 | MC1 | BR2 | REF | BR1 |
| 2011 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| 2012 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| 2013 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| 2014 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| 2015 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| 2016 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| 2017 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| 2018 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| 2019 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| 2020 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| 2021 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| 2022 | $112,638 | $97,905 | $81,820 | $71,601 | $65,021 | $48,611 | $14,393 | $0 | $2,774 |
| 2023 | $106,312 | $109,123 | $91,357 | $70,981 | $76,612 | $35,900 | $8,379 | $0 | $5,779 |
| 2024 | $123,723 | $134,754 | $85,251 | $79,662 | $95,376 | $55,907 | $17,957 | $0 | $4,565 |
| 2025 | $98,398 | $97,701 | $78,915 | $65,221 | $80,883 | $27,910 | $8,891 | $0 | $1,588 |
| 2026 | $87,687 | $100,480 | $73,997 | $62,752 | $73,390 | $40,924 | $10,088 | $0 | $198 |
| 2027 | $109,197 | $99,483 | $83,255 | $70,643 | $67,172 | $29,309 | $8,900 | $0 | $1,909 |
| 2028 | $104,845 | $83,440 | $78,289 | $72,629 | $52,424 | $46,293 | $10,077 | $0 | ($4,651) |
| 2029 | $117,479 | $61,671 | $80,670 | $76,599 | $46,453 | $49,859 | $8,209 | $0 | $1,186 |
| 2030 | $112,458 | $92,318 | $88,918 | $72,876 | $41,381 | $51,074 | ($1,224) | $0 | ($1,627) |
| 2031 | $126,505 | $66,790 | $79,808 | $82,262 | $52,010 | $35,005 | $8,579 | $0 | $238 |
| 2032 | $119,262 | $100,959 | $94,948 | $83,944 | $45,121 | $55,309 | $6,137 | $0 | ($3,252) |
| 2033 | $96,030 | $66,927 | $72,856 | $71,061 | $41,971 | $27,989 | $2,537 | $0 | ($3,955) |
| 2034 | $116,063 | $88,698 | $80,278 | $72,403 | $37,700 | $41,472 | ($1,874) | $0 | ($7,616) |
| 2035 | $110,613 | $95,066 | $73,372 | $73,390 | $45,420 | $27,000 | ($3,204) | $0 | ($15,581) |
| 2036 | $122,133 | $95,724 | $68,344 | $72,660 | $46,663 | $42,786 | ($7,740) | $0 | ($13,660) |
| 2037 | $114,333 | $70,992 | $77,269 | $57,897 | $48,285 | $44,668 | ($26,850) | $0 | ($13,799) |
| 2038 | $127,209 | $103,440 | $63,552 | $64,265 | $39,363 | $40,775 | ($22,506) | $0 | ($18,849) |
| 2039 | $103,004 | $63,531 | $58,383 | $48,046 | $36,366 | $11,230 | ($32,306) | $0 | ($23,309) |
| 2040 | $73,733 | $89,792 | $41,193 | $37,846 | $26,452 | $23,195 | ($37,491) | $0 | ($28,757) |

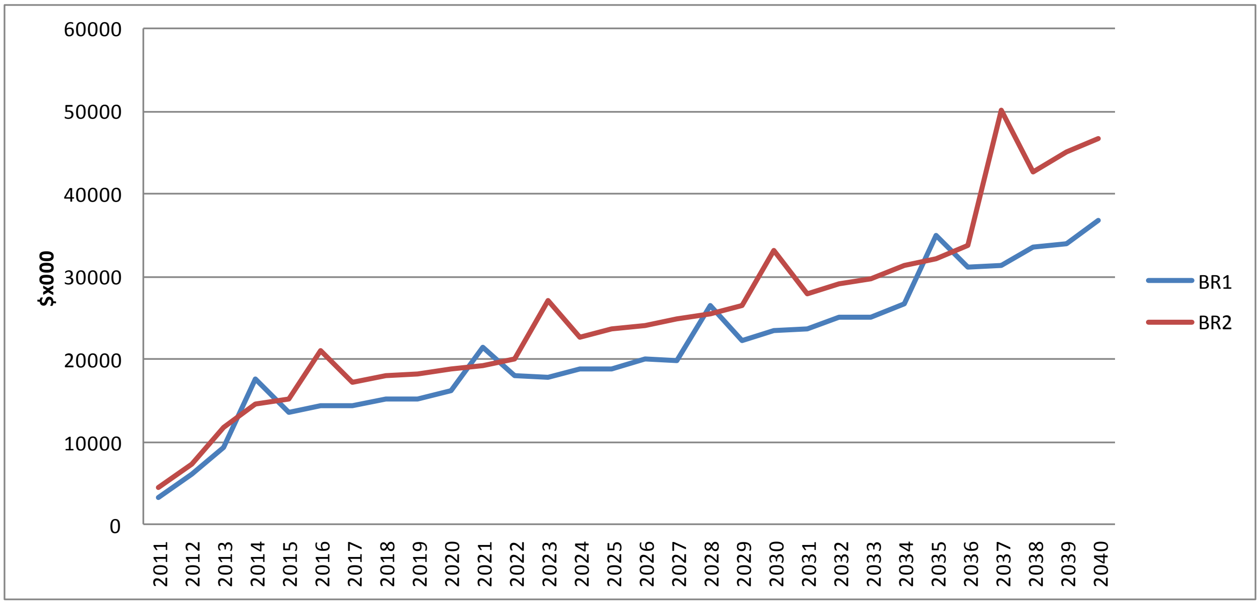
Figure 9:
Coal Units
Present Value Utility Cost Differentials vs. All New Build Plan
(PVUC New Build - PVUC Existing Unit)

