

#### 6.4 PERFORMANCE MEASURES

A summary tabulation of the expected value of all performance measures is provided in Table 29 below. Plan detail results behind this summary tabulation are attached in Appendix D, Economic Impact for Each Alternative Resource Plan HC.

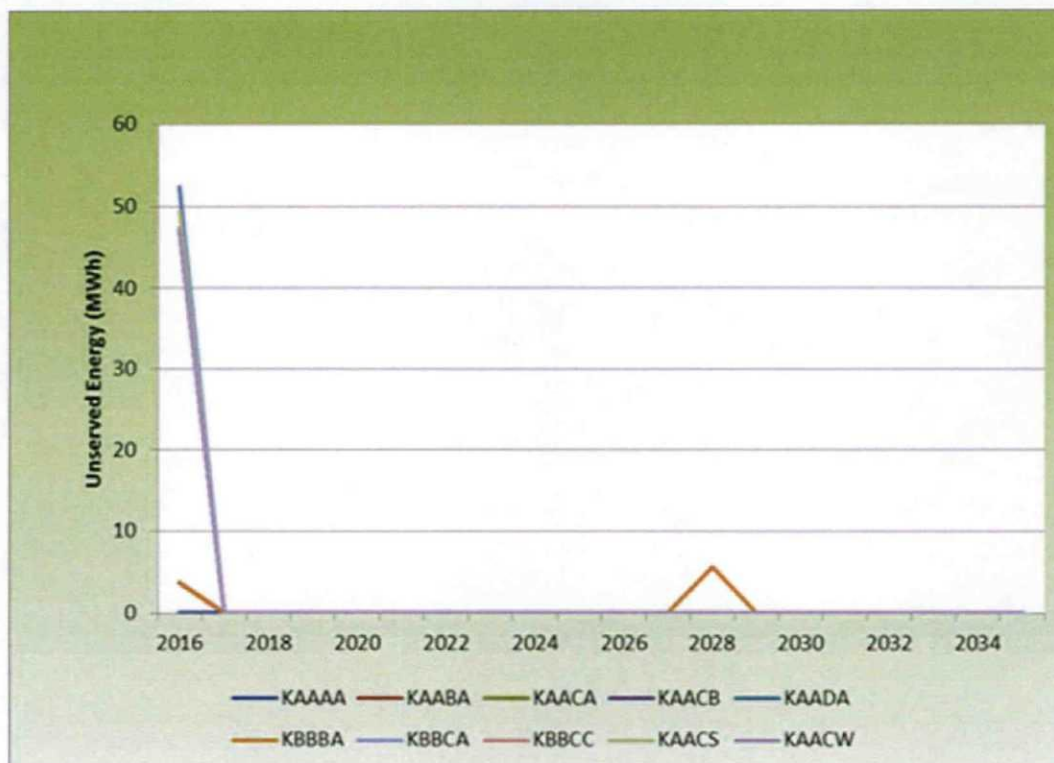
**Table 29: Expected Value of Performance Measures \*\* Highly Confidential \*\***

| Plan  | NPVRR (\$MM) | Levelized Annual Rates (\$/KW-hr) | Maximum Rate Increase |
|-------|--------------|-----------------------------------|-----------------------|
| KAACS | 21,463       |                                   |                       |
| KAACA | 21,464       |                                   |                       |
| KAACB | 21,517       |                                   |                       |
| KAABA | 21,533       |                                   |                       |
| KBBBA | 21,547       |                                   |                       |
| KAADA | 21,622       |                                   |                       |
| KAACW | 21,675       |                                   |                       |
| KBBCA | 21,741       |                                   |                       |
| KBBCC | 21,843       |                                   |                       |
| KAAAA | 23,053       |                                   |                       |

## 6.5 UNSERVED ENERGY

The expected value of unserved energy for all KCPL Alternative Resource Plans is provided in Table 30 below:

**Table 30: Unserved Energy**



## **6.6 JOINT-PLANNING KCP&L/GMO RESOURCE PLANS**

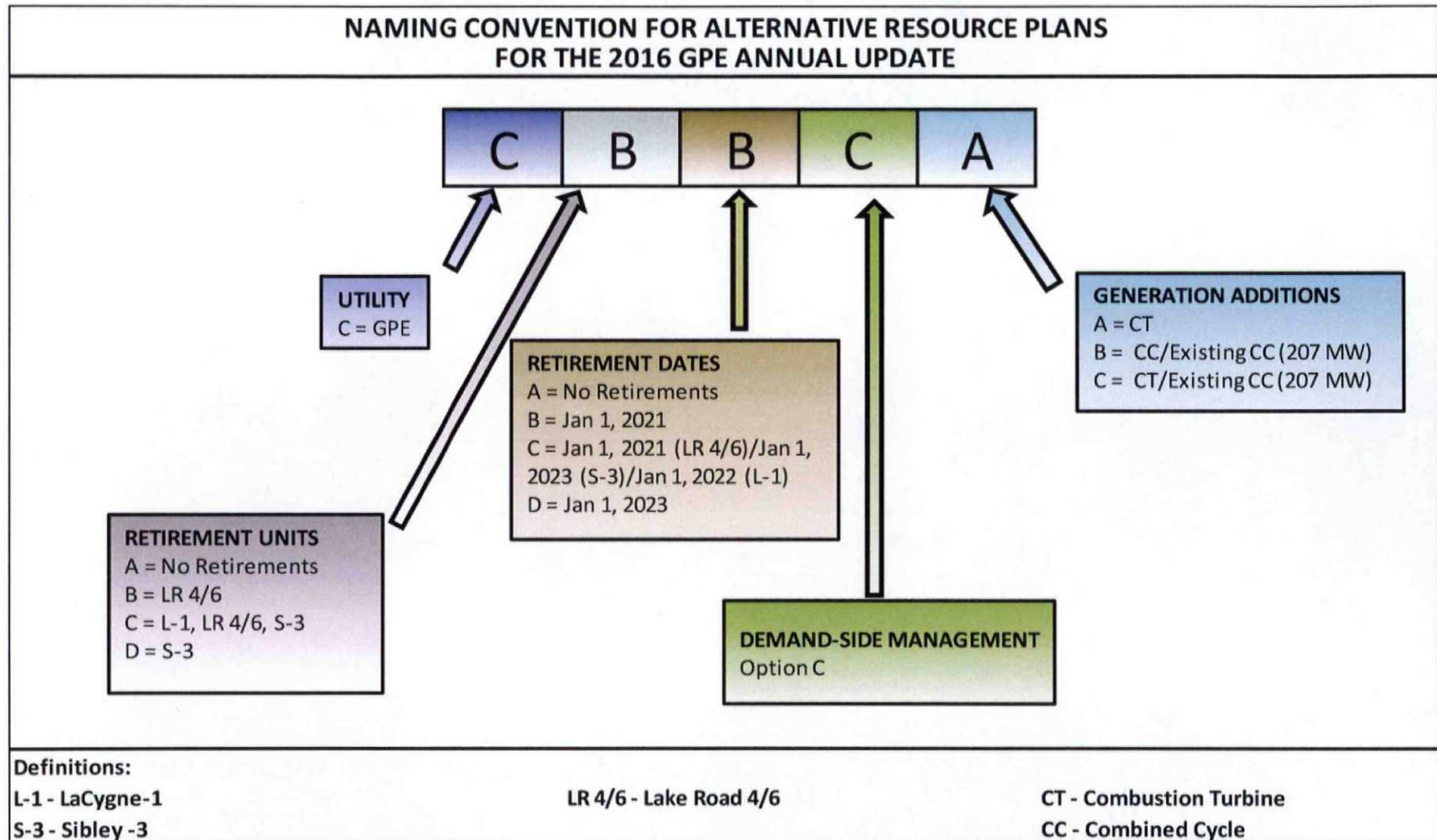
KCP&L also considers it prudent resource planning to develop and analyze alternative resource plans that are based upon KCP&L and GMO combining resources. Evaluating alternative resource plans on a joint planning basis can provide a platform to determine if joint planning “serves the public interest” as mandated in 4 CSR 240-22.010 Policy Objectives.

The joint-planning Alternative Resource Plans were developed to reflect combinations of the KCP&L and GMO Alternative Resource Plans. For example, combined company plan CBBCA is the combination of KCP&L alternative resource plan KAACA (no retirements/DSM Option C) and GMO alternative resource plan GBBCA (retire Lake Road 4/6 by 2021/DSM Option C).

The NPVRR for each joint-planning alternative resource plan was determined under the same 18 scenarios analyzed for the stand alone companies. For example, electricity market prices, natural gas prices, CO<sub>2</sub> allowance prices, etc. were unchanged from the stand-alone company scenarios.

The plan-naming convention utilized for the joint-planning Alternative Resource Plans developed is shown in Table 31. The Alternative Resource Plans were developed using various capacities of supply-side resources and demand-side resources. In total, five joint-planning Alternative Resource Plans were developed for the integrated resource analysis for the 2016 Annual Update. An overview of the Alternative Resource Plans is shown in Table 32 below

Table 31: Joint-Planning Alternative Resource Plan Naming Convention



**Table 32: Overview of Joint-Planning Resource Plans**

| Plan Name | DSM Level | Cease Burning Coal   | Year to Cease Burning Coal      | Renewable Additions                   |                                         | Generation Addition (if needed)                                             |
|-----------|-----------|----------------------|---------------------------------|---------------------------------------|-----------------------------------------|-----------------------------------------------------------------------------|
| CBBCA     | Option C  | Sibley-1<br>Sibley-2 | 2019                            | Solar:<br>2016 - 8 MW<br>2026 - 12 MW | Wind:<br>2016 - 350 MW<br>2017 - 260 MW | n/n                                                                         |
|           |           | Lake Road 4/6        | 2021<br>(convert to NG in 2016) |                                       |                                         |                                                                             |
| CCCCA     | Option C  | Sibley-1<br>Sibley-2 | 2019                            | Solar:<br>2016 - 8 MW<br>2026 - 12 MW | Wind:<br>2016 - 350 MW<br>2017 - 260 MW | 414 MW CT in 2023<br>207 MW CT in 2033                                      |
|           |           | Lake Road 4/6        | 2021<br>(convert to NG in 2016) |                                       |                                         |                                                                             |
|           |           | LaCygne-1            | 2022                            |                                       |                                         |                                                                             |
|           |           | Sibley-3             | 2023                            |                                       |                                         |                                                                             |
| CCCCB     | Option C  | Sibley-1<br>Sibley-2 | 2019                            | Solar:<br>2016 - 8 MW<br>2026 - 12 MW | Wind:<br>2016 - 350 MW<br>2017 - 260 MW | Add 207 MW<br>Existing CC in 2017<br>207 MW CC in 2023<br>207 MW CC in 2033 |
|           |           | Lake Road 4/6        | 2021<br>(convert to NG in 2016) |                                       |                                         |                                                                             |
|           |           | LaCygne-1            | 2022                            |                                       |                                         |                                                                             |
|           |           | Sibley-3             | 2023                            |                                       |                                         |                                                                             |
| CCCCC     | Option C  | Sibley-1<br>Sibley-2 | 2019                            | Solar:<br>2016 - 8 MW<br>2026 - 12 MW | Wind:<br>2016 - 350 MW<br>2017 - 260 MW | Add 207 MW<br>Existing CC in 2017<br>207 MW CT in 2023<br>207 MW CT in 2033 |
|           |           | Lake Road 4/6        | 2021<br>(convert to NG in 2016) |                                       |                                         |                                                                             |
|           |           | LaCygne-1            | 2022                            |                                       |                                         |                                                                             |
|           |           | Sibley-3             | 2023                            |                                       |                                         |                                                                             |
| CDDCA     | Option C  | Sibley-3             | 2023                            | Solar:<br>2016 - 8 MW<br>2026 - 12 MW | Wind:<br>2016 - 350 MW<br>2017 - 260 MW | 207 MW CT in 2035                                                           |

Revenue requirement results for each of the combined company Alternative Resource Plans are shown in Table 33 below.

**Table 33: Joint-Planning Twenty-Year Net Present Value Revenue Requirement**

| Rank<br>(L-H) | Plan  | NPVRR<br>(\$mm) | Delta |
|---------------|-------|-----------------|-------|
| 1             | CDDCA | \$31,712        | \$0   |
| 2             | CBBCA | \$31,748        | \$37  |
| 3             | CCCCA | \$31,969        | \$257 |
| 4             | CCCCC | \$32,067        | \$355 |
| 5             | CCCCB | \$32,123        | \$411 |

The joint-planning Alternative Resource Plan (ARP), CDDCA, provided the lowest Net Present Value Revenue Requirement (NPVRR). This plan consists of retirement of Sibley-3 by 2023 in addition to Sibley-1, Sibley-2, and Montrose Units 1, 2, and 3. The next lowest NPVRR plan was CBBCA, which is the combination of the KCP&L and GMO Preferred Plans, and consisting of retirement of Lake Road 4/6 by 2021 in addition to Sibley-1, Sibley-2, and Montrose Units 1, 2, and 3. The NPVRR difference between these two plans is \$37 Million over the 20-year planning period out of a total NPVRR of ~\$32 Billion.

Table 34 and Table 35 show the expected value of NPVRR for the joint plans with and without CO<sub>2</sub> restrictions. The “Without” CO<sub>2</sub> restrictions shows the expected value over the nine scenarios that have \$0 CO<sub>2</sub> emission allowance cost. The “With” CO<sub>2</sub> restrictions shows the expected value over the nine scenarios that include the Company’s non-zero CO<sub>2</sub> emission allowance forecast. Under the scenarios with CO<sub>2</sub> restrictions, the plan that includes retirement of Sibley 3 is the lowest cost plan. Under scenarios without CO<sub>2</sub> restrictions, the lowest cost plan includes continued operation at Sibley 3. Given the results of the joint plans, no changes to the GMO or KCP&L Preferred Plans were warranted.

**Table 34: Joint Plan Results With CO<sub>2</sub> Restrictions**

| Total Revenue Requirement - EV 9EPs (CO <sub>2</sub> - YES) |       |              |       |                                 |                                                     |           |
|-------------------------------------------------------------|-------|--------------|-------|---------------------------------|-----------------------------------------------------|-----------|
| Rank (L-H)                                                  | Plan  | NPVRR (\$mm) | Delta | Retirements                     | Additions                                           | DSM level |
| 1                                                           | CDDCA | \$33,088     | \$0   | S-3 2023                        | 207MW CTs in 2035                                   | C         |
| 2                                                           | CBBCA | \$33,220     | \$133 | LR 4/6 2021                     | None                                                | C         |
| 3                                                           | CCCCA | \$33,246     | \$158 | LR 4/6 2021, L-1 2022, S-3 2023 | CTs: 414MW 2023, 207MW 2033                         | C         |
| 4                                                           | CCCCB | \$33,324     | \$236 | LR 4/6 2021, L-1 2022, S-3 2023 | Existing CC 207MW 2017, CCs: 207MW 2023, 207MW 2033 | C         |
| 5                                                           | CCCCC | \$33,335     | \$247 | LR 4/6 2021, L-1 2022, S-3 2023 | Existing CC 207MW 2017, CTs: 207MW 2023, 207MW 2033 | C         |

**Table 35: Joint Plan Results Without CO<sub>2</sub> Restrictions**

| Total Revenue Requirement - EV 9EPs (CO <sub>2</sub> - NO) |       |              |       |                                 |                                                     |           |
|------------------------------------------------------------|-------|--------------|-------|---------------------------------|-----------------------------------------------------|-----------|
| Rank (L-H)                                                 | Plan  | NPVRR (\$mm) | Delta | Retirements                     | Additions                                           | DSM level |
| 1                                                          | CBBCA | \$30,767     | \$0   | LR 4/6 2021                     | None                                                | C         |
| 2                                                          | CDDCA | \$30,794     | \$28  | S-3 2023                        | 207MW CTs in 2035                                   | C         |
| 3                                                          | CCCCA | \$31,118     | \$351 | LR 4/6 2021, L-1 2022, S-3 2023 | CTs: 414MW 2023, 207MW 2033                         | C         |
| 4                                                          | CCCCC | \$31,222     | \$455 | LR 4/6 2021, L-1 2022, S-3 2023 | Existing CC 207MW 2017, CCs: 207MW 2023, 207MW 2033 | C         |
| 5                                                          | CCCCB | \$31,322     | \$555 | LR 4/6 2021, L-1 2022, S-3 2023 | Existing CC 207MW 2017, CCs: 207MW 2023, 207MW 2033 | C         |

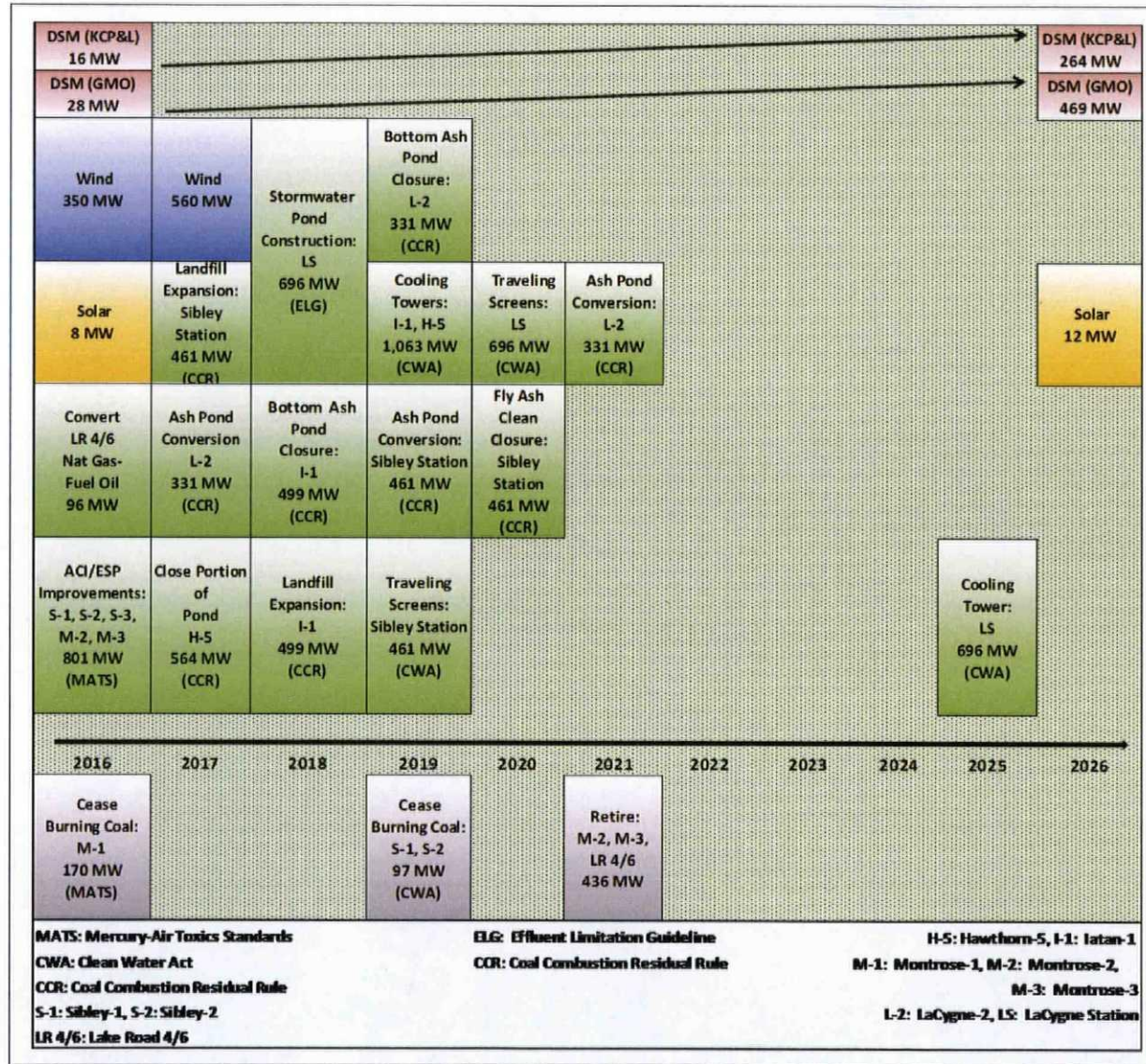
A summary tabulation of the expected value of all performance measures is provided in Table 36 below. Detailed results behind this summary tabulation are attached in Appendix D.

