VOLUME 6

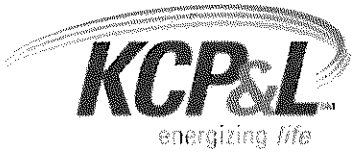
INTEGRATED RESOURCE ANALYSIS

KCP&L GREATER MISSOURI OPERATIONS COMPANY (GMO)

INTEGRATED RESOURCE PLAN

4 CSR 240-22.060

APRIL, 2015



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VOLUME 6: INTEGRATED RESOURCE ANALYSIS

PURPOSE: This rule requires the utility to design alternative resource plans to meet the planning objectives identified in 4 CSR 240-22.010(2) and sets minimum standards for the scope and level of detail required in resource plan analysis, and economically equivalent analysis of alternative resource plans. This rule also requires the utility to identify the critical uncertain factors that affect the performance of alternative resource plans and establishes minimum standards for the methods used to assess the risks associated with these uncertainties.

SECTION 1: RESOURCE PLANNING OBJECTIVES

(1) Resource Planning Objectives. The utility shall design alternative resource plans to satisfy at least the objectives and priorities identified in 4 CSR 240-22.010(2). The utility may identify additional planning objectives that alternative resource plans will be designed to meet. The utility shall describe and document its additional planning objectives and its guiding principles to design alternative resource plans that satisfy all of the planning objectives and priorities.

The fundamental objective of all the alternative resource plans is to provide the public with energy services that are safe reliable and efficient. The plans comply with current legal mandates in a manner that serves the public interest and is consistent with state energy and environmental policies.

All of the Alternative Resource Plans developed for the IRP are based upon the impact of future renewable generation requirements for Kansas City Power & Light Greater Missouri Operating Company (GMO). In Missouri, these requirements are based on Rule 4 CSR 240-20.100 which requires that an electric utility's compliance with the Renewable Energy Standard (RES) is based on total retail electric sales, or total retail electric energy usage, delivered in each

year to its Missouri retail customers. The specific RES requirements are provided in Section 3.1 (A) 1.

Other items that drove plan selection for this filing are the impact of demand side management (DSM) programs, potential coal unit retirements, choice of alternative generation, natural gas conversion, imposition of environmental rules, and the Southwest Power Pool's capacity market requirements. Other factors were also analyzed, but were determined not critical to the selection of alternative resource plans. Details of these additional factors and how they were examined are given in Section 5: of this volume.

As required by Rule 22.010(2), demand-side resources were analyzed on an equivalent basis with supply-side resources.

Net present value of revenue requirements (NPVRR) of each plan including probable environmental costs (PEC) was calculated. Minimization of NPVRR with PEC was used as the primary criteria for determination of the ordinal preference of a particular plan. Risks associated with critical uncertain factors, those associated with new or more stringent legal mandates are included in the integrated analysis of the resource planning process. Rate increases associated with the alternative resource plans are determined in the analysis as well. All performance measures are detailed in Section 2: of this document.

SECTION 2: PERFORMANCE MEASURES

(2) Specification of Performance Measures. The utility shall specify, describe, and document a set of quantitative measures for assessing the performance of alternative resource plans with respect to resource planning objectives.

(A) These performance measures shall include at least the following:

1. Present worth of utility revenue requirements, with and without any rate of return or financial performance incentives for demand-side resources the utility is planning to request;

Annual Revenue Requirement is calculated by totaling all expenses of the company in a year plus the return on rate base. The rate base increases as capital expenditures grow and plant is placed into service, but is reduced by depreciation and amortization of assets. This measure includes the total cost of operation of the company and any costs associated with probable environmental compliance.

The NPVRR is calculated by applying the discount rate consistent with rule 4 CSR 240-22.060 (2) (B) to the future estimated Annual Revenue Requirement to estimate the total future requirement on a present value basis. This value is the primary measure of a plan's financial performance.

DSM expenditures have been expensed in the year that they are incurred, so there is no increase to rate base for these outlays. The impact of DSM assumed financial performance incentives has been shown in the performance measures.

2. Present worth of probable environmental costs;

The Present Worth of Probable Environmental Costs are determined by removing all capital and O&M costs from future environmental retrofits to estimate the cost of utility operations absent environmental expenditures. These

results are compared to the NPVRR of the plans with environmental costs to determine the cost of these laws on total company operation and financial performance.

CO_2 credits are assumed to be a market risk. In the integrated analysis, endpoints contain different assumptions of CO_2 credit prices or no CO_2 market at all. Therefore the analysis of plans without PEC is calculated both with and without a CO_2 market.

3. Present worth of out-of-pocket costs to participants in demand-side programs and demand-side rates;

The cost of DSM programs is an input to the integrated analysis. As such it is an exogenous driver of each plan and does not exhibit variability within the analysis of an individual plan. The present value of these programs is calculated using the estimated future costs of the programs and applying the discount rate consistent with rule 4 CSR 240-22.060 (2) (B).

4. Levelized annual average rates;

Annual average rates are calculated by dividing the total estimated annual revenue requirement, calculated as described earlier in this section, by the forecasted total retail energy sales volume. The levelized value is the simple average of the 20-year estimate of annual rates.

5. Maximum single-year increase in annual average rates;

Single year increases (and decreases) in rates are developed as year-over-year percent change to the rate calculation as described earlier in this section. The Maximum value is determined from the highest year-over-year percent change.

6. Financial ratios (e.g., pretax interest coverage, ratio of total debt to total capital, ratio of net cash flow to capital expenditures) or other credit metrics indicative of the utility's ability to finance alternative resource plans; and

The company uses three financial metrics; pretax times interest earned, total debt to total capital and free cash flow to capital expenditures.

7. Other measures that utility decision makers believe are appropriate for assessing the performance of alternative resource plans relative to the planning objectives identified in 4 CSR 240-22.010(2).

The Company finds that the required financial measures provide an appropriate indication of financial performance. No additional measures are proposed.

(B) All present worth and levelization calculations shall use the utility discount rate and all costs and benefits shall be expressed in nominal dollars.

For all purposes in this analysis, a discount rate of 8.090% has been utilized.

SECTION 3: ALTERNATIVE RESOURCE PLANS

(3) Development of Alternative Resource Plans. The utility shall use appropriate combinations of candidate demand-side resources and supply-side resources to develop a set of alternative resource plans, each of which is designed to achieve one (1) or more of the planning objectives identified in 4 CSR 240-22.010(2). Demand-side resources are the demand-side candidate resource options and portfolios developed in 4 CSR 240-22.050(6). Supply-side resources are the supply-side candidate resource options developed in 4 CSR 240-22.040(4). The goal is to develop a set of alternative plans based on substantively different mixes of supply-side resources and demand-side resources and variations in the timing of resource acquisition to assess their relative performance under expected future conditions as well as their robustness under a broad range of future conditions.

Alternative Resource Plans were developed using a combination of various capacities of supply-side resources, demand-side resources, and various resource addition timing.

3.1 DEVELOPMENT OF ALTERNATIVE RESOURCE PLANS

(A) The utility shall develop, and describe and document, at least one (1) alternative resource plan, and as many as may be needed to assess the range of options for the choices and timing of resources, for each of the following cases. Each of the alternative resource plans for cases pursuant to paragraphs (3)(A)1.–(3)(A)5. shall provide resources to meet at least the projected load growth and resource retirements over the planning period in a manner specified by the case. The utility shall examine cases that—

1. Minimally comply with legal mandates for demand-side resources, renewable energy resources, and other mandated energy resources. This constitutes the compliance benchmark resource plan for planning purposes;

All Alternative Resource Plans comply with the renewable energy mandates (Missouri Renewable Energy Standard) and demand-side mandates excluding the Persistence DSM found in Alternative Resource plan GBBDA.

A recap of the RES model supporting renewable non-solar additions is provided in Table 1 below.

Table 1: GMO Non-Solar Renewable Requirements

Year	Retail Electric Sales	RES Requirement	GMO Requirement	GMO Renewable Generation	Future Renewable Additions
	MWh		MWh	MWh	MW
2015	8,719,081	4.90%	427,235	359,356	
2016	8,816,783	4.90%	432,022	356,856	
2017	8,880,546	4.90%	435,147	1,483,217	260
2018	8,944,678	9.80%	876,578	1,484,071	
2019	9,009,227	9.80%	882,904	1,616,027	50
2020	9,081,103	9.80%	889,948	1,616,027	
2021	9,142,765	14.70%	1,343,986	1,616,027	
2022	9,217,794	14.70%	1,355,016	1,616,027	
2023	9,295,070	14.70%	1,366,375	1,616,027	
2024	9,380,424	14.70%	1,378,922	1,616,027	
2025	9,453,083	14.70%	1,389,603	1,616,027	
2026	9,535,982	14.70%	1,401,789	1,616,027	
2027	9,622,928	14.70%	1,414,570	1,616,027	
2028	9,719,941	14.70%	1,428,831	1,616,027	
2029	9,800,646	14.70%	1,440,695	1,616,027	
2030	9,981,272	14.70%	1,467,247	1,616,027	
2031	10,073,381	14.70%	1,480,787	1,616,027	
2032	10,174,788	14.70%	1,495,694	1,299,131	
2033	10,258,089	14.70%	1,507,939	999,293	
2034	10,352,181	14.70%	1,521,771	999,293	

2. Utilize only renewable energy resources, up to the maximum potential capability of renewable resources in each year of the planning horizon, if that results in more renewable energy resources than the minimally compliant plan. This constitutes the aggressive renewable energy resource plan for planning purposes;

Alternative Resource Plan GBBCW was developed to meet this rule.

3. Utilize only demand-side resources, up to the maximum achievable potential of demand-side resources in each year of the planning horizon, if that results in more demand-side resources than the minimally compliant plan. This constitutes the aggressive demand-side resource plan for planning purposes;

Any Alternative Resource Plan that has a letter "A" as the fourth character is utilized Maximum Achievable Potential DSM.

4. In the event that legal mandates identify energy resources other than renewable energy or demand-side resources, utilize only the other energy resources, up to the maximum potential capability of the other energy resources in each year of the planning horizon, if that results in more of the other energy resources than the compliance benchmark resource plan. For planning purposes, this constitutes the aggressive legally-mandated other energy resource plan;

No other legal mandates have been identified.

5. Optimally comply with legal mandates for demand-side resources, renewable energy resources, and other targeted energy resources. This constitutes the optimal compliance resource plan, where every legal mandate is at least minimally met, but some resources may be optimally utilized at levels greater than the mandated minimums;

All Alternative Resource Plans comply with the renewable energy mandates (Missouri Renewable Energy Standard) and demand-side mandates excluding the Persistence DSM found in Alternative Resource Plan GBBDA.

6. Any other plan specified by the commission as a special contemporary issue pursuant to 4 CSR 240-22.080(4);

No Alternative Resource Plans were required to evaluate any special contemporary issues.

7. Any other plan specified by commission order; and

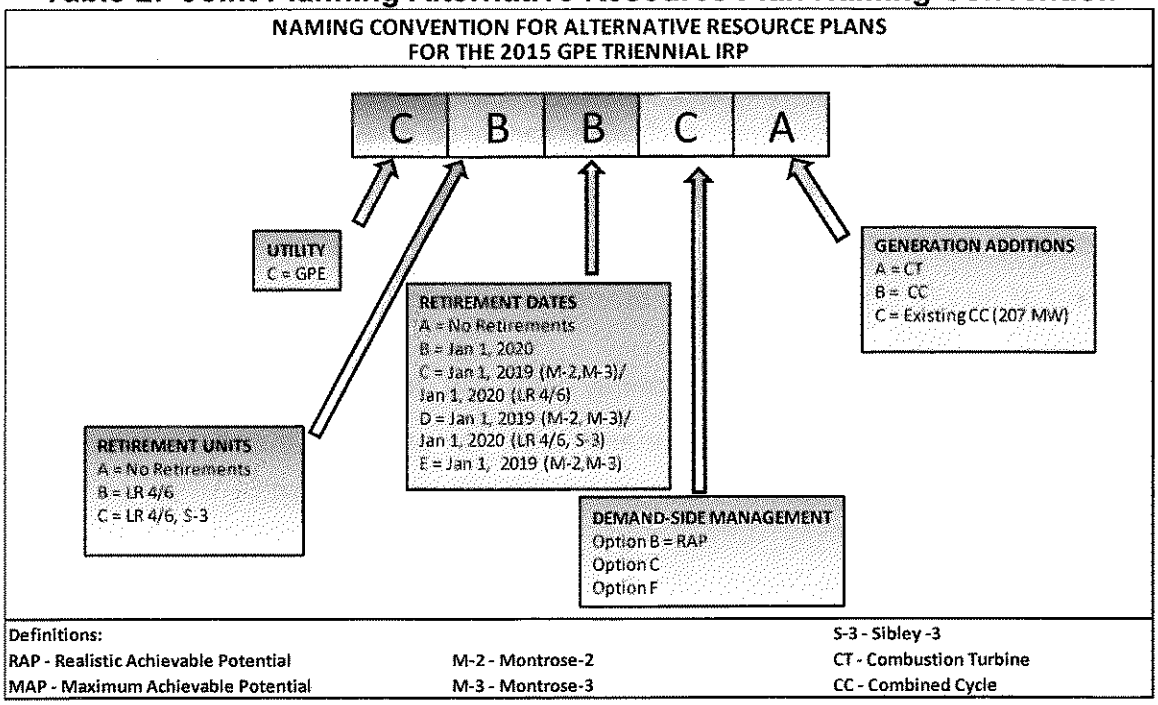
There are no other plans specified by commission order.

8. Any additional alternative resource plans that the utility deems should be analyzed.

GMO also considers prudent resource planning to develop and analyze alternative resource plans that are based upon GMO and KCP&L 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.

Alternative Resource Plans were developed using a combination of various supply-side sources, demand-side resources and various resource addition timing. The plan-naming convention utilized for the joint planning Alternative Resource Plans developed is shown in Table 2 below:

Table 2: Joint Planning Alternative Resource Plan Naming Convention



Various joint company Alternative Resource Plans were derived and an overview of each is provided in the tables below. It should be noted that each joint planning Alternative Resource Plan assumes cease burning coal at Montrose Units 1, 2, and 3, and Sibley Units 1 and 2.

Table 3: Overview of Joint Planning Alternative Resource Plans

Plan Name	DSM Level	Facility	Year to Cease Burning Coal	Renewable Additions		Generation Addition (if needed)
CAEFA	Option F	Sibley-1 Sibley-2 Lake Road 4/6 Montrose-1 Montrose-2 Montrose-3	2019 2019 Convert to Gas 2016 2019 2019	Solar: 2016 - 8 MW 2026 - 12 MW	Wind: 2016 - 350 MW 2017 - 560 MW 2019 - 50 MW	207 MW CT in 2031
CBBFA	Option F	Sibley-1 Sibley-2 Lake Road 4/6 Montrose-1 Montrose-2 Montrose-3	2019 2019 2020 2016 2021 2021	Solar: 2016 - 8 MW 2026 - 12 MW	Wind: 2016 - 350 MW 2017 - 560 MW 2019 - 50 MW	207 MW CT in 2029 207 MW CT in 2033
CBCFA	Option F	Sibley-1 Sibley-2 Lake Road 4/6 Montrose-1 Montrose-2 Montrose-3	2019 2019 2020 2016 2019 2019	Solar: 2016 - 8 MW 2026 - 12 MW	Wind: 2016 - 350 MW 2017 - 560 MW 2019 - 50 MW	207 MW CT in 2020 207 MW CT in 2033
CBCFC	Option F	Sibley-1 Sibley-2 Lake Road 4/6 Montrose-1 Montrose-2 Montrose-3	2019 2019 2020 2016 2019 2019	Solar: 2016 - 8 MW 2026 - 12 MW	Wind: 2016 - 350 MW 2017 - 560 MW 2019 - 50 MW	207 MW Existing CC in 2016 207 MW CT in 2033
CCDFC	Option F	Sibley-1 Sibley-2 Sibley-3 Lake Road 4/6 Montrose-1 Montrose-2 Montrose-3	2019 2019 2020 2020 2016 2019 2019	Solar: 2016 - 8 MW 2026 - 12 MW	Wind: 2016 - 350 MW 2017 - 560 MW 2019 - 50 MW	207 MW Existing CC in 2016 414 MW CT in 2020 207 MW CT in 2034

Table 4: Overview of Joint Planning Alternative Resource Plans (continued)

Plan Name	DSM Level	Facility	Year to Cease Burning Coal	Renewable Additions		Generation Addition (if needed)
CBCCA	Option C	Sibley-1 Sibley-2 Lake Road 4/6 Montrose-1 Montrose-2 Montrose-3	2019 2019 2020 2016 2019 2019	Solar: 2016 - 8 MW 2026 - 12 MW	Wind: 2016 - 350 MW 2017 - 560 MW 2019 - 50 MW	207 MW CT in 2019 207 MW CT in 2026 207 MW CT in 2030 207 MW CT in 2034
CBCCC	Option C	Sibley-1 Sibley-2 Lake Road 4/6 Montrose-1 Montrose-2 Montrose-3	2019 2019 2020 2016 2019 2019	Solar: 2016 - 8 MW 2026 - 12 MW	Wind: 2016 - 350 MW 2017 - 560 MW 2019 - 50 MW	207 MW Existing CC in 2016 207 MW CT in 2026 207 MW CT in 2030 207 MW CT in 2034
CCDCC	Option C	Sibley-1 Sibley-2 Sibley-3 Lake Road 4/6 Montrose-1 Montrose-2 Montrose-3	2019 2019 2020 2020 2016 2019 2019	Solar: 2016 - 8 MW 2026 - 12 MW	Wind: 2016 - 350 MW 2017 - 560 MW 2019 - 50 MW	207 MW Existing CC in 2016 414 MW CT in 2020 207 MW CT in 2027 207 MW CT in 2031

All plans assuming joint planning were each subjected to similar analysis as the integrated analysis for each of the stand-alone company plans. The resulting expected value NPVRR for each of the joint planning Alternative Resource Plans is detailed in the table below.

Table 5: Joint Planning Alternative Resource Plan Results

Total Revenue Requirement			
Rank	Plan	NPVRR ($mm)	Delta
1	CBBFA	29,106.38	0.00
2	CAEFA	29,153.90	47.53
3	CCDFC	29,181.08	74.70
4	CBCFA	29,195.77	89.39
5	CBCFC	29,216.81	110.43
6	CCDCC	29,229.79	123.42
7	CBCCA	29,274.40	168.02
8	CBCCC	29,281.86	175.49

(B) The alternative resource plans developed at this stage of the analysis shall not *include load-building programs, which shall be analyzed as required by 4 CSR 240-22.070(5).*

No load-building programs have been included as a resource in any alternative resource plan.

(C) The utility shall include in its development of alternative resource plans the impact of—

1. The potential retirement or life extension of existing generation plants;

GMO announced on January 20, 2015 that Sibley-1 and Sibley-2 will cease burning coal by 2020. Cease burning coal options were evaluated in the Alternative Resource Plans for Lake Road 4/6 and Sibley 3.

2. The addition of equipment and other retrofits on generation plants to meet environmental requirements; and

Retrofits and other action potentially expected to be required to comply with currently proposed environmental regulations and assumed compliance dates are modeled for GMO's remaining coal units. The following table provides current assumptions regarding these expected environmental regulations and the retrofits and actions assumed to meet compliance.

Table 6: Retrofits and Actions due to Environmental Regulations

Environmental Driver	Emittant	Compliance Year (Expected)	Status	Retrofit
Mercury and Air Toxics Standards (MATS)	Mercury, PM, HCl	April, 2016	Judicial review ongoing.	ACI, ESP Improvements, Low Chlorine Coal
Ozone National Ambient Air Quality Standards (O_3 NAAQS)	NO_x	(2021)	Under revision by EPA, final rule October 2015	SNCR (LR 4/6)
PM National Ambient Air Quality Standards (PM NAAQS)	PM, SO_2, NO_x	(2023)	Final rule issued - KC area in attainment	SCR (on all units)
SO_2 National Ambient Air Quality Standards (SO_2 NAAQS)	SO_2	(2020-2023)	Final Rule issued - KC area attainment/nonattainment currently undetermined	Scrubber/BH (on all units)
Clean Water Act 316(b) (Fish Impingment)	-	(2016-2020)	Final rule issued, judicial review ongoing	Fish Friendly Screens
Clean Water Act 316(b) (Fish Entrainment)	-	(2020)	Final rule issued, judicial review ongoing	Cooling Towers
Clean Water Act 316(a) (Thermal Discharge)	-	(2019-2024)	KCP&L in discussion with MDNR/EPA	Cooling Towers (river units earlier, lake units later)
Effluent Guidelines	Wastewater Constituents	(2018-2023)	Final Rule September 2015	Cease Wet Sluicing
Coal Combustion Residual (CCR)	Ash/Water	(2018-2019)	Final Rule December 2014	Cease Wet Sluicing/Increased Dust Controls

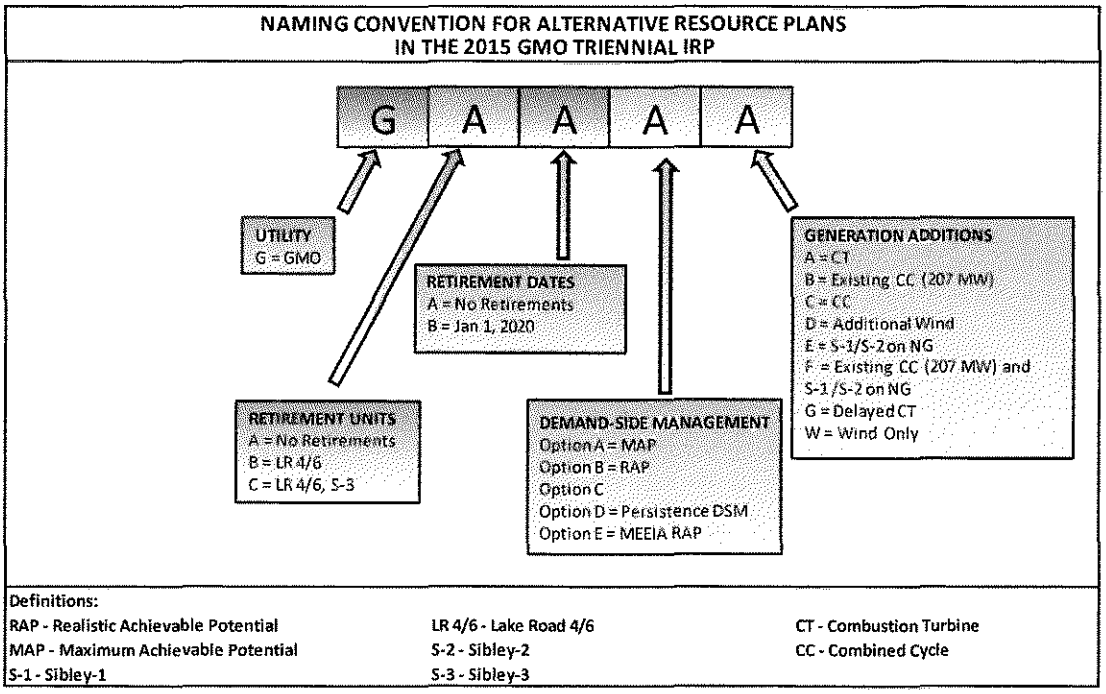
3. The conclusion of any currently implemented demand-side resources.

Alternative Resource Plan GBBDA was developed to evaluate this rule.

(D) The utility shall provide a description of each alternative resource plan including the type and size of each demand-side resource and supply-side resource addition and a listing of the sequence and schedule for the end of life of existing resources and for the acquisition of each new resource.

Alternative Resource Plans were developed using a combination of various capacities of supply-side resources, demand-side resources, and resource addition quantities and timing differences. The plan-naming convention utilized for GMO's alternative resource plans developed is shown in Table 7 below:

Table 7: Alternative Resource Plan Naming Convention



In total, twenty-five Alternative Resource Plans were developed for the integrated resource analysis. The following tables provide an overview of the Alternative Resource Plans. Note that wind and solar additions shown are based on

nameplate capacity. Each individual plan is shown in Table 15 through Table 39 below.

Table 8: Overview of Alternative Resource Plans

Plan Name	DSM Level	Facility	Year to Cease Burning Coal	Renewable Additions		Generation Addition (if needed)
GAAAA	Option A - MAP	Sibley-1 Sibley-2	2019	Solar: 2016 - 5 MW 2026 - 5 MW	Wind: 2017 - 260 MW 2019 - 50 MW	n/n
GBBAA	Option A - MAP	Sibley-1 Sibley-2	2019	Solar: 2016 - 5 MW 2026 - 5 MW	Wind: 2017 - 260 MW 2019 - 50 MW	n/n
		Lake Road 4/6	2020 (convert to NG in 2016)			
GCBAA	Option A - MAP	Sibley-1 Sibley-2	2019	Solar: 2016 - 5 MW 2026 - 5 MW	Wind: 2017 - 260 MW 2019 - 50 MW	n/n
		Lake Road 4/6	2020 (convert to NG in 2016)			
		Sibley-3	2020			

Table 9: Overview of Alternative Resource Plans (continued)

Plan Name	DSM Level	Facility	Year to Cease Burning Coal	Renewable Additions		Generation Addition (if needed)
GAABA	Option B	Sibley-1 Sibley-2	2019	Solar: 2016 - 5 MW 2026 - 5 MW	Wind: 2017 - 260 MW 2019 - 50 MW	n/n
GBBBA	Option B	Sibley-1 Sibley-2	2019	Solar: 2016 - 5 MW 2026 - 5 MW	Wind: 2017 - 260 MW 2019 - 50 MW	n/n
		Lake Road 4/6	2020 (convert to NG in 2016)			
GBBBB	Option B	Sibley-1 Sibley-2	2019	Solar: 2016 - 5 MW 2026 - 5 MW	Wind: 2017 - 260 MW 2019 - 50 MW	207 MW Existing CC in 2016
		Lake Road 4/6	2020 (convert to NG in 2016)			
GCBBA	Option B	Sibley-1 Sibley-2	2019	Solar: 2016 - 5 MW 2026 - 5 MW	Wind: 2017 - 260 MW 2019 - 50 MW	414 MW CT in 2020
		Lake Road 4/6	2020 (convert to NG in 2016)			
		Sibley-3	2020			

Table 10: Overview of Alternative Resource Plans (continued)

Plan Name	DSM Level	Facility	Year to Cease Burning Coal	Renewable Additions		Generation Addition (if needed)
GAACA	Option C	Sibley-1 Sibley-2	2019	Solar: 2016 - 5 MW 2026 - 5 MW	Wind: 2017 - 260 MW 2019 - 50 MW	207 MW CT in 2016 207 MW CT in 2030
GAACB	Option C	Sibley-1 Sibley-2	2019	Solar: 2016 - 5 MW 2026 - 5 MW	Wind: 2017 - 260 MW 2019 - 50 MW	207 MW Existing CC in 2016 207 MW CT in 2030
GAACE	Option C	Convert to NG: Sibley-1 Sibley-2	2019	Solar: 2016 - 5 MW 2026 - 5 MW	Wind: 2017 - 260 MW 2019 - 50 MW	207 MW CT in 2016 207 MW CT in 2034
GAACF	Option C	Convert to NG: Sibley-1 Sibley-2	2019	Solar: 2016 - 5 MW 2026 - 5 MW	Wind: 2017 - 260 MW 2019 - 50 MW	207 MW Existing CC in 2016 207 MW CT in 2034

Table 11: Overview of Alternative Resource Plans (continued)

Plan Name	DSM Level	Facility	Year to Cease Burning Coal	Renewable Additions		Generation Addition (if needed)
GBBCA	Option C	Sibley-1 Sibley-2	2019	Solar: 2016 - 5 MW 2026 - 5 MW	Wind: 2017 - 260 MW 2019 - 50 MW	207 MW CT in 2016 207 MW CT in 2026
		Lake Road 4/6	2020 (convert to NG in 2016)			
GBBCB	Option C	Sibley-1 Sibley-2	2019	Solar: 2016 - 5 MW 2026 - 5 MW	Wind: 2017 - 260 MW 2019 - 50 MW	207 MW Existing CC in 2016 207 MW CT in 2026
		Lake Road 4/6	2020 (convert to NG in 2016)			
GBBCC	Option C	Sibley-1 Sibley-2	2019	Solar: 2016 - 5 MW 2026 - 5 MW	Wind: 2017 - 260 MW 2019 - 50 MW	200 MW CC in 2016 200 MW CC in 2025 200 MW CC in 2034
		Lake Road 4/6	2020 (convert to NG in 2016)			
GBBCD	Option C	Sibley-1 Sibley-2	2019	Solar: 2016 - 5 MW 2026 - 5 MW	Wind: 2017 - 260 MW 2019 - 150 MW	207 MW CT in 2016 207 MW CT in 2027
		Lake Road 4/6	2020 (convert to NG in 2016)			

Table 12: Overview of Alternative Resource Plans (continued)

Plan Name	DSM Level	Facility	Year to Cease Burning Coal	Renewable Additions		Generation Addition (if needed)
GBBCF	Option C	Convert to NG: Sibley-1 Sibley-2	2019	Solar: 2016 - 5 MW 2026 - 5 MW	Wind: 2017 - 260 MW 2019 - 50 MW	207 MW Existing CC in 2016 207 MW CT in 2030
		Lake Road 4/6	2020 (convert to NG in 2016)			
GBBCG	Option C	Sibley-1 Sibley-2	2019	Solar: 2016 - 5 MW 2026 - 5 MW	Wind: 2017 - 260 MW 2019 - 50 MW	207 MW CT in 2020 207 MW CT in 2026
		Lake Road 4/6	2020 (convert to NG in 2016)			
GBBCW	Option C	Sibley-1 Sibley-2	2019	Solar: 2016 - 5 MW 2026 - 5 MW	Wind: 2017 - 260 MW 2019 - 50 MW	670 MW Wind in 2016 670 MW Wind in 2026
		Lake Road 4/6	2020 (convert to NG in 2016)			
GCBCA	Option C	Sibley-1 Sibley-2	2019	Solar: 2016 - 5 MW 2026 - 5 MW	Wind: 2017 - 260 MW 2019 - 50 MW	207 MW CT in 2016 414 MW CT in 2020 207 MW CT in 2029
		Lake Road 4/6	2020 (convert to NG in 2016)			
		Sibley-3	2020			

Table 13: Overview of Alternative Resource Plans (continued)

Plan Name	DSM Level	Facility	Year to Cease Burning Coal	Renewable Additions		Generation Addition (if needed)
GCBCB	Option C	Sibley-1 Sibley-2	2019	Solar: 2016 - 5 MW 2026 - 5 MW	Wind: 2017 - 260 MW 2019 - 50 MW	207 MW Existing CC in 2016 414 MW CT in 2020 207 MW CT in 2029
		Lake Road 4/6	2020 (convert to NG in 2016)			
		Sibley-3	2020			
GCBCG	Option C	Sibley-1 Sibley-2	2019	Solar: 2016 - 5 MW 2026 - 5 MW	Wind: 2017 - 260 MW 2019 - 50 MW	621 MW CT in 2020 207 MW CT in 2029
		Lake Road 4/6	2020 (convert to NG in 2016)			
		Sibley-3	2020			
GBBDA	Option D - Persistence	Sibley-1 Sibley-2	2019	Solar: 2016 - 5 MW 2026 - 5 MW	Wind: 2017 - 260 MW 2019 - 50 MW	207 MW CT in 2016 207 MW CT in 2020 207 MW CT in 2024 207 MW CT in 2031
		Lake Road 4/6	2020 (convert to NG in 2016)			

Table 14: Overview of Alternative Resource Plans (continued)

Plan Name	DSM Level	Facility	Year to Cease Burning Coal	Renewable Additions		Generation Addition (if needed)
GBBEG	Option E - MEEIA to RAP	Sibley-1 Sibley-2	2019	Solar: 2016 - 5 MW 2026 - 5 MW	Wind: 2017 - 260 MW 2019 - 50 MW	207 MW CT in 2034
		Lake Road 4/6	2020 (convert to NG in 2016)			
GCBEB	Option E - MEEIA to RAP	Sibley-1 Sibley-2	2019	Solar: 2016 - 5 MW 2026 - 5 MW	Wind: 2017 - 260 MW 2019 - 50 MW	207 MW Existing CC in 2016 414 MW CT in 2020
		Lake Road 4/6	2020 (convert to NG in 2016)			
		Sibley-3	2020			
GCBEG	Option E - MEEIA to RAP	Sibley-1 Sibley-2	2019	Solar: 2016 - 5 MW 2026 - 5 MW	Wind: 2017 - 260 MW 2019 - 50 MW	621 MW CT in 2020
		Lake Road 4/6	2020 (convert to NG in 2016)			
		Sibley-3	2020			

These individual plans are shown in the following tables:

Table 15: Alternative Resource Plan GAAAA

Year	CT's (MW)	Wind (MW)	Solar (MW)	DSM (MW)	Retire (MW)	Existing Capacity (MW)
2015	0			55		2143
2016	0		5	82		2143
2017	0	260		172		2135
2018	0			295		2135
2019	0	50		414		2038
2020	0			530		2038
2021	0			642		2038
2022	0			755		2038
2023	0			854		2038
2024	0			953		2038
2025	0			1011		2038
2026	0		5	1067		2038
2027	0			1123		2038
2028	0			1147		2038
2029	0			1173		2038
2030	0			1196		2038
2031	0			1218		2038
2032	0			1240		2038
2033	0			1260		2038
2034	0			1263		2038

Plan GAAAA assumes LR 4/6 on N.G. by 2016, S-1 and S-2 cease burning coal in 2019. DSM: A Resource additions (if needed): CT's

Table 16: Alternative Resource Plan GBBAA

Year	CT's (MW)	Wind (MW)	Solar (MW)	DSM (MW)	Retire (MW)	Existing Capacity (MW)
2015	0			55		2143
2016	0		5	82		2143
2017	0	260		172		2135
2018	0			295		2135
2019	0	50		414		2038
2020	0			530	96	1942
2021	0			642		1942
2022	0			755		1942
2023	0			854		1942
2024	0			953		1942
2025	0			1011		1942
2026	0		5	1067		1942
2027	0			1123		1942
2028	0			1147		1942
2029	0			1173		1942
2030	0			1196		1942
2031	0			1218		1942
2032	0			1240		1942
2033	0			1260		1942
2034	0			1263		1942