| | Present Value Utility Cost Differential with All New Build Plan (PVUC New Build - PVUC Existing Unit) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | **GH2** | **MC3** | **GH1** | **BR3** | **MC2** | **MC1** | **BR2** | **REF** | **BR1** |
| **2011** | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| **2012** | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| **2013** | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| **2014** | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| **2015** | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| **2016** | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| **2017** | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| **2018** | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| **2019** | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| **2020** | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| **2021** | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| **2022** | $51,668 | $44,910 | $37,532 | $32,844 | $29,826 | $22,299 | $6,602 | $0 | $1,272 |
| **2023** | $45,700 | $46,908 | $39,271 | $30,512 | $32,933 | $15,432 | $3,602 | $0 | $2,484 |
| **2024** | $49,840 | $54,284 | $34,342 | $32,091 | $38,421 | $22,521 | $7,234 | $0 | $1,839 |
| **2025** | $37,146 | $36,882 | $29,791 | $24,621 | $30,534 | $10,536 | $3,356 | $0 | $600 |
| **2026** | $31,021 | $35,547 | $26,178 | $22,200 | $25,963 | $14,478 | $3,569 | $0 | $70 |
| **2027** | $36,201 | $32,981 | $27,601 | $23,420 | $22,269 | $9,717 | $2,951 | $0 | $633 |
| **2028** | $32,573 | $25,923 | $24,322 | $22,564 | $16,287 | $14,382 | $3,131 | $0 | ($1,445) |
| **2029** | $34,203 | $17,955 | $23,486 | $22,301 | $13,524 | $14,516 | $2,390 | $0 | $345 |
| **2030** | $30,682 | $25,187 | $24,260 | $19,883 | $11,290 | $13,935 | ($334) | $0 | ($444) |
| **2031** | $32,345 | $17,077 | $20,405 | $21,033 | $13,298 | $8,950 | $2,193 | $0 | $61 |
| **2032** | $28,575 | $24,190 | $22,750 | $20,113 | $10,811 | $13,252 | $1,470 | $0 | ($779) |
| **2033** | $21,562 | $15,027 | $16,359 | $15,956 | $9,424 | $6,285 | $570 | $0 | ($888) |
| **2034** | $24,421 | $18,663 | $16,892 | $15,235 | $7,933 | $8,726 | ($394) | $0 | ($1,603) |
| **2035** | $21,811 | $18,745 | $14,468 | $14,471 | $8,956 | $5,324 | ($632) | $0 | ($3,072) |
| **2036** | $22,568 | $17,688 | $12,629 | $13,427 | $8,623 | $7,906 | ($1,430) | $0 | ($2,524) |
| **2037** | $19,798 | $12,293 | $13,380 | $10,026 | $8,361 | $7,735 | ($4,650) | $0 | ($2,389) |
| **2038** | $20,643 | $16,786 | $10,313 | $10,429 | $6,388 | $6,617 | ($3,652) | $0 | ($3,059) |
| **2039** | $15,664 | $9,661 | $8,879 | $7,307 | $5,530 | $1,708 | ($4,913) | $0 | ($3,545) |
| **2040** | $10,508 | $12,796 | $5,870 | $5,393 | $3,770 | $3,306 | ($5,343) | $0 | ($4,098) |

Figure 10:
Coal Units
Accumulated PV Utility Cost from First Year with a Negative Differential

| | Accumulated PV Utility Cost from First Year with a Negative Differential | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | GH2 | MC3 | GH1 | BR3 | MC2 | MC1 | BR2 | REF | BR1 |
| 2011 | | | | | | | | | |
| 2012 | | | | | | | | | |
| 2013 | | | | | | | | | |
| 2014 | | | | | | | | | |
| 2015 | | | | | | | | | |
| 2016 | | | | | | | | | |
| 2017 | | | | | | | | | |
| 2018 | | | | | | | | | |
| 2019 | | | | | | | | | |
| 2020 | | | | | | | | | |
| 2021 | | | | | | | | | |
| 2022 | | | | | | | | | |
| 2023 | | | | | | | | | |
| 2024 | | | | | | | | | |
| 2025 | | | | | | | | | |
| 2026 | | | | | | | | | |
| 2027 | | | | | | | | | |
| 2028 | | | | | | | | | ($1,445) |
| 2029 | | | | | | | | | ($1,100) |
| 2030 | | | | | | | ($334) | | ($1,544) |
| 2031 | | | | | | | | | ($1,483) |
| 2032 | | | | | | | | | ($2,262) |
| 2033 | | | | | | | | | ($3,150) |
| 2034 | | | | | | | ($394) | | ($4,753) |
| 2035 | | | | | | | ($1,026) | | ($7,825) |
| 2036 | | | | | | | ($2,456) | | ($10,349) |
| 2037 | | | | | | | ($7,106) | | ($12,738) |
| 2038 | | | | | | | ($10,758) | | ($15,797) |
| 2039 | | | | | | | ($15,671) | | ($19,342) |
| 2040 | | | | | | | ($21,014) | | ($23,440) |

**Figure 11:**
**Total Fixed Cost Assumption**
**Brown 1 and 2**




Figures 12 through 14 show an example of the progression from the original input assumptions to the adjusted assumptions used in the analysis. This particular example is taken from Brown 2. Figure 12 shows the original FOM assumptions for Brown 2 along with the resulting adjusted values using the [redacted].