**Table 36: Joint-Planning Expected Value of Performance Measures \*\* Highly Confidential \*\***

| Plan  | NPVRR (\$MM) | Levelized Annual Rates (\$/KW-hr) | Maximum Rate Increase |
|-------|--------------|-----------------------------------|-----------------------|
| CDDCA | 31,712       |                                   |                       |
| CBBCA | 31,748       |                                   |                       |
| CCCCA | 31,969       |                                   |                       |
| CCCCC | 32,067       |                                   |                       |
| CCCCB | 32,123       |                                   |                       |

The Joint-Planning Alternative Resource Plan that reflects the combination of the KCP&L Preferred Plan, KAACA and GMO's Preferred Plan, GBBCA is Alternative Resource Plan CBBCA. This plan is comprised of the following components for years 2016 – 2026 and shown in Figure 5 below. The joint-planning additions shown are equivalent to the stand-alone KCP&L and GMO Alternative Resource Plans, KAACA and GBBCA, respectively.

Figure 5: Joint Planning Alternative Resource Plan CBBCA - 2016 through 2026



The Joint-Planning Alternative Resource Plan for the 20-year planning period is shown in Table 37 below:

**Table 37: Joint-Planning Alternative Resource Plan**

| Year | CT's<br>(MW) | Wind<br>(MW) | Solar<br>(MW) | DSM<br>(MW) | Retire<br>(MW) | Existing<br>Capacity<br>(MW) |
|------|--------------|--------------|---------------|-------------|----------------|------------------------------|
| 2016 | 0            | 350          | 8             | 44          | 170            | 6627                         |
| 2017 | 0            | 560          |               | 109         |                | 6827                         |
| 2018 | 0            |              |               | 179         |                | 6827                         |
| 2019 | 0            |              |               | 241         | 97             | 6741                         |
| 2020 | 0            |              |               | 334         |                | 6775                         |
| 2021 | 0            |              |               | 420         | 436            | 6366                         |
| 2022 | 0            |              |               | 500         |                | 6366                         |
| 2023 | 0            |              |               | 578         |                | 6381                         |
| 2024 | 0            |              |               | 650         |                | 6319                         |
| 2025 | 0            |              |               | 695         |                | 6319                         |
| 2026 | 0            |              | 12            | 733         |                | 6321                         |
| 2027 | 0            |              |               | 763         |                | 6321                         |
| 2028 | 0            |              |               | 793         |                | 6321                         |
| 2029 | 0            |              |               | 822         |                | 6321                         |
| 2030 | 0            |              |               | 847         |                | 6321                         |
| 2031 | 0            |              |               | 867         |                | 6321                         |
| 2032 | 0            |              |               | 886         |                | 6321                         |
| 2033 | 0            |              |               | 905         |                | 6321                         |
| 2034 | 0            |              |               | 924         |                | 6321                         |
| 2035 | 0            |              |               | 939         |                | 6321                         |

## 6.7 JOINT-PLANNING ECONOMIC IMPACT

The economic impact by year of the Joint-Planning Alternative Resource Plan CBBCA is represented in Table 38 below. The economic impact of all plans can be found in Appendix D.

**Table 38: Joint-Planning Alternative Resource Plan - Economic Impact \*\* Highly Confidential \*\***

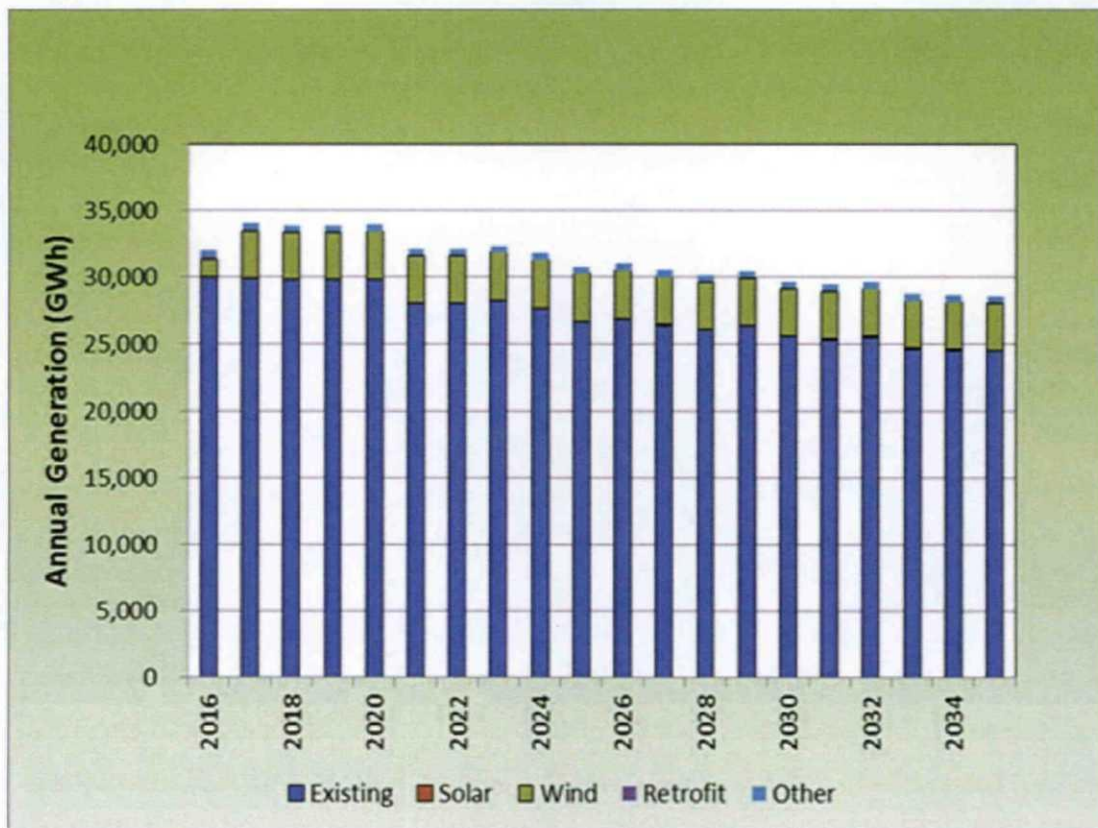
| Year | Revenue Requirement (\$MM) | Levelized Annual Rates (\$/kW-hr) | Rate Increase |
|------|----------------------------|-----------------------------------|---------------|
| 2016 | 2,655                      |                                   |               |
| 2017 | 2,715                      |                                   |               |
| 2018 | 2,787                      |                                   |               |
| 2019 | 2,969                      |                                   |               |
| 2020 | 3,025                      |                                   |               |
| 2021 | 3,080                      |                                   |               |
| 2022 | 3,170                      |                                   |               |
| 2023 | 3,235                      |                                   |               |
| 2024 | 3,290                      |                                   |               |
| 2025 | 3,380                      |                                   |               |
| 2026 | 3,423                      |                                   |               |
| 2027 | 3,498                      |                                   |               |
| 2028 | 3,534                      |                                   |               |
| 2029 | 3,579                      |                                   |               |
| 2030 | 3,652                      |                                   |               |
| 2031 | 3,693                      |                                   |               |
| 2032 | 3,762                      |                                   |               |
| 2033 | 3,864                      |                                   |               |
| 2034 | 3,917                      |                                   |               |
| 2035 | 3,993                      |                                   |               |

## 6.8 JOINT-PLANNING ANNUAL GENERATION

The expected value of annual generation of the Joint-Planning Alternative Resource Plan CBBCA is represented in Table 39 below. The annual generation of all Joint-Planning plans can be found in Appendix C, Generation and Emissions for Each Alternative Resource Plan.

**Table 39: Joint-Planning Alternative Resource Plan CBBCA**

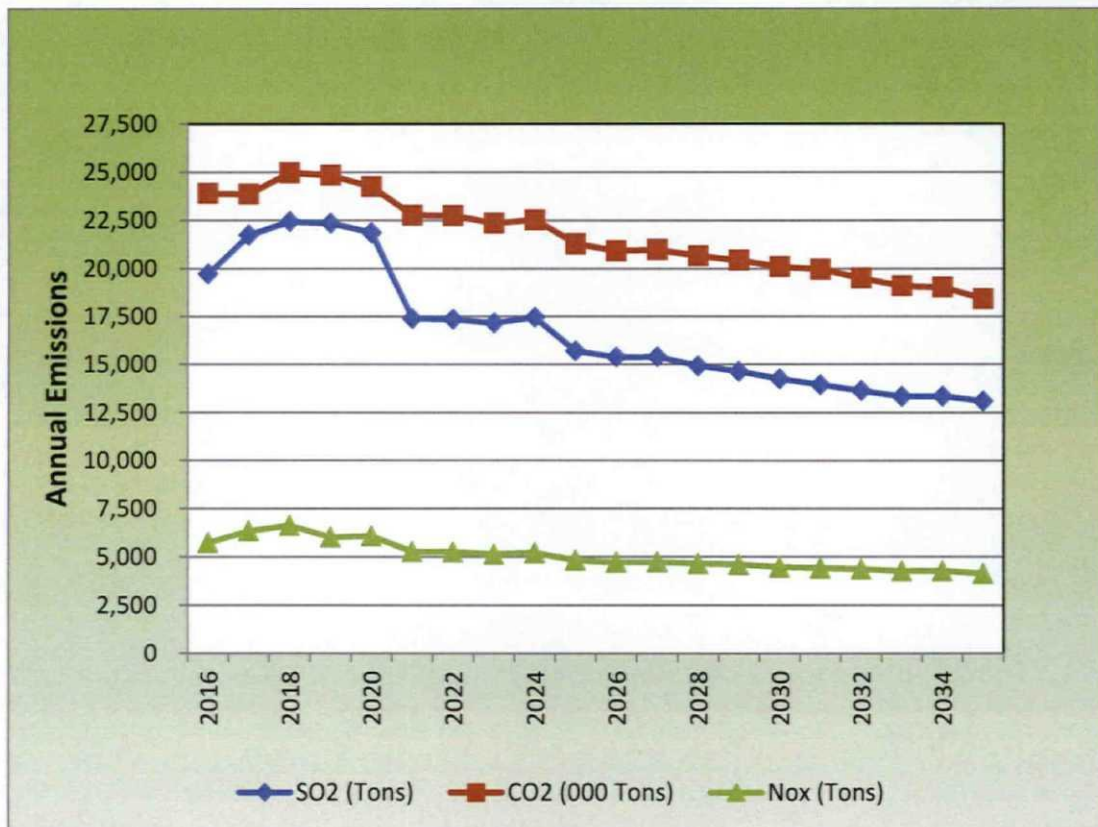
**Annual Generation**



## 6.9 JOINT-PLANNING ANNUAL EMISSIONS

The expected values of annual emissions of the Joint-Planning Alternative Resource Plan CBBCA are represented in Table 40 below. The annual emissions of all Joint-Planning plans can be found in Appendix C.

**Table 40: Joint-Planning Alternative Resource Plan CBBCA Annual Emissions**



## SECTION 7: RESOURCE ACQUISITION STRATEGY

### 7.1 2016 ANNUAL UPDATE PREFERRED PLAN

The 2016 Annual Update Preferred Plan for the 20-year planning period is shown in Table 41 below:

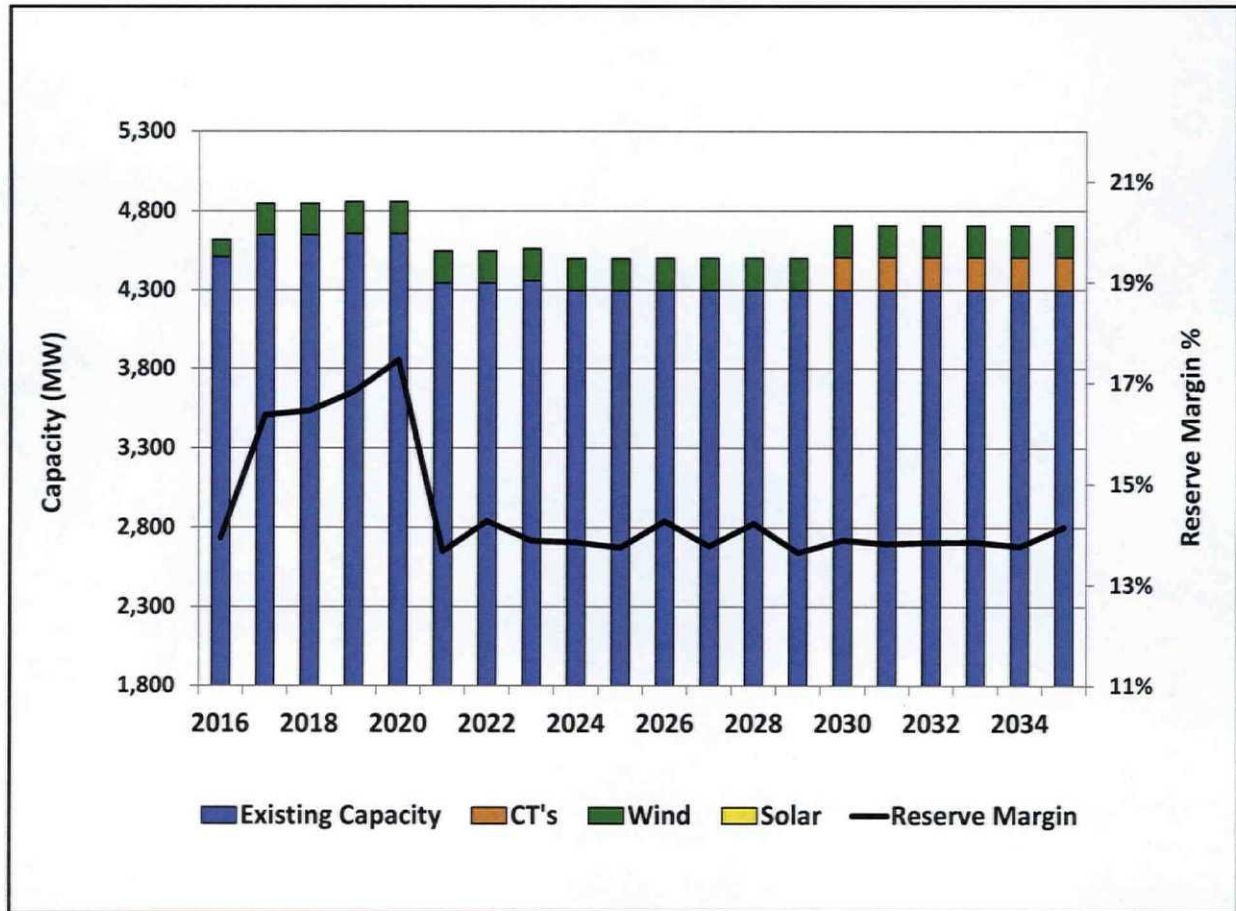
**Table 41: 2016 Annual Update Preferred Plan**

| Year | CT's<br>(MW) | Wind<br>(MW) | Solar<br>(MW) | DSM<br>(MW) | Retire<br>(MW) | Existing<br>Capacity<br>(MW) |
|------|--------------|--------------|---------------|-------------|----------------|------------------------------|
| 2016 | 0            | 350          | 3             | 16          | 170            | 4506                         |
| 2017 | 0            | 300          |               | 43          |                | 4644                         |
| 2018 | 0            |              |               | 79          |                | 4644                         |
| 2019 | 0            |              |               | 105         |                | 4654                         |
| 2020 | 0            |              |               | 142         |                | 4654                         |
| 2021 | 0            |              |               | 171         | 340            | 4341                         |
| 2022 | 0            |              |               | 193         |                | 4341                         |
| 2023 | 0            |              |               | 214         |                | 4356                         |
| 2024 | 0            |              |               | 231         |                | 4295                         |
| 2025 | 0            |              |               | 249         |                | 4295                         |
| 2026 | 0            |              | 7             | 264         |                | 4296                         |
| 2027 | 0            |              |               | 273         |                | 4296                         |
| 2028 | 0            |              |               | 281         |                | 4296                         |
| 2029 | 0            |              |               | 289         |                | 4296                         |
| 2030 | 207          |              |               | 298         |                | 4296                         |
| 2031 | 0            |              |               | 301         |                | 4296                         |
| 2032 | 0            |              |               | 305         |                | 4296                         |
| 2033 | 0            |              |               | 309         |                | 4296                         |
| 2034 | 0            |              |               | 313         |                | 4296                         |
| 2035 | 0            |              |               | 315         |                | 4296                         |

### 7.1.1 PREFERRED PLAN COMPOSITION

Existing and new capacity additions for the 2016 Annual Update Preferred Plan are shown in Table 42 below:

**Table 42: Preferred Plan Capacity Additions**



Based upon current RPS rule requirements, the Preferred Plan includes 10 MW of solar additions. The 350 MW wind resource addition in 2016 is comprised of two wind facilities that are in commercial operation. An additional 300 MW of wind is planned for 2017. A 207 MW combustion turbine (CT) resource addition is currently anticipated in 2030.

### 7.1.2 PREFERRED PLAN ECONOMIC IMPACT

The expected value of economic impact by year of the Preferred Plan is represented in Table 43 below. The economic impact of all plans can be found in Appendix D.

**Table 43: Preferred Plan Economic Impact \*\* Highly Confidential \*\***

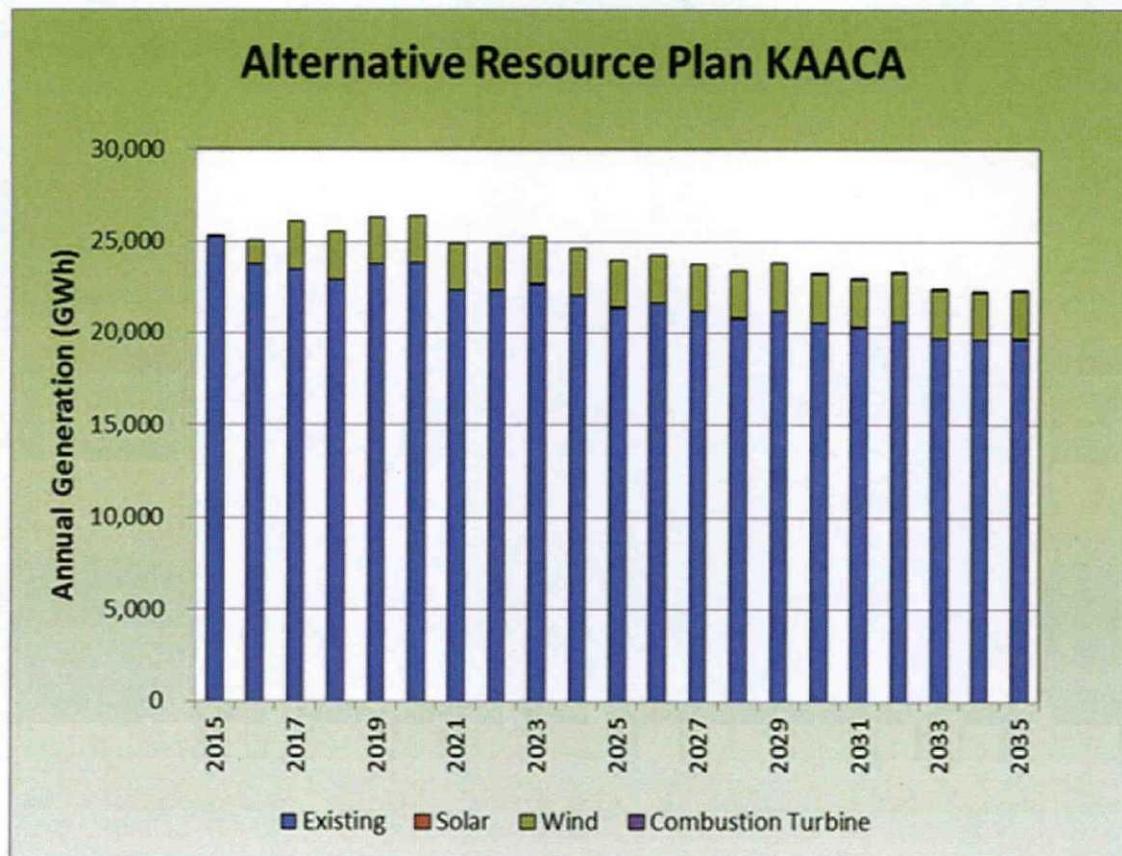
| Year | Revenue Requirement (\$MM) | Levelized Annual Rates (\$/kW-hr) | Rate Increase |
|------|----------------------------|-----------------------------------|---------------|
| 2016 | 1,812                      |                                   |               |
| 2017 | 1,860                      |                                   |               |
| 2018 | 1,911                      |                                   |               |
| 2019 | 2,021                      |                                   |               |
| 2020 | 2,052                      |                                   |               |
| 2021 | 2,091                      |                                   |               |
| 2022 | 2,144                      |                                   |               |
| 2023 | 2,161                      |                                   |               |
| 2024 | 2,194                      |                                   |               |
| 2025 | 2,266                      |                                   |               |
| 2026 | 2,285                      |                                   |               |
| 2027 | 2,342                      |                                   |               |
| 2028 | 2,374                      |                                   |               |
| 2029 | 2,387                      |                                   |               |
| 2030 | 2,484                      |                                   |               |
| 2031 | 2,507                      |                                   |               |
| 2032 | 2,531                      |                                   |               |
| 2033 | 2,605                      |                                   |               |
| 2034 | 2,646                      |                                   |               |
| 2035 | 2,680                      |                                   |               |

### 7.1.3 PREFERRED PLAN ANNUAL GENERATION

The expected value of annual generation for the Preferred Plan is shown in Table 44 below.