Plan GBBAA assumes LR 4/6 not operating by 2020, S-1 and S-2 cease burning coal in 2019. DSM: A Resource additions (if needed): CT's

Table 17: Alternative Resource Plan GCBAA

Year	CT's (MW)	Wind (MW)	Solar (MW)	DSM (MW)	Retire (MW)	Existing Capacity (MW)
2015	0			55		2143
2016	0		5	82		2143
2017	0	260		172		2135
2018	0			295		2135
2019	0	50		414		2038
2020	0			530	460	1578
2021	0			642		1578
2022	0			755		1578
2023	0			854		1578
2024	0			953		1578
2025	0			1011		1578
2026	0		5	1067		1578
2027	0			1123		1578
2028	0			1147		1578
2029	0			1173		1578
2030	0			1196		1578
2031	0			1218		1578
2032	0			1240		1578
2033	0			1260		1578
2034	0			1263		1578

Plan GCBAA assumes LR 4/6 and S-3 not operating by 2020, S-1 and S-2, cease burning coal in 2019. DSM: A Resource additions (if needed): CT's

Table 18: Alternative Resource Plan GAABA

Year	CT's (MW)	Wind (MW)	Solar (MW)	DSM (MW)	Retire (MW)	Existing Capacity (MW)
2015	0			55		2143
2016	0		5	63		2143
2017	0	260		131		2135
2018	0			201		2135
2019	0	50		270		2038
2020	0			337		2038
2021	0			401		2038
2022	0			462		2038
2023	0			519		2038
2024	0			571		2038
2025	0			592		2038
2026	0		5	610		2038
2027	0			626		2038
2028	0			642		2038
2029	0			656		2038
2030	0			668		2038
2031	0			679		2038
2032	0			691		2038
2033	0			702		2038
2034	0			702		2038

Plan GAABA assumes LR 4/6 on N.G. by 2016, S-1 and S-2 cease burning coal in 2019. DSM: B Resource additions (if needed): CT's

Table 19: Alternative Resource Plan GBBBA

Year	CT's (MW)	Wind (MW)	Solar (MW)	DSM (MW)	Retire (MW)	Existing Capacity (MW)
2015	0			55		2143
2016	0		5	63		2143
2017	0	260		131		2135
2018	0			201		2135
2019	0	50		270		2038
2020	0			337	96	1942
2021	0			401		1942
2022	0			462		1942
2023	0			519		1942
2024	0			571		1942
2025	0			592		1942
2026	0		5	610		1942
2027	0			626		1942
2028	0			642		1942
2029	0			656		1942
2030	0			668		1942
2031	0			679		1942
2032	0			691		1942
2033	0			702		1942
2034	0			702		1942

Plan GBBBA assumes LR 4/6 not operating by 2020, S-1 and S-2 cease burning coal in 2019. DSM: B Resource additions (if needed): CT's

Table 20: Alternative Resource Plan GBBBB

Year	CC/CT's (MW)	Wind (MW)	Solar (MW)	DSM (MW)	Retire (MW)	Existing Capacity (MW)
2015	0			55		2143
2016	207		5	63		2143
2017	0	260		131		2135
2018	0			201		2135
2019	0	50		270		2038
2020	0			337	96	1942
2021	0			401		1942
2022	0			462		1942
2023	0			519		1942
2024	0			571		1942
2025	0			592		1942
2026	0		5	610		1942
2027	0			626		1942
2028	0			642		1942
2029	0			656		1942
2030	0			668		1942
2031	0			679		1942
2032	0			691		1942
2033	0			702		1942
2034	0			702		1942

Plan GBBBB assumes LR 4/6 not operating by 2020, S-1 and S-2 cease burning coal in 2019. DSM: B Purchase existing CC. Resource additions (if needed): CT's

Table 21: Alternative Resource Plan GCBBA

Year	CT's (MW)	Wind (MW)	Solar (MW)	DSM (MW)	Retire (MW)	Existing Capacity (MW)
2015	0			55		2143
2016	0		5	63		2143
2017	0	260		131		2135
2018	0			201		2135
2019	0	50		270		2038
2020	414			337	460	1578
2021	0			401		1578
2022	0			462		1578
2023	0			519		1578
2024	0			571		1578
2025	0			592		1578
2026	0		5	610		1578
2027	0			626		1578
2028	0			642		1578
2029	0			656		1578
2030	0			668		1578
2031	0			679		1578
2032	0			691		1578
2033	0			702		1578
2034	0			702		1578

Plan GCBBA assumes LR 4/6 and S-3 not operating by 2020, S-1 and S-2, cease burning coal in 2019. DSM: B Resource additions (if needed): CT's

Table 22: Alternative Resource Plan GAACA

Year	CT's (MW)	Wind (MW)	Solar (MW)	DSM (MW)	Retire (MW)	Existing Capacity (MW)
2015	0			55		2143
2016	207		5	50		2143
2017	0	260		91		2135
2018	0			116		2135
2019	0	50		124		2038
2020	0			153		2038
2021	0			176		2038
2022	0			197		2038
2023	0			202		2038
2024	0			208		2038
2025	0			216		2038
2026	0		5	223		2038
2027	0			229		2038
2028	0			236		2038
2029	0			244		2038
2030	207			251		2038
2031	0			257		2038
2032	0			262		2038
2033	0			268		2038
2034	0			274		2038

Plan GAACA assumes LR 4/6 on N.G. by 2016, S-1 and S-2 cease burning coal in 2019.
DSM: C Resource additions (if needed): CT's

Table 23: Alternative Resource Plan GAACB

Year	CC/CT's (MW)	Wind (MW)	Solar (MW)	DSM (MW)	Retire (MW)	Existing Capacity (MW)
2015	0			55		2143
2016	207		5	50		2143
2017	0	260		91		2135
2018	0			116		2135
2019	0	50		124		2038
2020	0			153		2038
2021	0			176		2038
2022	0			197		2038
2023	0			202		2038
2024	0			208		2038
2025	0			216		2038
2026	0		5	223		2038
2027	0			229		2038
2028	0			236		2038
2029	0			244		2038
2030	207			251		2038
2031	0			257		2038
2032	0			262		2038
2033	0			268		2038
2034	0			274		2038

Plan GAACB assumes S-1 and S-2 cease burning coal in 2019. DSM: C Purchase existing CC. Resource additions (if needed): CT's

Table 24: Alternative Resource Plan GAACE

Year	CT's (MW)	Wind (MW)	Solar (MW)	DSM (MW)	Retire (MW)	Existing Capacity (MW)
2015	0			55		2143
2016	207		5	50		2143
2017	0	260		91		2135
2018	0			116		2135
2019	0	50		124		2135
2020	0			153		2135
2021	0			176		2135
2022	0			197		2135
2023	0			202		2135
2024	0			208		2135
2025	0			216		2135
2026	0		5	223		2135
2027	0			229		2135
2028	0			236		2135
2029	0			244		2135
2030	0			251		2135
2031	0			257		2135
2032	0			262		2135
2033	0			268		2135
2034	207			274		2135

Plan GAACE assumes S-1 and S-2 are converted to burning nat gas in 2020. DSM: C Resource additions (if needed): CT's

Table 25: Alternative Resource Plan GAACF

Year	CC/CT's (MW)	Wind (MW)	Solar (MW)	DSM (MW)	Retire (MW)	Existing Capacity (MW)
2015	0			55		2143
2016	207		5	50		2143
2017	0	260		91		2135
2018	0			116		2135
2019	0	50		124		2135
2020	0			153		2135
2021	0			176		2135
2022	0			197		2135
2023	0			202		2135
2024	0			208		2135
2025	0			216		2135
2026	0		5	223		2135
2027	0			229		2135
2028	0			236		2135
2029	0			244		2135
2030	0			251		2135
2031	0			257		2135
2032	0			262		2135
2033	0			268		2135
2034	207			274		2135

Plan GAACF assumes are converted to burning nat gas in 2020. DSM: C Purchase existing CC. Resource additions (if needed): CT's

Table 26: Alternative Resource Plan GBBCA

Year	CT's (MW)	Wind (MW)	Solar (MW)	DSM (MW)	Retire (MW)	Existing Capacity (MW)
2015	0			55		2143
2016	207		5	50		2143
2017	0	260		91		2135
2018	0			116		2135
2019	0	50		124		2038
2020	0			153	96	1942
2021	0			176		1942
2022	0			197		1942
2023	0			202		1942
2024	0			208		1942
2025	0			216		1942
2026	207		5	223		1942
2027	0			229		1942
2028	0			236		1942
2029	0			244		1942
2030	0			251		1942
2031	0			257		1942
2032	0			262		1942
2033	0			268		1942
2034	0			274		1942

Plan GBBCA assumes LR 4/6 not operating by 2020, S-1 and S-2 cease burning coal in 2019. DSM: C Resource additions (if needed): CT's

Table 27: Alternative Resource Plan GBBCB

Year	CC/CT's (MW)	Wind (MW)	Solar (MW)	DSM (MW)	Retire (MW)	Existing Capacity (MW)
2015	0			55		2143
2016	207		5	50		2143
2017	0	260		91		2135
2018	0			116		2135
2019	0	50		124		2038
2020	0			153	96	1942
2021	0			176		1942
2022	0			197		1942
2023	0			202		1942
2024	0			208		1942
2025	0			216		1942
2026	207		5	223		1942
2027	0			229		1942
2028	0			236		1942
2029	0			244		1942
2030	0			251		1942
2031	0			257		1942
2032	0			262		1942
2033	0			268		1942
2034	0			274		1942

Plan GBBCB assumes LR 4/6 not operating by 2020, S-1 and S-2 cease burning coal in 2019. DSM: C Purchase existing CC. Resource additions (if needed): CT's

Table 28: Alternative Resource Plan GBBCC

Year	CC's (MW)	Wind (MW)	Solar (MW)	DSM (MW)	Retire (MW)	Existing Capacity (MW)
2015	0			55		2143
2016	200		5	50		2143
2017	0	260		91		2135
2018	0			116		2135
2019	0	50		124		2038
2020	0			153	96	1942
2021	0			176		1942
2022	0			197		1942
2023	0			202		1942
2024	0			208		1942
2025	200			216		1942
2026	0		5	223		1942
2027	0			229		1942
2028	0			236		1942
2029	0			244		1942
2030	0			251		1942
2031	0			257		1942
2032	0			262		1942
2033	0			268		1942
2034	200			274		1942

Plan GBBCC assumes LR 4/6 not operating by 2020, S-1 and S-2 cease burning coal in 2019. DSM: C Resource additions (if needed): CC's

Table 29: Alternative Resource Plan GBBCD

Year	CT's (MW)	Wind (MW)	Solar (MW)	DSM (MW)	Retire (MW)	Existing Capacity (MW)
2015	0			55		2143
2016	207		5	50		2143
2017	0	260		91		2135
2018	0			116		2135
2019	0	150		124		2038
2020	0			153	96	1942
2021	0			176		1942
2022	0			197		1942
2023	0			202		1942
2024	0			208		1942
2025	0			216		1942
2026	0		5	223		1942
2027	207			229		1942
2028	0			236		1942
2029	0			244		1942
2030	0			251		1942
2031	0			257		1942
2032	0			262		1942
2033	0			268		1942
2034	0			274		1942

Plan GBBCD assumes LR 4/6 not operating by 2020, S-1 and S-2 cease burning coal in 2019. DSM: C Additional 100 MW of Wind Resource additions (if needed): CT's

Table 30: Alternative Resource Plan GBBCF

Year	CC/CT's (MW)	Wind (MW)	Solar (MW)	DSM (MW)	Retire (MW)	Existing Capacity (MW)
2015	0			55		2143
2016	207		5	50		2143
2017	0	260		91		2135
2018	0			116		2135
2019	0	50		124		2135
2020	0			153	96	2039
2021	0			176		2039
2022	0			197		2039
2023	0			202		2039
2024	0			208		2039
2025	0			216		2039
2026	0		5	223		2039
2027	0			229		2039
2028	0			236		2039
2029	0			244		2039
2030	207			251		2039
2031	0			257		2039
2032	0			262		2039
2033	0			268		2039
2034	0			274		2039

Plan GBBCF assumes LR 4/6 not operating by 2020, S-1 and S-2 cease burning coal in 2019. DSM: C Purchase existing CC. Resource additions (if needed): CT's

Table 31: Alternative Resource Plan GBBCG

Year	CC/CT's (MW)	Wind (MW)	Solar (MW)	DSM (MW)	Retire (MW)	Existing Capacity (MW)
2015	0			55		2143
2016	207		5	50		2143
2017	0	260		91		2135
2018	0			116		2135
2019	0	50		124		2038
2020	0			153	96	1942
2021	0			176		1942
2022	0			197		1942
2023	0			202		1942
2024	0			208		1942
2025	0			216		1942
2026	207		5	223		1942
2027	0			229		1942
2028	0			236		1942
2029	0			244		1942
2030	0			251		1942
2031	0			257		1942
2032	0			262		1942
2033	0			268		1942
2034	0			274		1942

Plan GBBCG assumes LR 4/6 not operating by 2020, S-1 and S-2 cease burning coal in 2019. DSM: C Resource additions (if needed): CT's

Table 32: Alternative Resource Plan GBBCW

Year	CT's (MW)	Wind Only (MW)	Solar (MW)	DSM (MW)	Retire (MW)	Existing Capacity (MW)
2015	0			55		2143
2016	0	670	5	50		2143
2017	0	260		91		2135
2018	0			116		2135
2019	0	50		124		2038
2020	0			153	96	1942
2021	0			176		1942
2022	0			197		1942
2023	0			202		1942
2024	0			208		1942
2025	0			216		1942
2026	0	670	5	223		1942
2027	0			229		1942
2028	0			236		1942
2029	0			244		1942
2030	0			251		1942
2031	0			257		1942
2032	0			262		1942
2033	0			268		1942
2034	0			274		1942

Plan GBBCW assumes LR 4/6 not operating by 2020, S-1 and S-2 cease burning coal in 2019. DSM: C Resource additions (if needed): Wind only

Table 33: Alternative Resource Plan GCBCA

Year	CT's (MW)	Wind (MW)	Solar (MW)	DSM (MW)	Retire (MW)	Existing Capacity (MW)
2015	0			55		2143
2016	207		5	50		2143
2017	0	260		91		2135
2018	0			116		2135
2019	0	50		124		2038
2020	414			153	460	1578
2021	0			176		1578
2022	0			197		1578
2023	0			202		1578
2024	0			208		1578
2025	0			216		1578
2026	0		5	223		1578
2027	0			229		1578
2028	207			236		1578
2029	0			244		1578
2030	0			251		1578
2031	0			257		1578
2032	0			262		1578
2033	0			268		1578
2034	0			274		1578

Plan GCBCA assumes LR 4/6 and S-3 not operating by 2020, S-1 and S-2, cease burning coal in 2019. DSM: C Resource additions (if needed): CT's

Table 34: Alternative Resource Plan GCBCB

Year	Existing CC/CT's (MW)	Wind (MW)	Solar (MW)	DSM (MW)	Retire (MW)	Existing Capacity (MW)
2015	0			55		2143
2016	207		5	50		2143
2017	0	260		91		2135
2018	0			116		2135
2019	0	50		124		2038
2020	414			153	460	1578
2021	0			176		1578
2022	0			197		1578
2023	0			202		1578
2024	0			208		1578
2025	0			216		1578
2026	0		5	223		1578
2027	0			229		1578
2028	207			236		1578
2029	0			244		1578
2030	0			251		1578
2031	0			257		1578
2032	0			262		1578
2033	0			268		1578
2034	0			274		1578

Plan GCBCB assumes LR 4/6 and S-3 not operating by 2020, S-1 and S-2, cease burning coal in 2019. DSM: C Purchase existing CC. Resource additions (if needed): CT's

Table 35: Alternative Resource Plan GCBCG

Year	CT's (MW)	Wind (MW)	Solar (MW)	DSM (MW)	Retire (MW)	Existing Capacity (MW)
2015	0			55		2143
2016	0		5	50		2143
2017	0	260		91		2135
2018	0			116		2135
2019	0	50		124		2038
2020	621			153	460	1578
2021	0			176		1578
2022	0			197		1578
2023	0			202		1578
2024	0			208		1578
2025	0			216		1578
2026	0		5	223		1578
2027	0			229		1578
2028	207			236		1578
2029	0			244		1578
2030	0			251		1578
2031	0			257		1578
2032	0			262		1578
2033	0			268		1578
2034	0			274		1578

Plan GCBCG assumes LR 4/6 and S-3 not operating by 2020, S-1 and S-2 cease burning coal in 2019. DSM: C. Resource additions (if needed): CT's.

Table 36: Alternative Resource Plan GBBDA

Year	CT's (MW)	Wind (MW)	Solar (MW)	DSM (MW)	Retire (MW)	Existing Capacity (MW)
2015	0			55		2143
2016	207		5	0		2143
2017	0	260		0		2135
2018	0			0		2135
2019	0	50		0		2038
2020	207			0	96	1942
2021	0			0		1942
2022	0			0		1942
2023	0			0		1942
2024	207			0		1942
2025	0			0		1942
2026	0		5	0		1942
2027	0			0		1942
2028	0			0		1942
2029	0			0		1942
2030	0			0		1942
2031	207			0		1942
2032	0			0		1942
2033	0			0		1942
2034	0			0		1942

Plan GBBDA assumes LR 4/6 not operating by 2020, S-1 and S-2 cease burning coal in 2019. DSM: D Resource additions (if needed): CT's.

Table 37: Alternative Resource Plan GBBEG

Year	CT's (MW)	Wind (MW)	Solar (MW)	DSM (MW)	Retire (MW)	Existing Capacity (MW)
2015	0			55		2143
2016	0		5	50		2143
2017	0	260		91		2135
2018	0			116		2135
2019	0	50		153		2038
2020	0			208	96	1942
2021	0			265		1942
2022	0			322		1942
2023	0			379		1942
2024	0			435		1942
2025	0			460		1942
2026	0		5	483		1942
2027	0			505		1942
2028	0			527		1942
2029	0			546		1942
2030	0			564		1942
2031	0			579		1942
2032	0			595		1942
2033	0			610		1942
2034	207			624		1942

Plan GBBEG assumes LR 4/6 not operating by 2020, S-1 and S-2 cease burning coal in 2019. DSM: E Resource additions (if needed): CT's.

Table 38: Alternative Resource Plan GCBEB

Year	CT/CC's (MW)	Wind (MW)	Solar (MW)	DSM (MW)	Retire (MW)	Existing Capacity (MW)
2015	0			55		2143
2016	207		5	50		2143
2017	0	260		91		2135
2018	0			116		2135
2019	0	50		153		2038
2020	414			208	460	1578
2021	0			265		1578
2022	0			322		1578
2023	0			379		1578
2024	0			435		1578
2025	0			460		1578
2026	0		5	483		1578
2027	0			505		1578
2028	0			527		1578
2029	0			546		1578
2030	0			564		1578
2031	0			579		1578
2032	0			595		1578
2033	0			610		1578
2034	0			624		1578

Plan GCBEB assumes LR 4/6 and S-3 not operating by 2020, S-1 and S-2, cease burning coal in 2019. DSM: E. Purchase existing CC. Resource additions (if needed): CT's.

Table 39: Alternative Resource Plan GCBEG

Year	CT's (MW)	Wind (MW)	Solar (MW)	DSM (MW)	Retire (MW)	Existing Capacity (MW)
2015	0			55		2143
2016	0		5	50		2143
2017	0	260		91		2135
2018	0			116		2135
2019	0	50		153		2038
2020	621			208	460	1578
2021	0			265		1578
2022	0			322		1578
2023	0			379		1578
2024	0			435		1578
2025	0			460		1578
2026	0		5	483		1578
2027	0			505		1578
2028	0			527		1578
2029	0			546		1578
2030	0			564		1578
2031	0			579		1578
2032	0			595		1578
2033	0			610		1578
2034	0			624		1578

Plan GCBEG assumes LR 4/6 and S-3 not operating by 2020, S-1 and S-2 cease burning coal in 2019. DSM: E. Resource additions (if needed): CT's.

SECTION 4: ANALYSIS OF RESOURCE PLANS

(4) Analysis of Alternative Resource Plans.

The utility shall describe and document its assessment of the relative performance of the alternative resource plans by calculating for each plan the value of each performance measure specified pursuant to section (2). This calculation shall assume values for uncertain factors that are judged by utility decision makers to be most likely. The analysis shall cover a planning horizon of at least twenty (20) years and shall be carried out on a year by year basis in order to assess the annual and cumulative impacts of alternative resource plans. The analysis shall be based on the assumption that rates will be adjusted annually, in a manner that is consistent with Missouri law. The analysis shall treat supply-side and demand-side resources on a logically-consistent and economically-equivalent basis, such that the same types or categories of costs, benefits, and risks shall be considered and such that these factors shall be quantified at a similar level of detail and precision for all resource types. The utility shall provide the following information:

(A) A summary tabulation that shows the performance of each alternative resource plan as measured by each of the measures specified in section (2) of this rule;

A summary tabulation of expected value of all performance measures for each plan is provided in Table 40.

Table 40: Expected Value of Performance Measures ** Highly Confidential **

Plan	NPVRR ($MM)	Probable Environmental Costs ($MM)	DSM Performance Incentive Costs ($MM)	Levelized Annual Rates ($/KW-hr)	Maximum Rate Increase	Times Interest Earned	Total Debt to Capital	Cap Ex to FFO
GBBBA	10,167	333	57.42	0.133	8.21%	3.68	47.70	1.52
GBBEG	10,206	334	47.10	0.130	7.19%	3.67	47.70	1.40
GCBBA	10,207	51	57.42	0.133	13.89%	3.67	47.70	1.82
GAABA	10,272	371	57.42	0.135	8.22%	3.69	47.70	1.49
GBBBB	10,363	331	57.42	0.135	11.59%	3.68	47.70	1.53
GBBCG	10,399	335	23.49	0.127	9.16%	3.62	47.70	1.23
GCBCB	10,402	52	23.49	0.126	12.50%	3.60	47.70	1.44
GCBEB	10,406	52	47.10	0.132	13.74%	3.64	47.70	1.77
GBBCB	10,408	344	23.49	0.126	9.10%	3.62	47.70	1.24
GCBEG	10,428	51	47.10	0.133	18.50%	3.65	47.70	1.80
GCBCG	10,440	51	23.49	0.127	17.34%	3.61	47.70	1.48
GBBCA	10,461	335	23.49	0.127	9.76%	3.62	47.70	1.24
GAACB	10,467	371	23.49	0.127	9.11%	3.62	47.70	1.20
GBBCD	10,499	334	23.49	0.127	9.76%	3.62	47.70	1.26
GCBCA	10,503	51	23.49	0.127	13.01%	3.60	47.70	1.45
GAACA	10,521	374	23.49	0.128	9.77%	3.62	47.70	1.20
GBBCF	10,553	402	23.49	0.128	9.11%	3.63	47.70	1.19
GBBCC	10,603	332	23.49	0.129	10.70%	3.59	47.70	1.14
GAACF	10,614	440	23.49	0.129	9.11%	3.63	47.70	1.16
GBBDA	10,638	336	0.00	0.124	8.75%	3.59	47.70	1.02
GAACE	10,672	445	23.49	0.129	9.11%	3.63	47.70	1.16
GCBAA	10,703	51	154.43	0.147	14.91%	3.93	47.71	2.82
GBBCW	10,861	331	23.49	0.130	24.76%	3.64	47.70	1.81
GBBAA	11,042	331	154.43	0.153	15.08%	3.91	47.70	2.33
GAAAA	11,145	369	154.43	0.155	15.08%	3.91	47.70	2.26

(B) For each alternative resource plan, a plot of each of the following over the planning horizon:

1. The combined impact of all demand-side resources on the base-case forecast of summer and winter peak demands;

The combined impact of all demand-side resources on the base-case forecast of summer and winter peak demands is shown in the following four charts. Note that Option D is Persistence DSM and therefore does not have any impact on Peak Demand.

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Chart 1: Demand Side Impact - DSM Option A ** Highly Confidential **

Chart 2: Demand Side Impact – DSM Option B ** Highly Confidential **

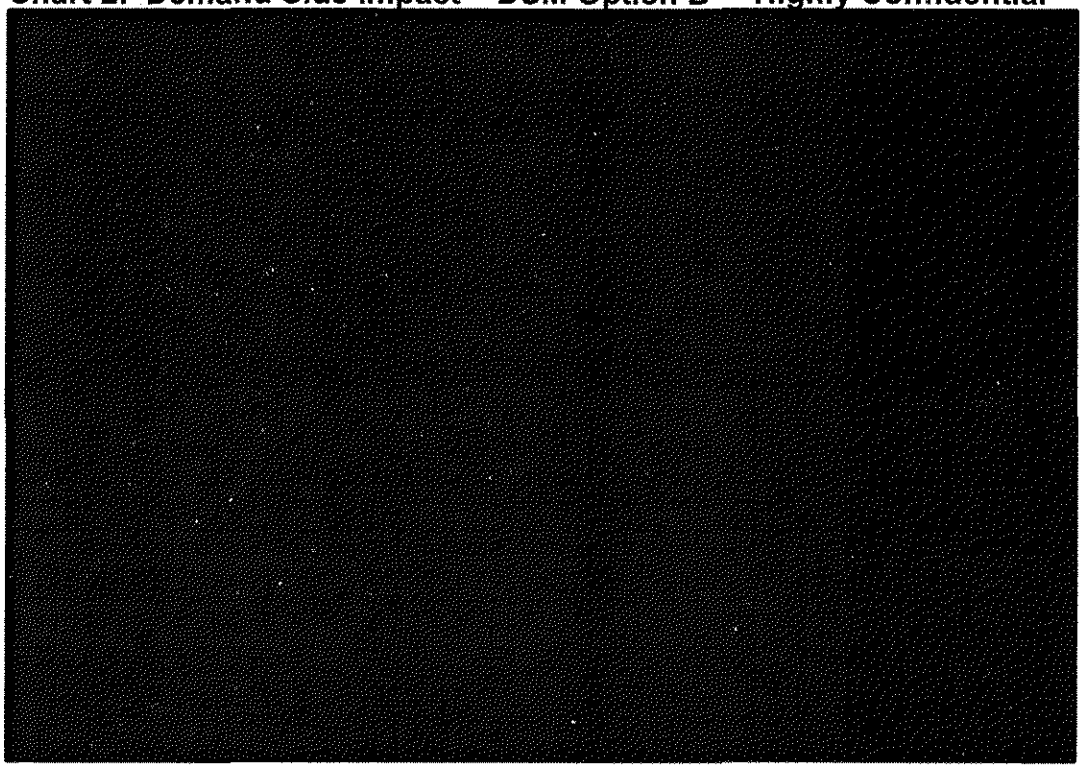

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Chart 3: Demand Side Impact – DSM Option C ** Highly Confidential **

Chart 4: Demand Side Impact – Option E ** Highly Confidential **

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2. The composition, by program and demand-side rate, of the capacity provided by demand-side resources;

The following four charts illustrate the combined capacity supplied by the four levels of DSM programs associated with the alternative resource plans. It should be noted that Option D is Persistence DSM and is included in each of the four DSM levels.