**Figure 12:**
**Fixed O&M Assumption**
**Brown 2**

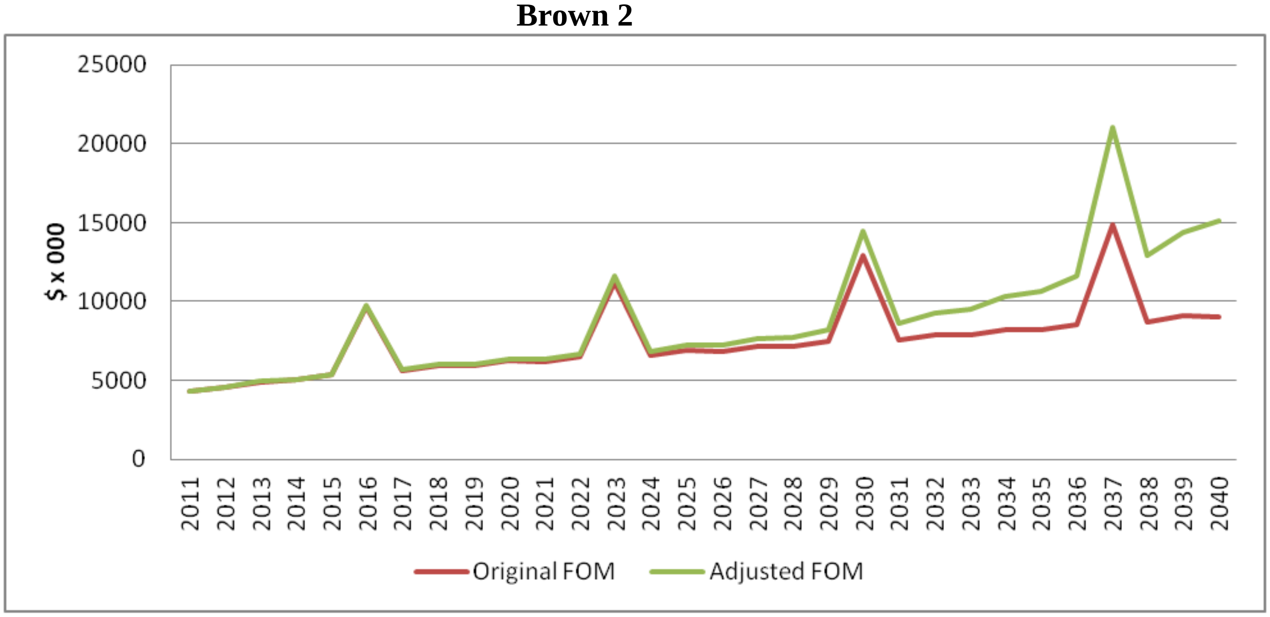


Figure 13 shows the original CapEx stream for Brown 2 along with the adjusted [redacted] stream for the same data. The large expenses in 2012 through 2014 correspond with capital for new environmental controls.

**Figure 13:**
**CAPEX Assumption**
**Brown 2**

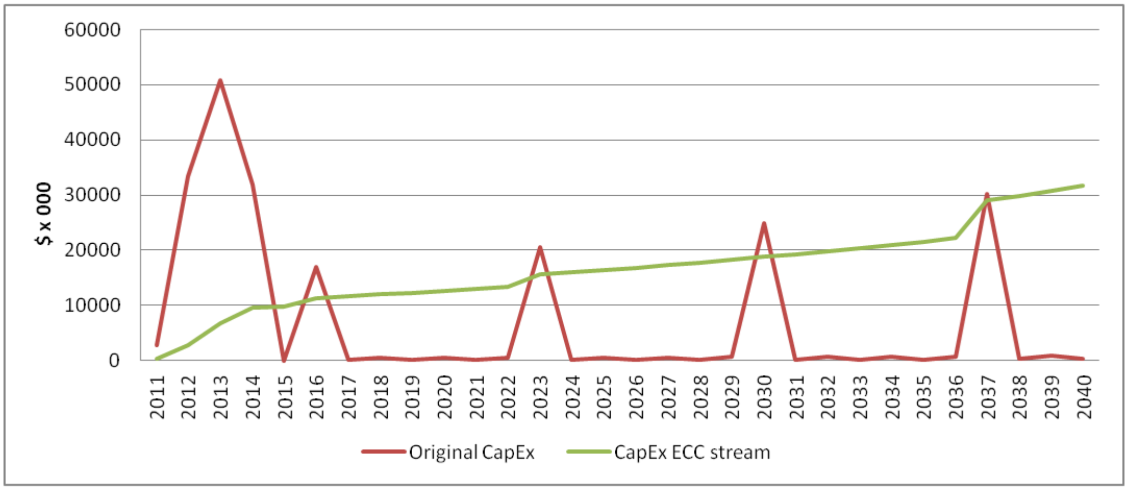
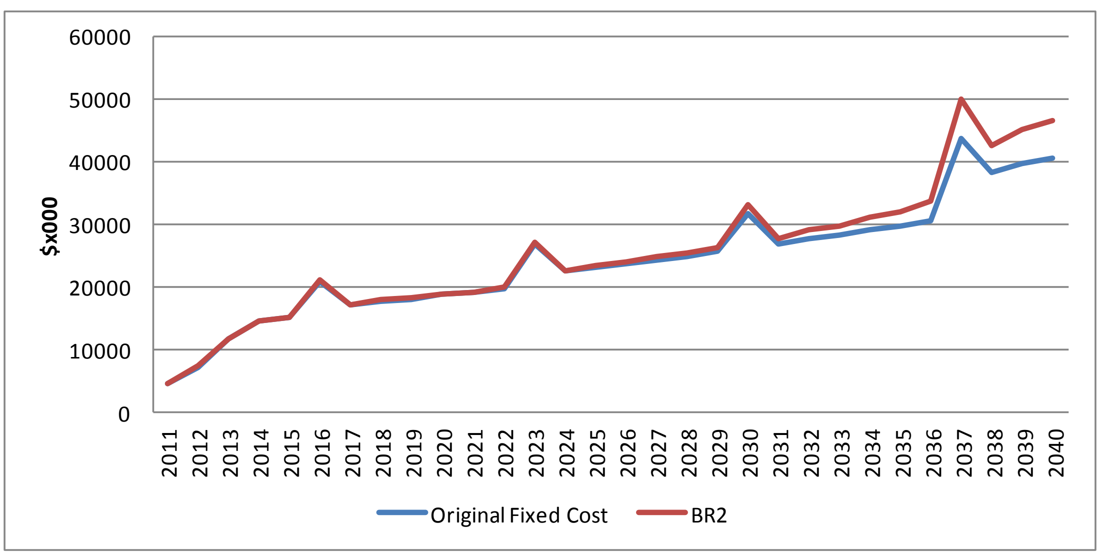



Figure 14 shows the original total fixed cost stream for Brown 2 along with the adjusted stream for the same data. The total fixed cost is the sum of the CapEx and the FOM streams.