The annual generation for all plans is included in Appendix C.

**Table 44: Preferred Plan Annual Generation**

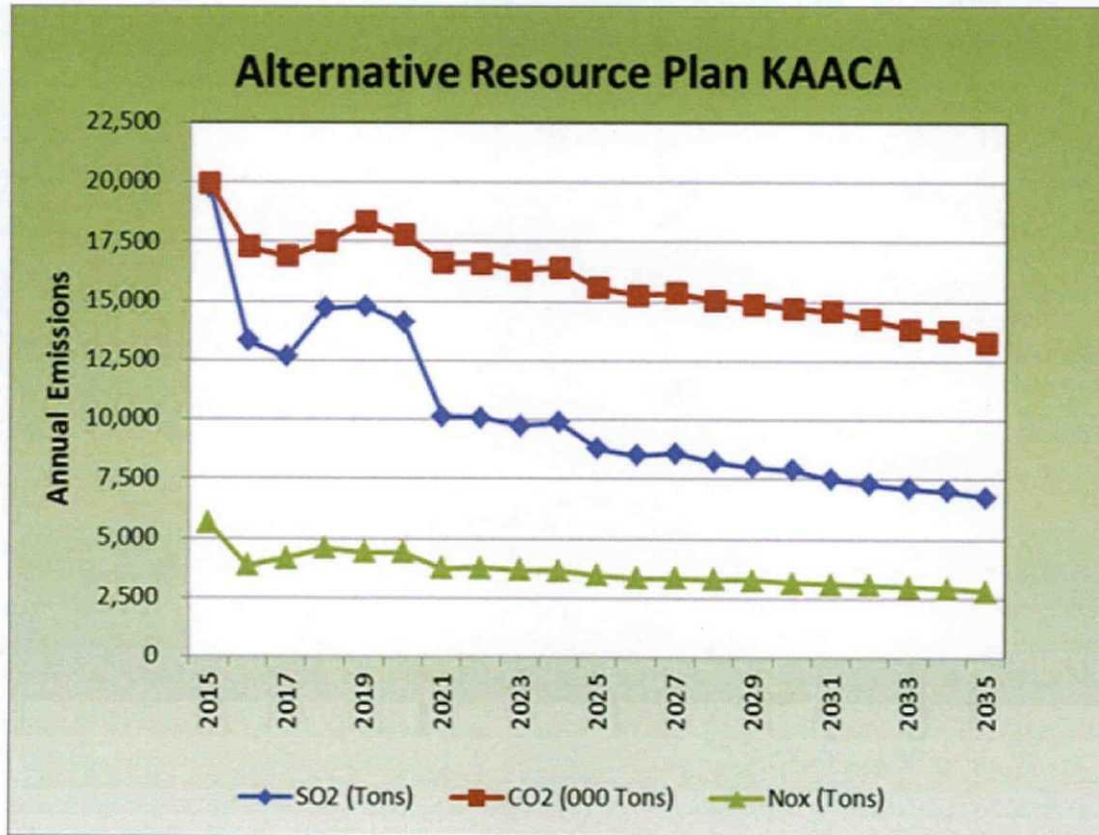


#### 7.1.4 PREFERRED PLAN ANNUAL EMISSIONS

The expected value of annual emissions for the Preferred Plan are shown in Table 45 below.

The annual generation for all plans is included in Appendix C.

Table 45: Preferred Plan Annual Emissions



### **7.1.5 PREFERRED PLAN DISCUSSION**

The Preferred Plan was not the lowest cost plan from a Net Present Value of Revenue Requirement (NPVRR) perspective. One Alternative Resource Plan (ARP), KAACS, had a slightly lower NPVRR than the Preferred Plan. This ARP varies from the Preferred Plan KAACA by excluding the 10 MW of commercial solar additions that the Preferred Plan includes. Because KCP&L feels it is prudent to further diversify its generation portfolio for compliance of future federal environmental regulations, as well as gain operational experience in solar generation technology, the Preferred Plan includes 10 MW of commercial solar additions has been selected.

The Preferred Plan also meets the fundamental planning objectives as required by Rule 22.010(2) to provide the public with energy services that are safe, reliable, and efficient, at just and reasonable rates, in compliance with all legal mandates, and in a manner that serves the public interest and is consistent with state energy and environmental policies.

## 7.2 CRITICAL UNCERTAIN FACTORS

The Critical Uncertain Factors for the 2016 Annual Update are identical to those in the 2015 Triennial IRP. The Company determined three risks to be critical uncertain factors that would be used in the risk sensitivities of the integrated analysis; load growth, natural gas prices and CO<sub>2</sub> credit prices. The probabilities for both load growth and natural gas are the same as used on all filings since the 2012 Triennial IRP – with Mid 50% and High and Low states at 25% weighted probabilities. For CO<sub>2</sub>, the decision states are now modeled as a 40% probability there will be a CO<sub>2</sub> credit market and 60% probability that no CO<sub>2</sub> credit market will exist. The weighted endpoint probability is the product these three weighted probabilities

The Critical Uncertain Factors identified were incorporated into a decision tree representation of the risks that will impact the performance of the alternative resource plans. A graphical representation of the decision tree risks is provided in Figure 6 below:

**Figure 6: Critical Uncertain Factors With Decision Tree Probabilities**

| Endpoint | Load Growth | Natural Gas | CO <sub>2</sub> | Endpoint Probability |
|----------|-------------|-------------|-----------------|----------------------|
| 1        | High        | High        | Yes             | 2.5%                 |
| 2        | High        | High        | No              | 3.8%                 |
| 3        | High        | Mid         | Yes             | 5.0%                 |
| 4        | High        | Mid         | No              | 7.5%                 |
| 5        | High        | Low         | Yes             | 2.5%                 |
| 6        | High        | Low         | No              | 3.8%                 |
| 7        | Mid         | High        | Yes             | 5.0%                 |
| 8        | Mid         | High        | No              | 7.5%                 |
| 9        | Mid         | Mid         | Yes             | 10.0%                |
| 10       | Mid         | Mid         | No              | 15.0%                |
| 11       | Mid         | Low         | Yes             | 5.0%                 |
| 12       | Mid         | Low         | No              | 7.5%                 |
| 13       | Low         | High        | Yes             | 2.5%                 |
| 14       | Low         | High        | No              | 3.8%                 |
| 15       | Low         | Mid         | Yes             | 5.0%                 |
| 16       | Low         | Mid         | No              | 7.5%                 |
| 17       | Low         | Low         | Yes             | 2.5%                 |
| 18       | Low         | Low         | No              | 3.8%                 |

The company performed an analysis to address the impact of the critical uncertain factors on Preferred Plan selection. This analysis ranks how plans perform relative to the representation of the eighteen endpoint tree. The results of the analysis are represented in the following tables.

### 7.2.1 CRITICAL UNCERTAIN FACTOR – HIGH LOAD GROWTH

| HIGH LOAD GROWTH |            |        |            |          |            |        |            |           |            |        |            |          |            |        |            |           |            |        |            |          |  |  |  |
|------------------|------------|--------|------------|----------|------------|--------|------------|-----------|------------|--------|------------|----------|------------|--------|------------|-----------|------------|--------|------------|----------|--|--|--|
| CO2 - Yes        |            |        |            | CO2 - No |            |        |            | CO2 - Yes |            |        |            | CO2 - No |            |        |            | CO2 - Yes |            |        |            | CO2 - No |  |  |  |
| HIGH GAS         | Endpoint 1 |        | Endpoint 2 |          | Endpoint 3 |        | Endpoint 4 |           | Endpoint 5 |        | Endpoint 6 |          | Endpoint 5 |        | Endpoint 6 |           | Endpoint 5 |        | Endpoint 6 |          |  |  |  |
|                  | PLAN       | NPVRR  | PLAN       | NPVRR    | PLAN       | NPVRR  | PLAN       | NPVRR     | PLAN       | NPVRR  | PLAN       | NPVRR    | PLAN       | NPVRR  | PLAN       | NPVRR     | PLAN       | NPVRR  | PLAN       | NPVRR    |  |  |  |
|                  | KBBBA      | 22,510 | KAACS      | 20,827   | KBBBA      | 22,798 | KAACS      | 21,168    | KBBBA      | 23,009 | KAACS      | 21,479   | KBBBA      | 23,009 | KAACS      | 21,479    | KBBBA      | 23,009 | KAACS      | 21,479   |  |  |  |
|                  | KAABA      | 22,549 | KAACA      | 20,828   | KAACS      | 22,868 | KAACA      | 21,170    | KAACS      | 23,071 | KAACA      | 21,481   | KAACS      | 23,071 | KAACA      | 21,481    | KAACS      | 23,071 | KAACA      | 21,481   |  |  |  |
|                  | KAACB      | 22,569 | KAACB      | 20,886   | KAACA      | 22,869 | KAACB      | 21,244    | KAACA      | 23,072 | KAACB      | 21,572   | KAACA      | 23,072 | KAACB      | 21,572    | KAACA      | 23,072 | KAACB      | 21,572   |  |  |  |
|                  | KAACS      | 22,575 | KAABA      | 20,895   | KAABA      | 22,874 | KAABA      | 21,269    | KAACB      | 23,099 | KAADA      | 21,598   | KAACB      | 23,099 | KAADA      | 21,598    | KAACB      | 23,099 | KAADA      | 21,598   |  |  |  |
|                  | KAACA      | 22,575 | KAADA      | 20,986   | KAACB      | 22,878 | KAADA      | 21,308    | KAABA      | 23,113 | KAABA      | 21,615   | KAABA      | 23,113 | KAABA      | 21,615    | KAABA      | 23,113 | KAABA      | 21,615   |  |  |  |
|                  | KAADA      | 22,789 | KBBBA      | 21,033   | KBBCC      | 23,022 | KAACW      | 21,349    | KBBCC      | 23,176 | KAACW      | 21,625   | KBBCC      | 23,176 | KAACW      | 21,625    | KBBCC      | 23,176 | KAACW      | 21,625   |  |  |  |
|                  | KBBCC      | 22,794 | KAACW      | 21,041   | KBBCA      | 23,049 | KBBBA      | 21,360    | KBBCA      | 23,221 | KBBBA      | 21,654   | KBBCA      | 23,221 | KBBBA      | 21,654    | KBBCA      | 23,221 | KBBBA      | 21,654   |  |  |  |
|                  | KBBCA      | 22,796 | KBBCA      | 21,233   | KAADA      | 23,064 | KBBCA      | 21,523    | KAADA      | 23,244 | KBBCA      | 21,779   | KAADA      | 23,244 | KBBCA      | 21,779    | KAADA      | 23,244 | KBBCA      | 21,779   |  |  |  |
|                  | KAACW      | 22,883 | KBBCC      | 21,418   | KAACW      | 23,144 | KBBCC      | 21,702    | KAACW      | 23,309 | KBBCC      | 21,954   | KAACW      | 23,309 | KBBCC      | 21,954    | KAACW      | 23,309 | KBBCC      | 21,954   |  |  |  |
|                  | KAAAA      | 23,989 | KAAAA      | 22,397   | KAAAA      | 24,342 | KAAAA      | 22,802    | KAAAA      | 24,608 | KAAAA      | 23,179   | KAAAA      | 24,608 | KAAAA      | 23,179    | KAAAA      | 24,608 | KAAAA      | 23,179   |  |  |  |

### 7.2.2 CRITICAL UNCERTAIN FACTOR – LOW LOAD GROWTH

| LOW LOAD GROWTH |        |             |        |             |       |             |       |         |             |       |             |       |             |       |             |        |         |           |       |       |        |          |        |  |  |
|-----------------|--------|-------------|--------|-------------|-------|-------------|-------|---------|-------------|-------|-------------|-------|-------------|-------|-------------|--------|---------|-----------|-------|-------|--------|----------|--------|--|--|
| CO2 - Yes       |        |             |        | CO2 - No    |       |             |       | MID GAS | CO2 - Yes   |       |             |       | CO2 - No    |       |             |        | LOW GAS | CO2 - Yes |       |       |        | CO2 - No |        |  |  |
| Endpoint 13     |        | Endpoint 14 |        | Endpoint 15 |       | Endpoint 16 |       |         | Endpoint 17 |       | Endpoint 18 |       | Endpoint 19 |       | Endpoint 20 |        |         |           |       |       |        |          |        |  |  |
| PLAN            | NPVRR  | PLAN        | NPVRR  | PLAN        | NPVRR | PLAN        | NPVRR |         | PLAN        | NPVRR | PLAN        | NPVRR | PLAN        | NPVRR | PLAN        | NPVRR  |         | PLAN      | NPVRR | PLAN  | NPVRR  |          |        |  |  |
| KBBBA           | 21,620 | KAACS       | 20,125 | KBBBA       | KBBBA | 21,960      | KAACS | 20,517  | KBBBA       | KBBBA | 22,227      | KAACS | 20,882      | KBBBA | KBBBA       | 22,227 | KAACS   | 20,882    | KBBBA | KBBBA | 22,227 | KAACS    | 20,882 |  |  |
| KAABA           | 21,669 | KAACA       | 20,127 |             | KAACS | 22,031      | KAACA | 20,520  |             | KAACS | 22,288      | KAACA | 20,885      |       | KAACS       | 22,288 | KAACA   | 20,885    |       | KAACS | 22,288 | KAACA    | 20,885 |  |  |
| KAACB           | 21,686 | KAACB       | 20,201 |             | KAACA | 22,032      | KAACB | 20,607  |             | KAACA | 22,289      | KAACB | 20,986      |       | KAACA       | 22,289 | KAACB   | 20,986    |       | KAACA | 22,289 | KAACB    | 20,986 |  |  |
| KAACS           | 21,687 | KAABA       | 20,217 |             | KAABA | 22,043      | KAABA | 20,638  |             | KAACB | 22,319      | KAADA | 20,995      |       | KAACB       | 22,319 | KAADA   | 20,995    |       | KAABA | 22,334 | KAACW    | 21,016 |  |  |
| KAACA           | 21,687 | KAADA       | 20,275 |             | KAACB | 22,044      | KAADA | 20,649  |             | KAABA | 22,334      | KAACW | 21,016      |       | KAABA       | 22,334 | KAACW   | 21,016    |       | KBBCC | 22,398 | KAABA    | 21,034 |  |  |
| KAADA           | 21,900 | KBBBA       | 20,314 |             | KBBCC | 22,190      | KAACW | 20,681  |             | KBBCC | 22,398      | KAABA | 21,034      |       | KBBCC       | 22,398 | KAABA   | 21,034    |       | KBBCA | 22,437 | KBBBA    | 21,046 |  |  |
| KBBCA           | 21,901 | KAACW       | 20,318 |             | KBBCA | 22,209      | KBBBA | 20,694  |             | KBBCA | 22,437      | KBBBA | 21,046      |       | KBBCA       | 22,437 | KBBBA   | 21,046    |       | KAADA | 22,461 | KBBCA    | 21,164 |  |  |
| KBBCC           | 21,911 | KBBCA       | 20,501 |             | KAADA | 22,226      | KBBCA | 20,848  |             | KAADA | 22,461      | KBBCA | 21,164      |       | KAADA       | 22,461 | KBBCA   | 21,164    |       | KAACW | 22,523 | KBBCC    | 21,350 |  |  |
| KAACW           | 21,987 | KBBCC       | 20,693 |             | KAACW | 22,301      | KBBCC | 21,035  |             | KAACW | 22,523      | KBBCC | 21,350      |       | KAACW       | 22,523 | KBBCC   | 21,350    |       | KAAAA | 23,831 | KAAAA    | 22,632 |  |  |
| KAAAA           | 23,121 | KAAAA       | 21,772 |             | KAAAA | 23,519      | KAAAA | 22,214  |             | KAAAA | 23,831      | KAAAA | 22,632      |       | KAAAA       | 23,831 | KAAAA   | 22,632    |       |       |        |          |        |  |  |

### 7.2.3 CRITICAL UNCERTAIN FACTOR – HIGH NATURAL GAS PRICES

| HIGH NATURAL GAS PRICES |        |            |        |          |            |        |            |           |          |             |        |             |        |  |  |
|-------------------------|--------|------------|--------|----------|------------|--------|------------|-----------|----------|-------------|--------|-------------|--------|--|--|
| CO2 - Yes               |        |            |        | CO2 - No |            |        |            | CO2 - Yes |          |             |        | CO2 - No    |        |  |  |
| Endpoint 1              |        | Endpoint 2 |        | MID LOAD | Endpoint 7 |        | Endpoint 8 |           | LOW LOAD | Endpoint 13 |        | Endpoint 14 |        |  |  |
| PLAN                    | NPVRR  | PLAN       | NPVRR  |          | PLAN       | NPVRR  | PLAN       | NPVRR     |          | PLAN        | NPVRR  | PLAN        | NPVRR  |  |  |
| KBBBA                   | 22,510 | KAACS      | 20,827 |          | KBBBA      | 22,044 | KAACS      | 20,456    |          | KBBBA       | 21,620 | KAACS       | 20,125 |  |  |
| KAABA                   | 22,549 | KAACA      | 20,828 |          | KAABA      | 22,087 | KAACA      | 20,458    |          | KAABA       | 21,669 | KAACA       | 20,127 |  |  |
| KAACB                   | 22,569 | KAACB      | 20,886 |          | KAACB      | 22,106 | KAACB      | 20,523    |          | KAACB       | 21,686 | KAACB       | 20,201 |  |  |
| KAACS                   | 22,575 | KAABA      | 20,895 |          | KAACS      | 22,110 | KAABA      | 20,534    |          | KAACS       | 21,687 | KAABA       | 20,217 |  |  |
| KAACA                   | 22,575 | KAADA      | 20,986 |          | KAACA      | 22,110 | KAADA      | 20,611    |          | KAACA       | 21,687 | KAADA       | 20,275 |  |  |
| KAADA                   | 22,789 | KBBBA      | 21,033 |          | KAADA      | 22,324 | KBBBA      | 20,655    |          | KAADA       | 21,900 | KBBBA       | 20,314 |  |  |
| KBBCC                   | 22,794 | KAACW      | 21,041 |          | KBBCA      | 22,327 | KAACW      | 20,661    |          | KBBCA       | 21,901 | KAACW       | 20,318 |  |  |
| KBBCA                   | 22,796 | KBBCA      | 21,233 |          | KBBCC      | 22,331 | KBBCA      | 20,849    |          | KBBCC       | 21,911 | KBBCA       | 20,501 |  |  |
| KAACW                   | 22,883 | KBBCC      | 21,418 | KAACW    | 22,414     | KBBCC  | 21,037     | KAACW     | 21,987   | KBBCC       | 20,693 |             |        |  |  |
| KAAAA                   | 23,989 | KAAAA      | 22,397 | KAAAA    | 23,531     | KAAAA  | 22,058     | KAAAA     | 23,121   | KAAAA       | 21,772 |             |        |  |  |