Chart 5: Capacity Composition – DSM Option A

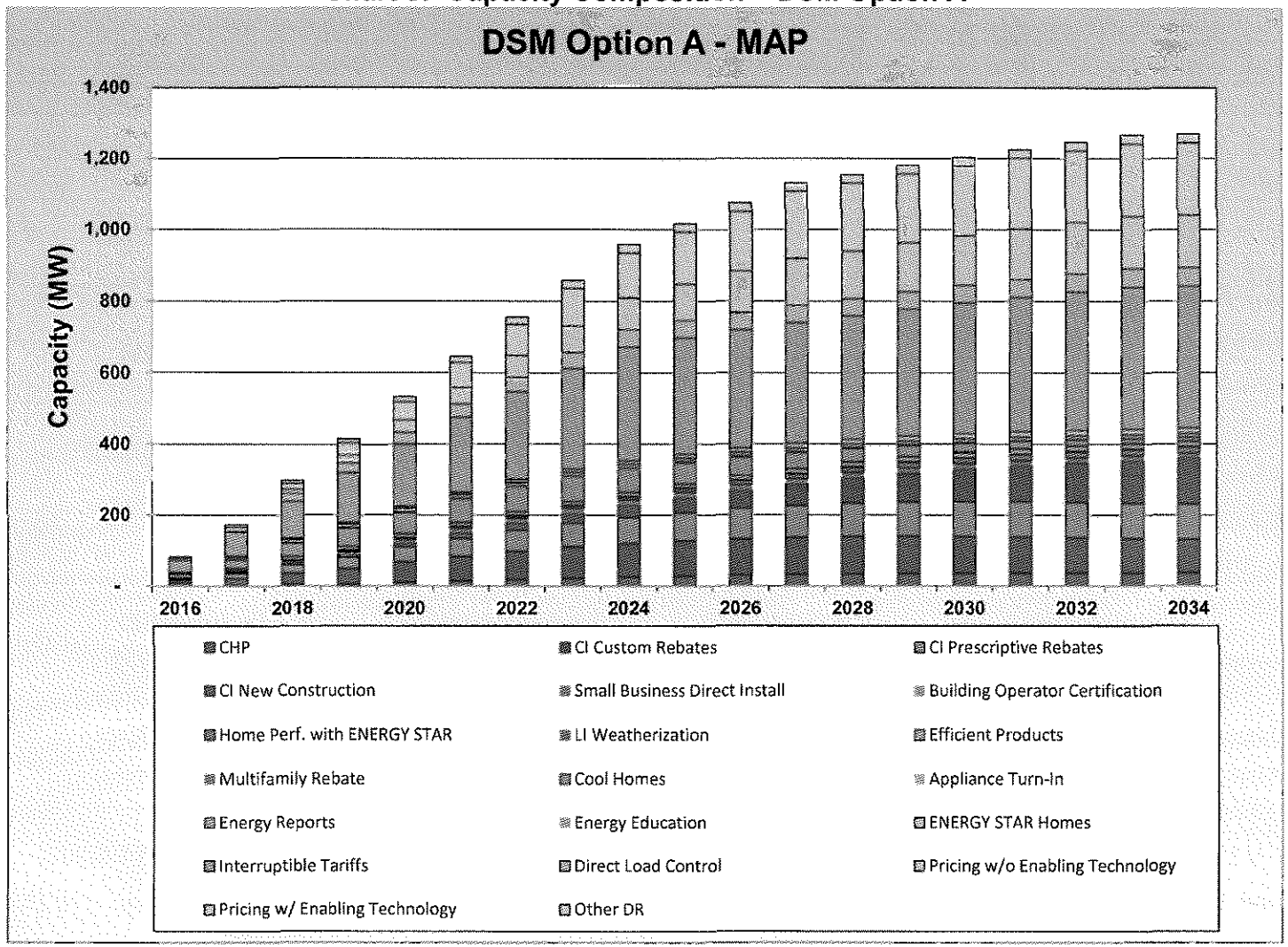


Chart 6: Capacity Composition – DSM Option B

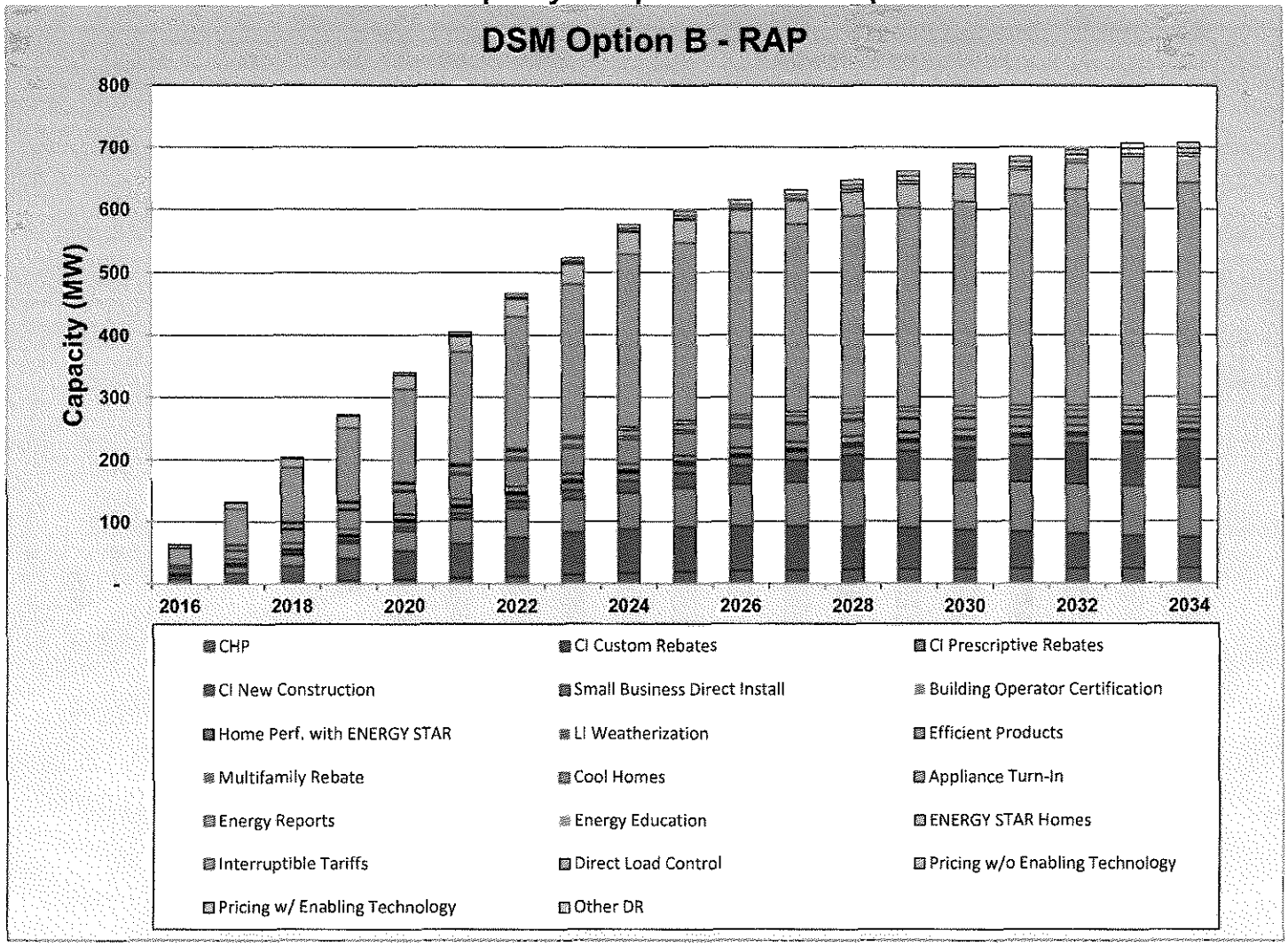


Chart 7: Capacity Composition – DSM Option C

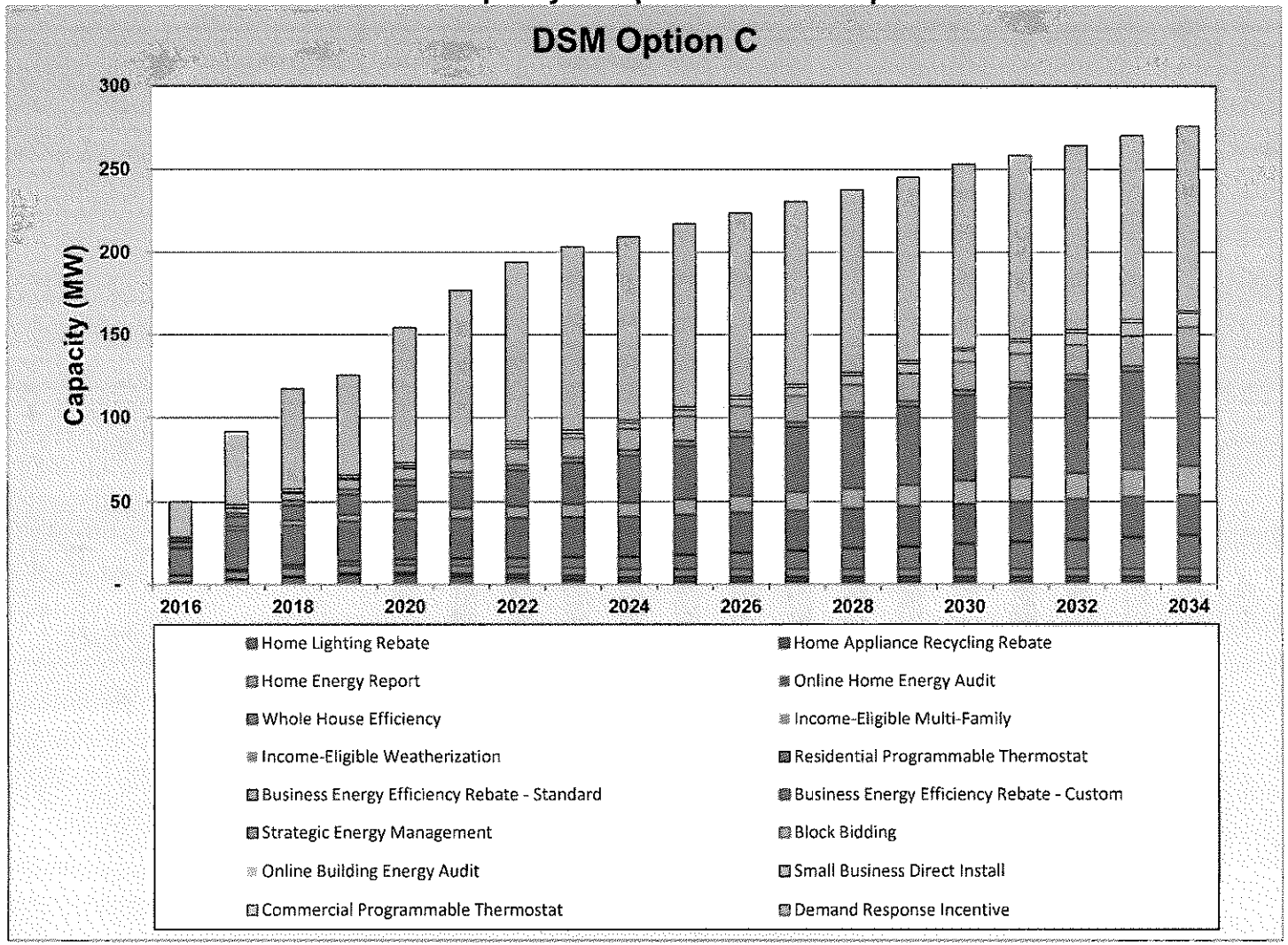
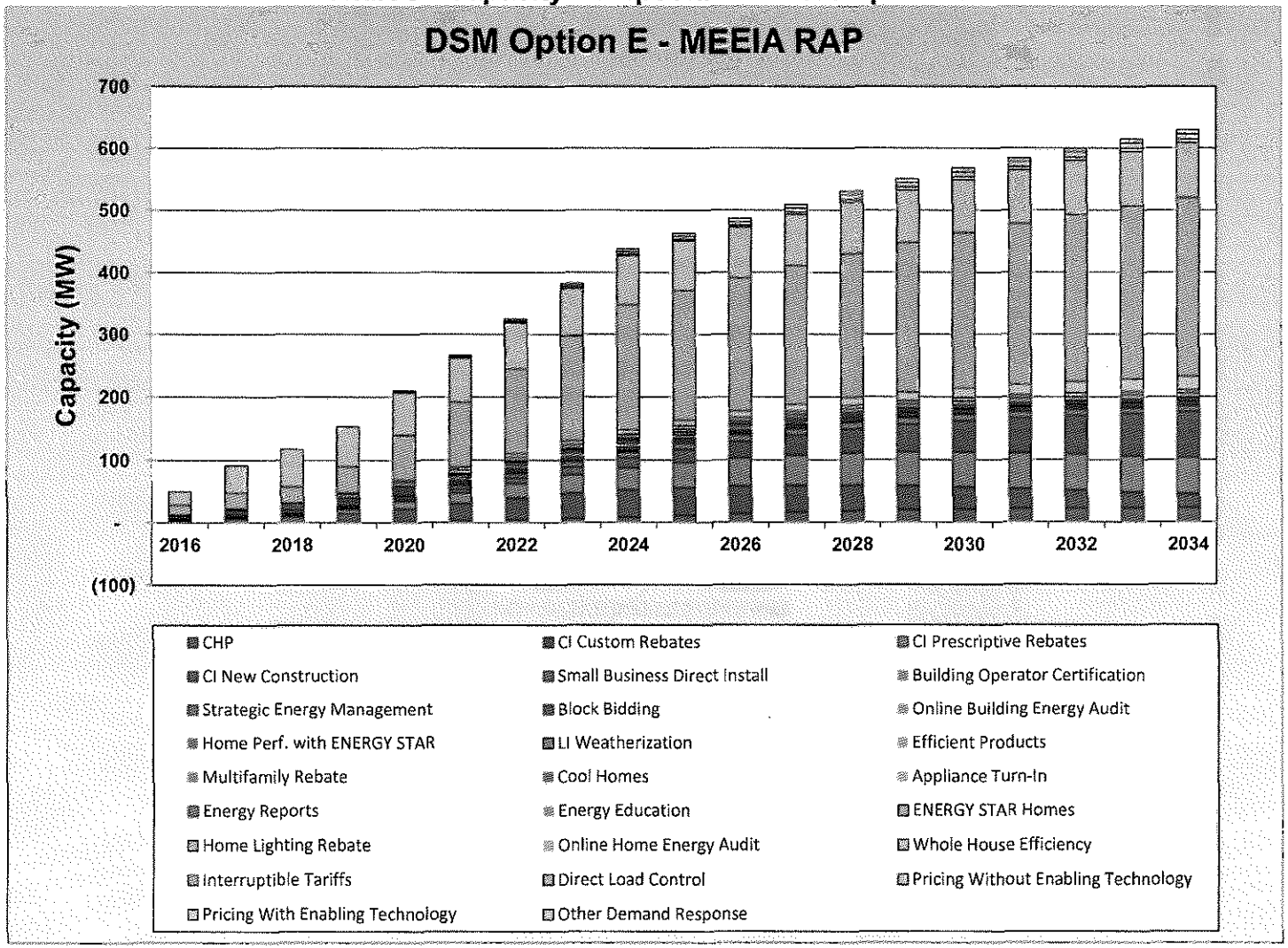


Chart 8: Capacity Composition – DSM Option E



3. The composition, by supply-side resource, of the capacity supplied to the transmission grid provided by supply-side resources. Existing supply-side resources may be shown as a single resource;

The following charts provide the supply-side resource composition for each Alternative Resource Plan.