**Figure 14:**
**Total Assumption**
**Brown 2**



Since the 2007 Life Assessment Study, operating costs of existing coal units have increased due to capital investments for new environmental controls and associated consumables. However, increases in capital costs of replacement capacity more than offset these increases in consumables, resulting in longer useful economic lives for existing coal units.

# VI. Results – Gas Units

The results of the life assessment study of the gas fired units are presented in Figures 15, 16, and 17. Figure 15 shows the differential in cost on a nominal basis. Figure 16 shows the present value of the same differentials. Figure 17 shows the present value sums accumulated from where the differential streams turn negative. Trimble County 5-10 and Paddy's Run 13 show that they are not candidates for retirement before the end of 2040. In each year over the study horizon, the differentials with the Reference Plan are greater than zero, which indicates that these units would not reach the end of their economic lives until sometime after 2040.

The Brown CTs show a different pattern than the Trimble County and Paddy's Run units. The results for Brown 5, 6, 7, and 11 indicate that these units may reach the end of their economic lives in the last four years of the study. The year indicated as the end of economic life is dependent on the stream of the fixed cost assumptions. Brown 5 shows a retirement year of 2040 due to an increase in total fixed cost from $4.9M to $26M. Brown 6 shows a retirement year of 2037 due to an increase in the total fixed cost in that year from $9.4M to $20.6M. This trend is repeated for Brown 7 in 2038 with an increase of $15.5M, and Brown 11 in 2035 with an increase of $10M. The timing of the overhaul and associated O&M and CapEx outlays affect the forecasted economic lives of each unit.

An in-depth analysis of the results shows that the main reason for these increases is the CapEx [redacted] streams. Figure 18 shows the total fixed costs for Brown 5, 6, 7, and 11. Figure 19 shows the same assumptions for Brown 8, 9 and 10. Although Brown 8, 9, and 10 show increases in fixed costs, these increases are approximately a third of the forecasted increases for Brown 5, 6, 7, and 11 due to the timing of their expected outages. This lower level of fixed costs results in these units remaining more cost effective than the potential replacement capacity.

Figure 15:
Nominal Utility Cost Differentials vs. All New Build Plan
(Nominal New Build - Nominal Existing Unit)

| | Present Value Utility Cost Differential with All New Build Plan (PVUC New Build - PVUC Existing Unit) | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **TC6** | **TC10** | **TC8** | **TC9** | **TC7** | **TC5** | **PD13** | **BR11** | **BR5** | **BR6** | **BR8** | **BR7** | **BR10** | **BR9** | **REF** |
| **2011** | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| **2012** | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| **2013** | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| **2014** | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| **2015** | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| **2016** | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| **2017** | $16,495 | $16,536 | $8,953 | $16,384 | $16,352 | $7,840 | $12,103 | $11,508 | $10,561 | $5,027 | $11,452 | $13,415 | $10,024 | $9,753 | $0 |
| **2018** | $16,216 | $16,257 | $15,839 | $9,495 | $9,464 | $14,686 | $2,100 | $11,026 | $10,193 | $11,201 | $10,980 | $5,194 | $9,616 | $9,341 | $0 |
| **2019** | $16,607 | $10,341 | $16,221 | $16,098 | $16,062 | $15,034 | $12,314 | $11,678 | $11,163 | $11,306 | $10,551 | $10,727 | $8,981 | $8,445 | $0 |
| **2020** | $16,027 | $15,556 | $15,630 | $15,504 | $15,465 | $14,409 | $12,375 | $11,441 | $4,844 | $10,715 | $11,423 | $10,500 | $9,806 | $8,057 | $0 |
| **2021** | $17,082 | $16,729 | $16,842 | $16,714 | $16,670 | $15,578 | $13,063 | $12,300 | $9,295 | $11,948 | $4,275 | $10,448 | $10,668 | $6,706 | $0 |
| **2022** | $10,646 | $16,907 | $16,845 | $16,892 | $16,840 | $15,528 | $13,229 | $11,565 | $8,529 | $12,291 | $9,837 | $11,450 | $9,875 | $7,529 | $0 |
| **2023** | $17,459 | $17,561 | $9,927 | $17,357 | $17,298 | $8,585 | $13,357 | $13,088 | $9,900 | $12,646 | $9,577 | $11,776 | $11,396 | $2,847 | $0 |
| **2024** | $18,505 | $18,609 | $18,040 | $8,898 | $8,844 | $16,612 | $13,053 | $13,670 | $8,332 | $12,177 | $9,158 | $11,278 | $1,436 | $8,935 | $0 |
| **2025** | $15,764 | $13,889 | $15,290 | $15,126 | $15,061 | $13,846 | $9,985 | $12,247 | $10,421 | $12,254 | $9,262 | $11,325 | $7,143 | $7,015 | $0 |
| **2026** | $16,197 | $15,662 | $15,710 | $15,543 | $15,469 | $14,208 | $13,108 | $6,587 | $10,606 | $12,525 | $9,241 | $11,317 | $7,071 | $7,677 | $0 |
| **2027** | $16,537 | $16,116 | $16,273 | $16,102 | $16,019 | $14,707 | $13,410 | $9,048 | $10,775 | $6,111 | $9,932 | $11,822 | $7,709 | $7,921 | $0 |
| **2028** | $12,858 | $16,867 | $16,773 | $16,849 | $16,754 | $15,124 | $13,708 | $9,293 | $10,795 | $9,254 | $10,288 | $3,422 | $8,037 | $8,255 | $0 |
| **2029** | $17,331 | $17,577 | $12,170 | $17,286 | $17,179 | $10,491 | $14,021 | $9,564 | $11,035 | $9,487 | $10,689 | $7,442 | $7,495 | $7,720 | $0 |
| **2030** | $17,773 | $18,477 | $17,805 | $11,262 | $11,158 | $15,966 | $14,350 | $9,822 | $5,381 | $9,144 | $9,930 | $7,724 | $8,744 | $8,976 | $0 |
| **2031** | $18,397 | $12,095 | $18,442 | $18,038 | $17,898 | $16,500 | $13,715 | $10,078 | $11,353 | $10,020 | $11,504 | $7,051 | $9,070 | $8,033 | $0 |
| **2032** | $19,227 | $19,429 | $19,289 | $18,876 | $18,713 | $17,203 | ($51) | $8,753 | $9,518 | $10,358 | ($1,176) | $8,062 | $7,772 | $8,813 | $0 |
| **2033** | $16,718 | $17,039 | $17,175 | $16,751 | $16,607 | $15,114 | $13,845 | $9,075 | $11,931 | $9,427 | $5,130 | $7,072 | $8,328 | $47 | $0 |
| **2034** | $13,393 | $17,494 | $17,209 | $17,191 | $17,032 | $15,246 | $13,956 | $9,098 | $11,488 | $9,149 | $4,967 | $6,712 | ($1,577) | $2,440 | $0 |
| **2035** | $16,443 | $18,058 | $13,125 | $17,270 | $17,099 | $11,046 | $14,156 | $9,082 | $12,037 | $9,517 | $4,607 | $6,990 | $1,673 | $1,754 | $0 |
| **2036** | $16,932 | $18,685 | $17,054 | $12,260 | $12,108 | $14,850 | $14,169 | ($3,555) | $12,191 | $9,476 | $5,503 | $6,371 | $874 | $2,555 | $0 |
| **2037** | $17,665 | $12,805 | $17,643 | $16,968 | $17,058 | $15,288 | $14,175 | $195 | $12,130 | ($6,051) | $4,478 | $6,716 | $1,721 | $2,558 | $0 |
| **2038** | $18,094 | $18,538 | $18,544 | $17,852 | $17,676 | $15,683 | $11,449 | ($57) | $12,003 | ($1,158) | $5,577 | ($14,071) | $1,645 | $2,510 | $0 |
| **2039** | $17,695 | $18,725 | $19,303 | $18,596 | $18,464 | $16,364 | $9,102 | $476 | $14,246 | ($403) | $6,896 | ($7,159) | $2,330 | $3,200 | $0 |
| **2040** | $1,923 | $2,777 | $2,686 | $2,754 | $2,742 | $2,235 | $1,897 | $20 | ($1,247) | ($177) | $1,034 | ($1,107) | $440 | $567 | $0 |