#### 7.2.4 CRITICAL UNCERTAIN FACTOR – LOW NATURAL GAS PRICES

| LOW NATURAL GAS PRICES |        |       |        |            |       |        |       |             |          |       |        |             |        |          |       |             |       |        |          |             |        |       |        |
|------------------------|--------|-------|--------|------------|-------|--------|-------|-------------|----------|-------|--------|-------------|--------|----------|-------|-------------|-------|--------|----------|-------------|--------|-------|--------|
| CO2 - Yes              |        |       |        | CO2 - No   |       |        |       | CO2 - Yes   |          |       |        | CO2 - No    |        |          |       |             |       |        |          |             |        |       |        |
| Endpoint 5             |        |       |        | Endpoint 6 |       |        |       | Endpoint 11 |          |       |        | Endpoint 12 |        |          |       | Endpoint 17 |       |        |          | Endpoint 18 |        |       |        |
| PLAN                   |        | NPVRR |        | PLAN       |       | NPVRR  |       | PLAN        |          | NPVRR |        | PLAN        |        | NPVRR    |       | PLAN        |       | NPVRR  |          | PLAN        |        | NPVRR |        |
| KBBBA                  | 23,009 | KAACS | 21,479 | MID LOAD   | KBBBA | 22,600 | KAACS | 21,164      | LOW LOAD | KBBBA | 22,227 | KAACS       | 20,882 | LOW LOAD | KBBBA | 22,227      | KAACS | 20,882 | LOW LOAD | KBBBA       | 22,227 | KAACS | 20,882 |
| KAACS                  | 23,071 | KAACA | 21,481 |            | KAACS | 22,661 | KAACA | 21,167      |          | KAACS | 22,288 | KAACA       | 20,885 |          | KAACS | 22,288      | KAACA | 20,885 |          | KAACS       | 22,288 | KAACA | 20,885 |
| KAACA                  | 23,072 | KAACB | 21,572 |            | KAACA | 22,663 | KAACB | 21,262      |          | KAACA | 22,289 | KAACB       | 20,986 |          | KAACA | 22,289      | KAACB | 20,986 |          | KAACA       | 22,289 | KAACB | 20,986 |
| KAACB                  | 23,099 | KAADA | 21,598 |            | KAACB | 22,691 | KAADA | 21,280      |          | KAACB | 22,319 | KAADA       | 20,995 |          | KAACB | 22,319      | KAADA | 20,995 |          | KAACB       | 22,319 | KAADA | 20,995 |
| KAABA                  | 23,113 | KAABA | 21,615 |            | KAABA | 22,705 | KAACW | 21,305      |          | KAABA | 22,334 | KAACW       | 21,016 |          | KAABA | 22,334      | KAACW | 21,016 |          | KAABA       | 22,334 | KAACW | 21,016 |
| KBBCC                  | 23,176 | KAACW | 21,625 |            | KBBCC | 22,768 | KAABA | 21,307      |          | KBBCC | 22,398 | KAABA       | 21,034 |          | KBBCC | 22,398      | KAABA | 21,034 |          | KBBCC       | 22,398 | KAABA | 21,034 |
| KBBCA                  | 23,221 | KBBBA | 21,654 |            | KBBCA | 22,811 | KBBBA | 21,334      |          | KBBCA | 22,437 | KBBBA       | 21,046 |          | KBBCA | 22,437      | KBBBA | 21,046 |          | KBBCA       | 22,437 | KBBBA | 21,046 |
| KAADA                  | 23,244 | KBBCA | 21,779 |            | KAADA | 22,834 | KBBCA | 21,456      |          | KAADA | 22,461 | KBBCA       | 21,164 |          | KAADA | 22,461      | KBBCA | 21,164 |          | KAADA       | 22,461 | KBBCA | 21,164 |
| KAACW                  | 23,309 | KBBCC | 21,954 |            | KAACW | 22,898 | KBBCC | 21,636      |          | KAACW | 22,523 | KBBCC       | 21,350 |          | KAACW | 22,523      | KBBCC | 21,350 |          | KAACW       | 22,523 | KBBCC | 21,350 |
| KAAAA                  | 24,608 | KAAAA | 23,179 |            | KAAAA | 24,200 | KAAAA | 22,884      |          | KAAAA | 23,831 | KAAAA       | 22,632 |          | KAAAA | 23,831      | KAAAA | 22,632 |          | KAAAA       | 23,831 | KAAAA | 22,632 |

## 7.2.5 CRITICAL UNCERTAIN FACTOR –CO<sub>2</sub> - YES

| CO2 CREDIT PRICES - Yes |            |        |            |        |            |         |          |            |        |            |        |             |        |          |             |        |             |        |             |        |
|-------------------------|------------|--------|------------|--------|------------|---------|----------|------------|--------|------------|--------|-------------|--------|----------|-------------|--------|-------------|--------|-------------|--------|
| HIGH GAS                |            |        |            |        |            | MID GAS |          |            |        |            |        | LOW GAS     |        |          |             |        |             |        |             |        |
| HIGH LOAD               | Endpoint 1 |        | Endpoint 3 |        | Endpoint 5 |         | MID LOAD | Endpoint 7 |        | Endpoint 9 |        | Endpoint 11 |        | LOW LOAD | Endpoint 13 |        | Endpoint 15 |        | Endpoint 17 |        |
|                         | PLAN       | NPVRR  | PLAN       | NPVRR  | PLAN       | NPVRR   |          | PLAN       | NPVRR  | PLAN       | NPVRR  | PLAN        | NPVRR  |          | PLAN        | NPVRR  | PLAN        | NPVRR  | PLAN        | NPVRR  |
|                         | KBBBA      | 22,510 | KBBBA      | 22,798 | KBBBA      | 23,009  |          | KBBBA      | 22,044 | KBBBA      | 22,359 | KBBBA       | 22,600 |          | KBBBA       | 21,620 | KBBBA       | 21,960 | KBBBA       | 22,227 |
|                         | KAABA      | 22,549 | KAACS      | 22,868 | KAACS      | 23,071  |          | KAABA      | 22,087 | KAACS      | 22,429 | KAACS       | 22,661 |          | KAABA       | 21,669 | KAACS       | 22,031 | KAACS       | 22,288 |
|                         | KAACB      | 22,569 | KAACA      | 22,869 | KAACA      | 23,072  |          | KAACB      | 22,106 | KAACA      | 22,430 | KAACA       | 22,663 |          | KAACB       | 21,686 | KAACA       | 22,032 | KAACA       | 22,289 |
|                         | KAACS      | 22,575 | KAABA      | 22,874 | KAACB      | 23,099  |          | KAACS      | 22,110 | KAABA      | 22,439 | KAACB       | 22,691 |          | KAACS       | 21,687 | KAABA       | 22,043 | KAACB       | 22,319 |
|                         | KAACA      | 22,575 | KAACB      | 22,878 | KAABA      | 23,113  |          | KAACA      | 22,110 | KAACB      | 22,441 | KAABA       | 22,705 |          | KAACA       | 21,687 | KAACB       | 22,044 | KAABA       | 22,334 |
|                         | KAADA      | 22,789 | KBBCC      | 23,022 | KBBCC      | 23,176  |          | KAADA      | 22,324 | KBBCC      | 22,585 | KBBCC       | 22,768 |          | KAADA       | 21,900 | KBBCC       | 22,190 | KBBCC       | 22,398 |
|                         | KBBCC      | 22,794 | KBBCA      | 23,049 | KBBCA      | 23,221  |          | KBBCA      | 22,327 | KBBCA      | 22,609 | KBBCA       | 22,811 |          | KBBCA       | 21,901 | KBBCA       | 22,209 | KBBCA       | 22,437 |
|                         | KBBCA      | 22,796 | KAADA      | 23,064 | KAADA      | 23,244  |          | KBBCA      | 22,327 | KBBCA      | 22,609 | KBBCA       | 22,811 |          | KBBCA       | 21,901 | KBBCA       | 22,209 | KBBCA       | 22,437 |
| HIGH LOAD               | Endpoint 1 |        | Endpoint 3 |        | Endpoint 5 |         | MID LOAD | Endpoint 7 |        | Endpoint 9 |        | Endpoint 11 |        | LOW LOAD | Endpoint 13 |        | Endpoint 15 |        | Endpoint 17 |        |
|                         | PLAN       | NPVRR  | PLAN       | NPVRR  | PLAN       | NPVRR   |          | PLAN       | NPVRR  | PLAN       | NPVRR  | PLAN        | NPVRR  |          | PLAN        | NPVRR  | PLAN        | NPVRR  | PLAN        | NPVRR  |
|                         | KBBBA      | 22,510 | KBBBA      | 22,798 | KBBBA      | 23,009  |          | KBBBA      | 22,044 | KBBBA      | 22,359 | KBBBA       | 22,600 |          | KBBBA       | 21,620 | KBBBA       | 21,960 | KBBBA       | 22,227 |
|                         | KAABA      | 22,549 | KAACS      | 22,868 | KAACS      | 23,071  |          | KAABA      | 22,087 | KAACS      | 22,429 | KAACS       | 22,661 |          | KAABA       | 21,669 | KAACS       | 22,031 | KAACS       | 22,288 |
| HIGH LOAD               | Endpoint 1 |        | Endpoint 3 |        | Endpoint 5 |         | MID LOAD | Endpoint 7 |        | Endpoint 9 |        | Endpoint 11 |        | LOW LOAD | Endpoint 13 |        | Endpoint 15 |        | Endpoint 17 |        |
|                         | PLAN       | NPVRR  | PLAN       | NPVRR  | PLAN       | NPVRR   |          | PLAN       | NPVRR  | PLAN       | NPVRR  | PLAN        | NPVRR  |          | PLAN        | NPVRR  | PLAN        | NPVRR  | PLAN        | NPVRR  |
|                         | KBBBA      | 22,510 | KBBBA      | 22,798 | KBBBA      | 23,009  |          | KBBBA      | 22,044 | KBBBA      | 22,359 | KBBBA       | 22,600 |          | KBBBA       | 21,620 | KBBBA       | 21,960 | KBBBA       | 22,227 |
|                         | KAABA      | 22,549 | KAACS      | 22,868 | KAACS      | 23,071  |          | KAABA      | 22,087 | KAACS      | 22,429 | KAACS       | 22,661 |          | KAABA       | 21,669 | KAACS       | 22,031 | KAACS       | 22,288 |
| HIGH LOAD               | Endpoint 1 |        | Endpoint 3 |        | Endpoint 5 |         | MID LOAD | Endpoint 7 |        | Endpoint 9 |        | Endpoint 11 |        | LOW LOAD | Endpoint 13 |        | Endpoint 15 |        | Endpoint 17 |        |
|                         | PLAN       | NPVRR  | PLAN       | NPVRR  | PLAN       | NPVRR   |          | PLAN       | NPVRR  | PLAN       | NPVRR  | PLAN        | NPVRR  |          | PLAN        | NPVRR  | PLAN        | NPVRR  | PLAN        | NPVRR  |
|                         | KBBBA      | 22,510 | KBBBA      | 22,798 | KBBBA      | 23,009  |          | KBBBA      | 22,044 | KBBBA      | 22,359 | KBBBA       | 22,600 |          | KBBBA       | 21,620 | KBBBA       | 21,960 | KBBBA       | 22,227 |
|                         | KAABA      | 22,549 | KAACS      | 22,868 | KAACS      | 23,071  |          | KAABA      | 22,087 | KAACS      | 22,429 | KAACS       | 22,661 |          | KAABA       | 21,669 | KAACS       | 22,031 | KAACS       | 22,288 |
| HIGH LOAD               | Endpoint 1 |        | Endpoint 3 |        | Endpoint 5 |         | MID LOAD | Endpoint 7 |        | Endpoint 9 |        | Endpoint 11 |        | LOW LOAD | Endpoint 13 |        | Endpoint 15 |        | Endpoint 17 |        |
|                         | PLAN       | NPVRR  | PLAN       | NPVRR  | PLAN       | NPVRR   |          | PLAN       | NPVRR  | PLAN       | NPVRR  | PLAN        | NPVRR  |          | PLAN        | NPVRR  | PLAN        | NPVRR  | PLAN        | NPVRR  |
|                         | KBBBA      | 22,510 | KBBBA      | 22,798 | KBBBA      | 23,009  |          | KBBBA      | 22,044 | KBBBA      | 22,359 | KBBBA       | 22,600 |          | KBBBA       | 21,620 | KBBBA       | 21,960 | KBBBA       | 22,227 |
|                         | KAABA      | 22,549 | KAACS      | 22,868 | KAACS      | 23,071  |          | KAABA      | 22,087 | KAACS      | 22,429 | KAACS       | 22,661 |          | KAABA       | 21,669 | KAACS       | 22,031 | KAACS       | 22,288 |
| HIGH LOAD               | Endpoint 1 |        | Endpoint 3 |        | Endpoint 5 |         | MID LOAD | Endpoint 7 |        | Endpoint 9 |        | Endpoint 11 |        | LOW LOAD | Endpoint 13 |        | Endpoint 15 |        | Endpoint 17 |        |
|                         | PLAN       | NPVRR  | PLAN       | NPVRR  | PLAN       | NPVRR   |          | PLAN       | NPVRR  | PLAN       | NPVRR  | PLAN        | NPVRR  |          | PLAN        | NPVRR  | PLAN        | NPVRR  | PLAN        | NPVRR  |
|                         | KBBBA      | 22,510 | KBBBA      | 22,798 | KBBBA      | 23,009  |          | KBBBA      | 22,044 | KBBBA      | 22,359 | KBBBA       | 22,600 |          | KBBBA       | 21,620 | KBBBA       | 21,960 | KBBBA       | 22,227 |
|                         | KAABA      | 22,549 | KAACS      | 22,868 | KAACS      | 23,071  |          | KAABA      | 22,087 | KAACS      | 22,429 | KAACS       | 22,661 |          | KAABA       | 21,669 | KAACS       | 22,031 | KAACS       | 22,288 |
| HIGH LOAD               | Endpoint 1 |        | Endpoint 3 |        | Endpoint 5 |         | MID LOAD | Endpoint 7 |        | Endpoint 9 |        | Endpoint 11 |        | LOW LOAD | Endpoint 13 |        | Endpoint 15 |        | Endpoint 17 |        |
|                         | PLAN       | NPVRR  | PLAN       | NPVRR  | PLAN       | NPVRR   |          | PLAN       | NPVRR  | PLAN       | NPVRR  | PLAN        | NPVRR  |          | PLAN        | NPVRR  | PLAN        | NPVRR  | PLAN        | NPVRR  |
|                         | KBBBA      | 22,510 | KBBBA      | 22,798 | KBBBA      | 23,009  |          | KBBBA      | 22,044 | KBBBA      | 22,359 | KBBBA       | 22,600 |          | KBBBA       | 21,620 | KBBBA       | 21,960 | KBBBA       | 22,227 |
|                         | KAABA      | 22,549 | KAACS      | 22,868 | KAACS      | 23,071  |          | KAABA      | 22,087 | KAACS      | 22,429 | KAACS       | 22,661 |          | KAABA       | 21,669 | KAACS       | 22,031 | KAACS       | 22,288 |
| HIGH LOAD               | Endpoint 1 |        | Endpoint 3 |        | Endpoint 5 |         | MID LOAD | Endpoint 7 |        | Endpoint 9 |        | Endpoint 11 |        | LOW LOAD | Endpoint 13 |        | Endpoint 15 |        | Endpoint 17 |        |
|                         | PLAN       | NPVRR  | PLAN       | NPVRR  | PLAN       | NPVRR   |          | PLAN       | NPVRR  | PLAN       | NPVRR  | PLAN        | NPVRR  |          | PLAN        | NPVRR  | PLAN        | NPVRR  | PLAN        | NPVRR  |
|                         | KBBBA      | 22,510 | KBBBA      | 22,798 | KBBBA      | 23,009  |          | KBBBA      | 22,044 | KBBBA      | 22,359 | KBBBA       | 22,600 |          | KBBBA       | 21,620 | KBBBA       | 21,960 | KBBBA       | 22,227 |
|                         | KAABA      | 22,549 | KAACS      | 22,868 | KAACS      | 23,071  |          | KAABA      | 22,087 | KAACS      | 22,429 | KAACS       | 22,661 |          | KAABA       | 21,669 | KAACS       | 22,031 | KAACS       | 22,288 |
| HIGH LOAD               | Endpoint 1 |        | Endpoint 3 |        | Endpoint 5 |         | MID LOAD | Endpoint 7 |        | Endpoint 9 |        | Endpoint 11 |        | LOW LOAD | Endpoint 13 |        | Endpoint 15 |        | Endpoint 17 |        |
|                         | PLAN       | NPVRR  | PLAN       | NPVRR  | PLAN       | NPVRR   |          | PLAN       | NPVRR  | PLAN       | NPVRR  | PLAN        | NPVRR  |          | PLAN        | NPVRR  | PLAN        | NPVRR  | PLAN        | NPVRR  |
|                         | KBBBA      | 22,510 | KBBBA      | 22,798 | KBBBA      | 23,009  |          | KBBBA      | 22,044 | KBBBA      | 22,359 | KBBBA       | 22,600 |          | KBBBA       | 21,620 | KBBBA       | 21,960 | KBBBA       | 22,227 |
|                         | KAABA      | 22,549 | KAACS      | 22,868 | KAACS      | 23,071  |          | KAABA      | 22,087 | KAACS      | 22,429 | KAACS       | 22,661 |          | KAABA       | 21,669 | KAACS       | 22,031 | KAACS       | 22,288 |
| HIGH LOAD               | Endpoint 1 |        | Endpoint 3 |        | Endpoint 5 |         | MID LOAD | Endpoint 7 |        | Endpoint 9 |        | Endpoint 11 |        | LOW LOAD | Endpoint 13 |        | Endpoint 15 |        | Endpoint 17 |        |
|                         | PLAN       | NPVRR  | PLAN       | NPVRR  | PLAN       | NPVRR   |          | PLAN       | NPVRR  | PLAN       | NPVRR  | PLAN        | NPVRR  |          | PLAN        | NPVRR  | PLAN        | NPVRR  | PLAN        | NPVRR  |
|                         | KBBBA      | 22,510 | KBBBA      | 22,798 | KBBBA      | 23,009  |          | KBBBA      | 22,044 | KBBBA      | 22,359 | KBBBA       | 22,600 |          | KBBBA       | 21,620 | KBBBA       | 21,960 | KBBBA       | 22,227 |
|                         | KAABA      | 22,549 | KAACS      | 22,868 | KAACS      | 23,071  |          | KAABA      | 22,087 | KAACS      | 22,429 | KAACS       | 22,661 |          | KAABA       | 21,669 | KAACS       | 22,031 | KAACS       | 22,288 |
| HIGH LOAD               | Endpoint 1 |        | Endpoint 3 |        | Endpoint 5 |         | MID LOAD | Endpoint 7 |        | Endpoint 9 |        | Endpoint 11 |        | LOW LOAD | Endpoint 13 |        | Endpoint 15 |        | Endpoint 17 |        |
|                         | PLAN       | NPVRR  | PLAN       | NPVRR  | PLAN       | NPVRR   |          | PLAN       | NPVRR  | PLAN       | NPVRR  | PLAN        | NPVRR  |          | PLAN        | NPVRR  | PLAN        | NPVRR  | PLAN        | NPVRR  |
|                         | KBBBA      | 22,510 | KBBBA      | 22,798 | KBBBA      | 23,009  |          | KBBBA      | 22,044 | KBBBA      | 22,359 | KBBBA       | 22,600 |          | KBBBA       | 21,620 | KBBBA       | 21,960 | KBBBA       | 22,227 |
|                         | KAABA      | 22,549 | KAACS      | 22,868 | KAACS      | 23,071  |          | KAABA      | 22,087 | KAACS      | 22,429 | KAACS       | 22,661 |          | KAABA       | 21,669 | KAACS       | 22,031 | KAACS       | 22,288 |
| HIGH LOAD               | Endpoint 1 |        | Endpoint 3 |        | Endpoint 5 |         | MID LOAD | Endpoint 7 |        | Endpoint 9 |        | Endpoint 11 |        | LOW LOAD | Endpoint 13 |        | Endpoint 15 |        | Endpoint 17 |        |
|                         | PLAN       | NPVRR  | PLAN       | NPVRR  | PLAN       | NPVRR   |          | PLAN       | NPVRR  | PLAN       | NPVRR  | PLAN        | NPVRR  |          | PLAN        | NPVRR  | PLAN        | NPVRR  | PLAN        | NPVRR  |
|                         | KBBBA      | 22,510 | KBBBA      | 22,798 | KBBBA      | 23,009  |          | KBBBA      | 22,044 | KBBBA      | 22,359 | KBBBA       | 22,600 |          | KBBBA       | 21,620 | KBBBA       | 21,960 | KBBBA       | 22,227 |
|                         | KAABA      | 22,549 | KAACS      | 22,868 | KAACS      | 23,071  |          | KAABA      | 22,087 | KAACS      | 22,429 | KAACS       | 22,661 |          | KAABA       | 21,669 | KAACS       | 22,031 | KAACS       | 22,288 |
| HIGH LOAD               | Endpoint 1 |        | Endpoint 3 |        | Endpoint 5 |         | MID LOAD | Endpoint 7 |        | Endpoint 9 |        | Endpoint 11 |        | LOW LOAD | Endpoint 13 |        | Endpoint 15 |        | Endpoint 17 |        |
|                         | PLAN       | NPVRR  | PLAN       | NPVRR  | PLAN       | NPVRR   |          | PLAN       | NPVRR  | PLAN       | NPVRR  | PLAN        | NPVRR  |          | PLAN        | NPVRR  | PLAN        | NPVRR  | PLAN        | NPVRR  |
|                         | KBBBA      | 22,510 | KBBBA      | 22,798 | KBBBA      | 23,009  |          | KBBBA      | 22,044 | KBBBA      | 22,359 | KBBBA       | 22,600 |          | KBBBA       | 21,620 | KBBBA       | 21,960 | KBBBA       | 22,227 |
|                         | KAABA      | 22,549 | KAACS      | 22,868 | KAACS      | 23,071  |          | KAABA      | 22,087 | KAACS      | 22,429 | KAACS       | 22,661 |          | KAABA       | 21,669 | KAACS       | 22,031 | KAACS       | 22,288 |
| HIGH LOAD               | Endpoint 1 |        | Endpoint 3 |        | Endpoint 5 |         | MID LOAD | Endpoint 7 |        | Endpoint 9 |        | Endpoint 11 |        | LOW LOAD | Endpoint 13 |        | Endpoint 15 |        | Endpoint 17 |        |
|                         | PLAN       | NPVRR  | PLAN       | NPVRR  | PLAN       | NPVRR   |          | PLAN       | NPVRR  | PLAN       | NPVRR  | PLAN        | NPVRR  |          | PLAN        | NPVRR  | PLAN        | NPVRR  | PLAN        | NPVRR  |
|                         | KBBBA      | 22,510 | KBBBA      | 22,798 | KBBBA      | 23,009  |          | KBBBA      | 22,044 | KBBBA      | 22,359 | KBBBA       | 22,600 |          | KBBBA       | 21,620 | KBBBA       | 21,960 | KBBBA       | 22,227 |
|                         | KAABA      | 22,549 | KAACS      | 22,868 | KAACS      | 23,071  |          | KAABA      | 22,087 | KAACS      | 22,429 | KAACS       | 22,661 |          | KAABA       | 21,669 | KAACS       | 22,031 | KAACS       | 22,288 |
| HIGH LOAD               | Endpoint 1 |        | Endpoint 3 |        | Endpoint 5 |         | MID LOAD | Endpoint 7 |        | Endpoint 9 |        | Endpoint 11 |        | LOW LOAD | Endpoint 13 |        | Endpoint 15 |        | Endpoint 17 |        |
|                         | PLAN       | NPVRR  | PLAN       | NPVRR  | PLAN       | NPVRR   |          | PLAN       | NPVRR  | PLAN       | NPVRR  | PLAN        | NPVRR  |          | PLAN        | NPVRR  | PLAN        | NPVRR  | PLAN        | NPVRR  |
|                         | KBBBA      | 22,510 | KBBBA      | 22,798 | KBBBA      | 23,009  |          | KBBBA      | 22,044 | KBBBA      | 22,359 | KBBBA       | 22,600 |          | KBBBA       | 21,620 | KBBBA       | 21,960 | KBBBA       | 22,227 |
|                         | KAABA      | 22,549 | KAACS      | 22,868 | KAACS      | 23,071  |          | KAABA      | 22,087 | KAACS      | 22,429 | KAACS       | 22,661 |          | KAABA       | 21,669 | KAACS       | 22,031 | KAACS       | 22,288 |
| HIGH LOAD               | Endpoint 1 |        | Endpoint 3 |        | Endpoint 5 |         | MID LOAD | Endpoint 7 |        | Endpoint 9 |        | Endpoint 11 |        | LOW LOAD | Endpoint 13 |        | Endpoint 15 |        | Endpoint 17 |        |
|                         | PLAN       | NPVRR  | PLAN       | NPVRR  | PLAN       | NPVRR   |          | PLAN       | NPVRR  | PLAN       | NPVRR  | PLAN        | NPVRR  |          | PLAN        | NPVRR  | PLAN        | NPVRR  | PLAN        | NPVRR  |
|                         | KBBBA      | 22,510 | KBBBA      | 22,798 | KBBBA      | 23,009  |          | KBBBA      | 22,044 | KBBBA      | 22,359 | KBBBA       | 22,600 |          | KBBBA       | 21,620 | KBBBA       | 21,960 | KBBBA       | 22,227 |
|                         | KAABA      | 22,549 | KAACS      | 22,868 | KAACS      | 23,071  |          | KAABA      | 22,087 | KAACS      | 22,429 | KAACS       | 22,661 |          | KAABA       | 21,669 | KAACS       | 22,031 | KAACS       | 22,288 |
| HIGH LOAD               | Endpoint 1 |        | Endpoint 3 |        | Endpoint 5 |         | MID LOAD | Endpoint 7 |        | Endpoint 9 |        | Endpoint 11 |        | LOW LOAD | Endpoint 13 |        | Endpoint 15 |        | Endpoint 17 |        |
|                         | PLAN       | NPVRR  | PLAN       | NPVRR  | PLAN       | NPVRR   |          | PLAN       | NPVRR  | PLAN       | NPVRR  | PLAN        | NPVRR  |          | PLAN        | NPVRR  | PLAN        | NPVRR  | PLAN        | NPVRR  |
|                         | KBBBA      | 22,510 | KBBBA      | 22,798 | KBBBA      | 23,009  |          | KBBBA      | 22,044 | KBBBA      | 22,359 | KBBBA       | 22,600 |          | KBBBA       | 21,620 | KBBBA       | 21,960 | KBBBA       | 22,227 |
|                         | KAABA      | 22,549 | KAACS      | 22,868 | KAACS      | 23,071  |          | KAABA      | 22,087 | KAACS      | 22,429 | KAACS       | 22,661 |          | KAABA       | 21,669 | KAACS       | 22,031 | KAACS       | 22,288 |
| HIGH LOAD               | Endpoint 1 |        | Endpoint 3 |        | Endpoint 5 |         | MID LOAD | Endpoint 7 |        | Endpoint 9 |        | Endpoint 11 |        | LOW LOAD | Endpoint 13 |        | Endpoint 15 |        | Endpoint 17 |        |
|                         | PLAN       | NPVRR  | PLAN       | NPVRR  | PLAN       | NPVRR   |          | PLAN       | NPVRR  | PLAN       | NPVRR  | PLAN        | NPVRR  |          | PLAN        | NPVRR  | PLAN        | NPVRR  | PLAN        | NPVRR  |
|                         | KBBBA      | 22,510 | KBBBA      | 22,798 | KBBBA      | 23,009  |          | KBBBA      | 22,044 | KBBBA      | 22,359 | KBBBA       | 22,600 |          | KBBBA       | 21,620 | KBBBA       | 21,960 | KBBBA       | 22,227 |
|                         | KAABA      | 22,549 | KAACS      | 22,868 | KAACS      | 23,071  |          | KAABA      | 22,087 | KAACS      | 22,429 | KAACS       | 22,661 |          | KAABA       | 21,669 | KAACS       | 22,031 | KAACS       | 22,288 |
| HIGH LOAD               | Endpoint 1 |        | Endpoint 3 |        | Endpoint 5 |         | MID LOAD | Endpoint 7 |        | Endpoint 9 |        | Endpoint 11 |        | LOW LOAD | Endpoint 13 |        | Endpoint 15 |        | Endpoint 17 |        |
|                         | PLAN       | NPVRR  | PLAN       | NPVRR  | PLAN       | NPVRR   |          | PLAN       | NPVRR  | PLAN       | NPVRR  | PLAN        | NPVRR  |          | PLAN        | NPVRR  | PLAN        | NPVRR  | PLAN        | NPVRR  |
|                         | KBBBA      | 22,510 | KBBBA      | 22,798 | KBBBA      | 23,009  |          | KBBBA      | 22,044 | KBBBA      | 22,359 | KBBBA       | 22,600 |          | KBBBA       | 21,620 | KBBBA       | 21,960 | KBBBA       | 22,227 |
|                         | KAABA      | 22,549 | KAACS      | 22,868 | KAACS      | 23,071  |          | KAABA      | 22,087 | KA         |        |             |        |          |             |        |             |        |             |        |