Chart 9: Alternative Resource Plan GAAAA - Capacity

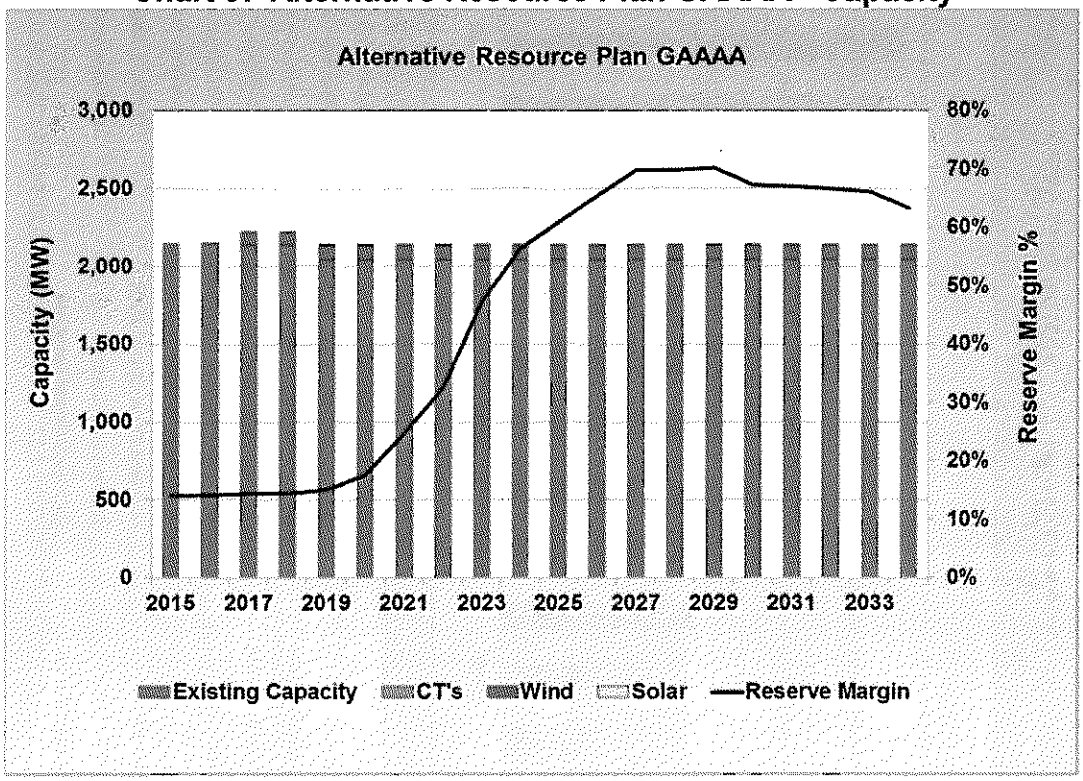


Chart 10: Alternative Resource Plan GBBAA - Capacity

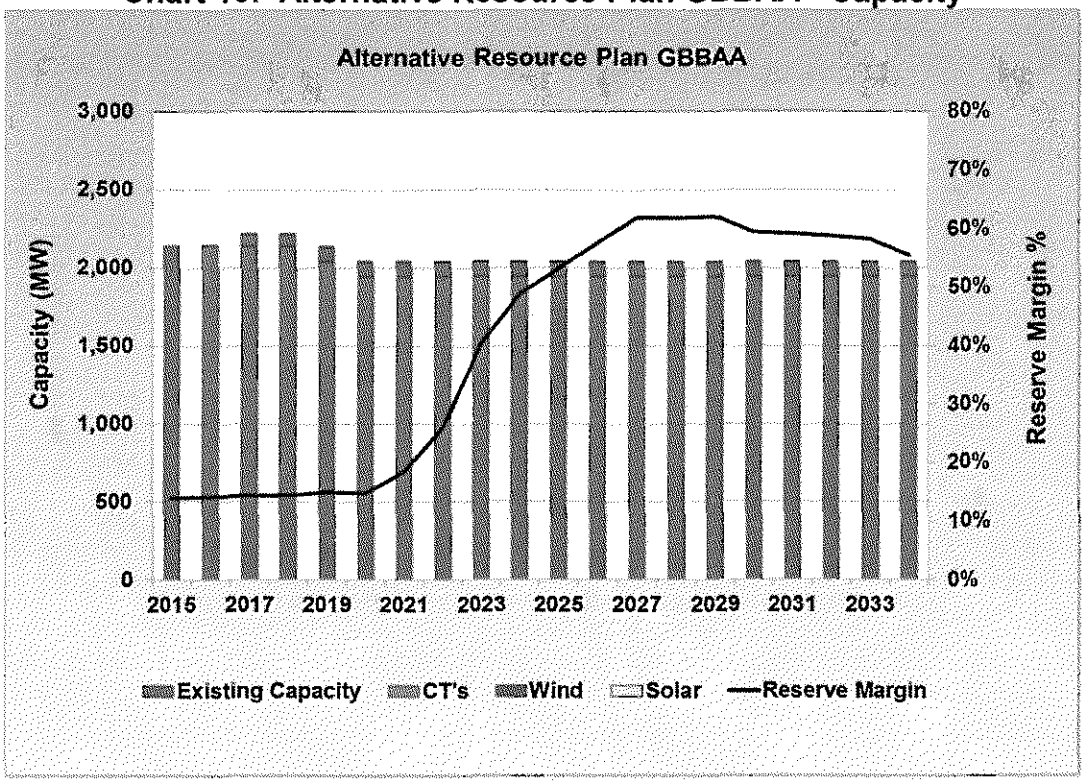


Chart 11: Alternative Resource Plan GCBAA - Capacity

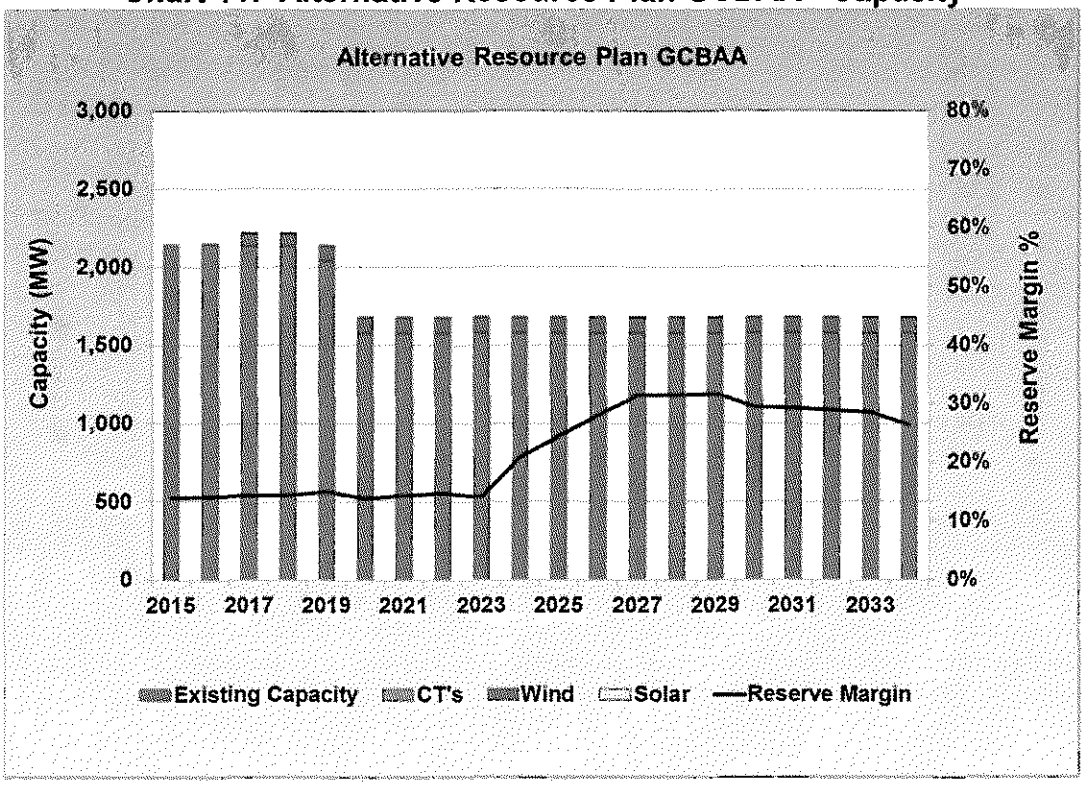


Chart 12: Alternative Resource Plan GAABA - Capacity

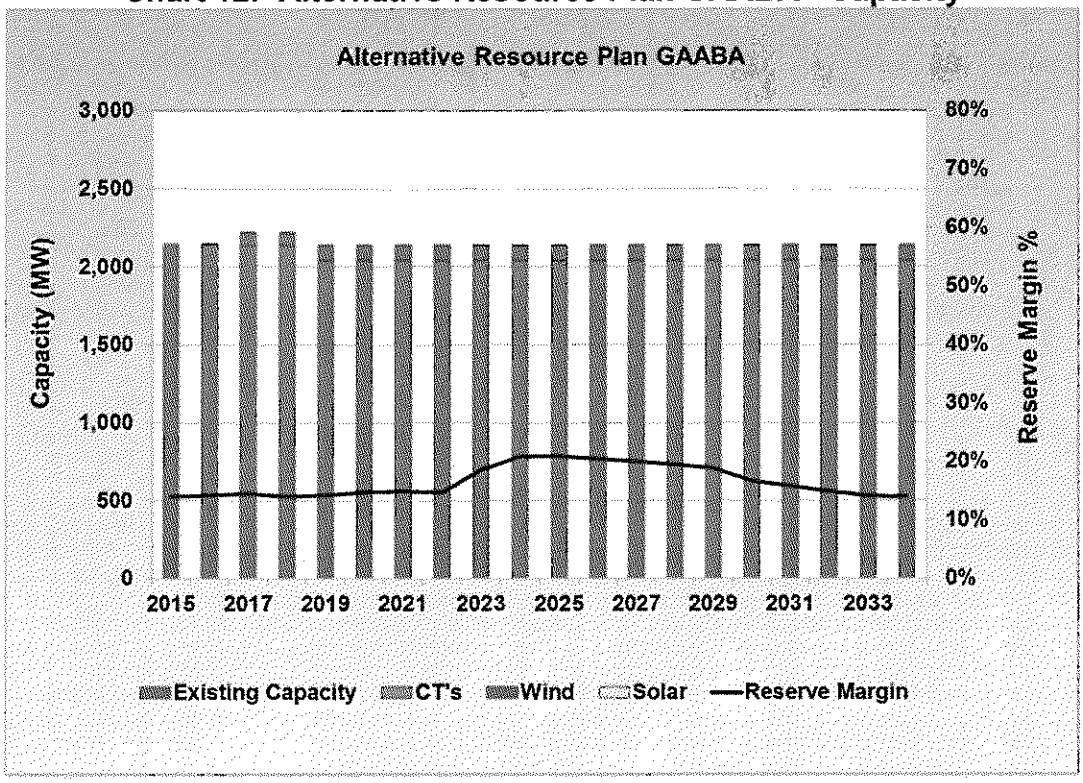


Chart 13: Alternative Resource Plan GBBBA - Capacity

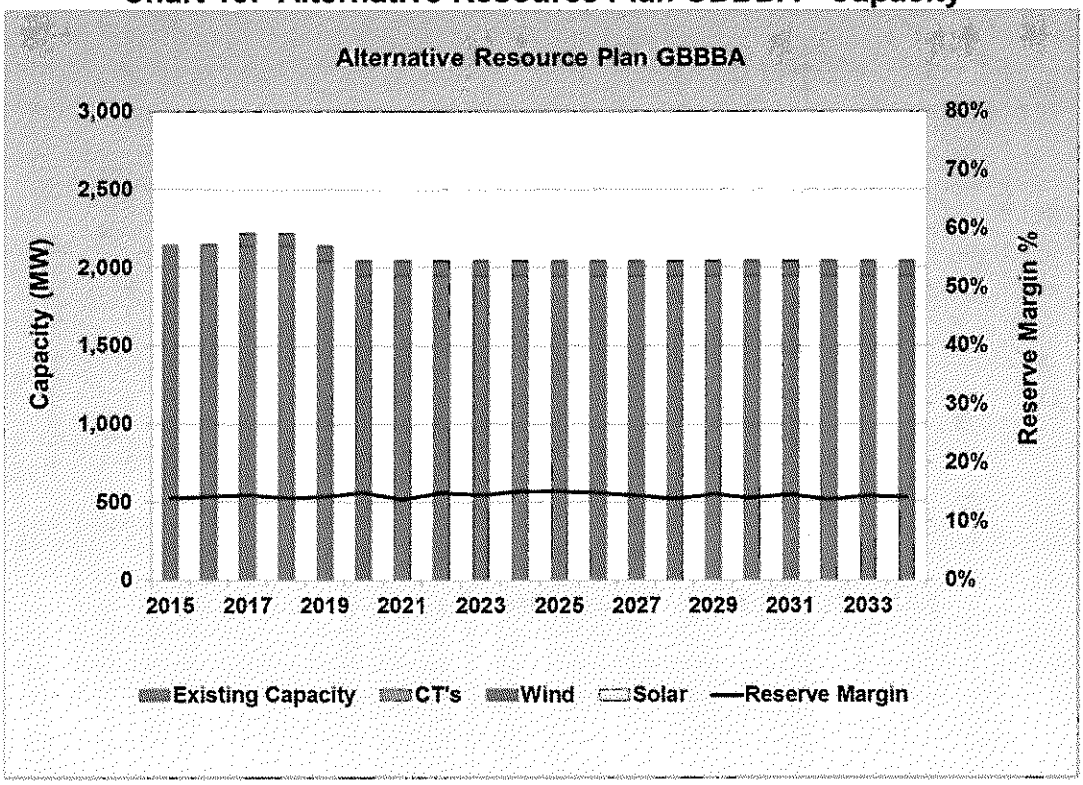


Chart 14: Alternative Resource Plan GBBBB - Capacity

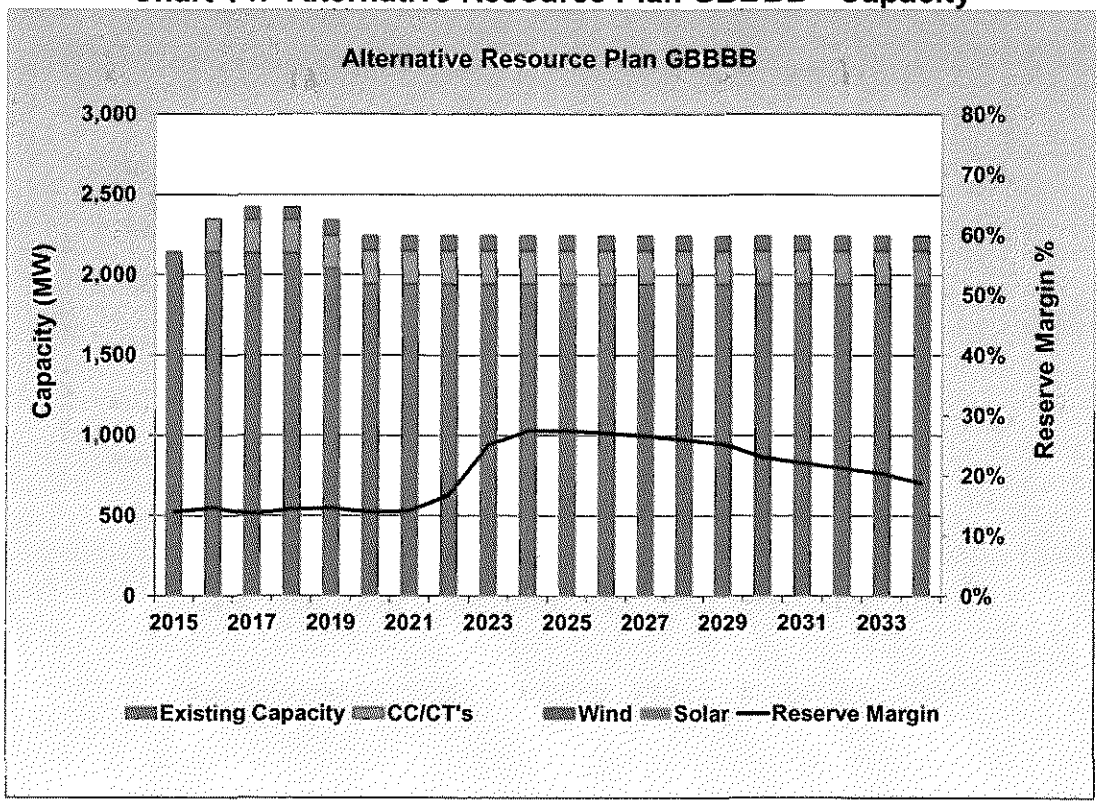


Chart 15: Alternative Resource Plan GCBBA - Capacity

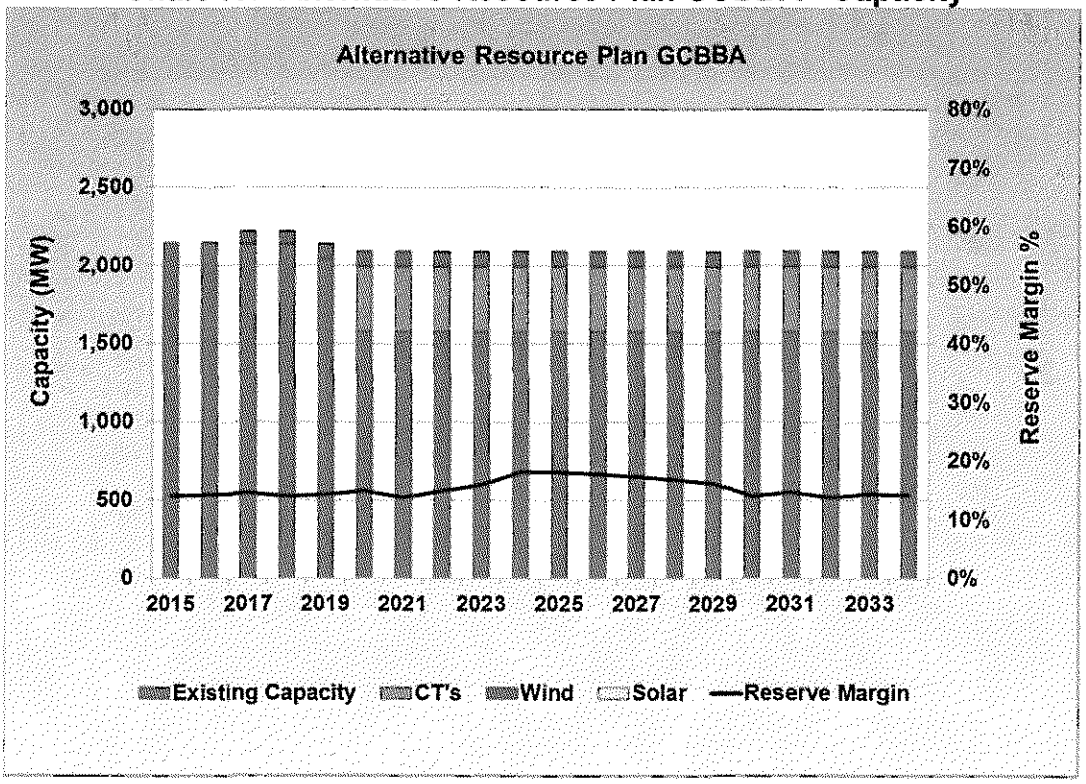


Chart 16: Alternative Resource Plan GAACA - Capacity

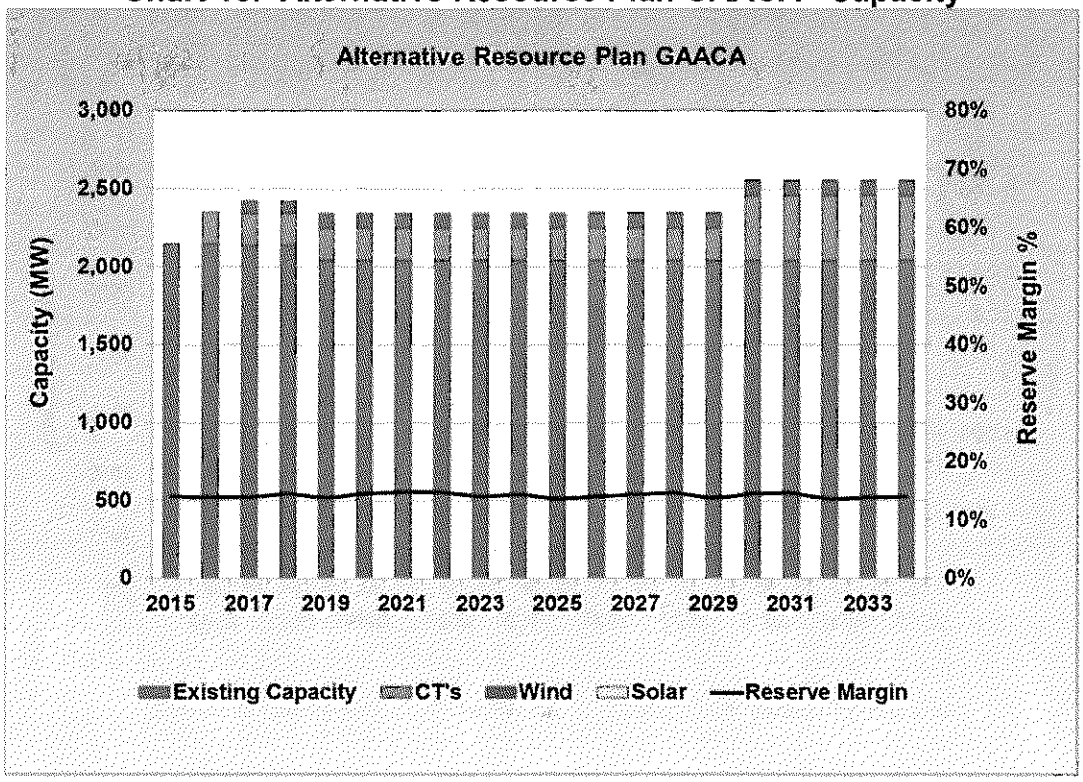


Chart 17: Alternative Resource Plan GAACB - Capacity

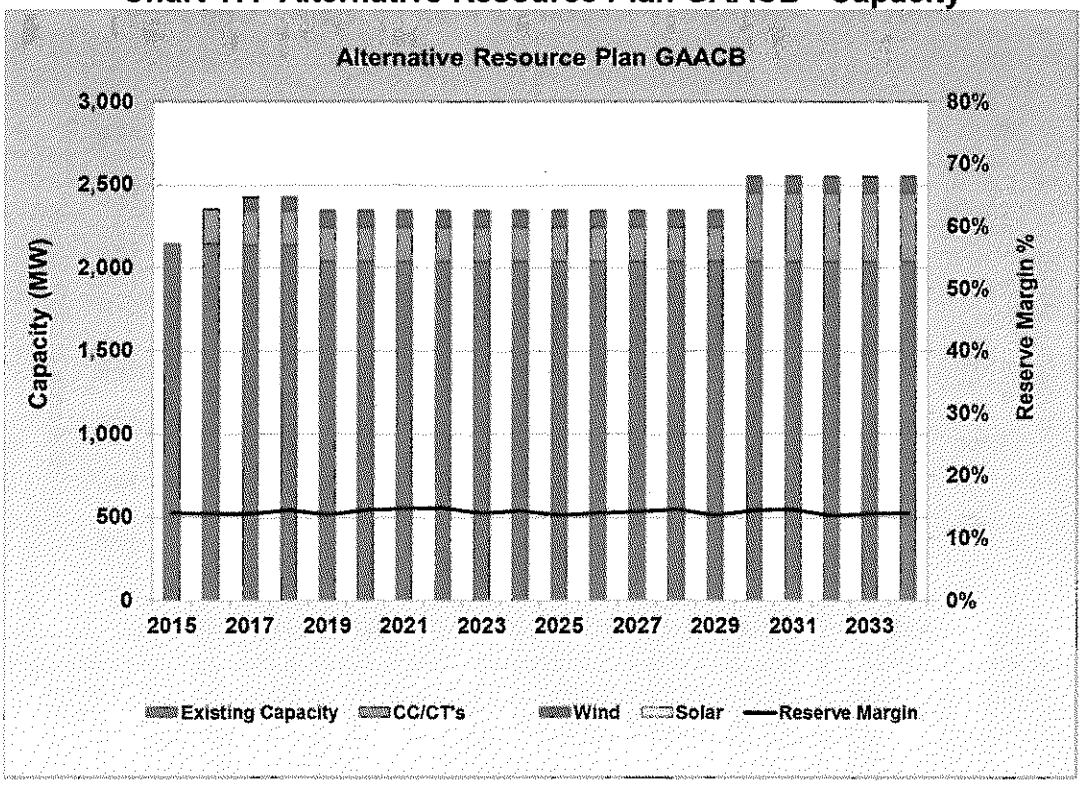


Chart 18: Alternative Resource Plan GAACE - Capacity

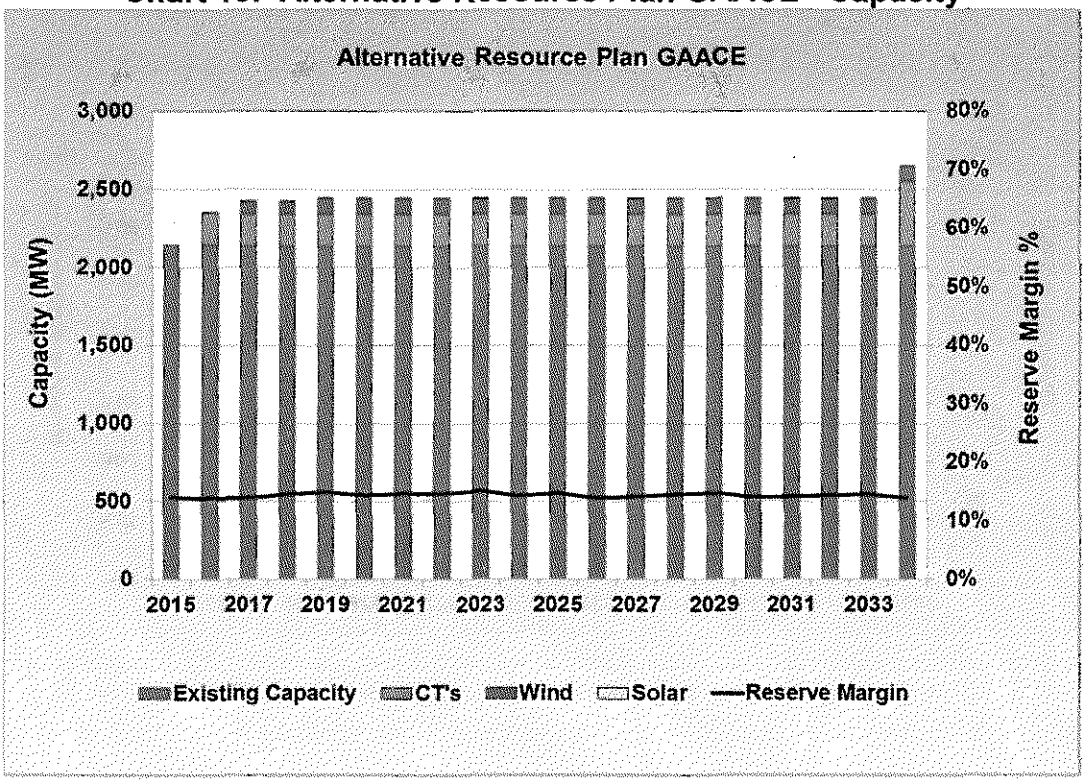


Chart 19: Alternative Resource Plan GAACF - Capacity

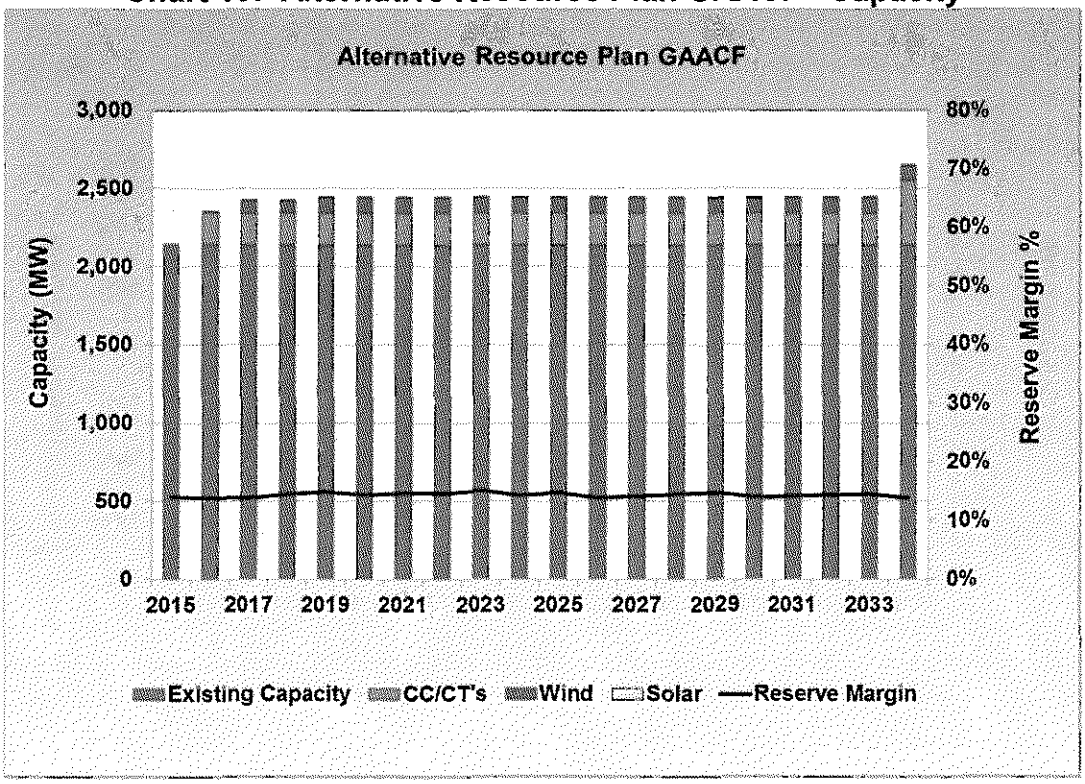


Chart 20: Alternative Resource Plan GBBCA - Capacity

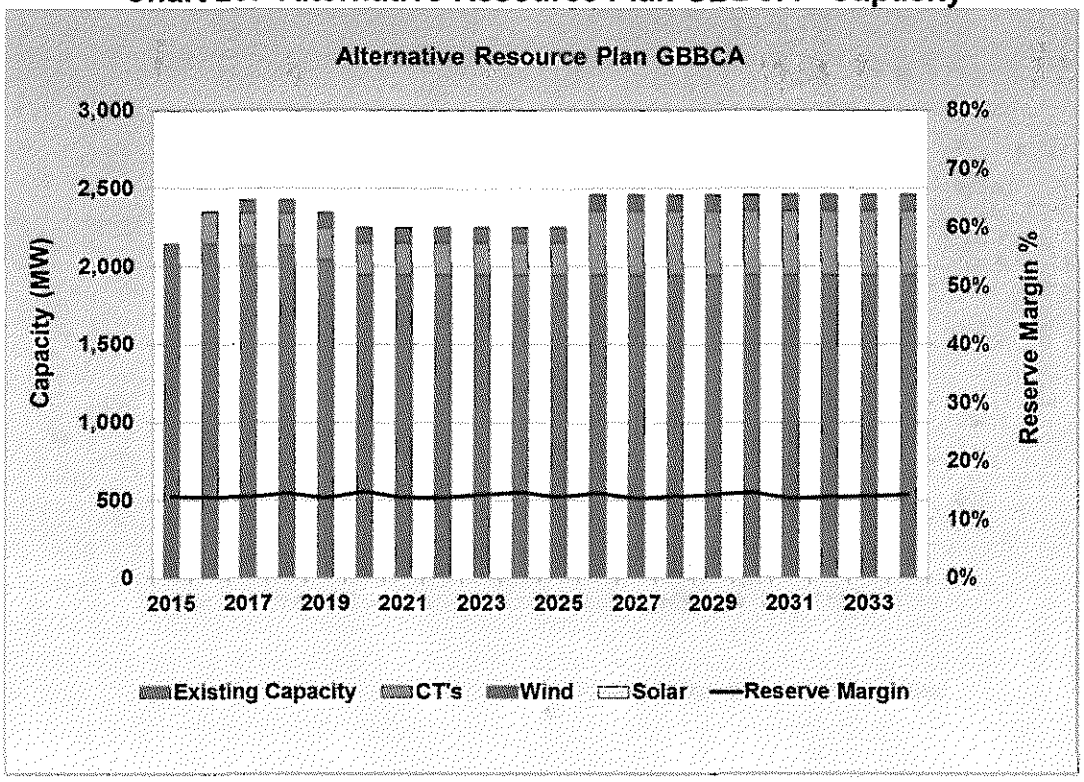


Chart 21: Alternative Resource Plan GBBCB - Capacity

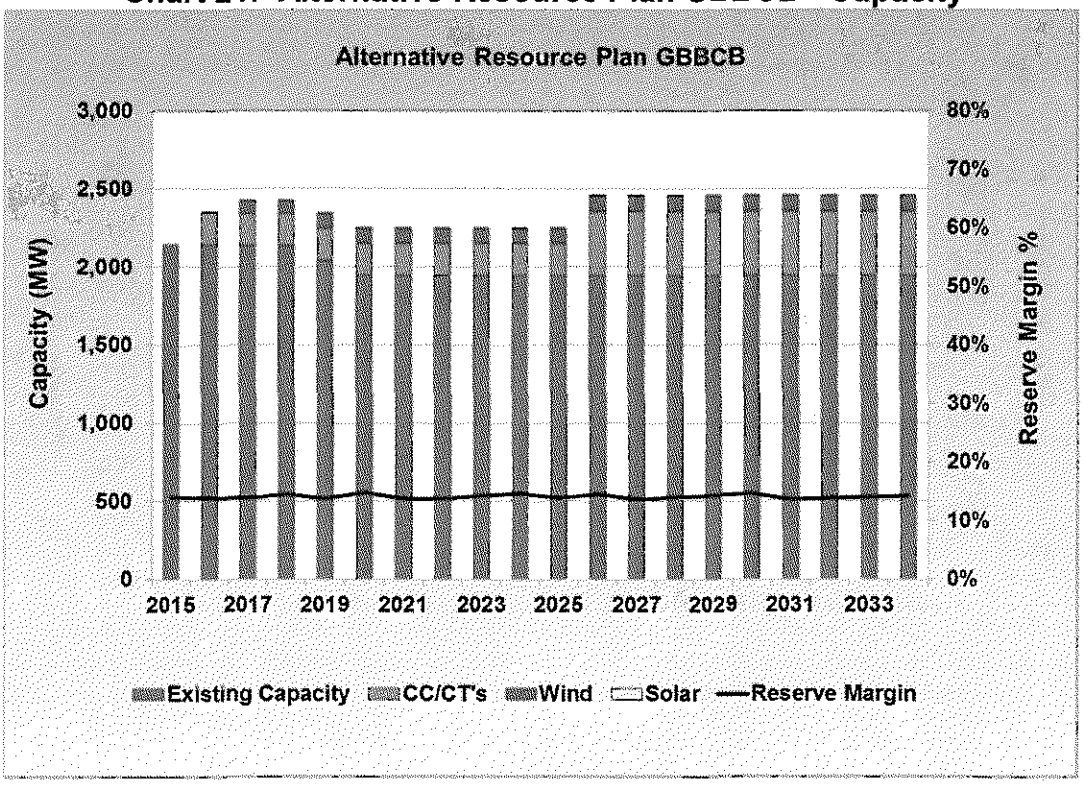


Chart 22: Alternative Resource Plan GBBCC - Capacity

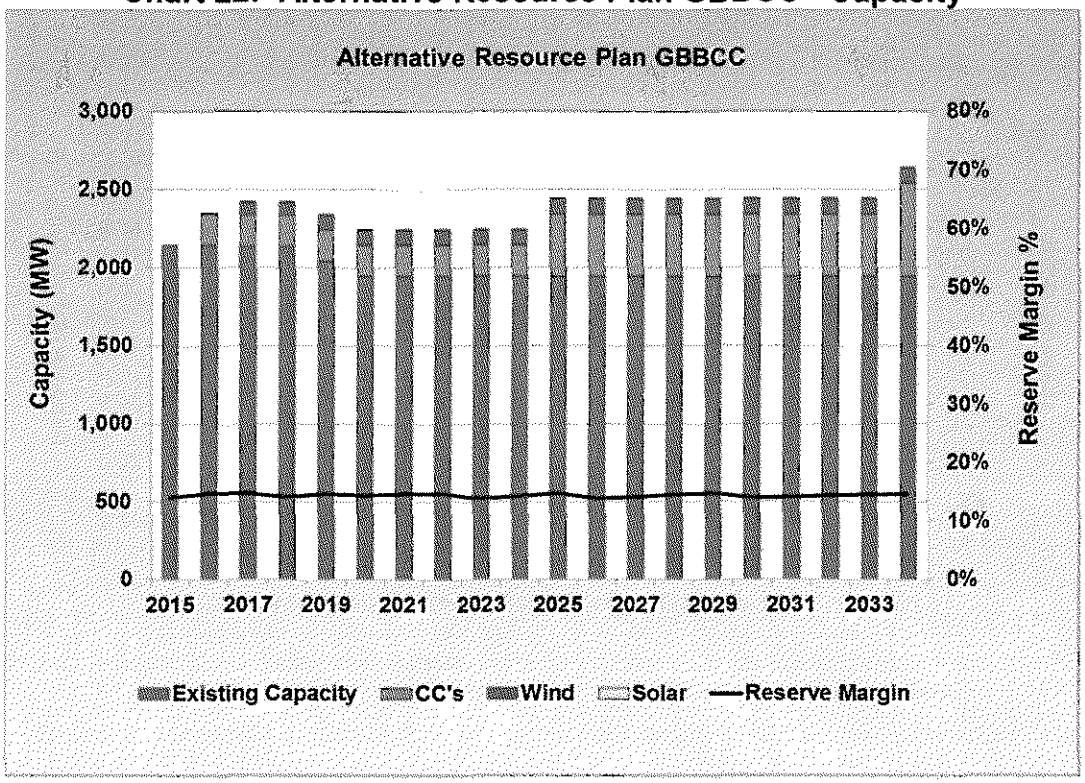


Chart 23: Alternative Resource Plan GBBCD - Capacity

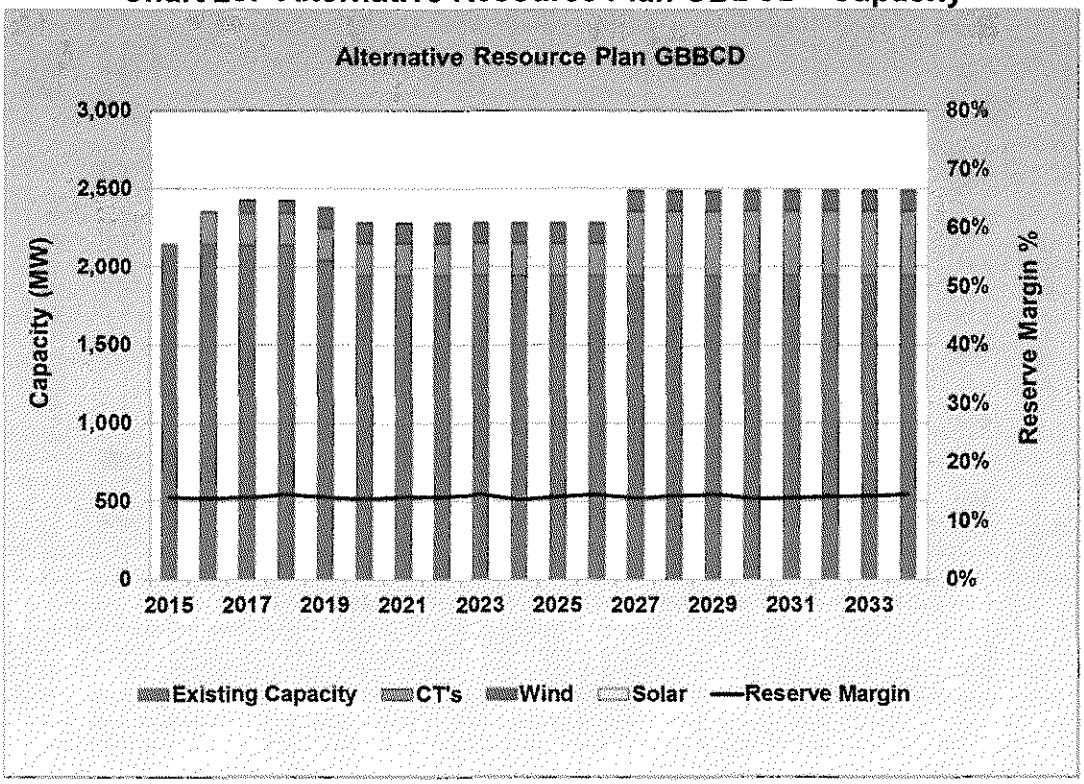


Chart 24: Alternative Resource Plan GBBCF - Capacity

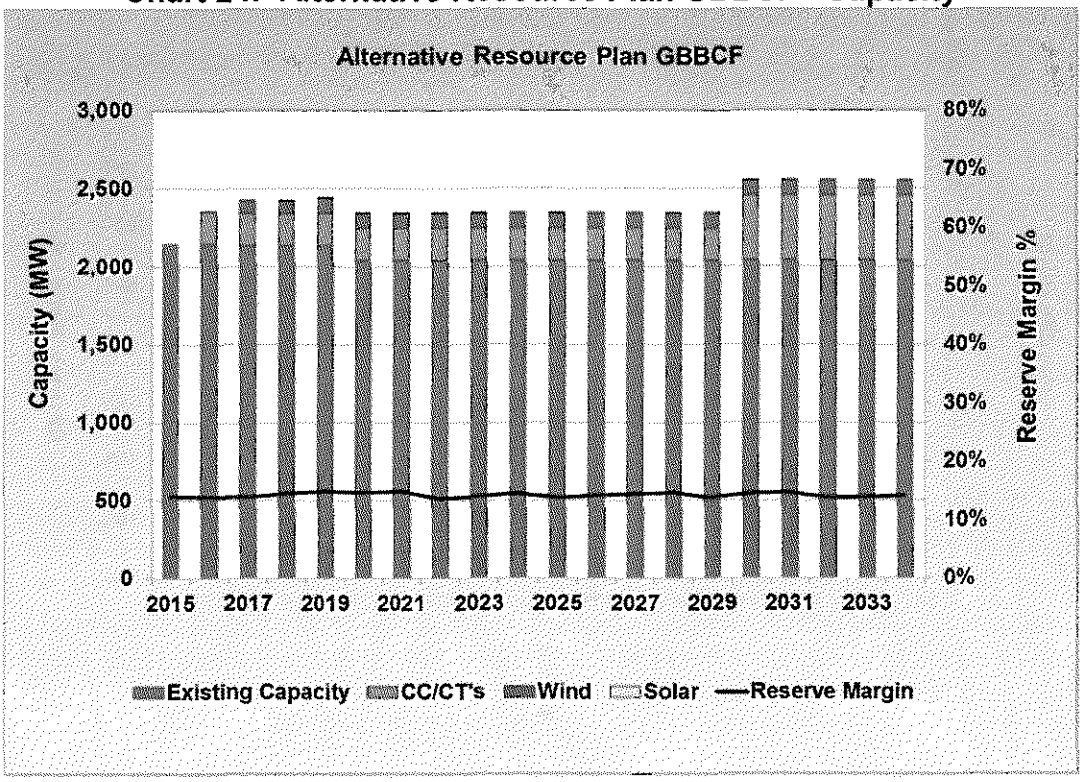


Chart 25: Alternative Resource Plan GBBCG – Capacity

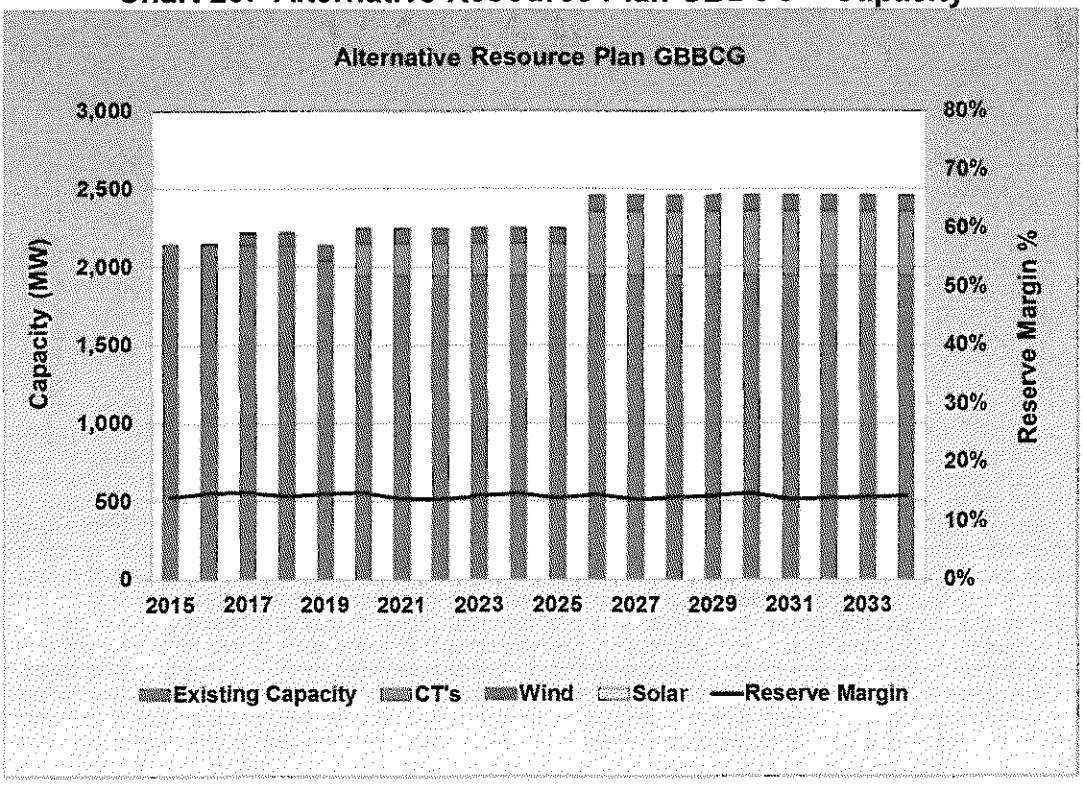


Chart 26: Alternative Resource Plan GBBCW - Capacity

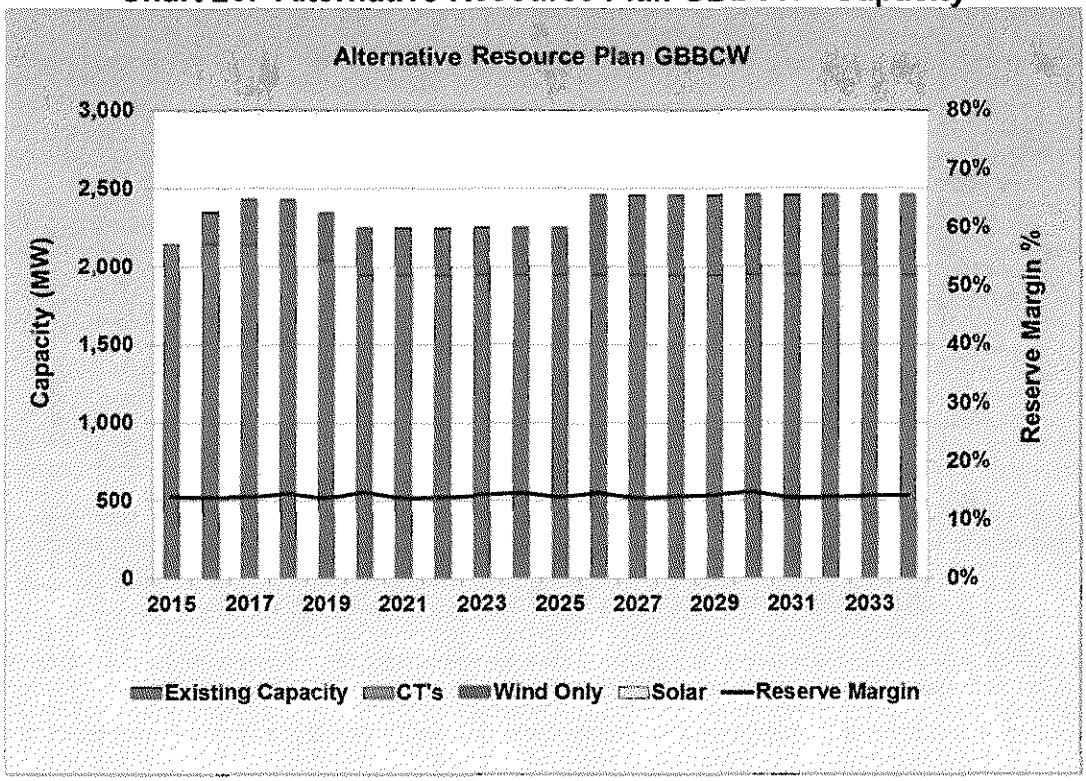


Chart 27: Alternative Resource Plan GCBCA - Capacity

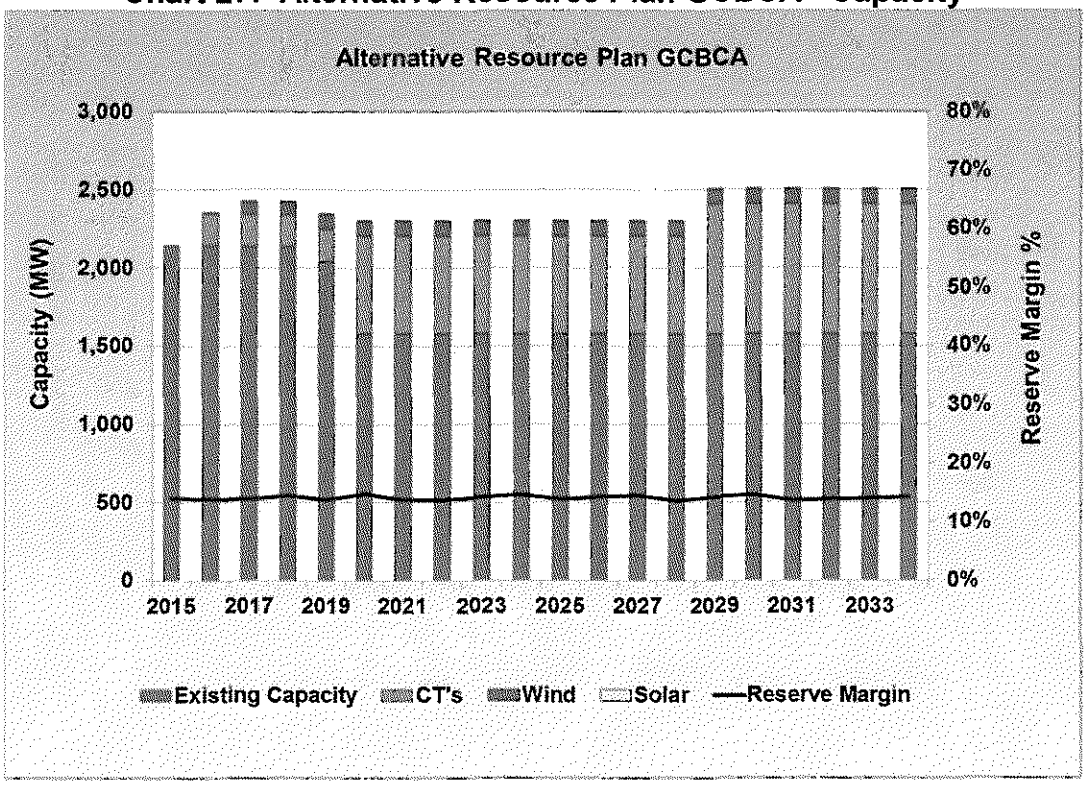


Chart 28: Alternative Resource Plan GCBCB – Capacity

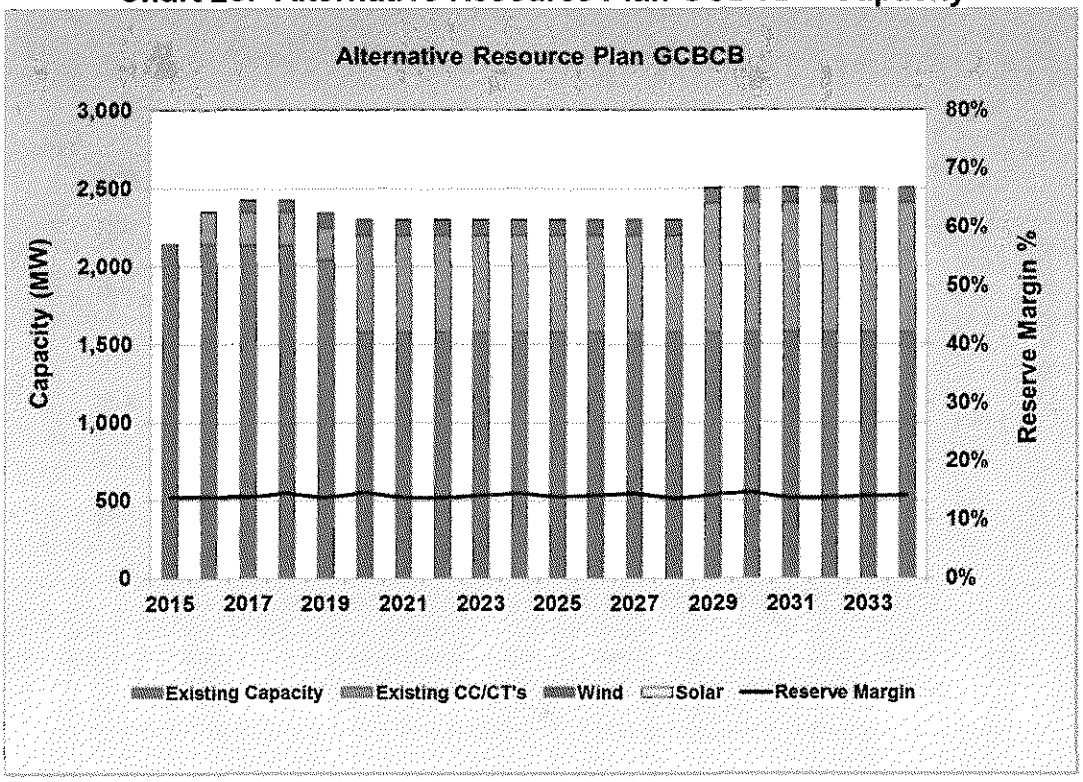


Chart 29: Alternative Resource Plan GCBCG – Capacity

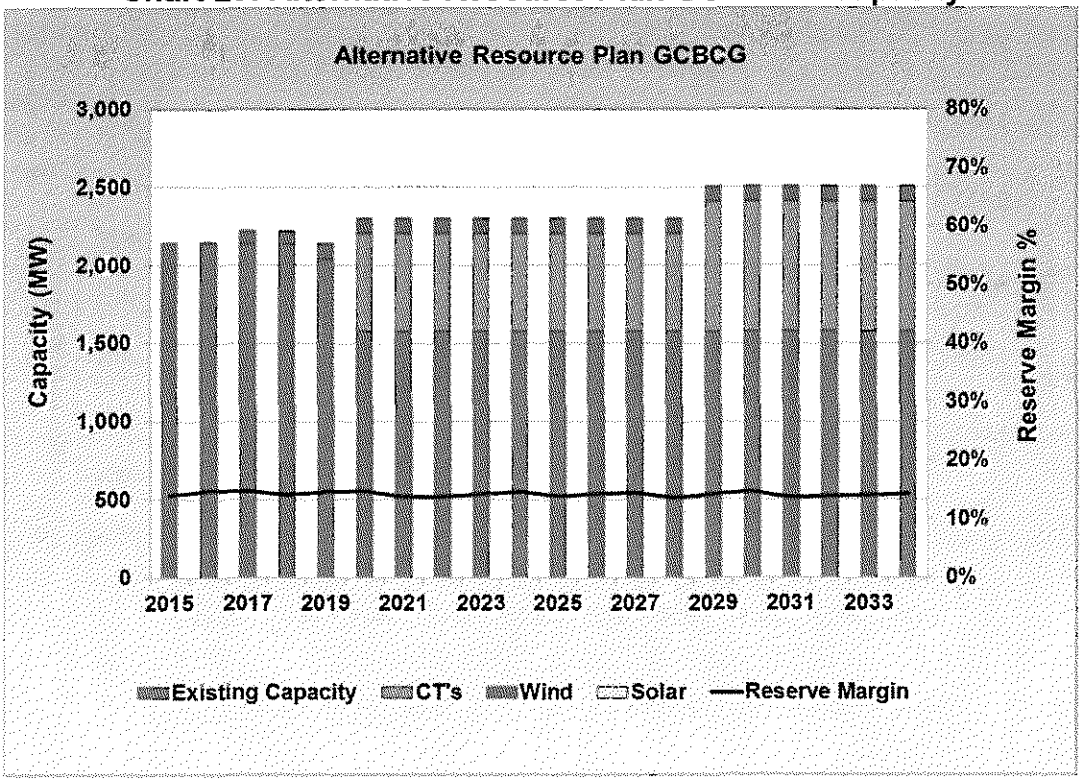


Chart 30: Alternative Resource Plan GBBDA - Capacity

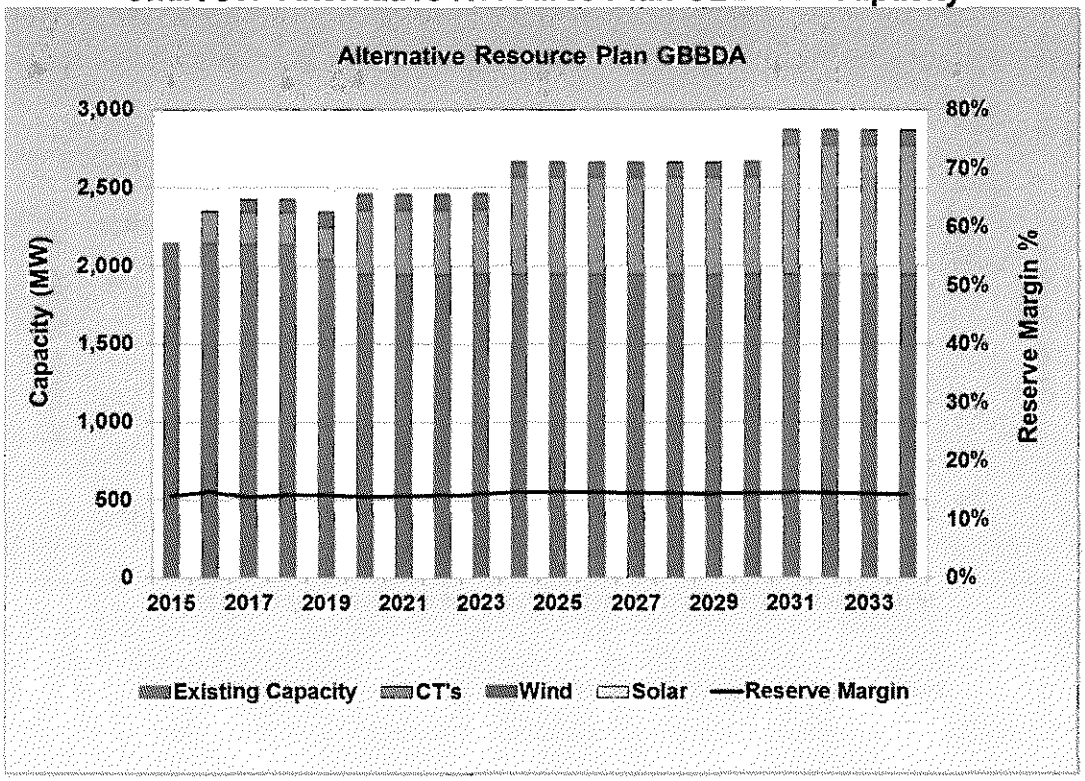


Chart 31: Alternative Resource Plan GBBEG - Capacity