Figure 16:
Gas Units
Present Value Utility Cost Differentials vs. All New Build Plan
(PVUC New Build - PVUC Existing Unit)

| | Present Value Utility Cost Differential with All New Build Plan (PVUC New Build - PVUC Existing Unit) | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | TC6 | TC10 | TC8 | TC9 | TC7 | TC5 | PD13 | BR11 | BR5 | BR6 | BR8 | BR7 | BR10 | BR9 | REF |
| 2011 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| 2012 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| 2013 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| 2014 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| 2015 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| 2016 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| 2017 | $10,470 | $10,495 | $5,683 | $10,399 | $10,379 | $4,976 | $7,682 | $7,304 | $6,703 | $3,190 | $7,268 | $8,515 | $6,362 | $6,190 | $0 |
| 2018 | $9,645 | $9,670 | $9,421 | $5,647 | $5,629 | $8,735 | $1,249 | $6,558 | $6,063 | $6,662 | $6,531 | $3,089 | $5,719 | $5,556 | $0 |
| 2019 | $9,257 | $5,764 | $9,041 | $8,973 | $8,953 | $8,380 | $6,864 | $6,509 | $6,222 | $6,302 | $5,881 | $5,979 | $5,006 | $4,707 | $0 |
| 2020 | $8,371 | $8,125 | $8,164 | $8,098 | $8,078 | $7,526 | $6,464 | $5,976 | $2,530 | $5,597 | $5,967 | $5,485 | $5,122 | $4,209 | $0 |
| 2021 | $8,362 | $8,189 | $8,244 | $8,182 | $8,160 | $7,625 | $6,394 | $6,021 | $4,550 | $5,849 | $2,093 | $5,114 | $5,222 | $3,283 | $0 |
| 2022 | $4,883 | $7,755 | $7,727 | $7,748 | $7,725 | $7,123 | $6,068 | $5,305 | $3,912 | $5,638 | $4,512 | $5,252 | $4,530 | $3,454 | $0 |
| 2023 | $7,505 | $7,549 | $4,267 | $7,461 | $7,436 | $3,690 | $5,742 | $5,626 | $4,256 | $5,436 | $4,117 | $5,062 | $4,899 | $1,224 | $0 |
| 2024 | $7,454 | $7,496 | $7,267 | $3,585 | $3,563 | $6,692 | $5,258 | $5,507 | $3,356 | $4,905 | $3,689 | $4,543 | $578 | $3,599 | $0 |
| 2025 | $5,951 | $5,243 | $5,772 | $5,710 | $5,686 | $5,227 | $3,769 | $4,623 | $3,934 | $4,626 | $3,496 | $4,275 | $2,697 | $2,648 | $0 |
| 2026 | $5,730 | $5,541 | $5,558 | $5,498 | $5,473 | $5,026 | $4,637 | $2,330 | $3,752 | $4,431 | $3,269 | $4,004 | $2,502 | $2,716 | $0 |
| 2027 | $5,482 | $5,343 | $5,395 | $5,338 | $5,311 | $4,876 | $4,446 | $3,000 | $3,572 | $2,026 | $3,293 | $3,919 | $2,556 | $2,626 | $0 |
| 2028 | $3,995 | $5,240 | $5,211 | $5,235 | $5,205 | $4,699 | $4,259 | $2,887 | $3,354 | $2,875 | $3,196 | $1,063 | $2,497 | $2,565 | $0 |
| 2029 | $5,046 | $5,117 | $3,543 | $5,033 | $5,001 | $3,054 | $4,082 | $2,784 | $3,213 | $2,762 | $3,112 | $2,167 | $2,182 | $2,247 | $0 |
| 2030 | $4,849 | $5,041 | $4,858 | $3,073 | $3,044 | $4,356 | $3,915 | $2,680 | $1,468 | $2,495 | $2,709 | $2,107 | $2,386 | $2,449 | $0 |
| 2031 | $4,704 | $3,092 | $4,715 | $4,612 | $4,576 | $4,219 | $3,507 | $2,577 | $2,903 | $2,562 | $2,941 | $1,803 | $2,319 | $2,054 | $0 |
| 2032 | $4,607 | $4,655 | $4,622 | $4,523 | $4,484 | $4,122 | ($12) | $2,097 | $2,280 | $2,482 | ($282) | $1,932 | $1,862 | $2,111 | $0 |