## 7.2.6 CRITICAL UNCERTAIN FACTOR –CO<sub>2</sub> - NO

| CO2 CREDIT PRICES - No |            |        |            |        |            |         |          |            |        |             |        |             |        |          |             |        |             |        |             |        |
|------------------------|------------|--------|------------|--------|------------|---------|----------|------------|--------|-------------|--------|-------------|--------|----------|-------------|--------|-------------|--------|-------------|--------|
| HIGH GAS               |            |        |            |        |            | MID GAS |          |            |        |             |        | LOW GAS     |        |          |             |        |             |        |             |        |
| HIGH LOAD              | Endpoint 2 |        | Endpoint 4 |        | Endpoint 6 |         | MID LOAD | Endpoint 8 |        | Endpoint 10 |        | Endpoint 12 |        | LOW LOAD | Endpoint 14 |        | Endpoint 16 |        | Endpoint 18 |        |
|                        | PLAN       | NPVRR  | PLAN       | NPVRR  | PLAN       | NPVRR   |          | PLAN       | NPVRR  | PLAN        | NPVRR  | PLAN        | NPVRR  |          | PLAN        | NPVRR  | PLAN        | NPVRR  | PLAN        | NPVRR  |
|                        | KAACS      | 20,827 | KAACS      | 21,168 | KAACS      | 21,479  |          | KAACS      | 20,458 | KAACS       | 20,825 | KAACS       | 21,184 |          | KAACS       | 20,125 | KAACS       | 20,517 | KAACS       | 20,882 |
|                        | KAACA      | 20,828 | KAACA      | 21,170 | KAACA      | 21,481  |          | KAACA      | 20,458 | KAACA       | 20,827 | KAACA       | 21,187 |          | KAACA       | 20,127 | KAACA       | 20,520 | KAACA       | 20,885 |
|                        | KAACB      | 20,888 | KAACB      | 21,244 | KAACB      | 21,572  |          | KAACB      | 20,523 | KAACB       | 20,906 | KAACB       | 21,282 |          | KAACB       | 20,201 | KAACB       | 20,607 | KAACB       | 20,986 |
|                        | KAABA      | 20,895 | KAABA      | 21,269 | KAADA      | 21,598  |          | KAABA      | 20,534 | KAABA       | 20,934 | KAADA       | 21,280 |          | KAABA       | 20,217 | KAABA       | 20,638 | KAADA       | 20,995 |
|                        | KAADA      | 20,988 | KAADA      | 21,308 | KAABA      | 21,615  |          | KAADA      | 20,611 | KAADA       | 20,960 | KAACW       | 21,305 |          | KAADA       | 20,275 | KAADA       | 20,649 | KAACW       | 21,016 |
|                        | KBBBA      | 21,033 | KAACW      | 21,349 | KAACW      | 21,625  |          | KBBBA      | 20,655 | KAACW       | 20,998 | KAABA       | 21,307 |          | KBBBA       | 20,314 | KAACW       | 20,681 | KAABA       | 21,034 |
|                        | KAACW      | 21,041 | KBBBA      | 21,360 | KBBBA      | 21,654  |          | KAACW      | 20,661 | KBBBA       | 21,010 | KBBBA       | 21,334 |          | KAACW       | 20,318 | KBBBA       | 20,694 | KBBBA       | 21,046 |
|                        | KBBCA      | 21,233 | KBBCA      | 21,523 | KBBCA      | 21,779  |          | KBBCA      | 20,849 | KBBCA       | 21,169 | KBBCA       | 21,456 |          | KBBCA       | 20,501 | KBBCA       | 20,848 | KBBCA       | 21,164 |
| HIGH LOAD              | KBBCC      | 21,418 | KBBCC      | 21,702 | KBBCC      | 21,954  | MID LOAD | KBBCC      | 21,037 | KBBCC       | 21,351 | KBBCC       | 21,636 | LOW LOAD | KBBCC       | 20,693 | KBBCC       | 21,035 | KBBCC       | 21,350 |
|                        | KAAAA      | 22,397 | KAAAA      | 22,802 | KAAAA      | 23,179  |          | KAAAA      | 22,058 | KAAAA       | 22,484 | KAAAA       | 22,884 |          | KAAAA       | 21,772 | KAAAA       | 22,214 | KAAAA       | 22,632 |

### 7.2.7 CRITICAL UNCERTAIN FACTORS – SUMMARY AND EVALUATION

This summary table, Table 46 provides the expected value for NPVRR across the eighteen endpoint tree by plan and the value for NPVRR for the mid-load, mid-gas and no-CO<sub>2</sub> scenario, Endpoint 9.

**Table 46: Alternative Resource Plan NPVRRs**

| Expected Value |        |       | Endpoint 9 |        |       |
|----------------|--------|-------|------------|--------|-------|
| PLAN           | NPVRR  | DELTA | PLAN       | NPVRR  | DELTA |
| KAACS          | 21,463 | -     | KBBBA      | 22,359 | -     |
| KAACA          | 21,464 | 2     | KAACS      | 22,429 | 70    |
| KAACB          | 21,517 | 54    | KAACA      | 22,430 | 70    |
| KAABA          | 21,533 | 71    | KAABA      | 22,439 | 79    |
| KBBBA          | 21,547 | 84    | KAACB      | 22,441 | 81    |
| KAADA          | 21,622 | 159   | KBBCC      | 22,585 | 226   |
| KAACW          | 21,675 | 212   | KBBCA      | 22,609 | 250   |
| KBBCA          | 21,741 | 278   | KAADA      | 22,625 | 266   |
| KBBCC          | 21,843 | 380   | KAACW      | 22,703 | 343   |
| KAAAA          | 23,053 | 1,590 | KAAAA      | 23,909 | 1,549 |

Table 47 below provides the Alternative Resource Plan that had the lowest NPVRR for each endpoint scenario.

**Table 47: Endpoint/Lowest NPVRR Alternative Resource Plan**

| EP | Plan  | Value  | Conditional Probability |
|----|-------|--------|-------------------------|
| 1  | KBBBA | 22,510 | 2.50%                   |
| 2  | KAACS | 20,827 | 3.75%                   |
| 3  | KBBBA | 22,798 | 5.00%                   |
| 4  | KAACS | 21,168 | 7.50%                   |
| 5  | KBBBA | 23,009 | 2.50%                   |
| 6  | KAACS | 21,479 | 3.75%                   |
| 7  | KBBBA | 22,044 | 5.00%                   |
| 8  | KAACS | 20,456 | 7.50%                   |
| 9  | KBBBA | 22,359 | 10.00%                  |
| 10 | KAACS | 20,825 | 15.00%                  |
| 11 | KBBBA | 22,600 | 5.00%                   |
| 12 | KAACS | 21,164 | 7.50%                   |
| 13 | KBBBA | 21,620 | 2.50%                   |
| 14 | KAACS | 20,125 | 3.75%                   |
| 15 | KBBBA | 21,960 | 5.00%                   |
| 16 | KAACS | 20,517 | 7.50%                   |
| 17 | KBBBA | 22,227 | 2.50%                   |
| 18 | KAACS | 20,882 | 3.75%                   |

The sum of the joint probabilities and the count of the number of times an Alternative Resource Plan is the low cost scenario endpoint is shown in Table 48 below:

**Table 48: Cumulative Probabilities of Lowest NPVRR Plans**

| Plan  | Cumulative Probability | Count |
|-------|------------------------|-------|
| KBBBA | 40%                    | 9     |
| KAACS | 60%                    | 9     |

### **7.3 IMPLEMENTATION PLAN**

The Implementation Plan provided in the 2015 Triennial IRP has not materially changed except that the two wind facilities that were under construction in 2015, Slate Creek and Waverly, are now in full commercial operation. The 300 MW of wind generation previously disclosed in the 2015 Triennial IRP is planned for 2017. Also, the 2016 Implementation Plan includes solar resource additions in 2016 consisting of ownership in 3 MW of Commercial and Industrial solar rooftop installations.

The Demand-Side Management program schedule has been updated and the current schedule is provided in Table 49 below. It should also be noted that KCP&L is exploring a behind-the-meter demand response (DR) system as a pilot project. The DR system, Innovari, enables two-way, real time communication and load control between the utility and customers, feeders, or substations.