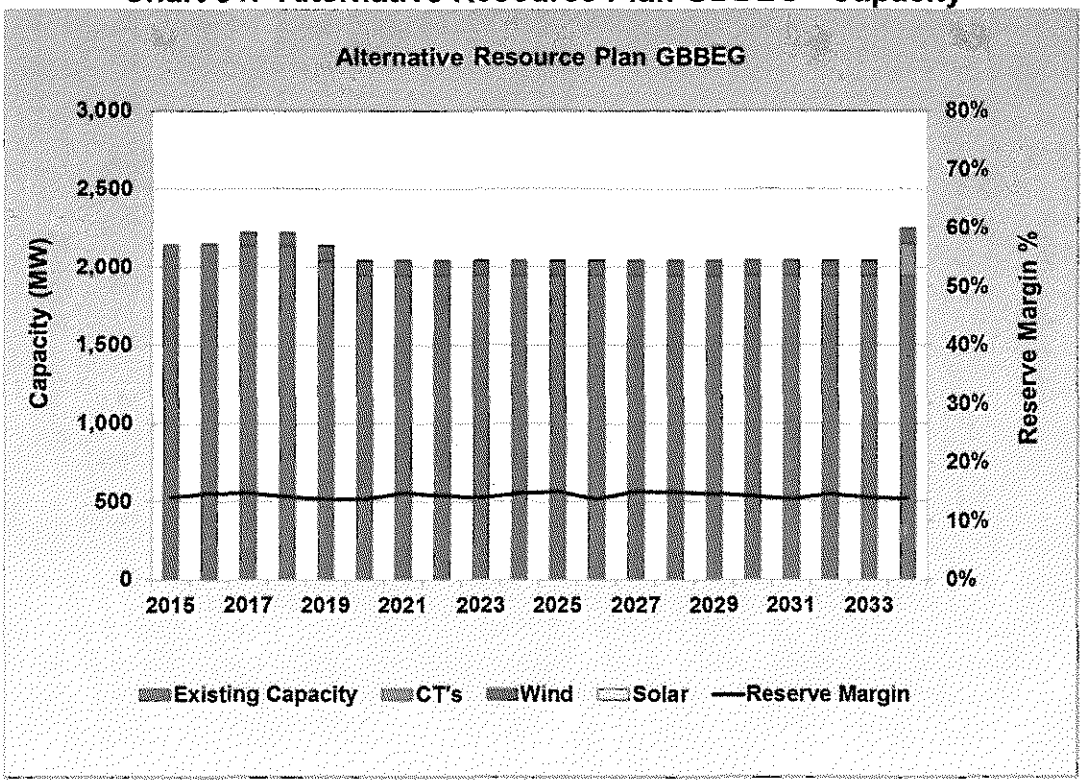


Chart 32: Alternative Resource Plan GCBEB - Capacity

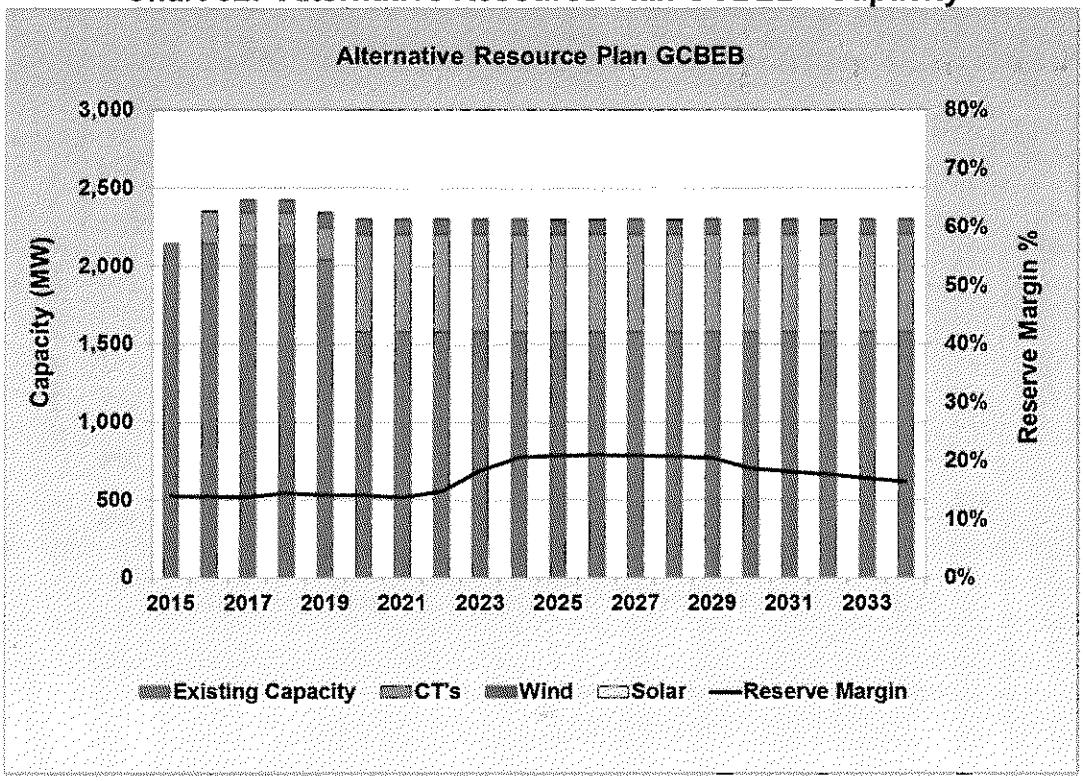
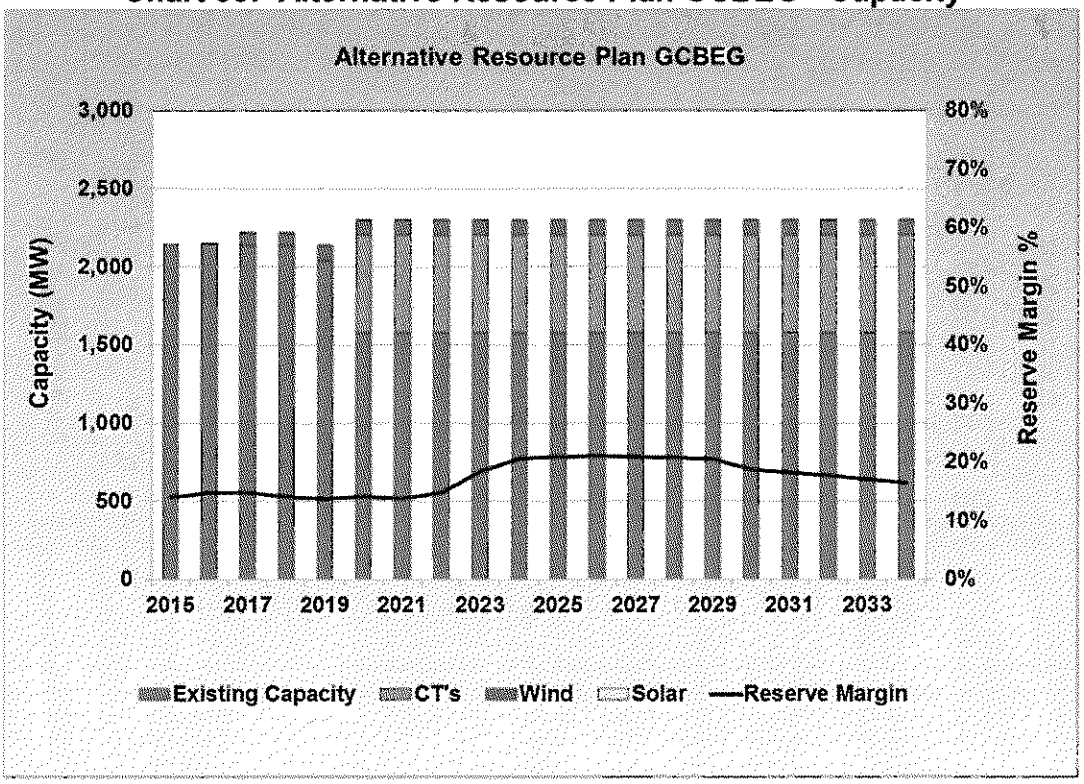


Chart 33: Alternative Resource Plan GCBEG - Capacity



4. The combined impact of all demand-side resources on the base-case forecast of annual energy requirements;

The following four charts illustrate the combined energy supplied by the four levels of DSM programs associated with the alternative resource plans. Note that Option D is Persistence DSM and therefore does not have any impact on Peak Energy.

Chart 34: Annual Energy Impact – DSM Option A

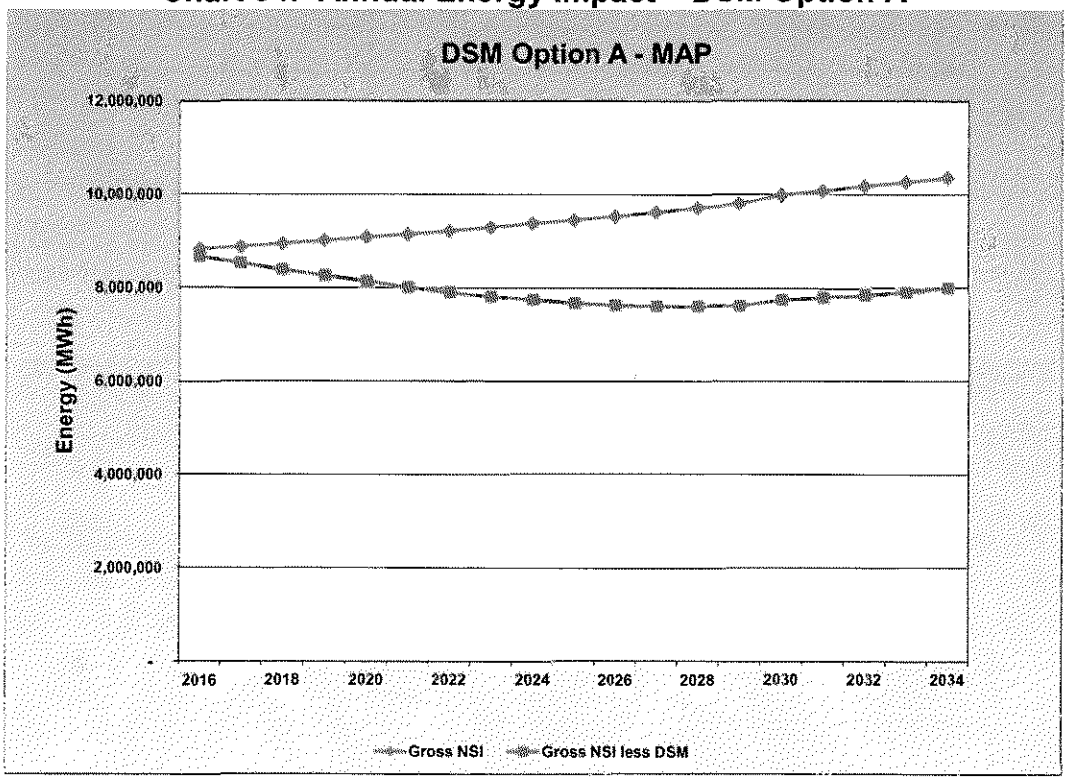


Chart 35: Annual Energy Impact – DSM Option B

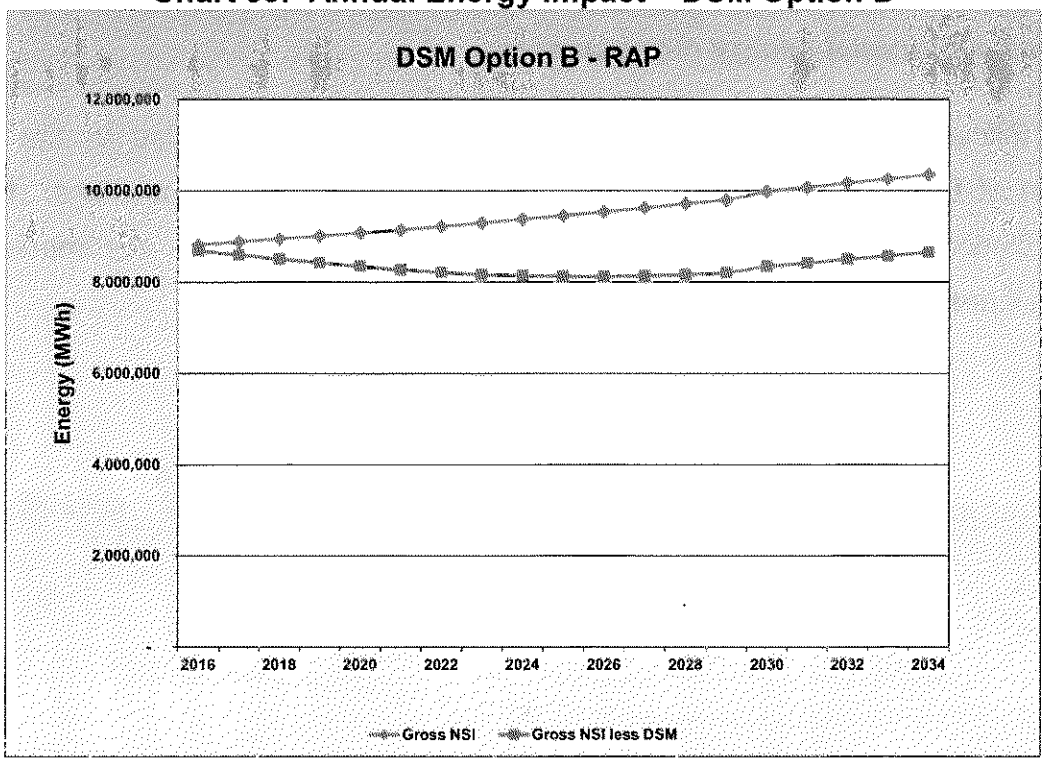


Chart 36: Annual Energy Impact – DSM Option C

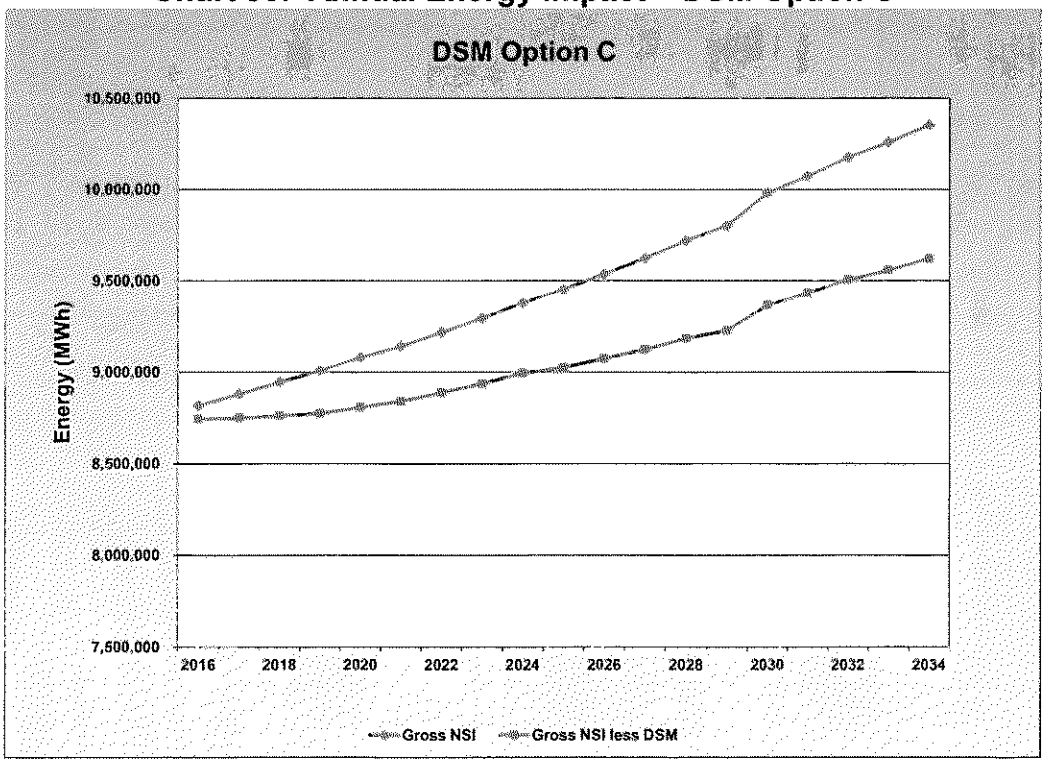
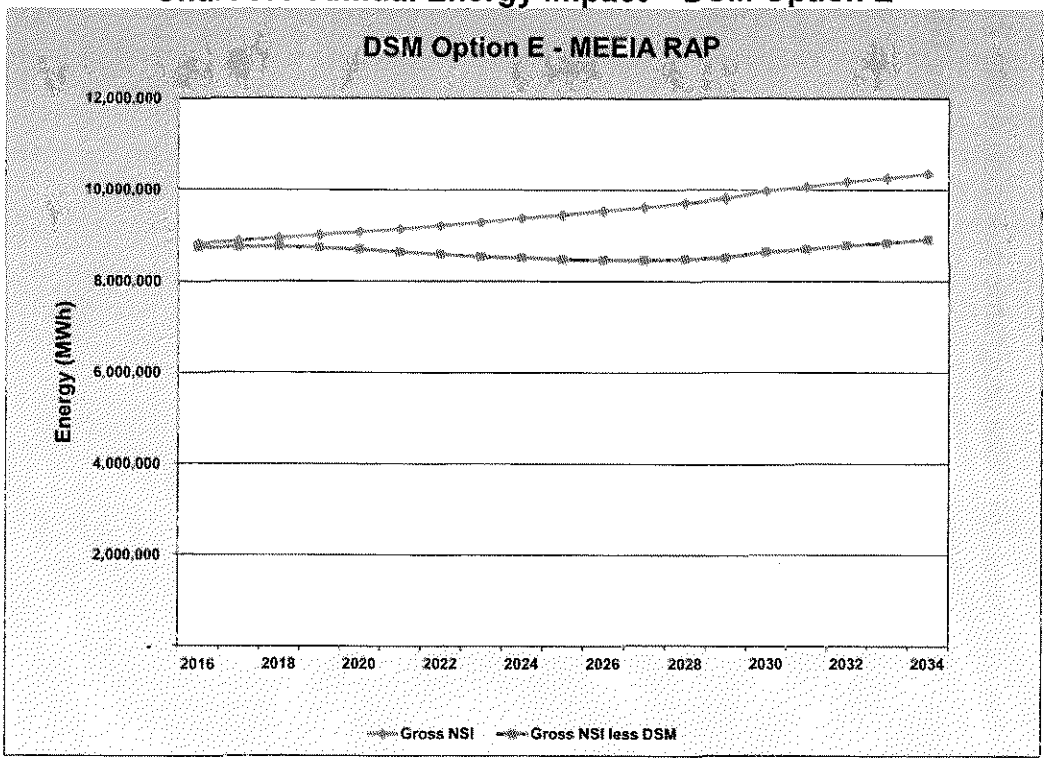


Chart 37: Annual Energy Impact – DSM Option E



5. The composition, by program and demand-side rate, of the annual energy provided by demand-side resources;

The following four charts illustrate the combined energy supplied by the four levels of DSM programs associated with the Alternative Resource Plans. It should be noted that Option D is Persistence DSM and is included in each of the four DSM levels.

Chart 38: Energy Composition – DSM Option A

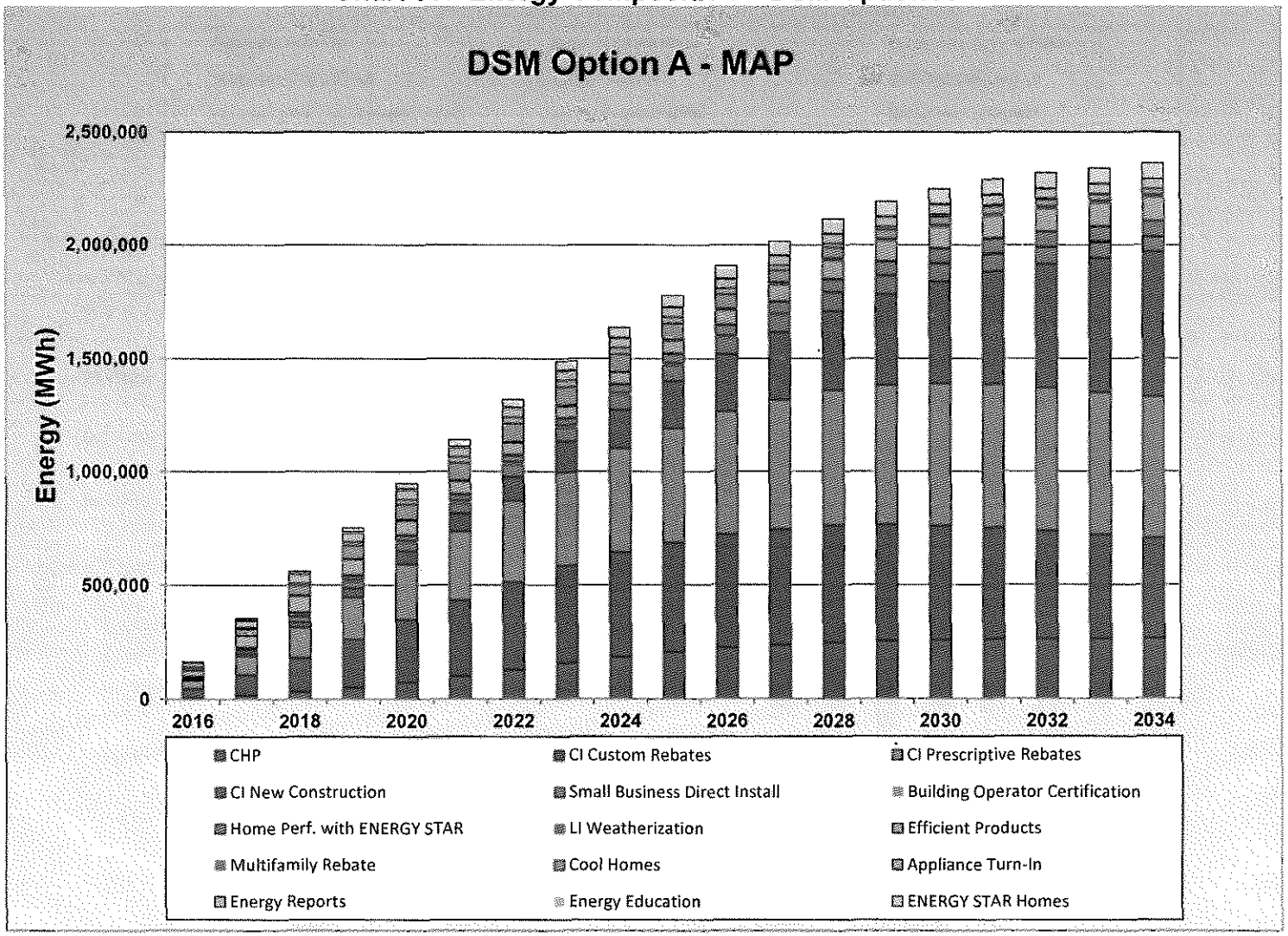


Chart 39: Energy Composition – DSM Option B

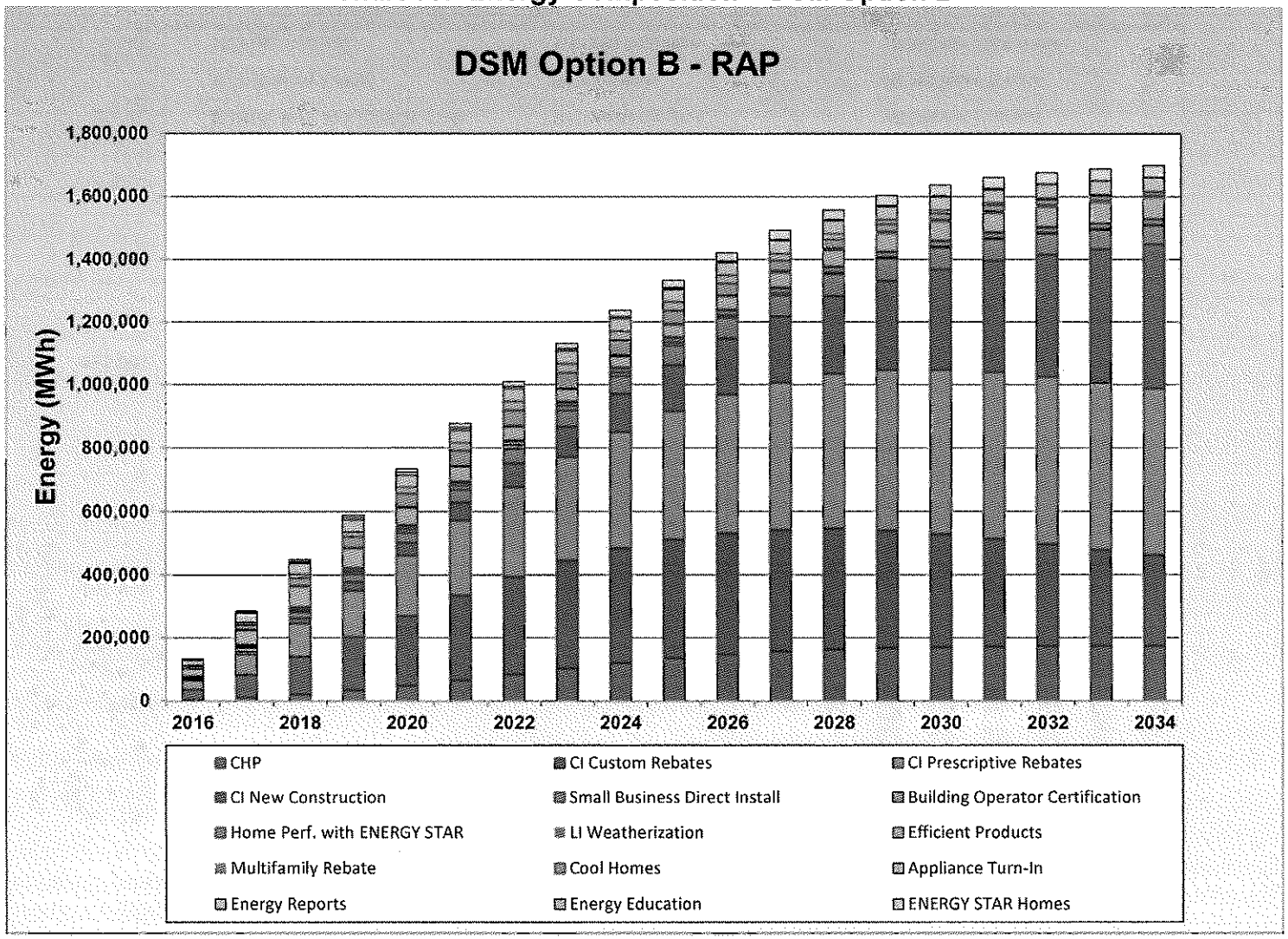


Chart 40: Energy Composition – DSM Option C

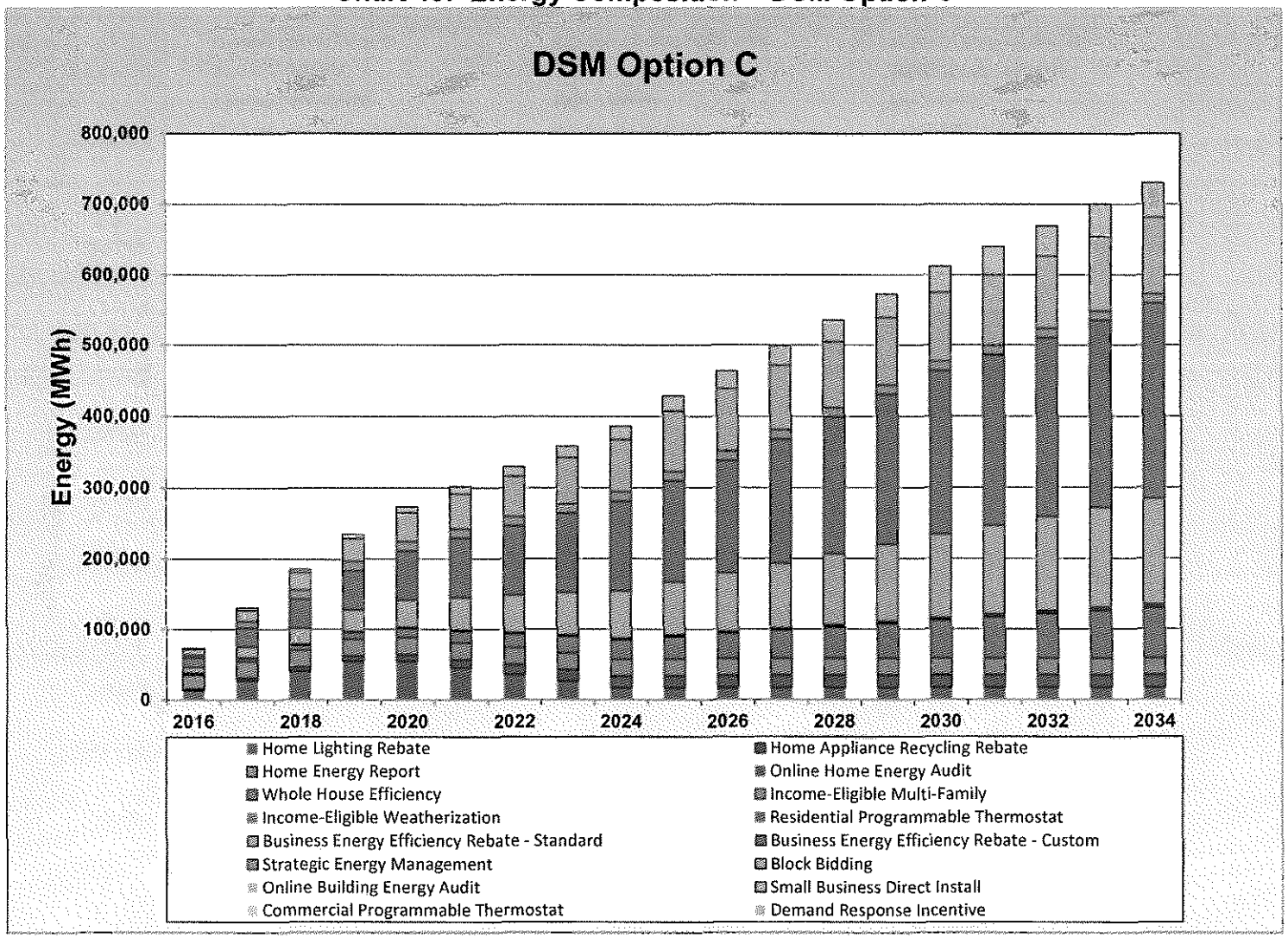
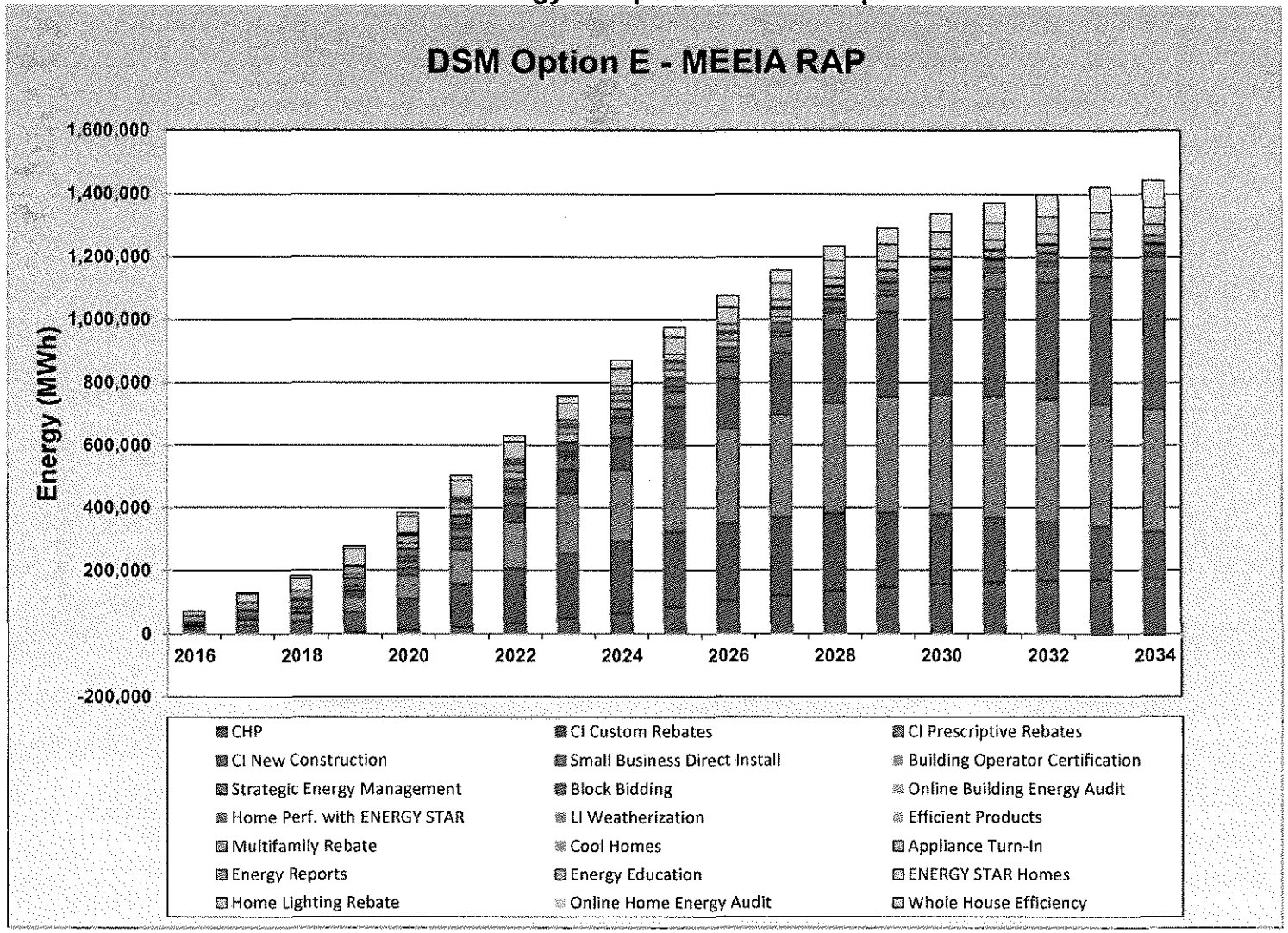


Chart 41: Energy Composition – DSM Option E



6. The composition, by supply-side resource, of the annual energy supplied to the transmission grid, less losses, provided by supply-side resources. Existing supply-side resources may be shown as a single resource;

The following charts detail the expected-value composition by supply-side resource of all energy generated by the assets and supplied to the transmission grid included in each plan. No allowances are developed for "losses" as it is not possible to determine the exact source of energy for a particular lost megawatt-hour of energy.