| 2033 | $3,754 | $3,826 | $3,856 | $3,761 | $3,729 | $3,394 | $3,109 | $2,038 | $2,679 | $2,117 | $1,152 | $1,588 | $1,870 | $10 | $0 |
| 2034 | $2,818 | $3,681 | $3,621 | $3,617 | $3,584 | $3,208 | $2,937 | $1,914 | $2,417 | $1,925 | $1,045 | $1,412 | ($332) | $513 | $0 |
| 2035 | $3,242 | $3,561 | $2,588 | $3,405 | $3,372 | $2,178 | $2,791 | $1,791 | $2,374 | $1,877 | $909 | $1,378 | $330 | $346 | $0 |
| 2036 | $3,129 | $3,453 | $3,151 | $2,265 | $2,237 | $2,744 | $2,618 | ($657) | $2,253 | $1,751 | $1,017 | $1,177 | $161 | $472 | $0 |
| 2037 | $3,059 | $2,217 | $3,055 | $2,938 | $2,954 | $2,647 | $2,455 | $34 | $2,101 | ($1,048) | $775 | $1,163 | $298 | $443 | $0 |
| 2038 | $2,936 | $3,008 | $3,009 | $2,897 | $2,868 | $2,545 | $1,858 | ($9) | $1,948 | ($188) | $905 | ($2,283) | $267 | $407 | $0 |
| 2039 | $2,691 | $2,848 | $2,935 | $2,828 | $2,808 | $2,489 | $1,384 | $72 | $2,166 | ($61) | $1,049 | ($1,089) | $354 | $487 | $0 |
| 2040 | $1,923 | $2,777 | $2,686 | $2,754 | $2,742 | $2,235 | $1,897 | $20 | ($1,247) | ($177) | $1,034 | ($1,107) | $440 | $567 | $0 |

Figure 17:
Gas Units
Accumulated PV Utility Cost from First Year with a Negative Differential

| | Accumulated PV Utility Cost from First Year with a Negative Differential | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **TC6** | **TC10** | **TC8** | **TC9** | **TC7** | **TC5** | **PD13** | **BR11** | **BR5** | **BR6** | **BR8** | **BR7** | **BR10** | **BR9** | **REF** |
| **2011** | | | | | | | | | | | | | | | |
| **2012** | | | | | | | | | | | | | | | |
| **2013** | | | | | | | | | | | | | | | |
| **2014** | | | | | | | | | | | | | | | |
| **2015** | | | | | | | | | | | | | | | |
| **2016** | | | | | | | | | | | | | | | |
| **2017** | | | | | | | | | | | | | | | |
| **2018** | | | | | | | | | | | | | | | |
| **2019** | | | | | | | | | | | | | | | |
| **2020** | | | | | | | | | | | | | | | |
| **2021** | | | | | | | | | | | | | | | |
| **2022** | | | | | | | | | | | | | | | |
| **2023** | | | | | | | | | | | | | | | |
| **2024** | | | | | | | | | | | | | | | |
| **2025** | | | | | | | | | | | | | | | |
| **2026** | | | | | | | | | | | | | | | |
| **2027** | | | | | | | | | | | | | | | |
| **2028** | | | | | | | | | | | | | | | |
| **2029** | | | | | | | | | | | | | | | |
| **2030** | | | | | | | | | | | | | | | |
| **2031** | | | | | | | | | | | | | | | |
| **2032** | | | | | | | ($12) | | | | ($282) | | | | |
| **2033** | | | | | | | | | | | | | | | |
| **2034** | | | | | | | | | | | | | ($332) | | |
| **2035** | | | | | | | | | | | | | | | |
| **2036** | | | | | | | | ($657) | | | | | | | |
| **2037** | | | | | | | | | | ($1,048) | | | | | |
| **2038** | | | | | | | | | | ($1,236) | | ($2,283) | | | |
| **2039** | | | | | | | | | | ($1,297) | | ($1,235) | | | |
| **2040** | | | | | | | | | ($1,247) | ($1,474) | | ($201) | | | |