### 7.3.1 DEMAND-SIDE MANAGEMENT SCHEDULE

The current schedule for planned DSM programs is shown in Table 49 below:

**Table 49: DSM Program Schedule**

| Program Name                                                                                                                                    | DSM Type          | New or Existing | Segment     | Program Implemented | Annual Report               | EM&V Completed and draft report available |
|-------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|-----------------|-------------|---------------------|-----------------------------|-------------------------------------------|
| Home Lighting Rebate                                                                                                                            | Energy Efficiency | New             | Residential | Apr., 2016*         | 90-days following Plan Year | 1-Yr following Plan Year                  |
| Home Appliance Recycling Rebate                                                                                                                 | Energy Efficiency | New             | Residential | Apr., 2016*         | 90-days following Plan Year | 1-Yr following Plan Year                  |
| Home Energy Report                                                                                                                              | Energy Efficiency | New             | Residential | Apr., 2016*         | 90-days following Plan Year | 1-Yr following Plan Year                  |
| Income-Eligible Home Energy Report                                                                                                              | Energy Efficiency | New             | Residential | Apr., 2016*         | 90-days following Plan Year | 1-Yr following Plan Year                  |
| Online Home Energy Audit                                                                                                                        | Educational       | New             | Residential | Apr., 2016*         | 90-days following Plan Year | 1-Yr following Plan Year                  |
| Whole House Efficiency                                                                                                                          | Energy Efficiency | New             | Residential | Apr., 2016*         | 90-days following Plan Year | 1-Yr following Plan Year                  |
| Income-Eligible Multi-Family                                                                                                                    | Energy Efficiency | New             | Residential | Apr., 2016*         | 90-days following Plan Year | 1-Yr following Plan Year                  |
| Residential Programmable Thermostat                                                                                                             | Demand Response   | New             | Residential | Apr., 2016*         | 90-days following Plan Year | 1-Yr following Plan Year                  |
| Business Energy Efficiency Rebate - Standard                                                                                                    | Energy Efficiency | New             | C&I         | Apr., 2016*         | 90-days following Plan Year | 1-Yr following Plan Year                  |
| Business Energy Efficiency Rebate - Custom                                                                                                      | Energy Efficiency | New             | C&I         | Apr., 2016*         | 90-days following Plan Year | 1-Yr following Plan Year                  |
| Strategic Energy Management                                                                                                                     | Energy Efficiency | New             | C&I         | Apr., 2016*         | 90-days following Plan Year | 1-Yr following Plan Year                  |
| Block Bidding                                                                                                                                   | Energy Efficiency | New             | C&I         | Apr., 2016*         | 90-days following Plan Year | 1-Yr following Plan Year                  |
| Online Business Energy Audit                                                                                                                    | Educational       | New             | C&I         | Apr., 2016*         | 90-days following Plan Year | 1-Yr following Plan Year                  |
| Small Business Direct Install                                                                                                                   | Energy Efficiency | New             | C&I         | Apr., 2016*         | 90-days following Plan Year | 1-Yr following Plan Year                  |
| Commercial Programmable Thermostat                                                                                                              | Demand Response   | New             | C&I         | Apr., 2016*         | 90-days following Plan Year | 1-Yr following Plan Year                  |
| Demand Response Incentive                                                                                                                       | Demand Response   | New             | C&I         | Apr., 2016*         | 90-days following Plan Year | 1-Yr following Plan Year                  |
| *On February 24, 2016, the Commission voted in favor of the Company's MEEIA cycle 2 plan. The Company is awaiting an Order from the Commission. |                   |                 |             |                     |                             |                                           |

## **SECTION 8: SPECIAL CONTEMPORARY ISSUES**

From the Commission Order, EO-2016-0038, the following Special Contemporary Resource Planning Issues are addressed as follows:

### **8.1 IMPACTS OF EMERGING ENERGY EFFICIENCY TECHNOLOGIES**

Review the impact of foreseeable emerging energy efficiency technologies throughout the 20-year planning period.

#### **Response:**

In 2015, KCP&L engaged the Applied Energy Group (AEG) to conduct a Demand Side Management (DSM) Resource Potential Study which will be completed in and will be used in developing the 2018 Triennial IRP. This question gets at the heart of what the overall purpose of the DSM potential study is, which is the review and analysis of all possible impacts from demand-side resources, especially emerging technologies, programs, and initiatives that will have incremental effects on the planning cycle in years to come. The DSM potential study will included the effects of improved and emerging technologies expected over the 20-year IRP planning horizon. The following sections describe the processes AEG incorporates in tracking, reviewing, and analyzing the impacts of emerging energy efficiency technologies

#### **AEG's Continuous In-House Research of Emerging Technologies**

AEG is constantly monitoring the trends and feasibility of technologies that are available on the market as well as those expected to be on the market in the coming years (e.g. super-efficient air conditioners, cutting-edge LED lighting technologies, heat pump water heaters, heat pump clothes dryers, behavioral programs, combined heat and power initiatives, the effects of codes and standards, electric vehicles, etc.).

AEG staff is currently active participants in several formalized and ongoing stakeholder processes to review, analyze, and package the latest measure assumptions for use in utility

DSM programs; including as members of the Pacific Northwest's Regional Technical Forum, the California Technical Forum, and the Illinois TRM Technical Advisory Committee. AEG participation in each of these groups, as well as ongoing work with utility and government clients around the country, allows them to stay on the cutting edge in terms of emerging technologies and technologies that are new to the market. The AEG measure-development approach and LoadMAP model allow for technologies to enter program portfolios whenever they become viable and cost-effective throughout the multi-year time horizon.

### **Measure Development in General**

As a centralized and consistent source to use across all of the planning, implementation, and evaluation consulting projects, AEG has developed and maintained a Database of Energy Efficiency Measures (DEEM) since 2004. DEEM is a comprehensive database that includes highly-detailed information on thousands of DSM measures and emerging technologies applicable to residential, commercial, and industrial customer segments. The key data points it contains which can be used to support analysis include:

- Unit energy and peak demand savings
- Measure replacement and installation costs (capital cost, incremental cost, annual operating and maintenance costs, etc.)
- Measure life
- Baseline characteristics (early retirement, normal replacement, applicable codes & standards)
- Non-energy benefits (water savings, health improvements, productivity gains, increased comfort, etc.)
- Applicability (market sector, geographic region, etc.)
- An AEG-internal measurement of data source quality, based on publication/review process, calculations, thoroughness, and other factors

DEEM is updated continually to reflect the most recent source material and state-of-the-art technological advancements. Each database entry is meticulously referenced to document the original source containing the measure information. Key sources compiled and assembled inside DEEM include:

- U.S. Department of Energy National Laboratories (PNNL, ORNL, NREL)
- U.S. Energy Information Administration (Annual Energy Outlook)
- State and regional technical reference manuals (TRM)
- Northwest Power & Conservation Council's Regional Technical Forum (RTF) workbooks
- California's Database for Energy Efficient Resources (DEER)
- RSMMeans Cost Data Books
- Building simulation data
- AEG and third-party evaluation and market research reports

### **Use of Emerging Technologies in the DSM Potential Study**

The definition of "emerging technology" when identifying and including specific measures in DSM potential studies is that a technology or practice is known and quantifiable, but is somewhere early on the adoption curve. While more time may be required to prove a measure's effects through evaluations, billing analysis, and other appropriate methods; if estimates of the measure parameters discussed above can be developed with sufficient quality for the purposes of resource planning, they will be included in the analysis. This may mean a given emerging technology is in the labs (e.g. higher lumen-per-watt evolutions of LED lamps), common in other countries but not yet the U.S. (e.g. heat pump clothes dryers), or is being piloted by utility programs before mainstream adoption has occurred (e.g. smart, internet-enabled thermostats).

This categorization frequently includes subjectivity, however, as sometimes hard and fast rules cannot be applied. This is why AEG conducts a thorough review process with both its clients and its client's external stakeholders. The measure list is distributed and discussed to

ensure that all parties have been able to provide input and suggestions toward appropriately characterizing the portfolio of DSM resources.

As with any forecasting activity, assumptions and landscapes will change on an ongoing basis, and should be revisited regularly. Refreshing and revising DSM potential studies every 2 to 4 years allows these changes to be incorporated such that resource acquisition plans can be adjusted accordingly.

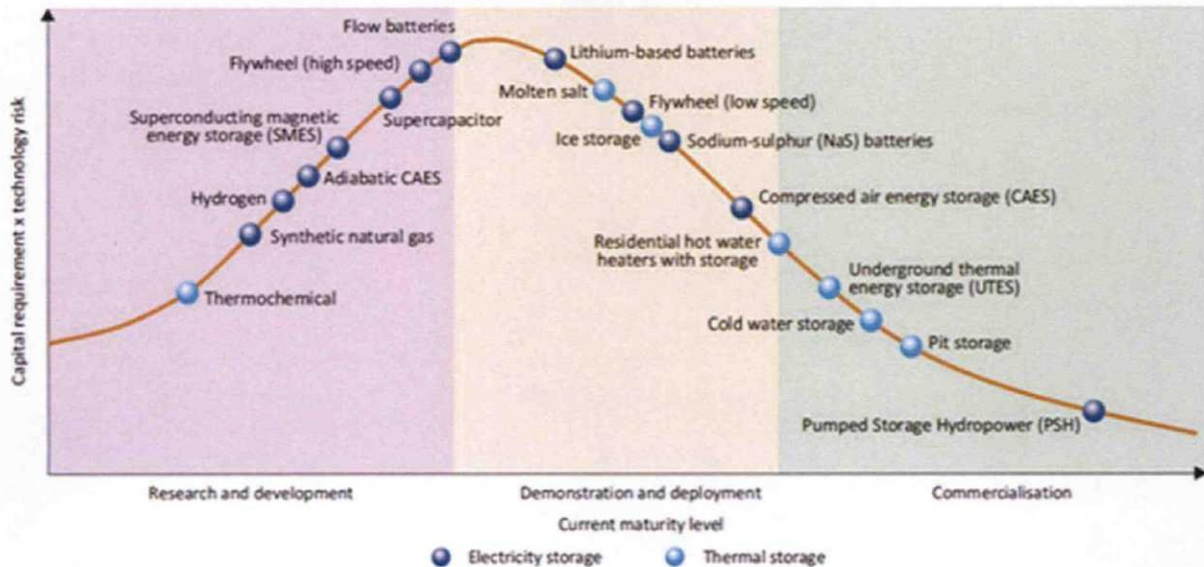
## **8.2 IMPACTS OF EMERGING ENERGY STORAGE TECHNOLOGIES**

Review the impact of foreseeable emerging energy storage technologies throughout the 20-year planning period.

### **Response:**

The International Energy Agency's (IEA) '2014 Technology Roadmap: Energy Storage' incorporated the following depiction of the maturity of emerging electricity and thermal energy storage technologies. This diagram, Figure 7, shows that KCP&L's 2015 Triennial IRP screening incorporated the three most mature electric storage technologies; pumped storage hydropower (PSH), compressed air energy storage (CAES), and sodium-sulfur (NaS) batteries. The diagram also identified flywheels, lithium based and flow batteries as electric storage technologies that have emerged from the research and development stage and are progressing toward commercialization. Since this study has been published, lithium based and flow batteries have continued to make significant progress along this maturity curve and are rapidly becoming commercially viable.

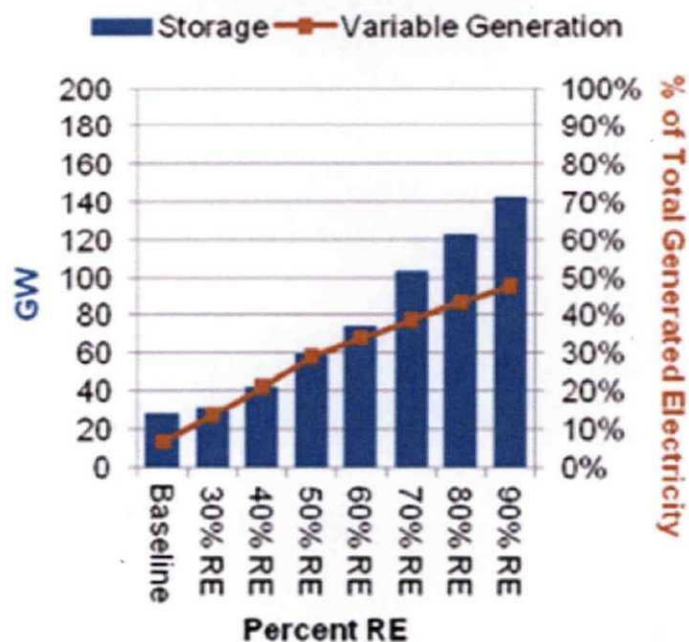
**Figure 7: Maturity of Energy Storage Technologies**



Source: Decourt, B. and R. Debarre (2013), "Electricity storage", *Factbook*, Schlumberger Business Consulting Energy Institute, Paris, France and Paksoy, H. (2013), "Thermal Energy Storage Today" presented at the IEA Energy Storage Technology Roadmap Stakeholder Engagement Workshop, Paris, France, 14 February.

The National Renewable Energy Laboratory (NREL) 2012 "Renewable Electricity Futures Study" projects that the total installed electricity storage capacity in the US could grow to between 103 GW and 152 GW in 2050. By 2050, storage capacity was estimated at 28 GW in the Low-Demand Baseline scenario, 31 GW in the 30% RE scenario, 74 GW in the 60% RE scenario, and 142 GW in the 90% RE scenario. Figure 8 illustrates how the magnitude of storage will grow as variable generation as a percent of total electric generation increases. Based on these NREL projections, minimal additional electricity storage would be required for bulk energy services in the 30% renewable energy scenario. With the combined KCP&L/GMO preferred resource plan, current projections are that renewable generation will not exceed 20% of our energy production portfolio throughout the planning period, significantly below the 30% level.

Figure 8: Storage Capacity in 2050



The KCP&L SmartGrid Demonstration project incorporated the demonstration and operational testing of the lithium-ion battery storage technology in a 1.0 MW/1.0 MWh Bulk Energy Storage System (BESS) and a 6.0 kW/11.2 kWh Premise Energy Storage System (PESS). KCP&L will continue to track the development and costs of these technologies, as well as the potential to use energy storage with renewable integration, for future resource planning.

#### **Energy Storage – The Falling Cost of Storage**

The energy storage technologies included in the 2015 IRP Supply Side Resource prescreening process were compressed air energy storage (CAES), pumped hydro, and sodium sulfur (NaS) batteries. Due to their relatively high cost (the NaS Battery ranked 20th in both the Technology Ranking by Nominal Utility Cost and Probable Environmental Cost analysis), along with the early development stage and limited commercial utility application, these energy storage technologies were not passed on to the integrated resource analysis.

Several recent studies are projecting significant reductions in the cost of battery energy storage technology by 2020. In 2014, the Brattle Group published the findings of a study they

performed for Oncor in a report titled “The Value of Distributed Electricity Storage in Texas”. This report cites several studies that project the installed cost of battery energy storage will drop to \$350/kWh by 2020, with the battery only component of the cost of being \$200/kWh. The study also indicated that battery only costs could reach \$110 /kWh if the low cost GigaFactory production projections by Tesla Motors, Inc. are realized.

More recently, in October 2015, Goldman Sachs published an Equity Research document entitled ‘The Great Battery Race – Framing the next frontier in clean technology – Electrical Energy Storage’ in which they projected that battery pack costs will approach \$125 - \$200 per kWh by 2020, further validating the drop in battery storage costs projected by Brattle Group in the Oncor study.

The Oncor study used an installed cost of \$350/kWh for energy storage systems configured with 3.0 MWh of energy storage for each MW of capacity. Based on the Oncor cost projections, a lithium battery storage system configured similarly (1.0 MW/6.0 MWh ratio) to the NaS system evaluated in the 2015 IRP would have a projected installed cost of \$1,650/kW, approximately half that of the NaS battery cost of \$3,549/kW.

These and other electricity storage technologies will continue to be monitored and evaluated for their economic viability and impact on future resource plans.

#### **Energy Storage as a Supply-Side Resource**

In 2014, the Brattle Group published the findings of a study they performed for Oncor in a report titled “The Value of Distributed Electricity Storage in Texas”. This study incorporated the significant reduction in battery storage projected to be achieved by 2020. The following excerpts summarize the findings of the Oncor study:

*“Our analysis shows that deploying electricity storage on distribution systems across Texas could provide substantial net benefits to the state. ...*

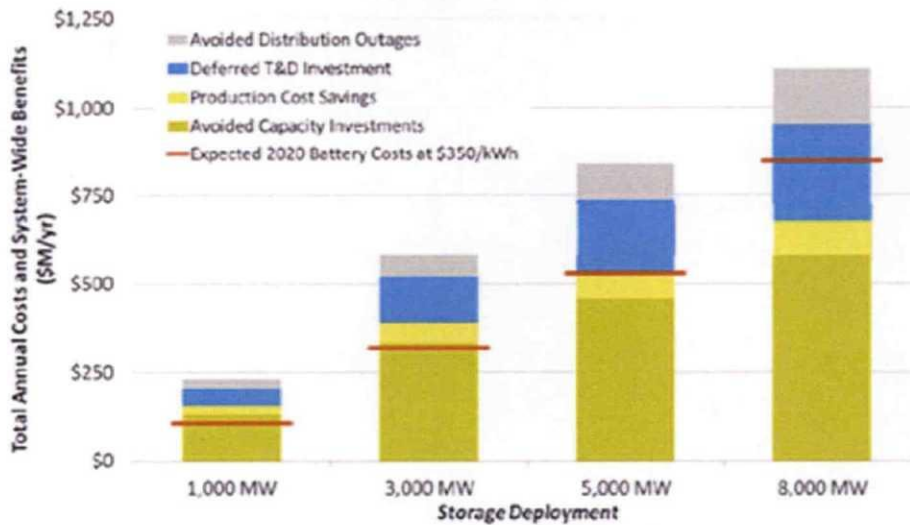
*"Our analysis assumes that the storage deployment plan will be developed to capture as much benefits as possible by integrating value from increasing customer reliability, improving the T&D systems, and transacting in the wholesale power markets. ..."*

*"However, while beneficial from an integrated, system-wide perspective, an efficient scale of storage deployment would not be reached if deployed solely by merchant developers in the wholesale market, by retail customers, or only for capturing T&D benefits."*

These findings are consistent with many other industry benefit cost assessments in that they show that, for the foreseeable future, to be economically viable storage systems must be deployed in a manner by which they can achieve multiple value streams. Figure 9 illustrates the levelized annual cost and benefit component estimated in the study. In each scenario, the benefits derived from Avoided Capacity Investments make up the bulk of the resulting benefits.

Through its SmartGrid Demonstration experience, KCP&L learned that care must be taken to ensure that the kW and kWh components are 'sized' properly for any specific application. A properly 'sized' energy storage component as a percentage of energy capacity varies considerably by application. For some ancillary services applications like frequency regulation, an energy storage system may only require 1.0 MWh or less of energy storage for each MW of capacity. While others like Energy Time Shift or Arbitrage may require 6-8 MWh of energy storage for each MW of capacity.

**Figure 9: Value of Distributed Electric Storage in Texas Findings**



### Energy Storage as a Demand Side Resource

Increasingly customers are investigating the potential of premise sighted storage often stemming from reliability/resiliency issues and concerns about the loss of utility power for extended periods. The DOE/EPRI 2013 'Electricity Storage Handbook in Collaboration with NRECA' and the DOE Smart Grid Computational Tool have identified the following potential benefit areas of electric energy storage systems when installed behind the customer meter, often in conjunction with solar PV generation systems.

#### Customer Energy Management Services Benefit Areas

- Power Quality
- Power Reliability & Resiliency
- Retail Energy Time Shift (/TOU)
- Demand Charge Management
- Renewable Energy Time Shift (w/TOU)
- DR Program Participation

### Utility Benefit Areas of Demand Side Electric Storage

- Electric Supply Capacity (Peak Shaving)
- Optimized Generation Operation
- Distribution Upgrade Deferral
- Distribution Voltage Support

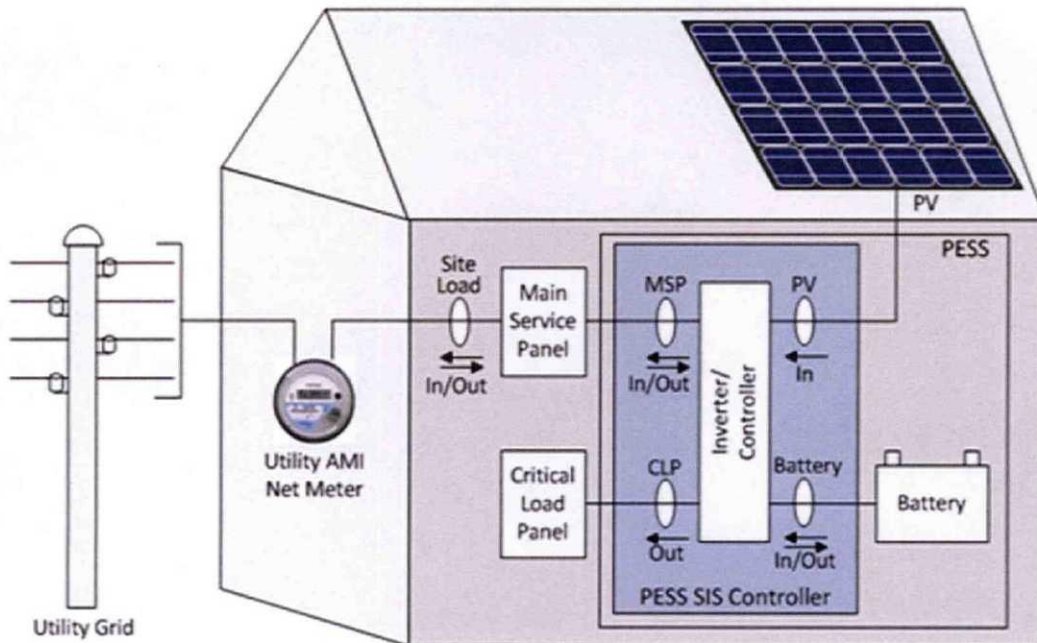
Electricity storage can be used for any of the benefit areas listed above, but it is rare for a single area to generate sufficient revenue to justify its investment. However, the flexibility of storage can be leveraged to provide multiple or stacked benefits to the customer and utility, with a single storage system that captures several revenue streams and becomes economically viable. How these services can be stacked depends on the location of the system within the grid and the storage technology used.