Chart 42: Annual Generation GAAAA

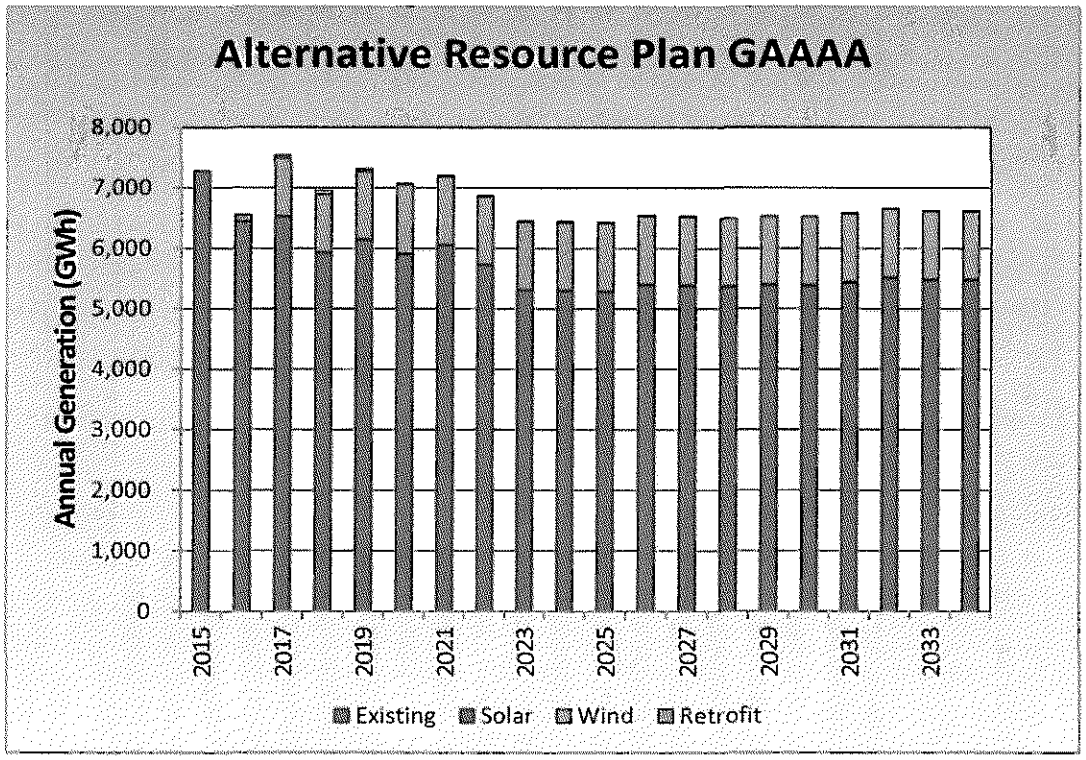


Chart 43: Annual Generation GBBAA

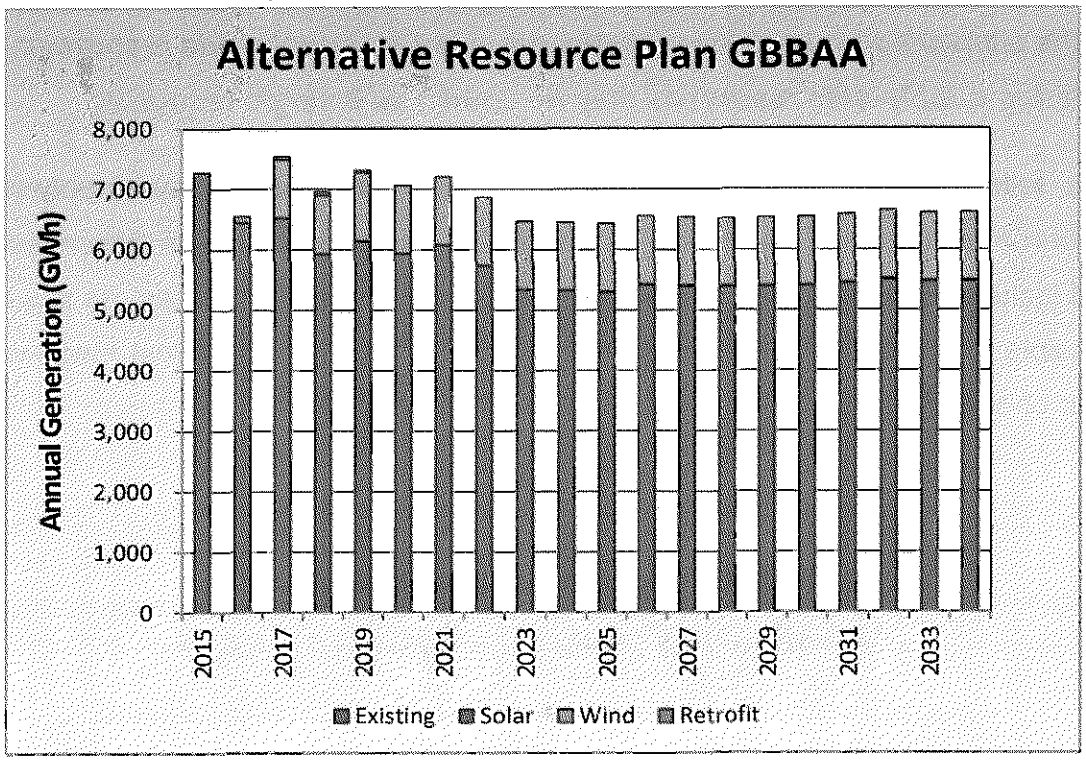


Chart 44: Annual Generation GCBAA

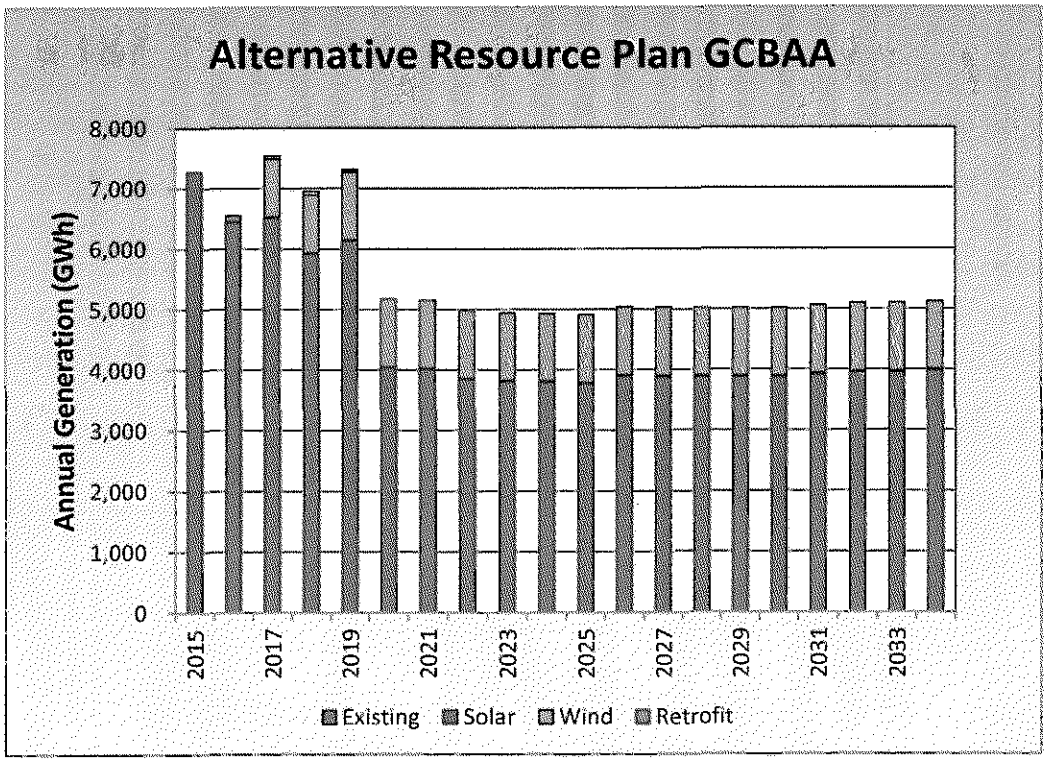


Chart 45: Annual Generation GAABA

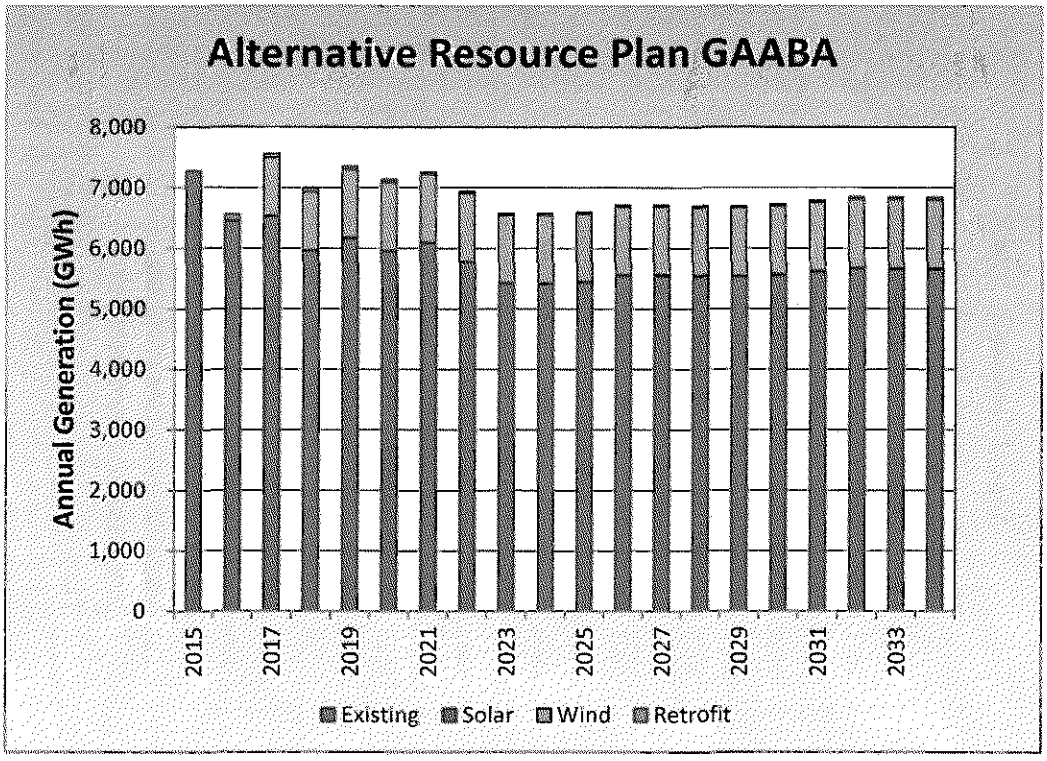


Chart 46: Annual Generation GBBBA

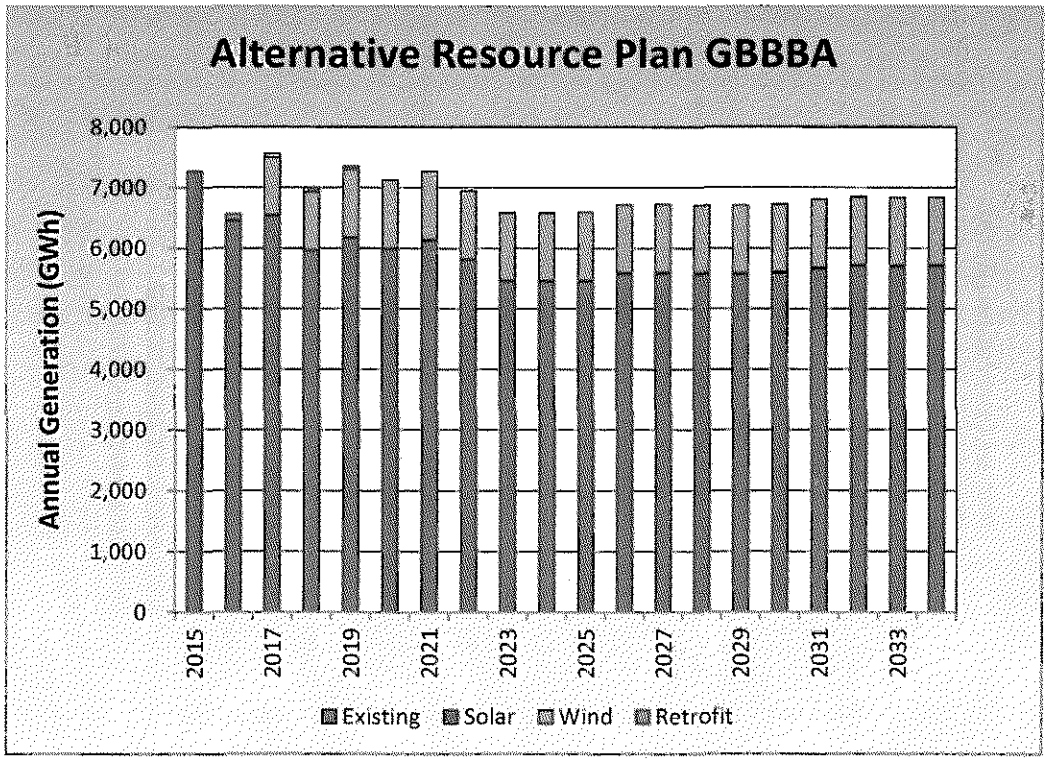


Chart 47: Annual Generation GBBBB

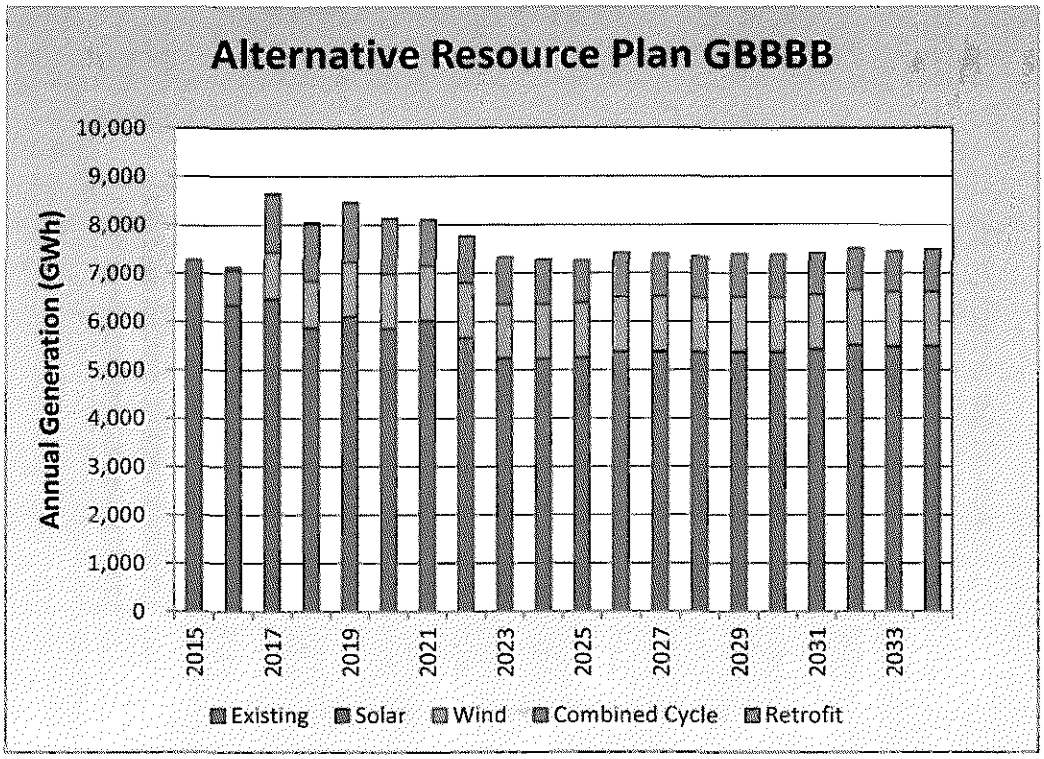


Chart 48: Annual Generation GCBBA

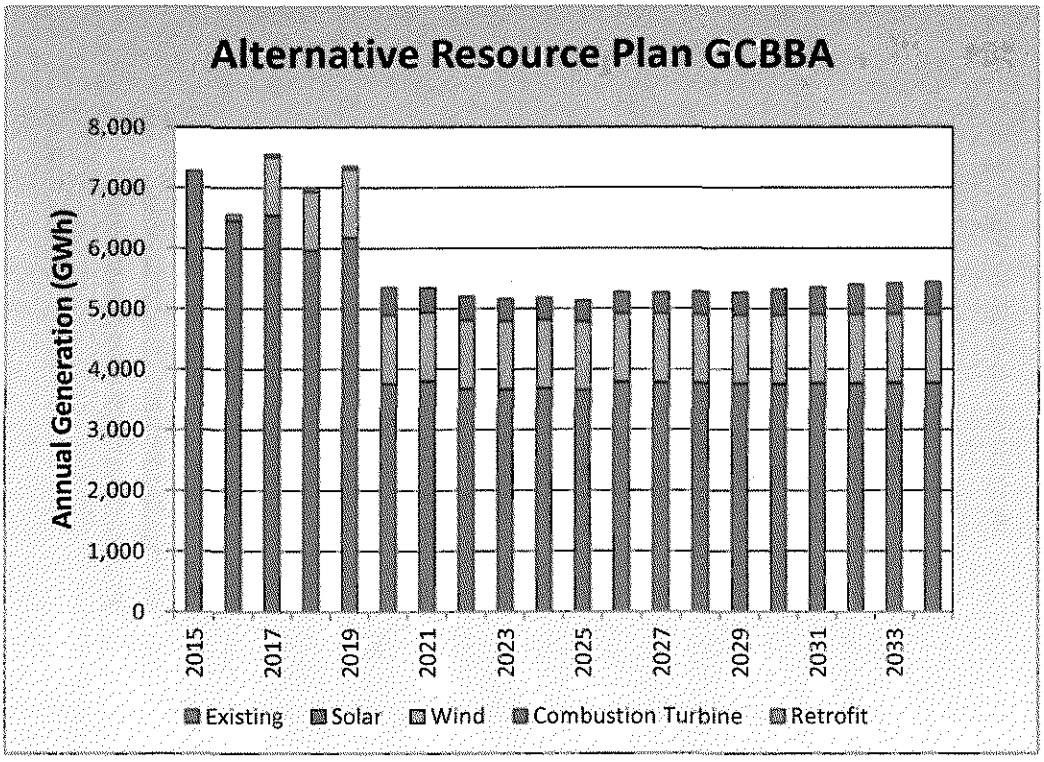


Chart 49: Annual Generation GAACA

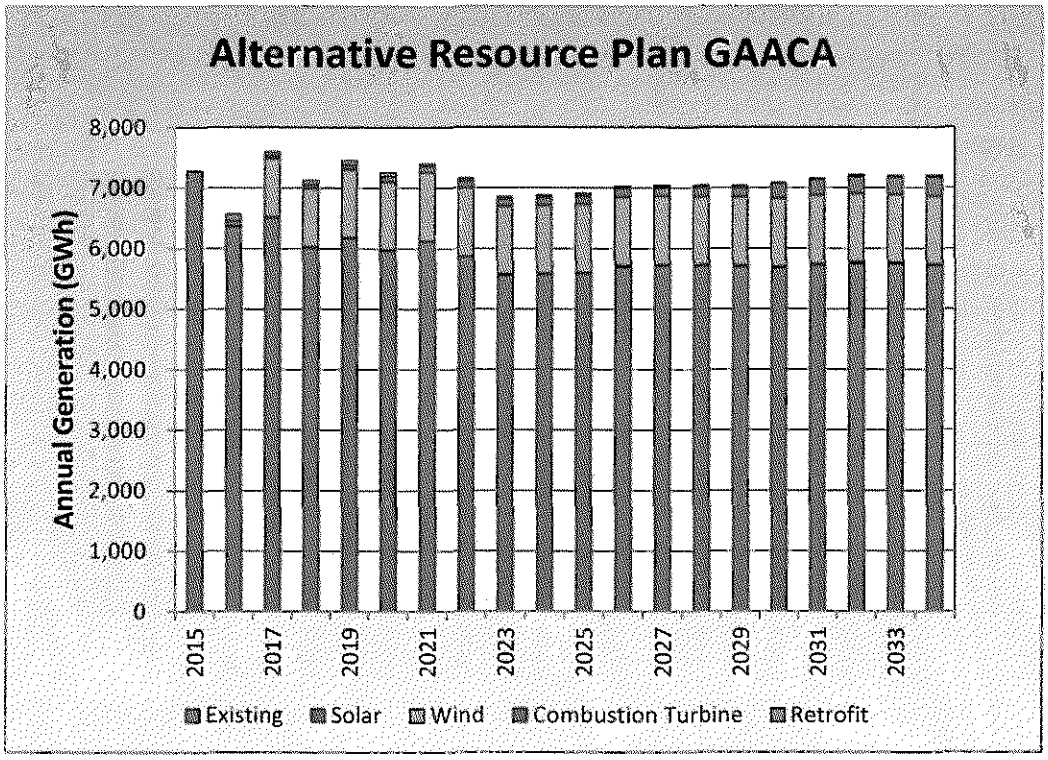


Chart 50: Annual Generation GAACB

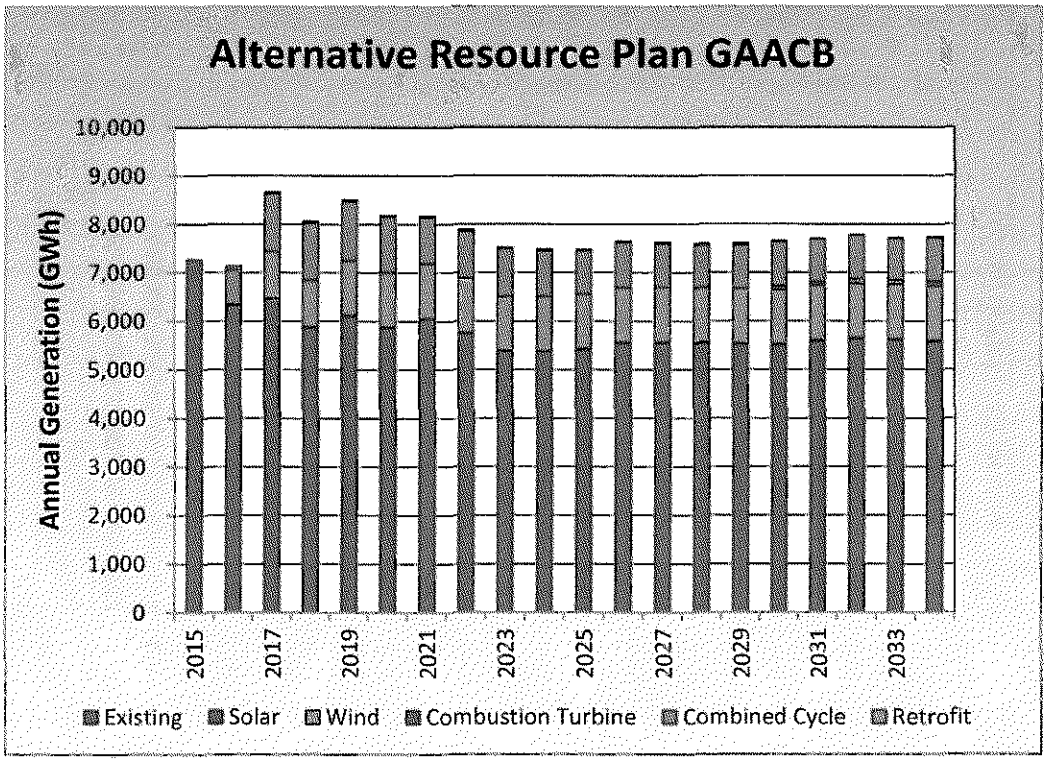


Chart 51: Annual Generation GAACE

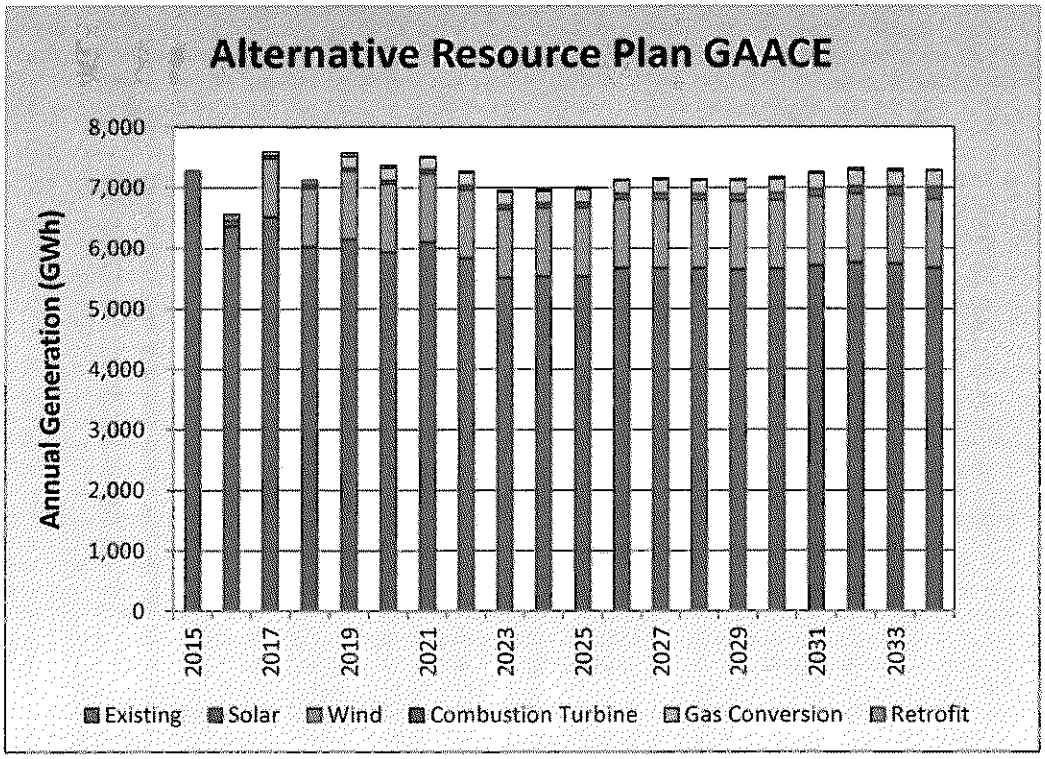


Chart 52: Annual Generation GAACF

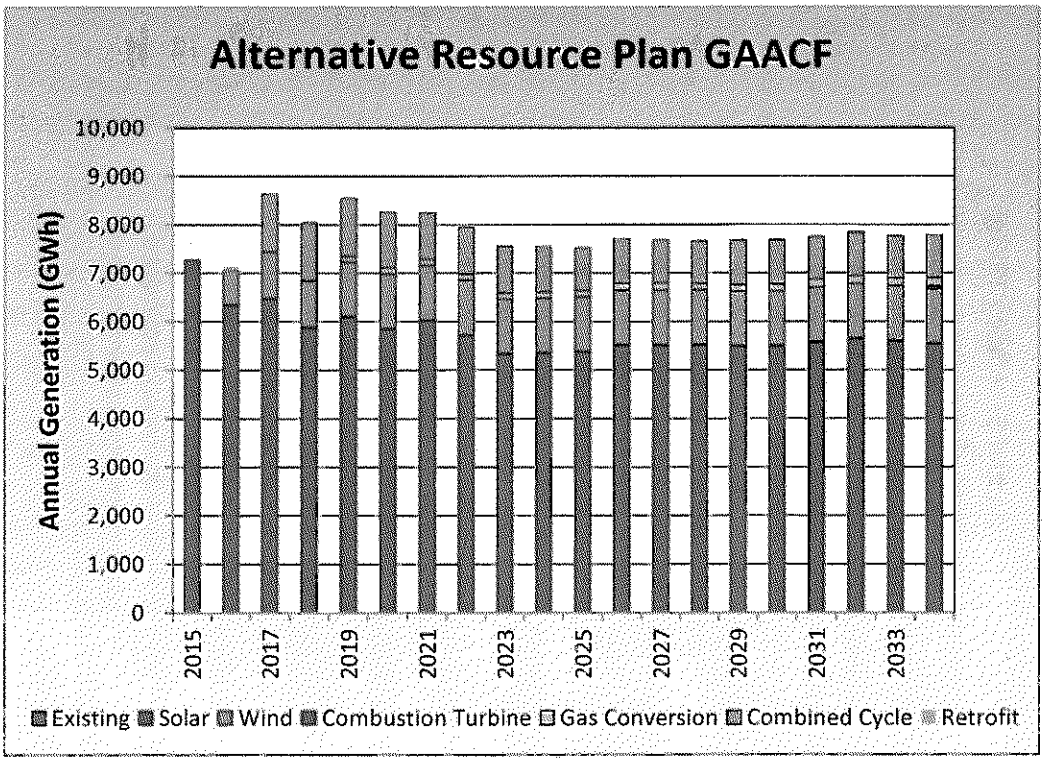


Chart 53: Annual Generation GBBCA

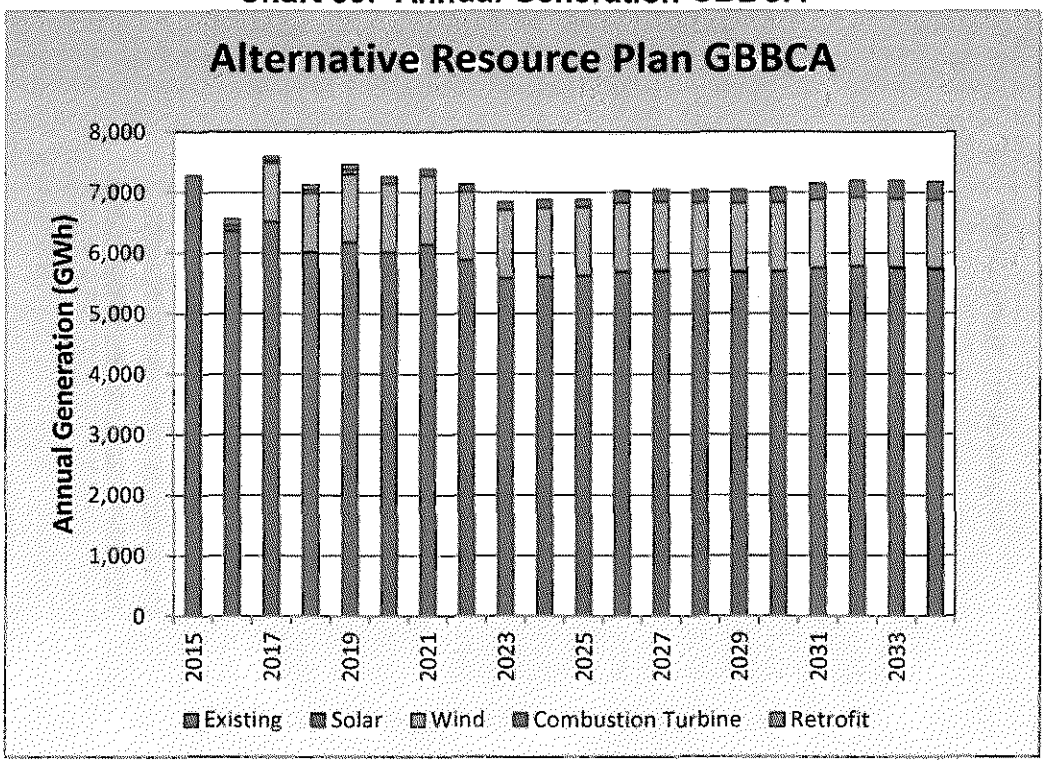


Chart 54: Annual Generation GBBCB

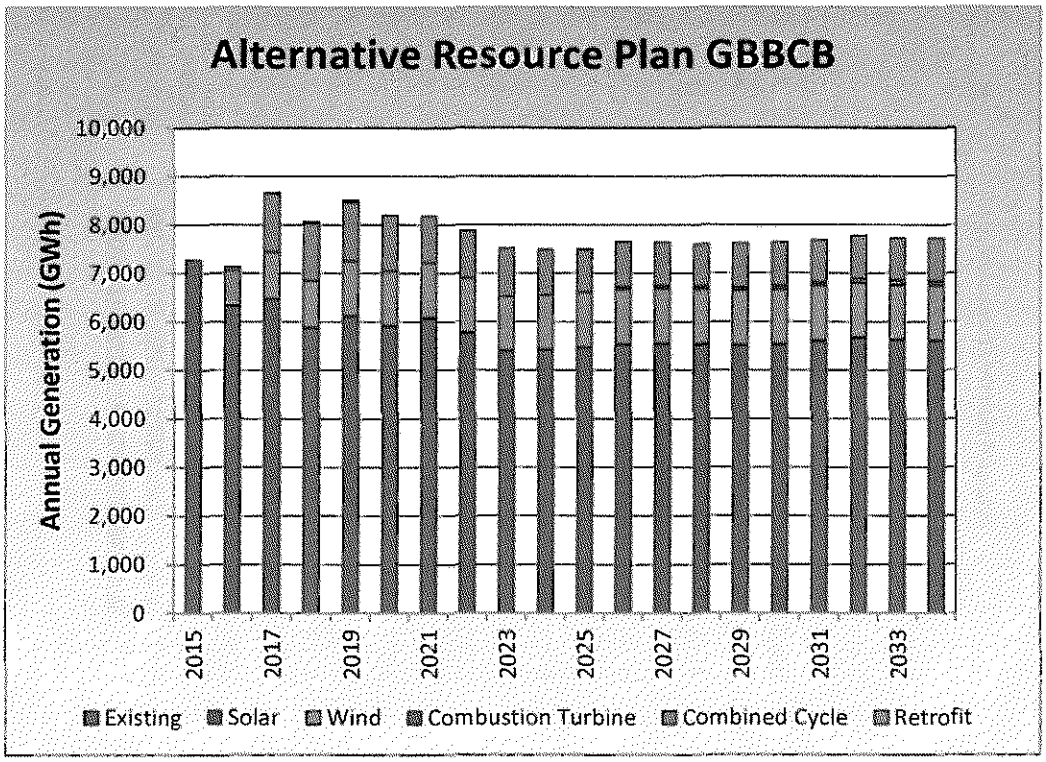


Chart 55: Annual Generation GBBCC

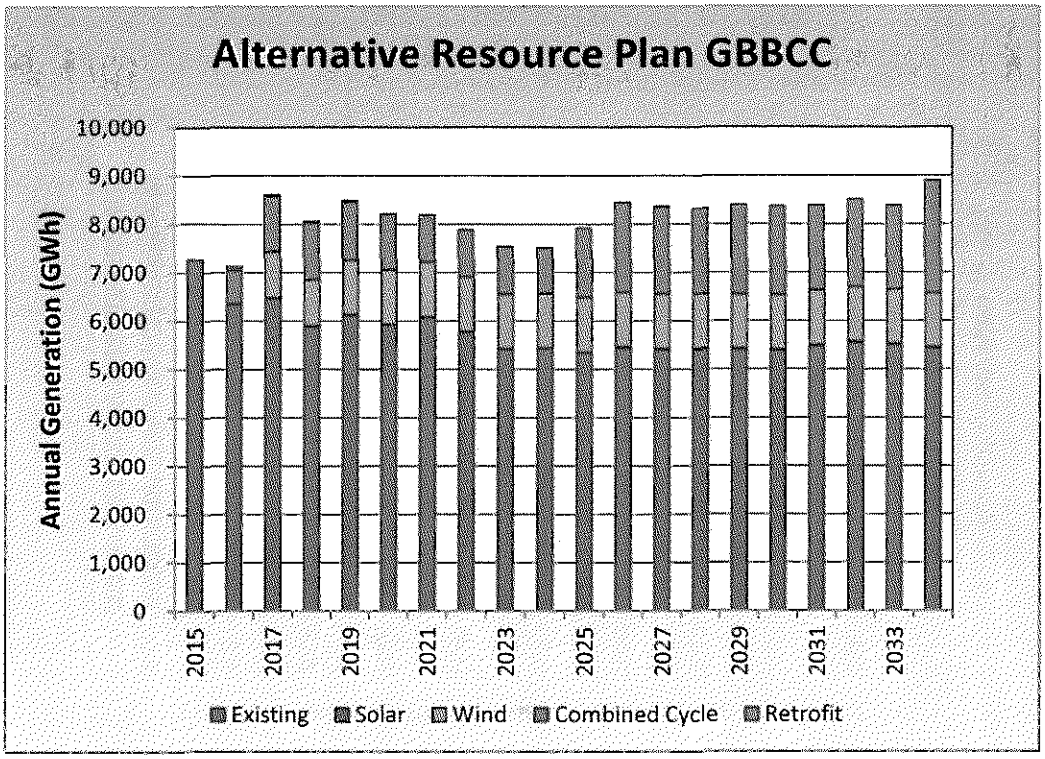