**Figure 18**
**Fixed Cost Assumptions**
**Brown 5, 6, 7 and 11**

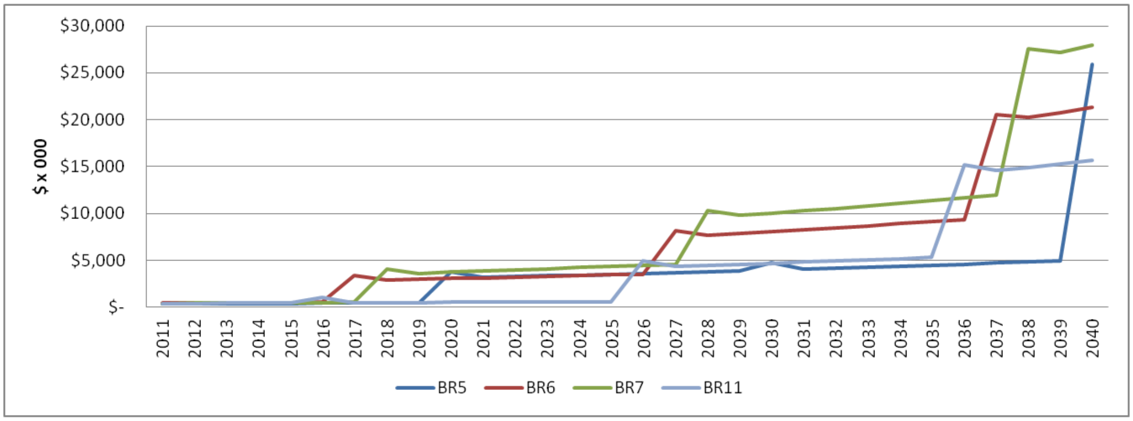
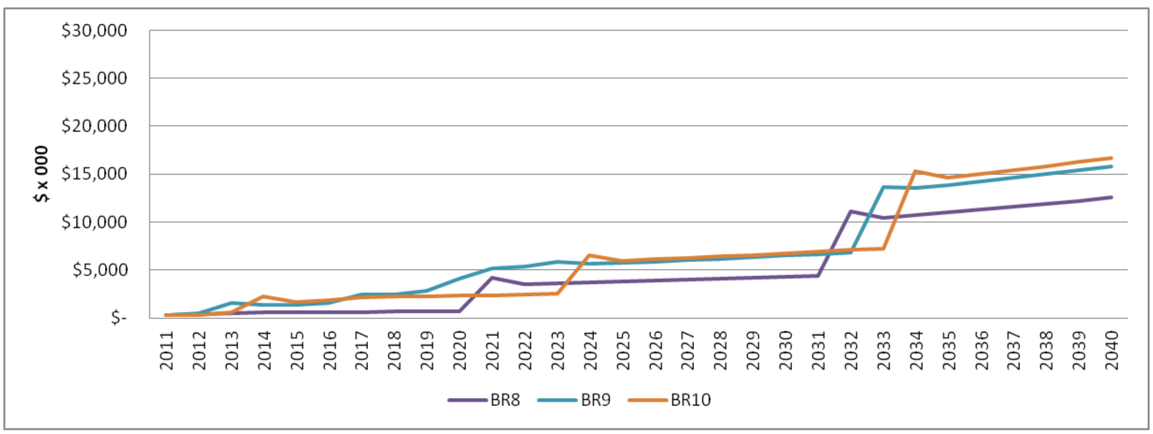



**Figure 19**
**Fixed Cost Assumptions**
**Brown 8, 9 and 10**



# VII. Results – Secondary CTs

Finally, there is a class of smaller generating units that are called Secondary CTs. These smaller peaking units include Haefling 1-3, Cane Run 11, Paddy's Run 11 & 12, and Zorn 1 and range in size from 12 to 23 MW (see Figure 2). A high percentage of the time, the Primary CTs fulfill the peak load needs of the Companies. These seven Secondary CT units are older gas-fired units that are beyond their expected economic lives in terms of operations. The primary role for several of these Secondary CT units is to provide black-start capabilities for the system. They have very high heat rates and operating costs and for the most part, are used to serve load only during extreme peak conditions. Because they are operated infrequently, these units have no ongoing FOM or CapEx. These units were analyzed against the gas fired deferral units in the Reference Plan. Since they do not have any fixed costs forecasted or modeled and they generate at very low capacity factors, they never incur significant costs and therefore do not reach the end of their economic lives within the study period.

Figure 20 shows the Nominal Value Utility Cost Differentials between the Reference Plan and the Secondary CTs. Since these are nominal values, they can be interpreted to be the amount that could be spent on these units in any given year before the overall cost differential would go negative. In any given year, LG&E-KU can spend up to that nominal amount before it would be more economical to retire the units.

Figure 20:
Secondary CTs
Nominal Utility Cost Differentials vs. All New Build Plan
(PVUC New Build - PVUC Existing Unit)

| | Nominal Utility Cost Differential with All New Build Plan (New Build - Existing Unit) | | | | | |
|---|---|---|---|---|---|---|
| | PD11 | ZN1 | CR11 | PD12 | HF13 | REF |
| 2011 | $0 | $0 | $0 | $0 | $0 | $0 |
| 2012 | $0 | $0 | $0 | $0 | $0 | $0 |
| 2013 | $0 | $0 | $0 | $0 | $0 | $0 |
| 2014 | $0 | $0 | $0 | $0 | $0 | $0 |
| 2015 | $0 | $0 | $0 | $0 | $0 | $0 |
| 2016 | $0 | $0 | $0 | $0 | $0 | $0 |
| 2017 | $3,899 | $3,899 | $3,739 | $3,109 | $2,084 | $0 |
| 2018 | $2,868 | $2,868 | $2,752 | $2,302 | $1,573 | $0 |
| 2019 | $3,058 | $3,058 | $2,947 | $2,540 | $1,877 | $0 |
| 2020 | $2,097 | $2,097 | $2,063 | $2,002 | $1,854 | $0 |
| 2021 | $4,441 | $4,441 | $4,321 | $3,886 | $3,214 | $0 |
| 2022 | $4,353 | $4,353 | $4,216 | $3,795 | $3,058 | $0 |
| 2023 | $4,925 | $4,925 | $4,743 | $4,153 | $3,158 | $0 |
| 2024 | $6,159 | $6,159 | $5,880 | $4,902 | $3,321 | $0 |
| 2025 | $1,814 | $1,814 | $1,880 | $2,399 | $3,024 | $0 |
| 2026 | $1,980 | $1,980 | $2,026 | $2,494 | $3,022 | $0 |
| 2027 | $2,276 | $2,276 | $2,276 | $2,744 | $3,161 | $0 |
| 2028 | $2,871 | $2,871 | $2,808 | $3,043 | $3,095 | $0 |
| 2029 | $3,344 | $3,344 | $3,239 | $3,326 | $3,140 | $0 |
| 2030 | $4,176 | $4,176 | $3,990 | $3,764 | $3,113 | $0 |
| 2031 | $4,604 | $4,604 | $4,383 | $4,048 | $3,228 | $0 |
| 2032 | $5,450 | $5,450 | $5,146 | $4,462 | $3,150 | $0 |
| 2033 | $2,137 | $2,137 | $2,099 | $2,720 | $3,152 | $0 |
| 2034 | $2,380 | $2,380 | $2,310 | $2,835 | $3,100 | $0 |
| 2035 | $2,754 | $2,754 | $2,641 | $3,003 | $3,022 | $0 |
| 2036 | $3,236 | $3,236 | $3,080 | $3,261 | $3,027 | $0 |
| 2037 | $3,827 | $3,827 | $3,623 | $3,557 | $3,016 | $0 |
| 2038 | $4,544 | $4,544 | $4,294 | $3,929 | $3,063 | $0 |
| 2039 | $2,493 | $2,493 | $2,365 | $3,221 | $3,482 | $0 |
| 2040 | $2,671 | $2,671 | $2,514 | $3,312 | $3,437 | $0 |