As part of the SmartGrid Demonstration Project, KCP&L incorporated a consumer Premise Energy Storage System (PESS) was installed at the SmartGrid Demonstration House in conjunction with the 2.82 kW solar PV array. The PESS consists of an 11.7 kWh lithium-ion battery with a unique hybrid inverter/converter rated for 6.0 kW discharge. The PESS was configured as illustrated in Figure 10 and was used to demonstrate and quantify the benefits derived from three typical end-use functions:

- Time-of-Use Energy Cost Management
- Renewable Energy Time Shift
- Electric Service Reliability

The analysis of these operational demonstrations was published in the 'KCP&L Green Impact Zone SmartGrid Demonstration Project Final Technical Report, version 2.0, dated May 22, 2015. This report is attached to this Annual Update as Appendix C.

**Figure 10: PESS Installation at SmartGrid Demonstration House**



The installed cost of the SmartGrid Demonstration PESS was approximately \$25,000 or \$4,165/kW (\$2,135/kWh) of electric energy storage capacity. As battery energy storage costs drop, demand side storage systems like the SmartGrid Demonstration PESS become more economically viable. In Morgan Stanley's 2014 'Blue Paper on Solar Power & Energy Storage' they project that by 2020 the total installed cost of a similarly configured PESS at \$8,625 cost, but could go as low as \$4,260. At these cost points, if the proper pricing programs are available and by leveraging multiple benefit streams, PESS may become an economical investment for some customers. It will depend largely on the value the individual customer places on continuity of electric supply during electric grid power outages.

KCP&L will continue to monitor demand side energy storage costs and trends and will incorporate these technologies and systems in future demand side potential studies.

### **8.3 ENVIRONMENTAL CAPITAL AND OPERATING COSTS FOR COAL-FIRED GENERATING UNITS**

Analyze and document the future capital and operating costs faced by each KCP&L coal-fired generating unit in order to comply with the following environmental standards:

- (1) **Clean Air Act New Source Review provisions:** The Company reviews proposed generation projects and permits these projects, as necessary, to comply with rule.
- (2) **1-hour Sulfur Dioxide National Ambient Air Quality Standard:** See Table 50, Table 51, and Table 52 below.
- (3) **National Ambient Air Quality Standards for ozone and fine particulate matter:** See Table 50, Table 51, and Table 52 below.
- (4) **Cross-State Air Pollution Rule, including the anticipated 2016 update to the rule to incorporate interstate transport requirements for the 2008 ozone National Ambient Air Quality Standard:**

The Company will comply through a combination of trading allowances within or outside its system in addition to changes in operations as necessary.

- (5) **Clean Air Interstate Rule :** This rule has been superseded by the Cross-State Air Pollution Rule.
- (6) **Mercury and Air Toxics Standards:** See Table 50, Table 51, and Table 52 below.
- (7) **Clean Water Act Section 316(b) Cooling Water Intake Standards:** See Table 50, Table 51, and Table 52 below.
- (8) **Clean Water Act Steam Electric Effluent Limitation Guidelines:** See Table 50, Table 51, and Table 52 below.
- (9) **Coal Combustion Waste rules:** See Table 50, Table 51, and Table 52 below.

(10) **Clean Air Act Section 111(d) Greenhouse Gas standards for existing sources:** See "Clean Power Plan" discussion below.

(11) **Clean Air Act Regional Haze Requirements:** The Company is in compliance with this rule.

Table 50: Environmental Capital Cost Estimates \*\* Highly Confidential \*\*

| Environmental Retrofit Technology<br>Capital Cost<br>(2015 \$ x Millions)                                                                                                                                                                                                                                                                                             | Montrose 2                                                                          | Montrose 3 | LaCygne 1 and 2 <sup>1</sup> | Hawthorn | Iatan 1 <sup>1</sup> |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|------------|------------------------------|----------|----------------------|
| MATS/Activated Carbon Injection                                                                                                                                                                                                                                                                                                                                       |  |            |                              |          |                      |
| MATS/ESP Rebuild                                                                                                                                                                                                                                                                                                                                                      |                                                                                     |            |                              |          |                      |
| CWA 316(b)/Fish-Friendly Screens                                                                                                                                                                                                                                                                                                                                      |                                                                                     |            |                              |          |                      |
| CWA 316(a)/Cooling Towers                                                                                                                                                                                                                                                                                                                                             |                                                                                     |            |                              |          |                      |
| ELG-CCR/Ash Conversion                                                                                                                                                                                                                                                                                                                                                |                                                                                     |            |                              |          |                      |
| <b>Notes</b><br>NA = Not Applicable<br> Equipment Installed<br>R=Retired before Rule is promulgated<br>MATS = Mercury and Air Toxics Standard<br>ELG = Effluent Limitation Guidelines<br>CCR = Coal Combustion Residual Rules<br>CWA = Clean Water Act<br><sup>1</sup> KCP&L's Share |                                                                                     |            |                              |          |                      |

Table 51: Environmental Fixed O&M Estimates \*\* Highly Confidential \*\*

| Environmental Retrofit Technology<br>Fixed O&M<br>(\$/kW - 2015 \$)                                                                                                                                                                                     | Montrose 2 | Montrose 3 | LaCygne 1 and 2 | Hawthorn | Iatan 1 |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|------------|-----------------|----------|---------|
| MATS/Activated Carbon Injection                                                                                                                                                                                                                         |            |            |                 |          |         |
| MATS/ESP Rebuild                                                                                                                                                                                                                                        |            |            |                 |          |         |
| CWA 316(b)/Fish-Friendly Screens                                                                                                                                                                                                                        |            |            |                 |          |         |
| CWA 316(a)/Cooling Towers                                                                                                                                                                                                                               |            |            |                 |          |         |
| ELG-CCR/Ash Conversion                                                                                                                                                                                                                                  |            |            |                 |          |         |
| <b>Notes</b><br>NA = Not Applicable<br>✓ Equipment Installed<br>R=Retired before Rule is promulgated<br>MATS = Mercury and Air Toxics Standard<br>ELG = Effluent Limitation Guidelines<br>CCR = Coal Combustion Residual Rules<br>CWA = Clean Water Act |            |            |                 |          |         |

Table 52: Retrofit Variable O&M Estimates \*\* Highly Confidential \*\*

| Environmental Retrofit Technology<br>Variable O&M<br>(\$/MWh - 2015 \$)                                                                                                                                                                                 | Montrose 2 | Montrose 3 | LaCygne 1 and 2 | Hawthorn | Iatan 1 |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|------------|-----------------|----------|---------|
| MATS/Activated Carbon Injection                                                                                                                                                                                                                         |            |            |                 |          |         |
| MATS/ESP Rebuild                                                                                                                                                                                                                                        |            |            |                 |          |         |
| CWA 316(b)/Fish-Friendly Screens                                                                                                                                                                                                                        |            |            |                 |          |         |
| CWA 316(a)/Cooling Towers                                                                                                                                                                                                                               |            |            |                 |          |         |
| ELG-CCR/Ash Conversion                                                                                                                                                                                                                                  |            |            |                 |          |         |
| <b>Notes</b><br>NA = Not Applicable<br>✓ Equipment Installed<br>R=Retired before Rule is promulgated<br>MATS = Mercury and Air Toxics Standard<br>ELG = Effluent LimitatiionGuidelines<br>CCR = Coal Combustion Residual Rules<br>CWA = Clean Water Act |            |            |                 |          |         |

**(12) Clean Power Plan:** Issued by the EPA in August 2015, the Clean Power Plan (“CPP”) regulations seek to reduce CO<sub>2</sub> emissions from certain power plants by 32% from 2005 levels by 2030. It does so by imposing CO<sub>2</sub> reduction obligations on existing power plants based on what EPA identified as the “Best System of Emission Reductions”. States are expected to develop State Implementation Plans (“SIPs”) that will ensure that the state meets its CO<sub>2</sub> reduction obligations. Reductions are to start in 2022 with further reductions phased in through 2030. States may choose a mass-based or rate-based compliance structure. A mass-based structure sets state CO<sub>2</sub> emission targets in terms of total tons emitted from covered resources. A rate-based structure sets state targets based on pounds of CO<sub>2</sub> emitted per MWh generated. The CPP requires initial SIPs to be submitted to the EPA by September 2016, with final SIPs due by September 2018. On February 9, 2016, the Supreme Court issued a stay of the CPP until legal challenges can be addressed. Some states have indicated that no further work will be done on SIP development until the stay is lifted.

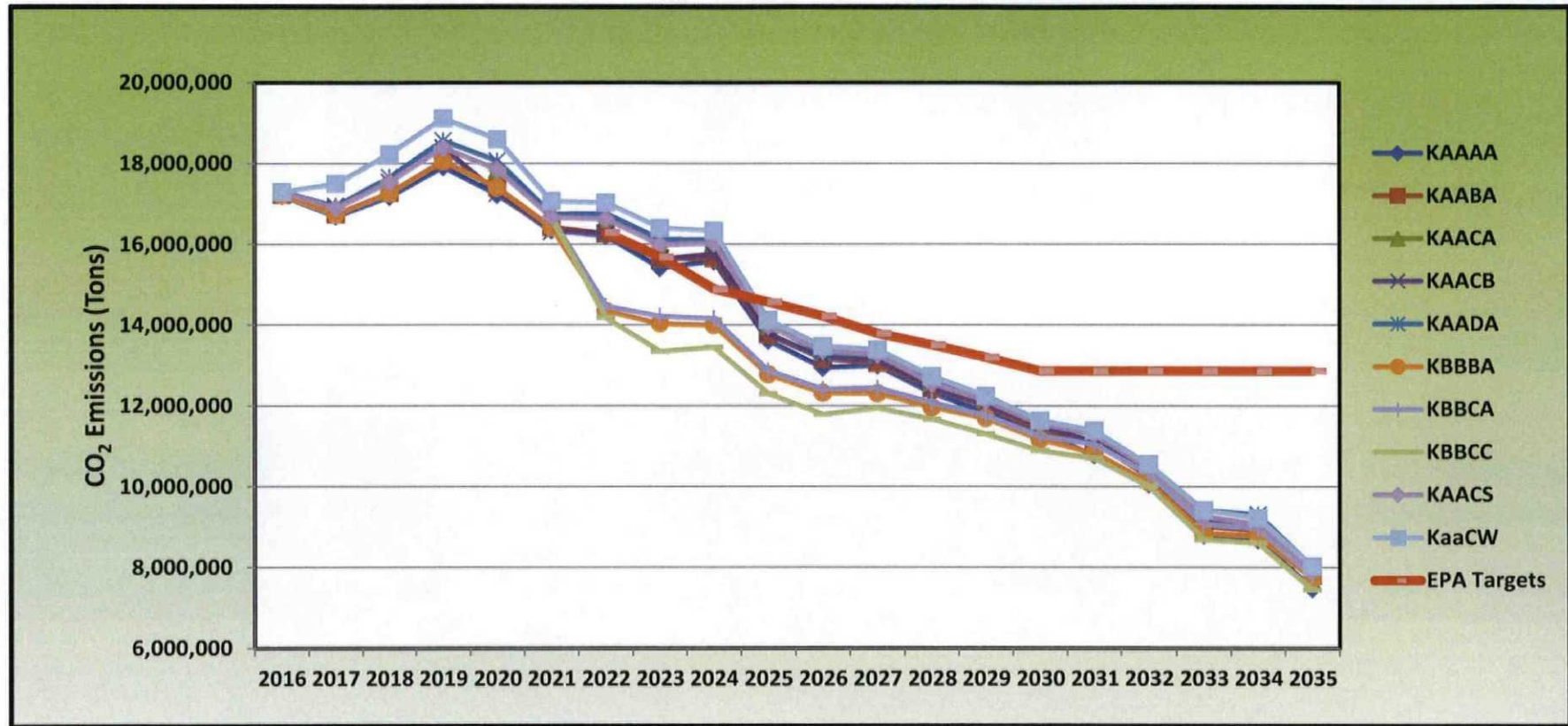
KCP&L has attempted to analyze the potential CPP impacts on its resource plans. Since the CPP State Implementation Plans have yet to be developed and approved, a number of important assumptions were required to perform this analysis. These assumptions include:

- A mass-based compliance structure
- When CO<sub>2</sub> emission allowances are allocated, the allocations are based on a utility’s share of 2012 emissions relative to state total emissions from covered resources
- No emission allowance set-asides for new renewable generation, new non-renewable generation or energy efficiency programs
- A CO<sub>2</sub> emission allowance trading market is established
- Regional wholesale electric market prices based on CO<sub>2</sub> emission allowances applied to covered resources

#### KCP&L CPP Analysis Results – CO<sub>2</sub> emissions

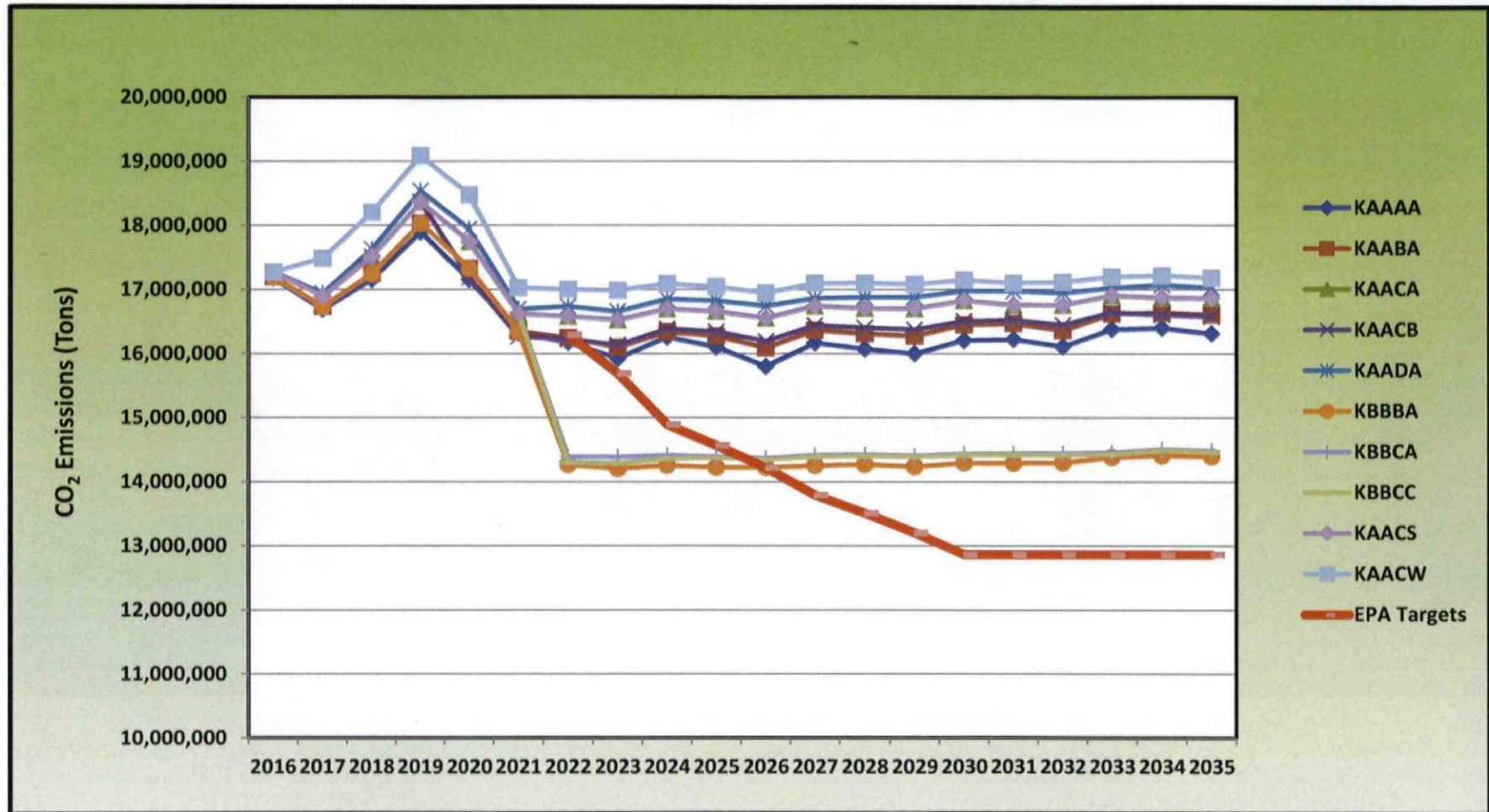
The following chart shows the expected value of CO<sub>2</sub> produced each year (in tons) for each KCP&L alternative resource plan modeled. This is the expected value over the nine scenarios that include CO<sub>2</sub> emission costs. The chart also shows the assumed amount of CO<sub>2</sub> emission allowances allocated to KCP&L (labeled “EPA Targets”). Note that projected CO<sub>2</sub> emissions for each of the alternative resource plans modeled indicate that KCP&L would generally be in compliance with the CPP. Emissions from several of the alternative resource plans slightly exceed the EPA targets in the first three CPP compliance years. The cost of these excess emissions is included in the NPVRR results. As the projected natural gas prices and CO<sub>2</sub> emissions allowance prices increase over the 2025-2035 time period modeled, the change in economic dispatch of KCP&L’s generation portfolio would reduce CO<sub>2</sub> emissions to levels below the CPP targets. Based on the NPVRR results from the 10 KCP&L alternative resource plans modeled, no additional coal plant retirements are indicated assuming the same level of DSM program impacts as the Preferred Plan. If higher levels of DSM are achievable long term, additional coal plant retirement may be economical under a CO<sub>2</sub> constrained future.

Table 53: Projected Annual CO<sub>2</sub> Emissions With CO<sub>2</sub> Restrictions



For comparison purposes, the following chart shows the expected value of CO<sub>2</sub> produced each year (in tons) for each of the KCP&L alternative resource plans modeled under the 9 scenarios without CO<sub>2</sub> costs applied. Note that for all plans, the annual projected CO<sub>2</sub> emissions generally exceed the CPP targets. The three alternative resource plans with projected CO<sub>2</sub> emissions below the EPA targets for the first four compliance years include retirement of LaCygne 1.

Table 54: Projected Annual CO<sub>2</sub> Emissions Without CO<sub>2</sub> Restrictions



### **Estimated CPP Cost Impact**

Based on analysis to date, the 20-year net present value of CPP compliance costs for KCP&L range from \*\* [REDACTED] \*\*. The upper end of the range represents the case where emission allowances are auctioned by Missouri and Kansas rather than allocated to the utilities.