Chart 56: Annual Generation GBBCD

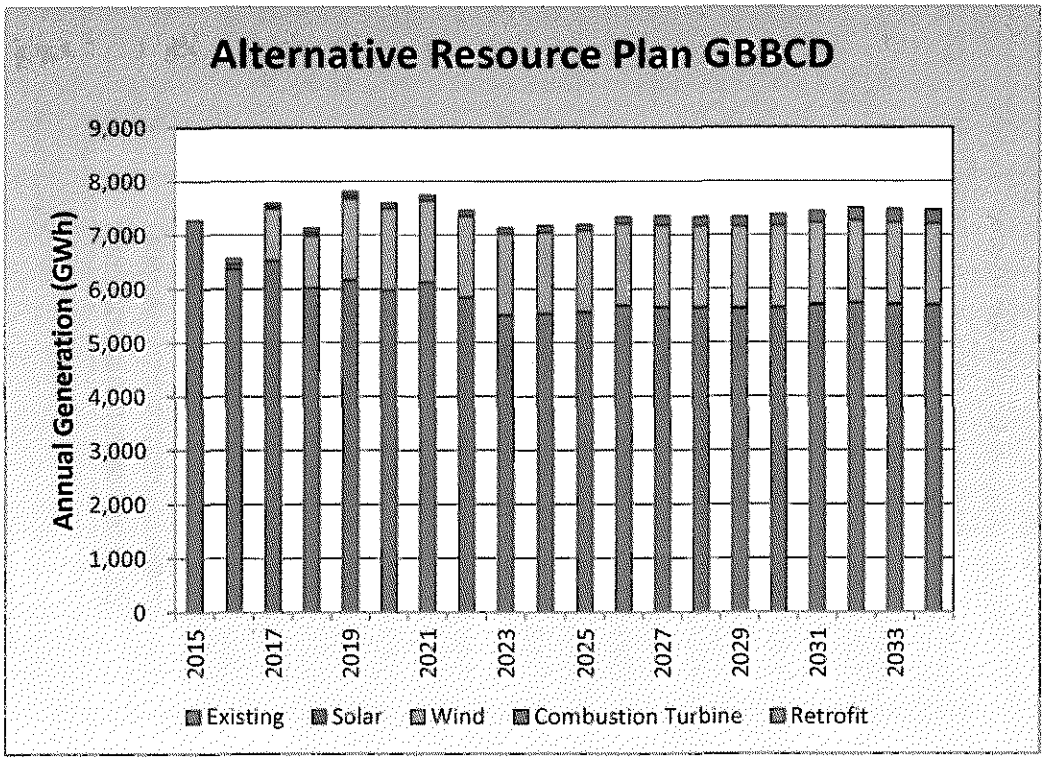


Chart 57: Annual Generation GBBCF

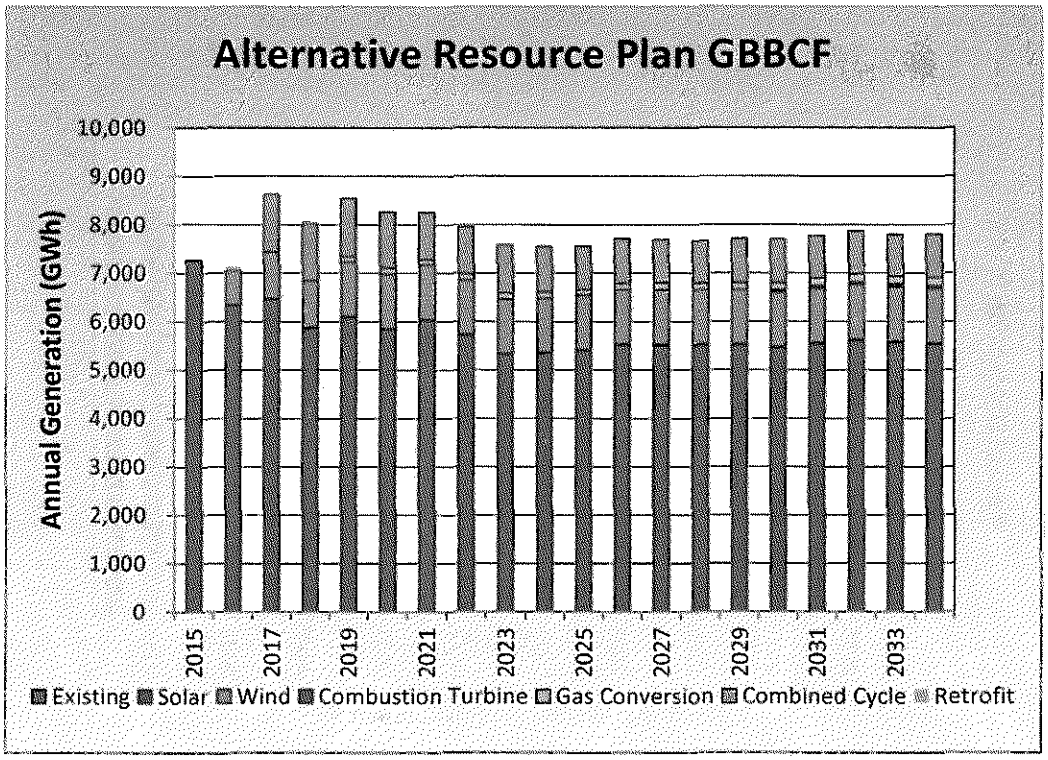


Chart 58: Annual Generation GBBCG

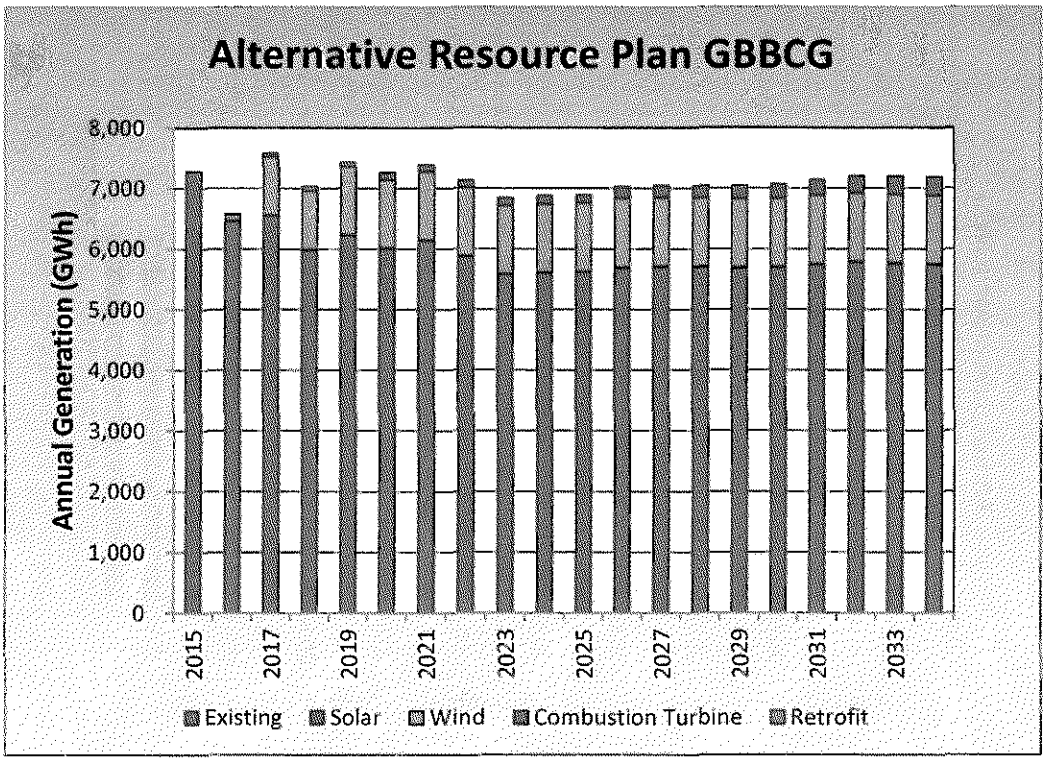


Chart 59: Annual Generation GBBCW

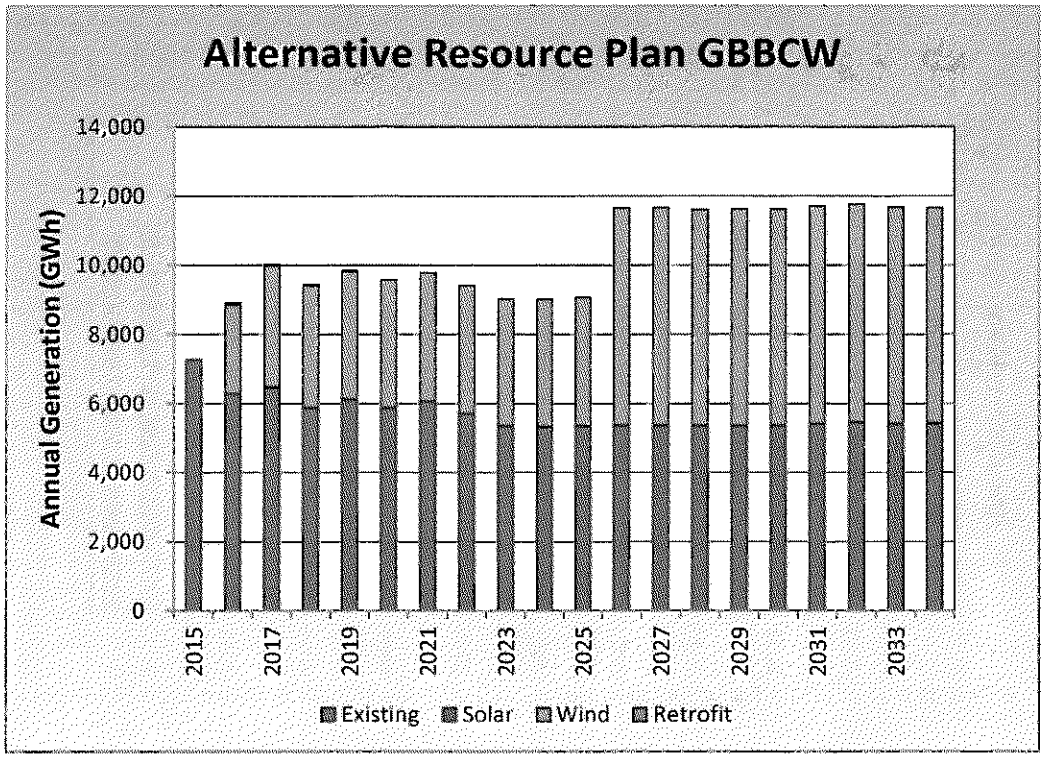


Chart 60: Annual Generation GCBCA

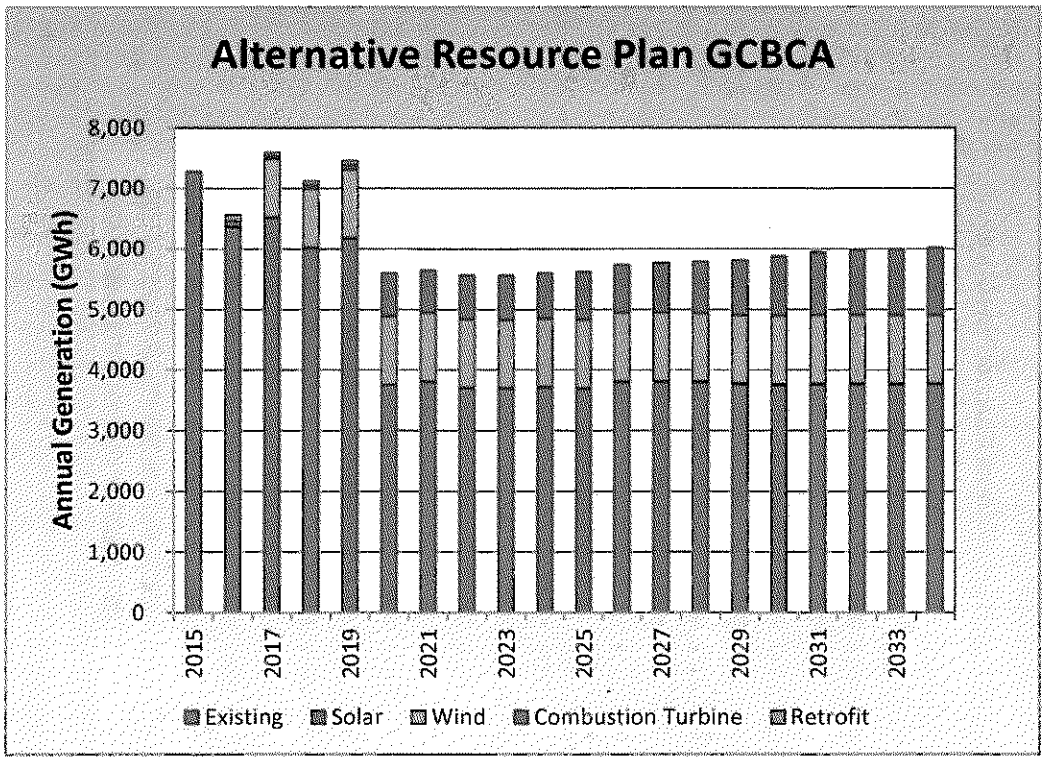


Chart 61: Annual Generation GCBCB

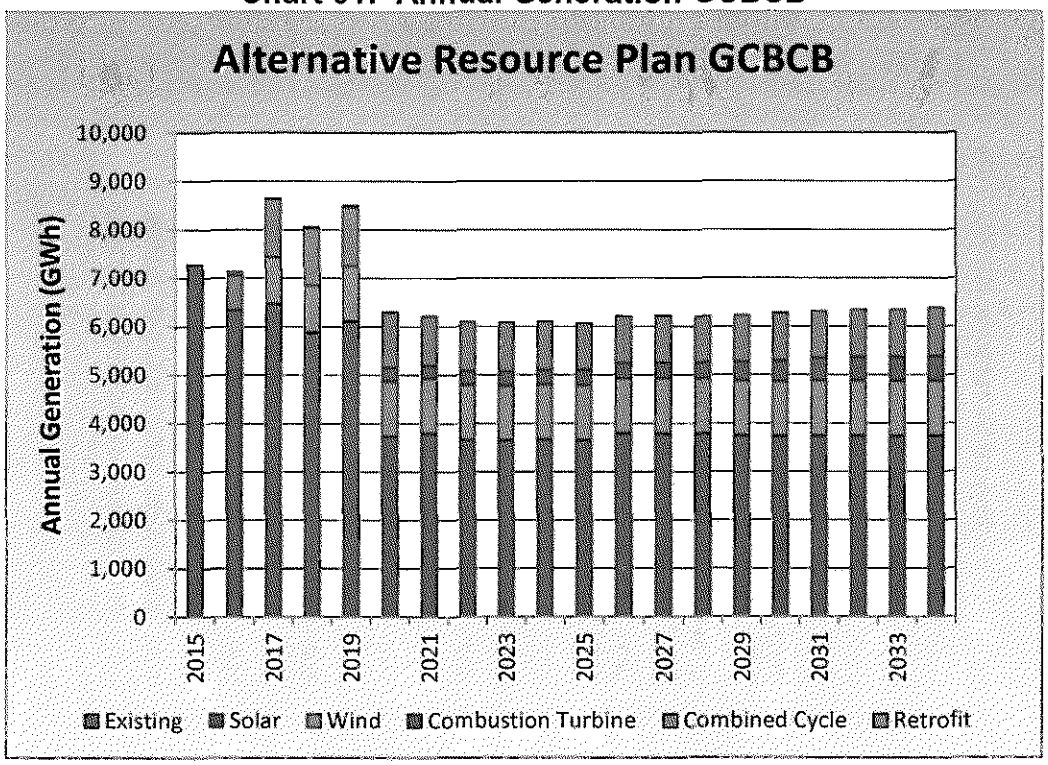


Chart 62: Annual Generation GCBCG

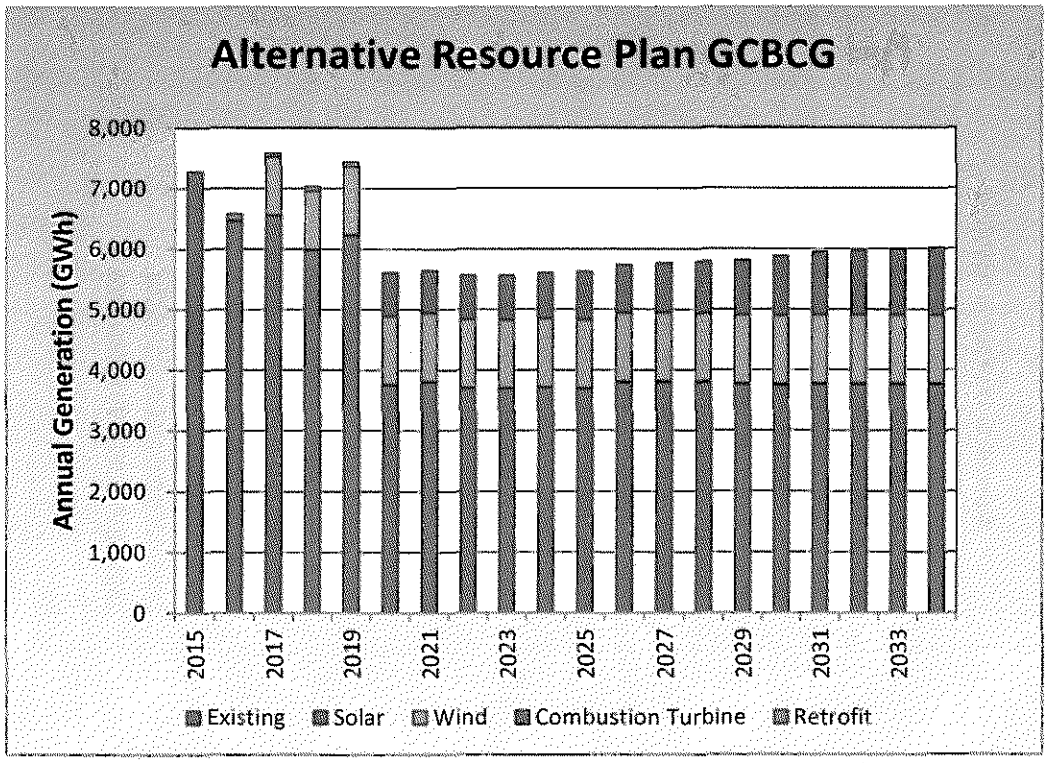


Chart 63: Annual Generation GBBDA

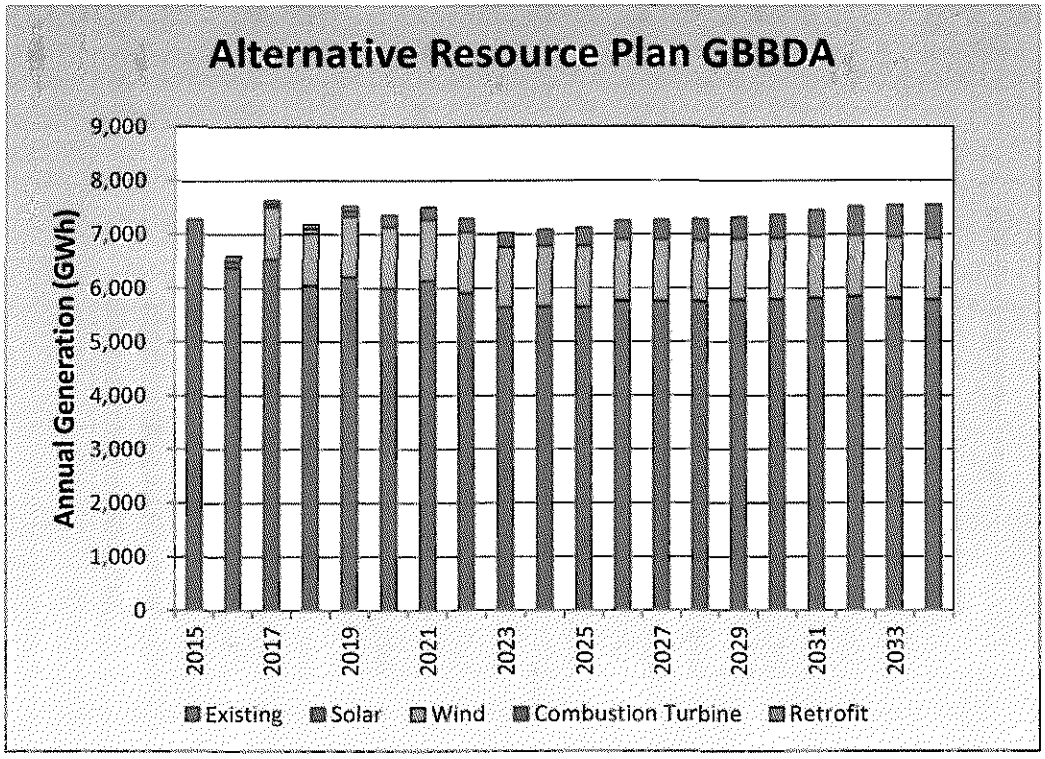


Chart 64: Annual Generation GBBEG

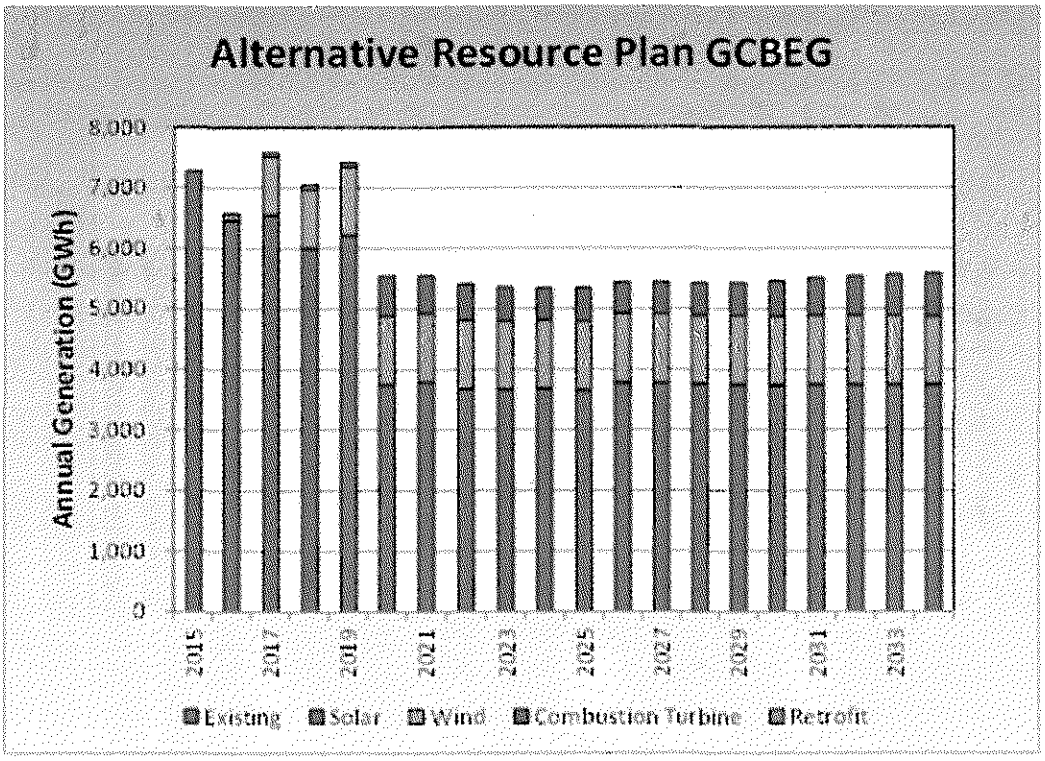


Chart 65: Annual Generation GCBEB

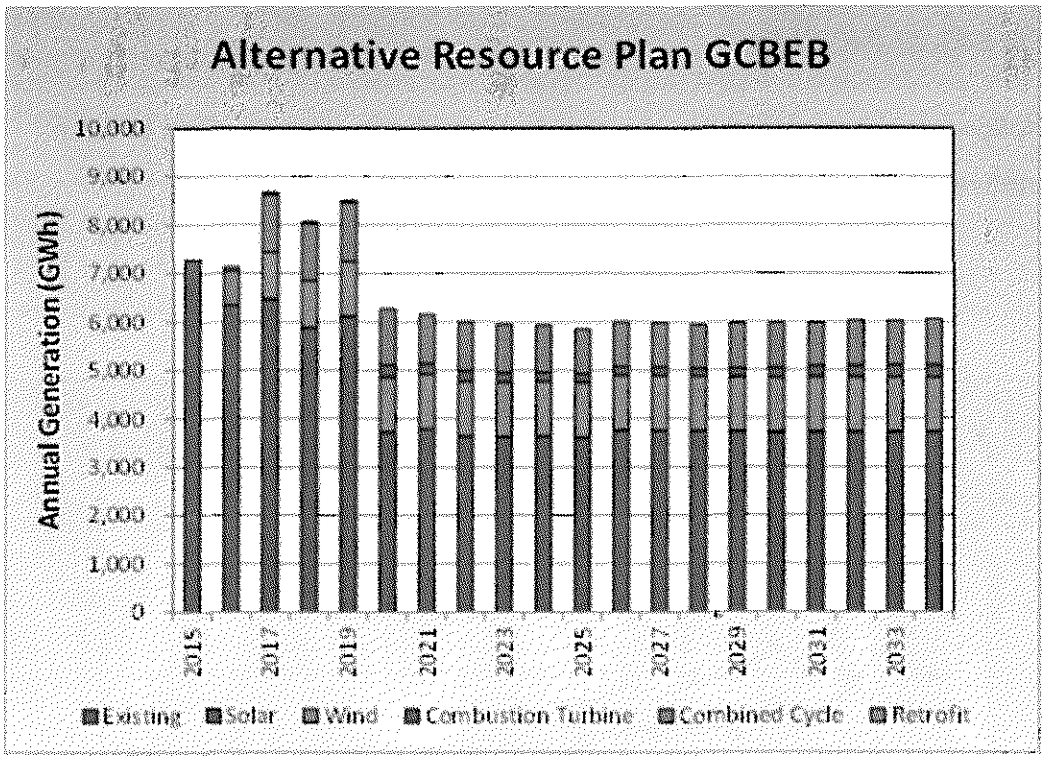
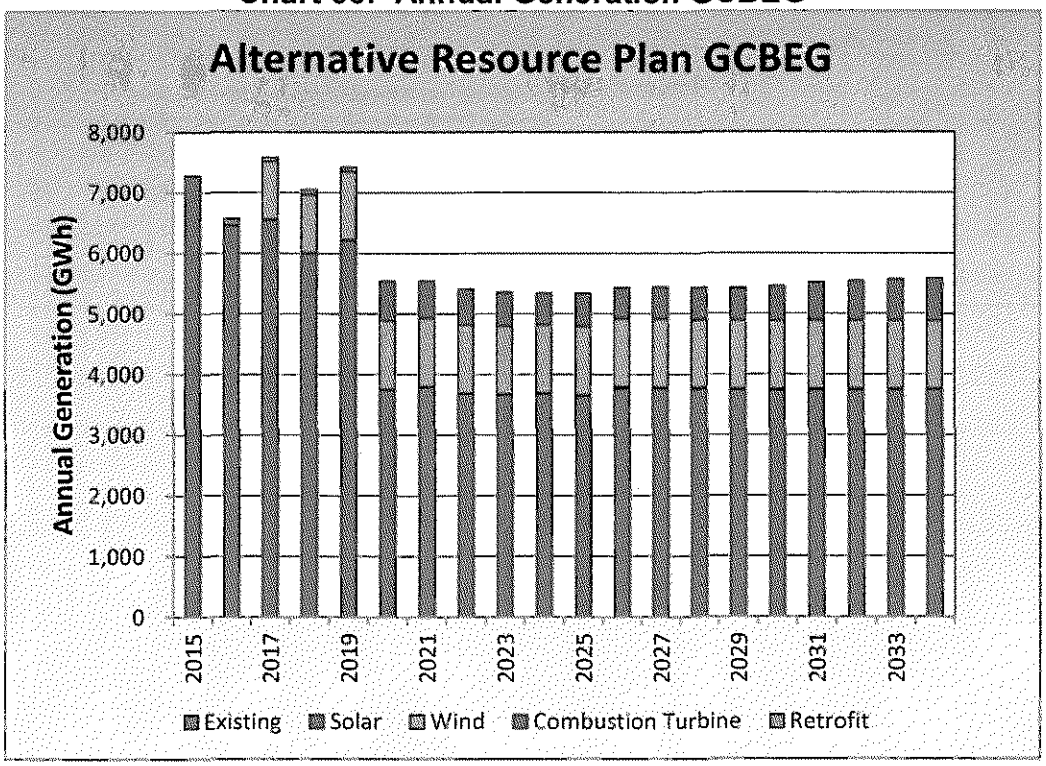


Chart 66: Annual Generation GCBEG



7. Annual emissions of each environmental pollutant identified pursuant to 4 CSR 240-22.040(2)(B);

The following charts detail the expected value of annual emissions in each alternative resource plan.