## VIII. Summary

Ventyx Inc. performed a Life Assessment of a number of LG&E and KU's generating assets to determine the effective useful economic lives of these assets. Newer units whose ages were not projected to reach a "nominal" end of operating life (60 years for coal fired generation and 30 years for gas fired generation) were not considered in this analysis. Likewise, none of LG&E and KU's hydro generation assets were considered in this analysis because previous asset economic life expectancy analysis has demonstrated that once the initial high cost of constructing the associated dam and reservoir are made, the actual operations and maintenance costs of the generators are relatively minor as compared to gas or coal fired replacement generation.

For the generating units analyzed, this study was divided into three parts: coal fired units, gas fired units, and a group of older units referred to collectively as Secondary CTs. Figure 21 summarizes the results of this Life Assessment for LG&E and KU's coal fired assets. The analysis projected an end of economic life for only two of the eight coal-fired units examined: Brown 1 and Brown 2. For the remaining coal fired units, the analysis showed no economic retirement date within the study horizon (2011 through 2040).

Figure 21:

| Coal Fired Generating Assets | |
|---|---|
| **Unit Name** | **Projected End of Economic Life** |
| Brown 1 | 2028 |
| Brown 2 | 2034 |
| Brown 3 | 2040 + |
| Ghent 1 | 2040 + |
| Ghent 2 | 2040 + |
| Mill Creek 1 | 2040 + |
| Mill Creek 2 | 2040 + |
| Mill Creek 3 | 2040 + |

The assessment of the economics of continuing to operate LG&E and KU's gas fired generating assets (Brown 5-11, Paddy's Run 13, and Trimble County 5-10) indicates that although all of these assets will pass the 30$^{th}$ year of operations during the study horizon, only four of these units show potential economic losses from continued operations during that time period. The results for Brown 5, 6, 7, and 11 indicate that these units may reach the end of their economic lives near the end of the study horizon – from eight to ten years beyond their 30$^{th}$ anniversaries of commercial operation. These dates are shown in Figure 22. Brown units 8, 9, and 10 which would reach 40 years of age in 2035 do not show an end of economic life before the end of the study horizon. These units do not have O&M costs or CapEx projections that show significant increases in the out years of the study horizon that appear to drive the potential retirement of the other Brown units. Without these cost increases, these units can be expected to remain economic throughout the study horizon. The remaining gas fired units (Paddy's Run 13, and Trimble County 5-10) also do not show an end of economic life through 2040.

**Figure 22:**

| Gas Fired Generating Assets | |
|---|---|
| **Unit Name** | **Projected End of Economic Life** |
| Brown 5 | 2040 |
| Brown 6 | 2037 |
| Brown 7 | 2038 |
| Brown 8 | 2040 + |
| Brown 9 | 2040 + |
| Brown 10 | 2040 + |
| Brown 11 | 2036 |
| Paddy's Run 13 | 2040 + |
| Trimble County 5 | 2036 |
| Trimble County 6 | 2040 + |
| Trimble County 7 | 2036 |
| Trimble County 8 | 2040 + |
| Trimble County 9 | 2036 |
| Trimble County 10 | 2040 + |

Finally, the seven Secondary CTs (Haefling 1-3, Cane Run 11, Paddy's Run 11 & 12, and Zorn 1) did not show an end of economic life within the study horizon. The primary reasons for this, despite all of these units being currently well past their original life expectancies (nominally 30 years for a gas fired unit), are the minimal operations and maintenance costs projected for these units, a lack of any significant periodic maintenance cost increases similar to all the other units examined, and a forecast for no CapEx on these assets over the entire study horizon. These results suggest a unique situation whereby these units are retained only for their black-start and capacity reserve purposes with absolutely minimal generation operations until and unless they experience a catastrophic failure that results in any significant cost to repair the unit. A table of nominal cost differentials vs. gas fired replacement generation is provided in Figure 20. These nominal cost differentials should be interpreted as the maximum threshold for expenditures in any one year that would result in the resource remaining economically viable. Nevertheless, it would be prudent to begin planning for the replacement of this 99 MW of generation capacity at some point over the next ten to fifteen years to avoid a situation where the company actually needs some portion of that capacity and it was unavailable due to a catastrophic failure resulting in a greater than economic threshold cost to repair.

## Appendices:

**Appendices contain proprietary and confidential information and have been redacted.**