Economic dispatch including an explicit CO<sub>2</sub> cost on KCP&L's covered resources shows a significant increase in gas generation as compared to historic operation. Given this increase in gas generation, the alternative resource plans modeled include additional cost for KCP&L's gas turbine fleet for increased O&M, year-round firm gas service, and the costs necessary to operate KCP&L's combined cycle unit (Hawthorn 6/9) on a year-round basis.

This analysis is based on several major assumptions that could ultimately be proved incorrect. For example, the assumed state CO<sub>2</sub> emission allowances allocation could be different from what KCP&L has assumed in this analysis. Given the Supreme Court CPP stay, it is uncertain as to when Missouri and Kansas will develop their SIPs specifying how the emission allowance would be allocated, if allocated at all. In addition, it appears that the CO<sub>2</sub> emission forecast used in this analysis may result in a regional shift of coal-based generation to gas-based generation greater than that required to meet the CPP mass-based CO<sub>2</sub> targets. Given this, more work is needed to refine the CO<sub>2</sub> emission allowance forecast. Results of this additional work will be provided in the next IRP annual update.

In addition to actions previously taken by the company to reduce CO<sub>2</sub> emissions related to retail load, (renewable generation additions, DSM program development and implementation, coal use reductions, plant efficiency improvements, etc.) current modeling indicates additional CO<sub>2</sub> reduction would come from increased existing combustion turbine utilization. Existing combustion turbines are not "covered resources" so their CO<sub>2</sub> emissions do not count towards the state's CO<sub>2</sub> limits. While this shift in generation to existing combustion turbine

resource would be permissible under the current CPP, EPA did not anticipate such a shift. As such, actual national CO<sub>2</sub> levels could exceed EPA's intended targets under such a scenario.

#### **8.4 TRANSMISSION GRID IMPACTS**

Analyze and document the cost of any transmission grid upgrades or additions needed to address transmission grid reliability, stability, or voltage support impacts that could result from the retirement of any existing KCP&L coal-fired generating unit in the time period established in the IRP process.

**Response:** The only KCP&L coal units identified for potential retirement in the IRP plan are Montrose units 1, 2, and 3. The approximate cost estimate for switching cap banks and reactors to replace the generators reactive capability would be \$3-5 million. Other transmission grid impact of retirement of the Montrose units should be minimal. Retirement of any of the larger KCP&L coal fired generators would necessitate the replacement of that supply with some other resource. It is not possible to identify the necessary transmission upgrades that might be associated with retirement of a specific generating unit without knowing the specific location of the replacement generation. From the transmission perspective, the most advantageous location for replacement generation is the site of the retired generation where the transmission capacity utilized by the retired generation would be available for new resources.

#### **8.5 DISTRIBUTED GENERATION POTENTIAL**

Analyze and document the range of potential levels of distributed generation in KCP&L's service territory for the 20-year planning horizon and the potential impacts of each identified level of distributed generation, and in particular distributed solar generation, on KCP&L's preferred resource plan. The potential impacts should quantify both the amount of electrical energy the distributed generation is expected to provide to the grid and the amount of electrical energy that the distributed generation customers are expected to consume on site that will offset the amount that the company would normally provide to those customers.

HC

**Response:**

**Distributed Solar PV Generation**

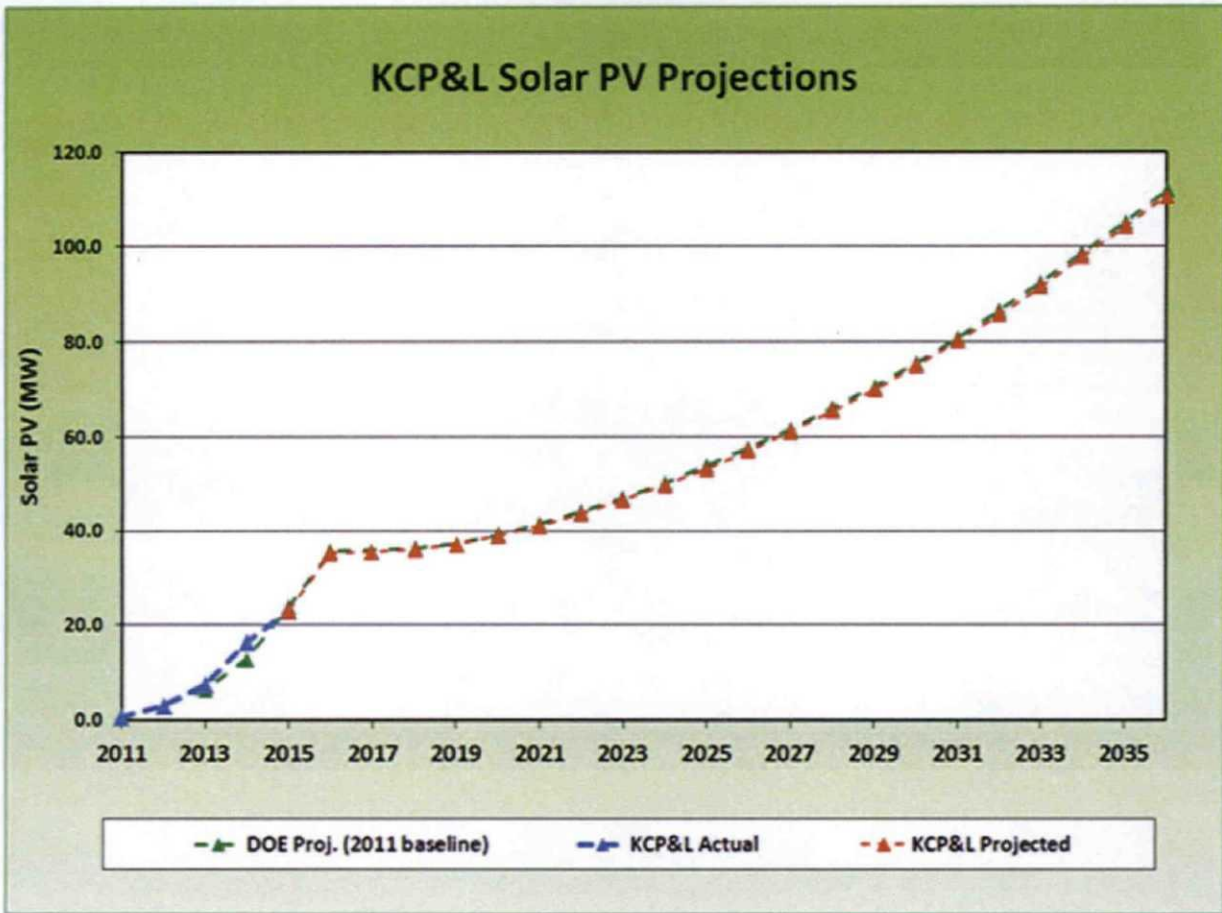
There is a substantial amount of uncertainty regarding distributed solar PV generation over a 20 year planning horizon. Nearly 100% of KCP&L's existing distributed solar generation is attributed to the Missouri law in which KCP&L paid up to \$2.00/watt in rebates for Missouri customer installed solar generation. Pursuant to that Missouri law, a one-time rebate cap was established not to exceed \$36.5M. KCP&L has currently committed solar rebates to the one-time cap. Distributed solar generation installations have reached a peak in 2014 with 9.1 MW of installed capacity. Subsequent to the rebate level decline to \$1.50 and \$1.00, 6.67 MW of solar generation was installed in 2015 within the combined KCP&L service territory.

As of 2015 year end, KCP&L and its customers had 23.08 MW of distributed solar generation installed producing an estimated 33.4 GWH (@ 16.5% load factor) of which 8.2 GWH were exported to the grid and the remaining 25.2 GWH being consumed onsite by the customer.

The KCP&L load forecast includes a projection of distributed solar generation throughout the 20 year planning horizon. The end-use level load forecasts were developed using both primary PV data collected by KCP&L and secondary data and projections of PV adoption produced by the U.S. Department of Energy (DOE) for the West North Central Region of the U.S. DOE updates its projections at least once a year and we use the most recently available projections whenever we update our models.

Table 55 illustrates the historical growth and the level of distributed solar PV generation included in the current load forecast relative to the DOE forecasted growth for the region.

Table 55: KCP&L Solar PV Projections



Due to the uncertainty of future PV adoption rates without rebates and other incentives, KCP&L is participating in a 2016 EPRI supplemental research project, 'Forecasting Residential Solar Photovoltaic Adoption', which seeks to develop methods for forecasting PV adoption. KCP&L will continue to track the development and cost of distributed generation and use the results of this EPRI project as well as the intake of Net Metering applications for future resource planning.

#### **Distributed Combined Heat & Power Generation (CHP)**

In the DSM Resource Potential Study conducted by Navigant for the KCP&L MO service territory in preparation for the 2015 Triennial IRP filing, Navigant conducted an analysis of

CHP systems to identify opportunities for this technology. Navigant evaluated the cost effectiveness of CHP systems driven by a range of prime movers, system configurations, and usage levels. Steam turbines and gas turbines were the only technologies to pass the TRC test. Navigant found that no systems passed a participant test without incentives. However, Navigant found that when incentives on par with those offered elsewhere in the U.S. were included, the system that passed the TRC screen also passed the participant test. With incentives, Navigant determined that, for the KCP&L MO service area, 30.4 MW of capacity reduction from CHP was realistically achievable over a 20 year planning horizon.

While KCP&L did not incorporate a specific CHP incentive program for the 2016-2018 MEEIA implementation cycle, CHP projects will be considered in the Business Energy Efficiency Rebate – Custom Program. KCP&L and the implementation contractor will work with customers interested in CHP to determine project costs, cost-effectiveness, tax credits, and financing options.

In 2015, KCP&L engaged the Applied Energy Group (AEG) to conduct a Demand Side Management (DSM) Resource Potential Study which will be used in developing the 2018 Triennial IRP. AEG will reevaluate the potential for CHP technologies as a distributed generation resource.

### **Other Distributed Generation Technologies**

KCP&L monitors the economic viability and potential impact other emerging distributed generation technologies (wind, bio, fuel cells, etc.). Currently we do not project that any other distributed generation technologies will be adopted at a significant enough level to have a measurable impact throughout the 20 year planning horizon.

## 8.6 ENERGY EFFICIENCY FINANCING

Review the options available to KCP&L for providing customer financing for energy efficiency measures. Discuss KCP&L's current, near term (next three years) and long-term activities and plans for providing customer financing for energy efficiency measures.

### **Response:**

KCP&L currently has no programs in place to provide direct customer financing for energy efficiency measures. The current KCP&L CIS system is not designed to support this financing process functionality. The Company is, however, currently in development of a new CIS platform that could potentially handle such processes. If the ongoing exploration and program evaluation indicates this offering is advantageous, the financing option will be investigated further.

In Q4 2015, KCP&L hosted several residential customer panelist discussions and surveys across the service territory. One of the questions inquired about interest in on-bill financing for residential HVAC systems. Of the 784 panelists who completed the survey, only about 25% expressed interest. Those who were interested were mainly-college educated, 35-84 years old, employed full time with a 'mid-level' income. These results align with those of the American Council for an Energy-Efficient Economy (ACEEE) research on utility financing. ACEEE found that "homeowner financing programs historically draw low participation rates and tend to attract educated and higher income-level homeowners who are the least in need of financing opportunities. Financing for those who are most in need, people with low or fixed incomes and poor credit, has had low success" – <http://aceee.org/topics/energy-efficiency-financing>.

Note that while KCP&L does not currently offer a financing option, there are other financing opportunities and funding sources available to the Company's customer base and encourages customers to explore these options. In fact, options like PACE or local, State or Federal

funding have been promoted on the KCP&L Energy Efficiency website. Some examples of potential financing options are:

- Energy Service Company (ESCO) financing
- Manufacturer direct financing for various energy efficient appliances
- Local Distributors and Contractors loans through private outside lenders
- Property-Assessed Clean Energy Programs (PACE) –financing Energy Efficiency and Renewables on commercial private property; to be repaid over 10-20 years through property assessments and paid as addition to the property tax bills. They are in the process of evaluating the option of offering to residential customers as well.
- Energy Loan Program (Sponsored by the DOE) – Available to public schools, colleges, city/county gov. buildings, public water and wastewater treatment facilities and public/private non-profit hospitals; 2016 FY interest rate set at 2.75%.

In the near-term, KCP&L will continue to monitor the marketplace and performance of the MEEIA programs. If the Company determines that additional financing options are needed to meet the Company's goals, the Company will then consider additional financing options including a deeper assessment of the new CIS platform functionality and the possibility of incorporating this mechanism into the program.

Long-term, KCP&L will continue as discussed above, and will keep current on market trends and how/if the Company needs to adjust the current program offerings, including the offering of a customer financing option.

## 8.7 CLEAN POWER PLAN COMPLIANCE

Describe how the preferred plan of the Company's last and current annual or triennial Integrated Resource Plans (IRPs) positions the utility for full or partial compliance with the U.S. Environmental Protection Agency's (EPA) Clean Power Plan (CPP) under Section 111(d) of the Clean Air Act, as released in final form on August 3, 2015. Please include in this regard:

(1). An evaluation of how renewable energy, energy efficiency and other demand-side resources (including combined heat and power) deployed by the Company after January 1, 2013 could contribute to compliance;

Since Missouri and Kansas would likely adopt a mass-based CPP compliance structure, actions previously taken by the company that reduce CO<sub>2</sub> emissions related to retail load, (renewable generation additions, DSM program development, etc.) would only indirectly contribute to CPP compliance. These activities would not create CO<sub>2</sub> credits like they would under a rate-based compliance structure.

(2). An evaluation of how renewable energy and energy efficiency and other demand-side resources (including combined heat and power) deployed by the Company after the submission of a final State Implementation Plan could qualify under EPA's proposed Clean Energy Investment Program (CEIP);

As shown in the Preferred Plan, the Company is currently expecting to add 10 MW of solar resources and increasing levels of Energy Efficiency programs over the 20-year planning period.

There are no current plans to add renewable resources that would qualify under the CEIP. The integrated analysis indicated that new wind resources added in this period would not be economic. Any energy efficiency measures that might qualify under the CEIP would not create CO<sub>2</sub> credits the Company could use for CPP compliance under a mass-based compliance structure.

(3). A description of additional investments (in fiscal, capacity, and energy terms by year) which will be required by the Company to meet the targets in the CPP under scenarios including: a statewide rate-based or mass-based emissions goal; a “trading-ready” approach; and participation in the CEIP;

Based on many assumptions that are subject to change, no significant investments are required for CPP compliance. The Company currently anticipates minor investments to allow for potential year-round operation of gas-fired generation.

(4). The barriers to achieving these additional investments;

At this time, the Company does not anticipate any barriers in achieving these minor investments.

(5). The price of carbon used by the Company in the analyses above; and

The carbon forecasts used by the Company are provided in Section 3 above.

(6). An indication of the Company’s preferences regarding various compliance options under a state implementation plan. ;

The Company prefers a mass-based approach without offsets and a carbon trading market.

## **8.8 SOLAR ASSESSMENT**

Describe any assessment of the value of solar (VOS) performed or used by the Company specifically for its Missouri service territory.

### **Response:**

The current Missouri laws established with HB142 are built on a Net Metering model, therefore a VOS study has not been considered.

## **8.9     TRANSMISSION GRID IMPACTS**

Analyze and document the cost of any transmission grid upgrades or additions needed to address transmission grid reliability, stability, or voltage support impacts that could result from the retirement of any existing KCP&L coal-fired generating unit.

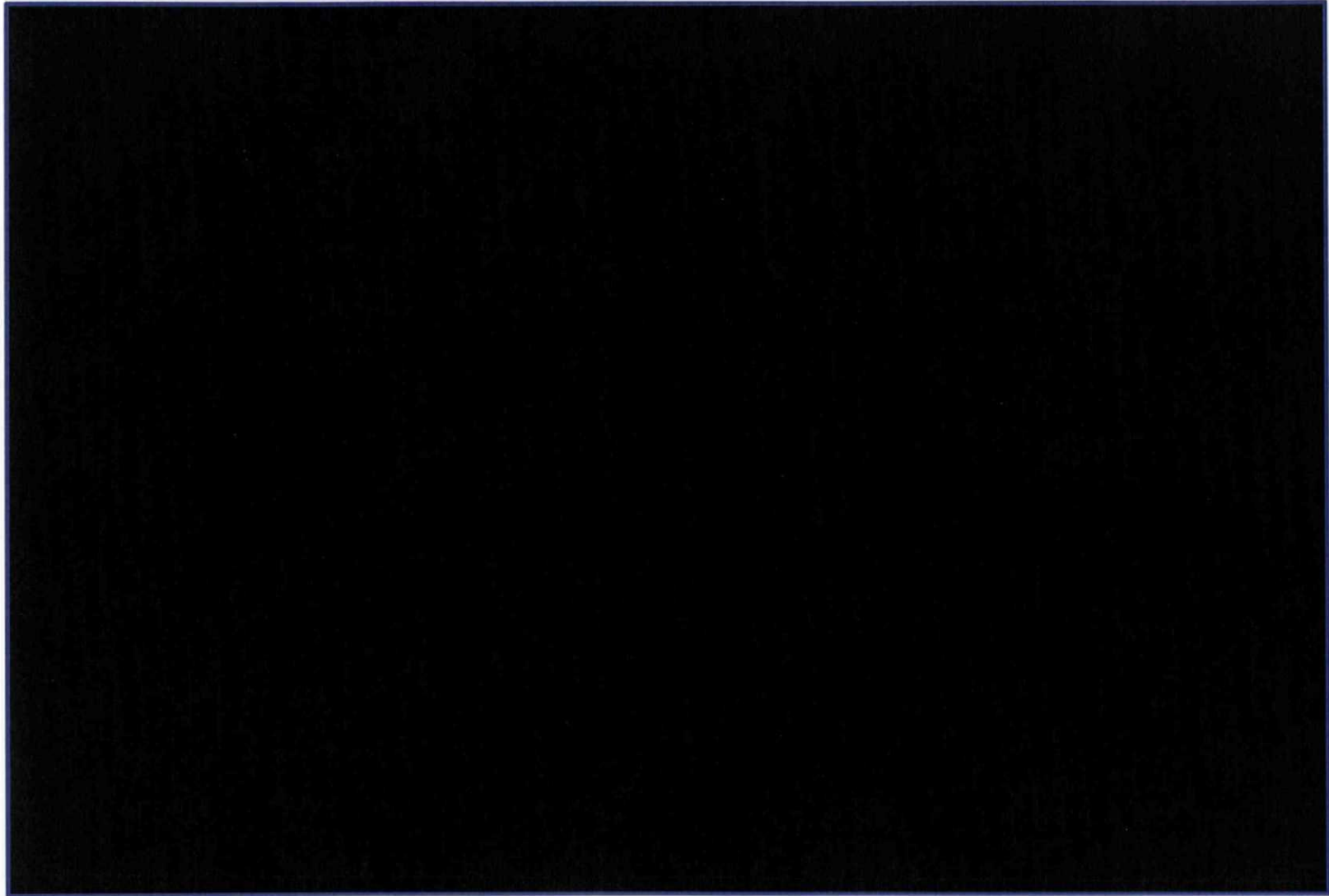
**Response:** See response to Special Contemporary Issue 8.4 above.

## **8.10    GENERATION COST AND PERFORMANCE DATA**

Analyze and document cost and performance information sufficient to fairly analyze and compare utility scale wind and solar resources, including distributed generation, to other supply-side alternatives.

**Response:** Utilizing cost and operating data obtained from Electric Power Research Institute Technical Assessment Guide (EPRI-TAG®), the Energy Information Administration, and recently obtained market intelligence, an analysis comparing supply-side resources including utility solar, utility scale wind and distributed generation options is provided in Table 56 below:

**Table 56: Supply Side Technology Analysis \*\* Highly Confidential \*\***



#### **8.11    IMPACT OF EMERGING ENERGY EFFICIENCY TECHNOLOGIES**

Analyze the impact of emerging energy efficiency technologies throughout the planning period.

**Response:** See response to Special Contemporary Issue 8.1 above.