Chart 67: Annual Emissions GAAAA

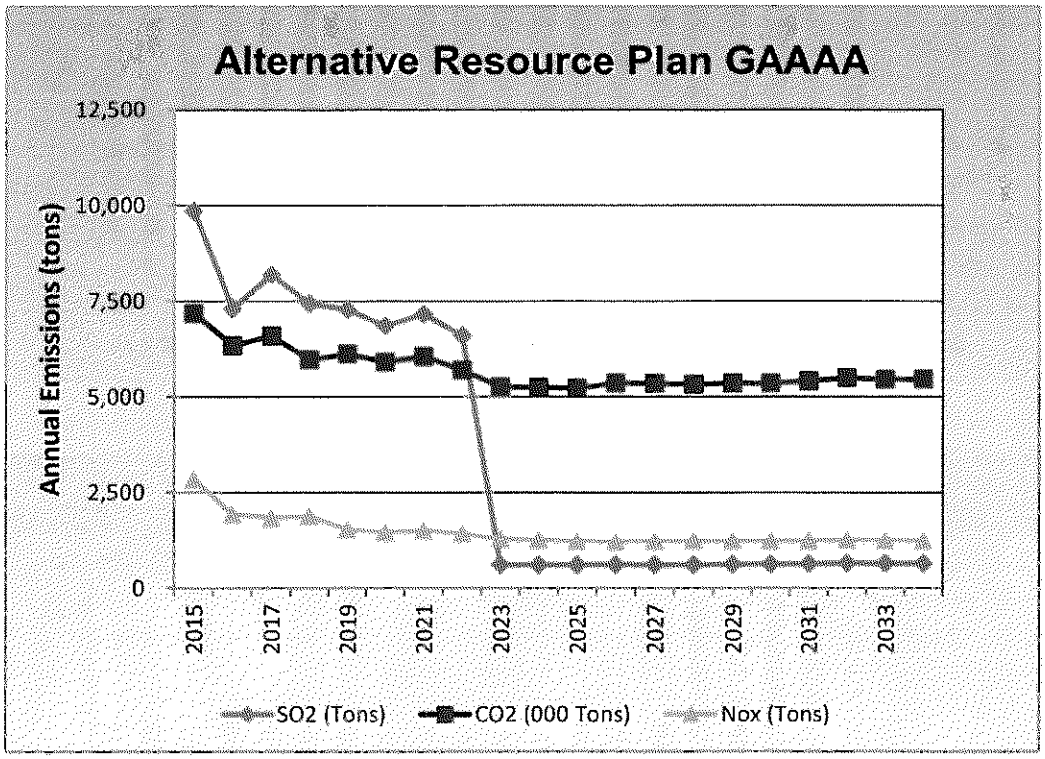


Chart 68: Annual Emissions GBBAA

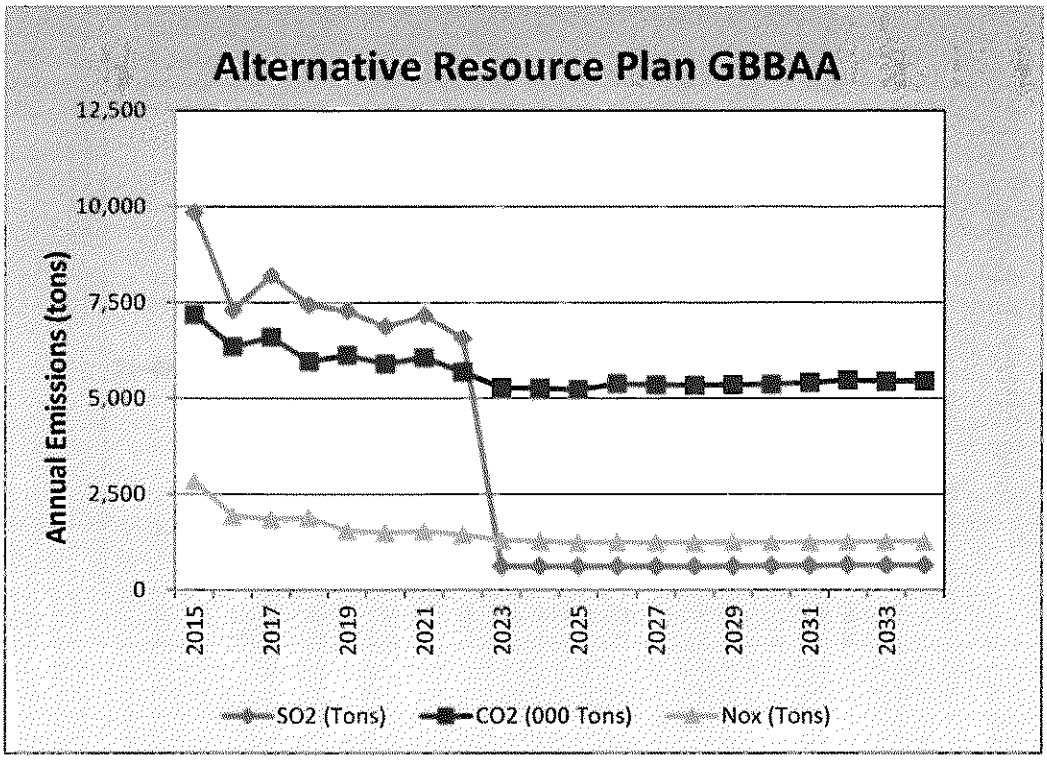


Chart 69: Annual Emissions GCBAA

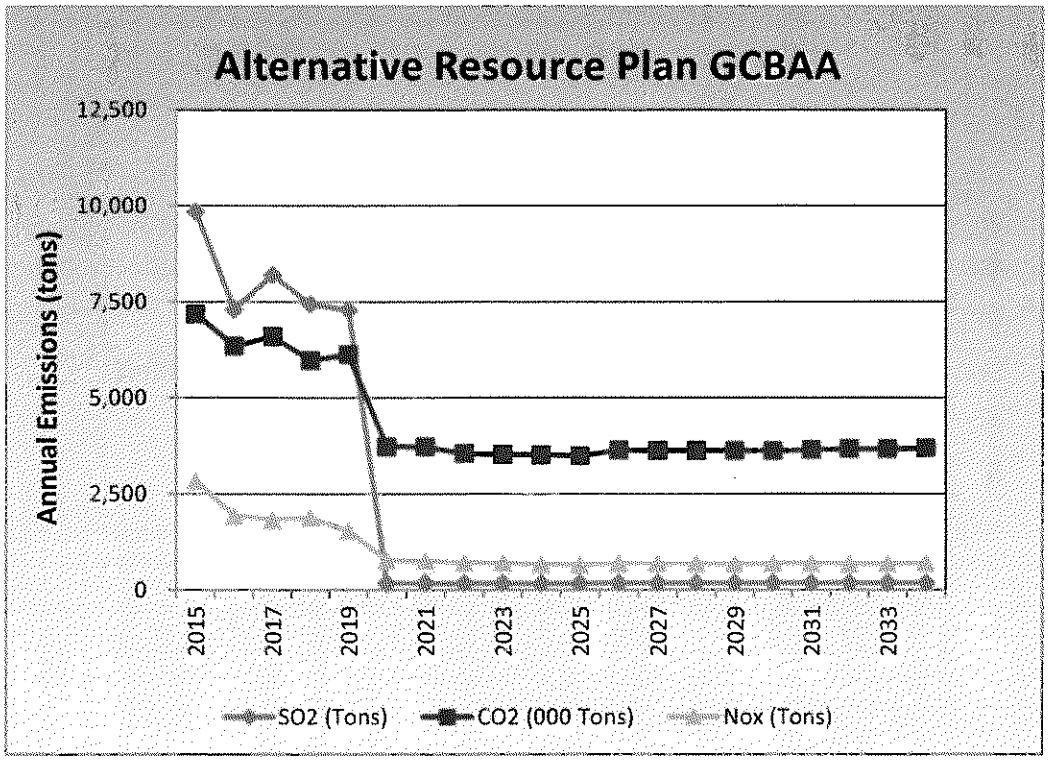


Chart 70: Annual Emissions GAABA

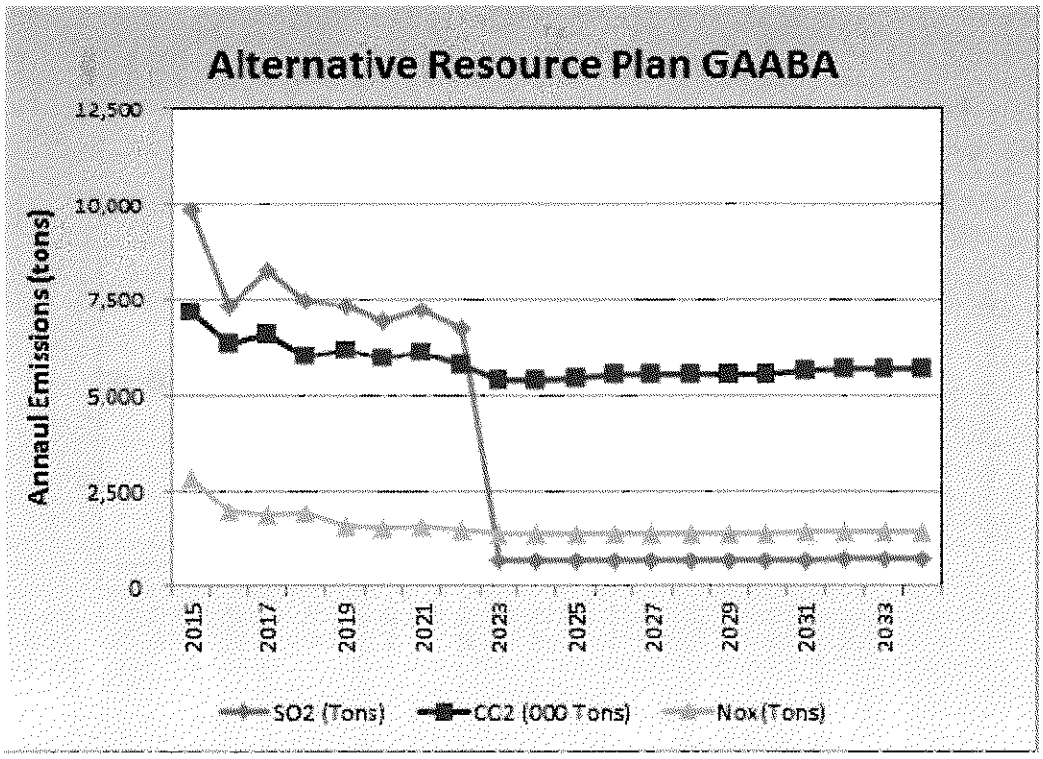


Chart 71: Annual Emissions GBBBA

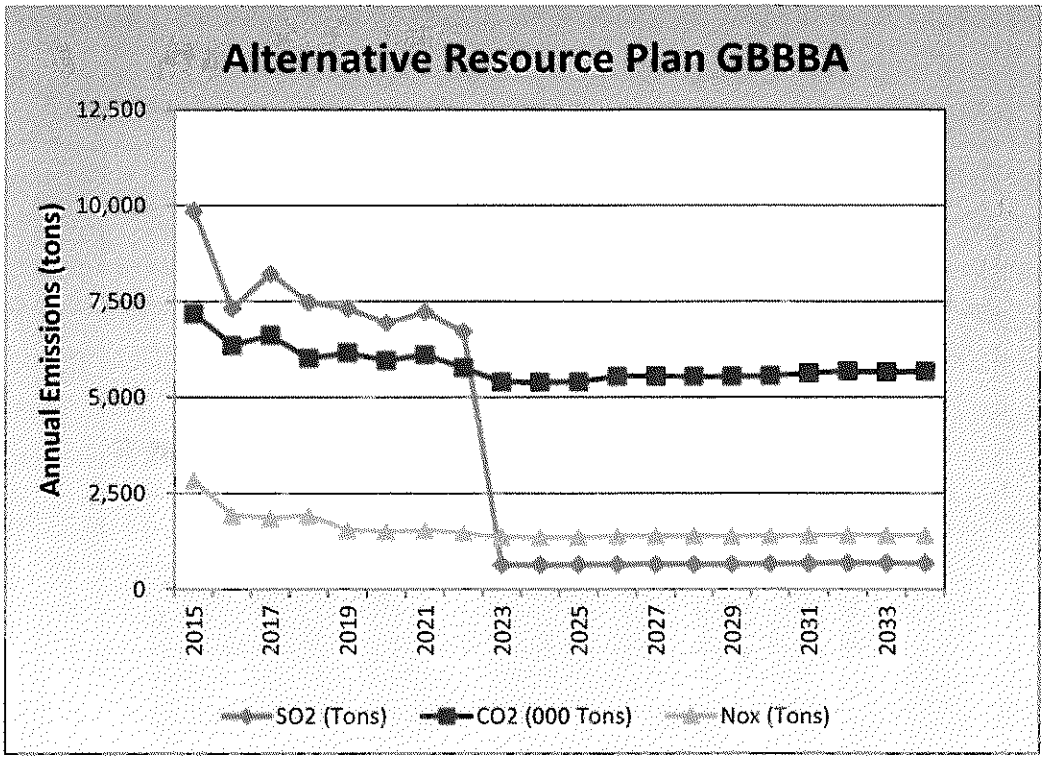


Chart 72: Annual Emissions GBBBB

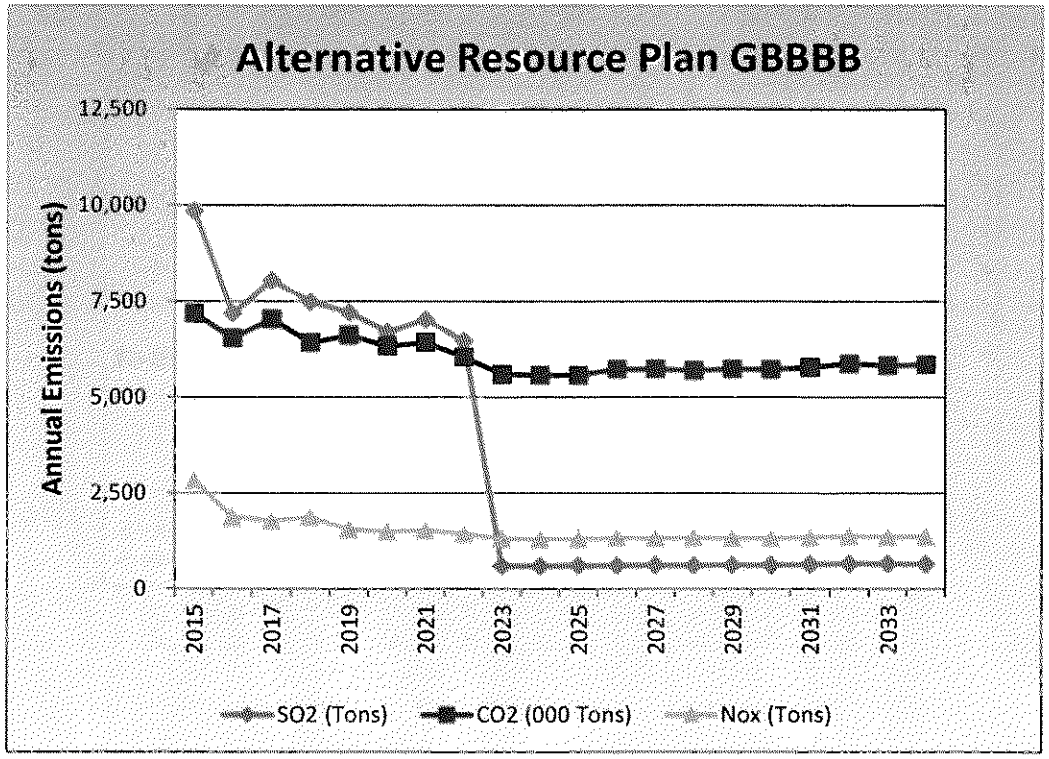


Chart 73: Annual Emissions GCBBA

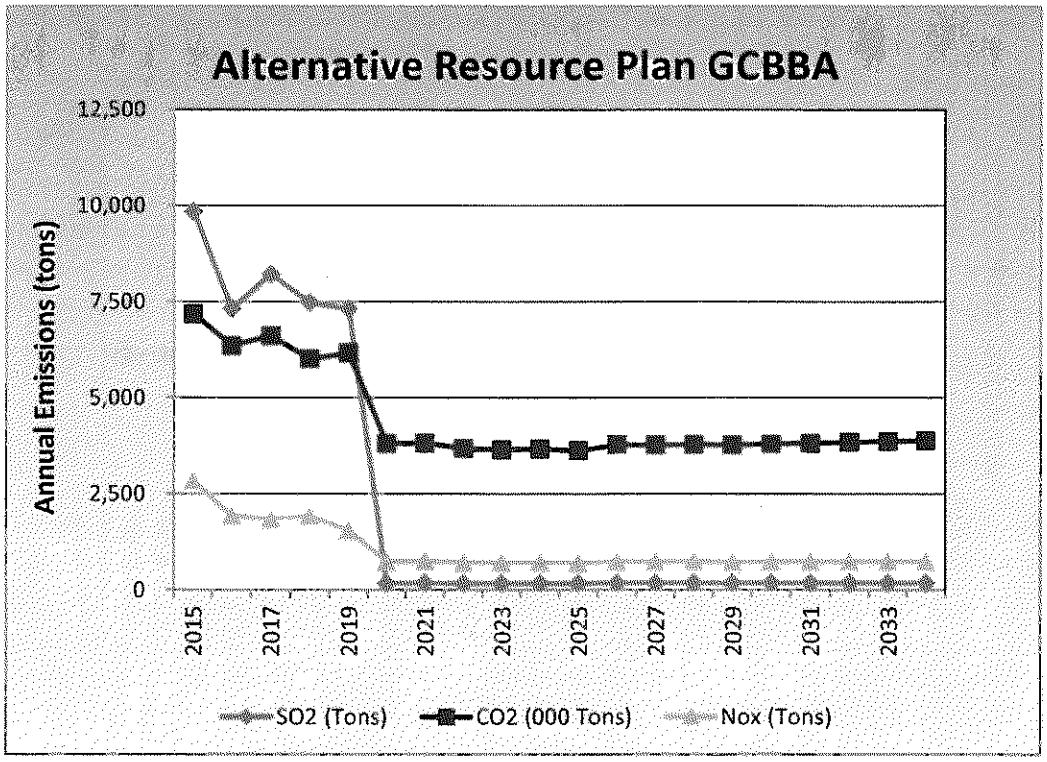


Chart 74: Annual Emissions GAACA

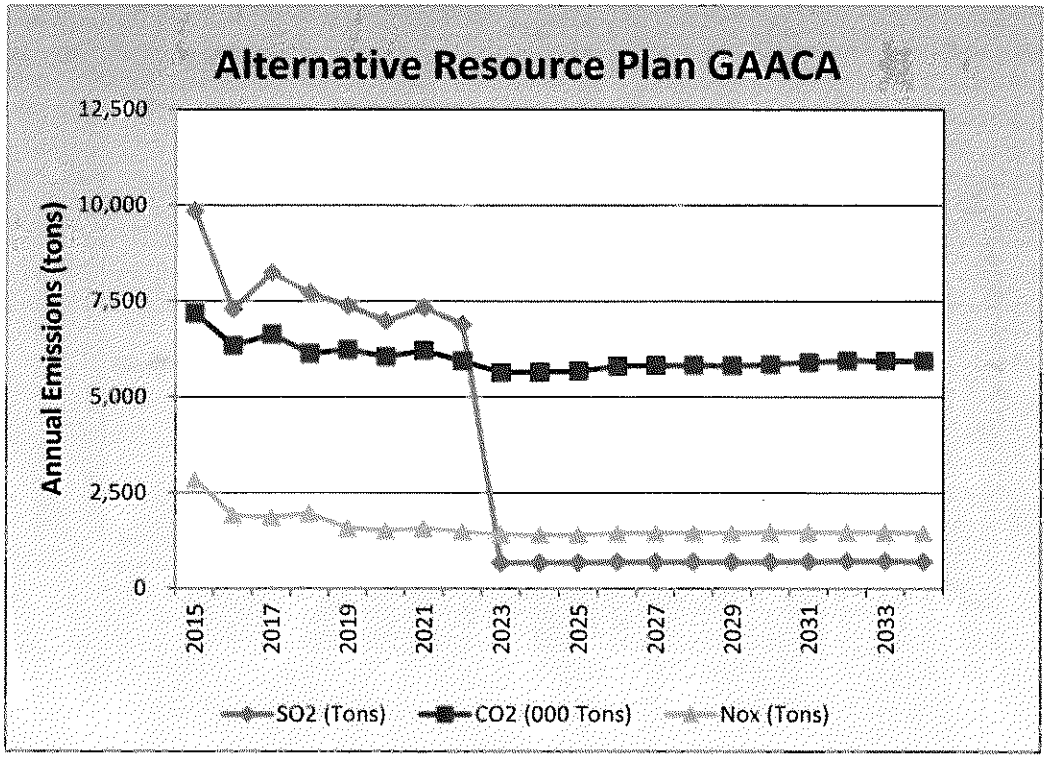


Chart 75: Annual Emissions GAACB

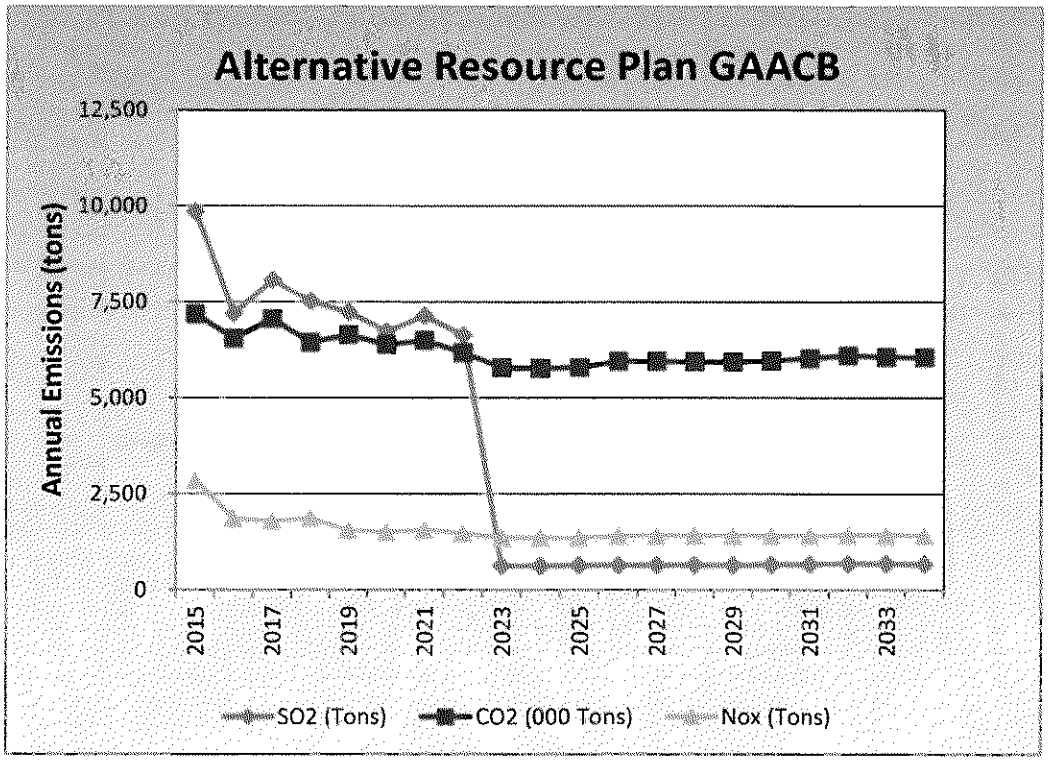


Chart 76: Annual Emissions GAACE

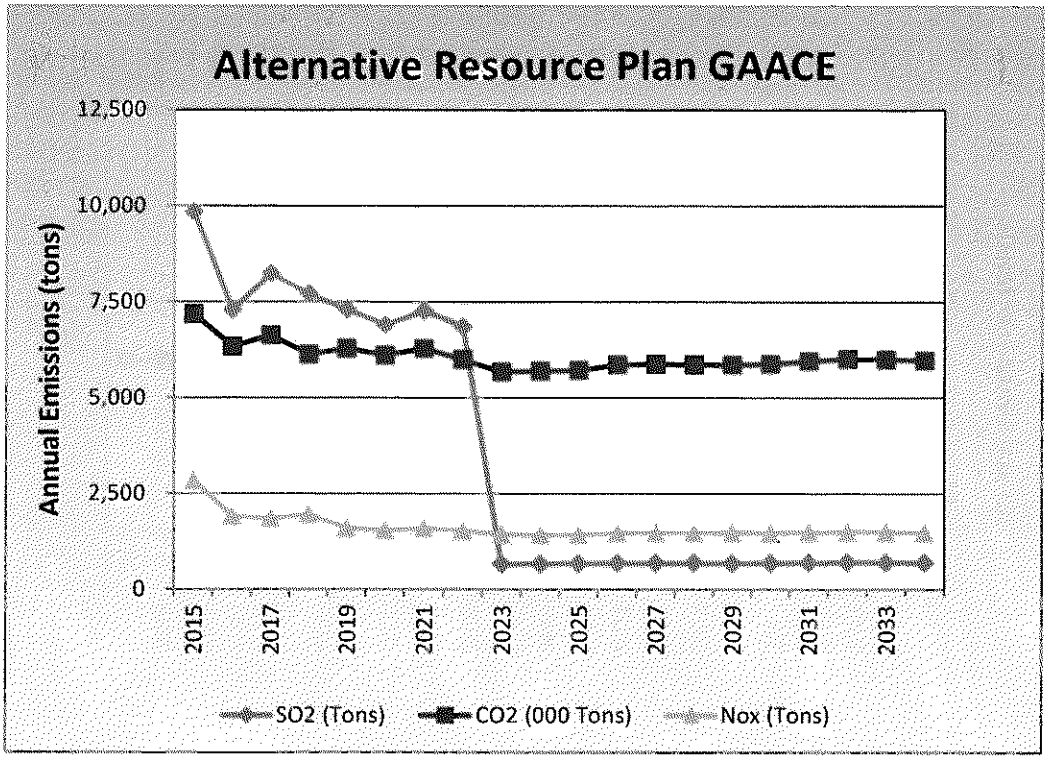


Chart 77: Annual Emissions GAACF

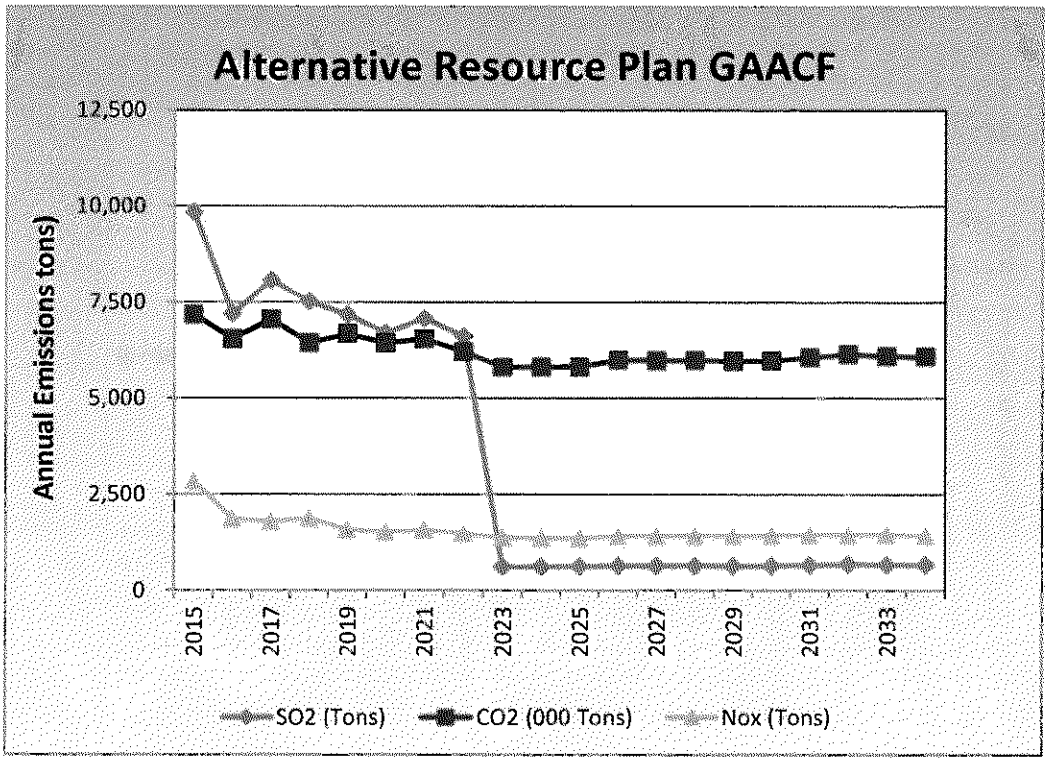


Chart 78: Annual Emissions GBBCA

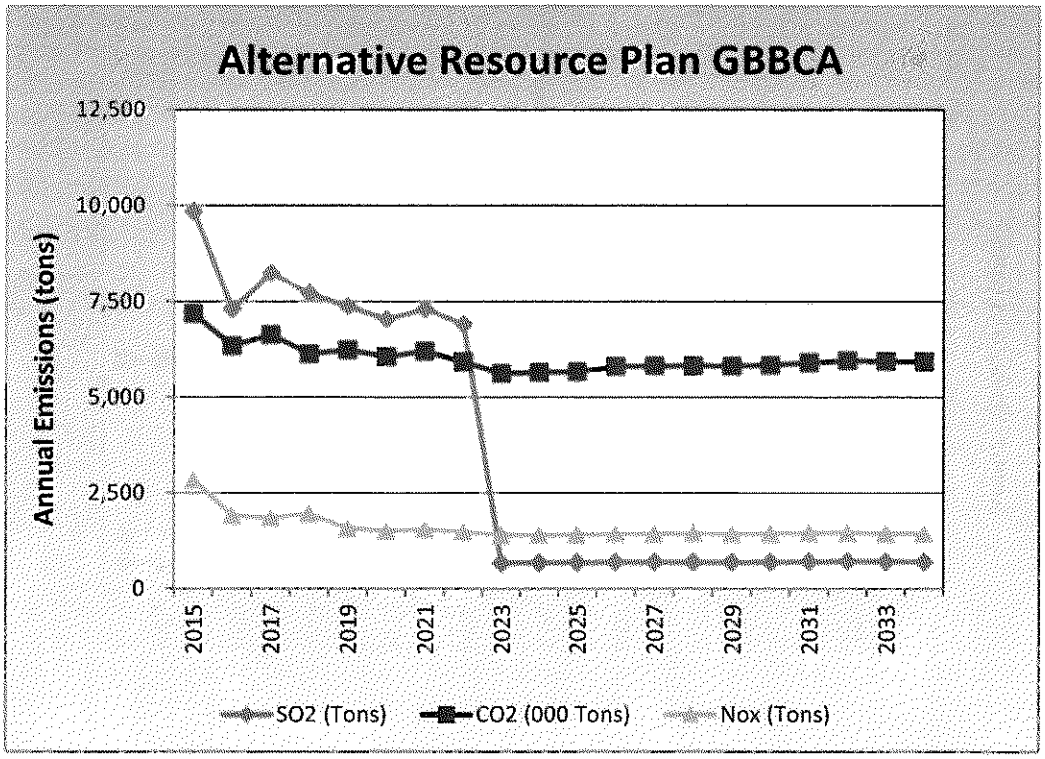


Chart 79: Annual Emissions GBBCB

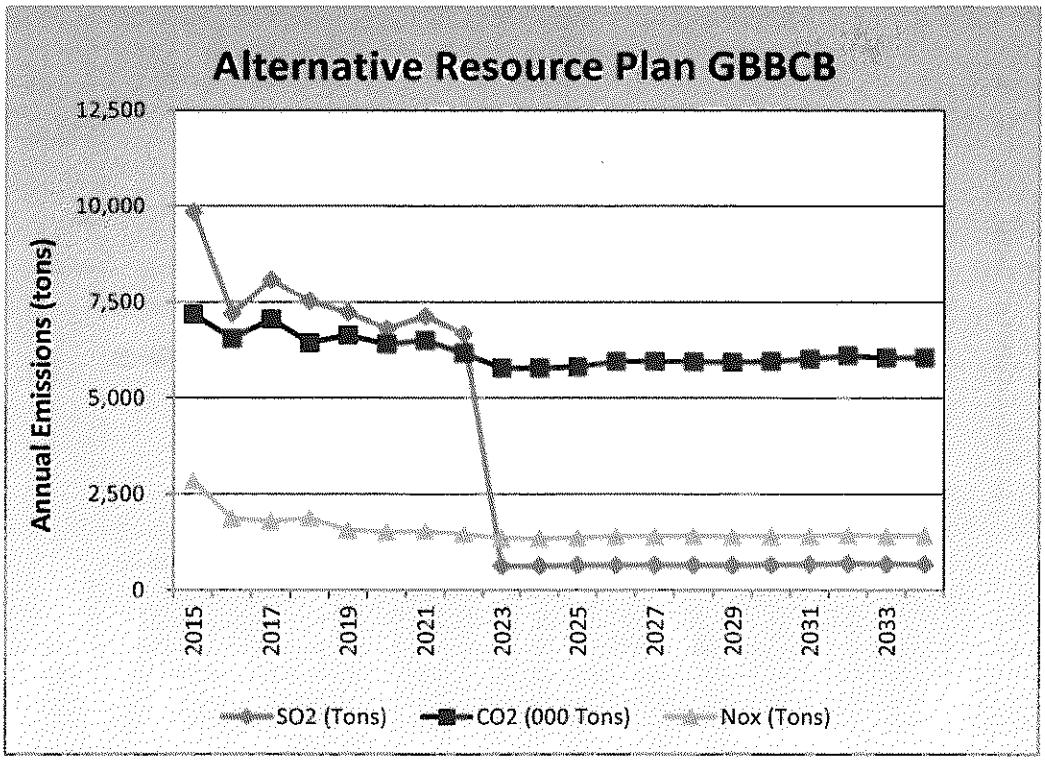


Chart 80: Annual Emissions GBBCC

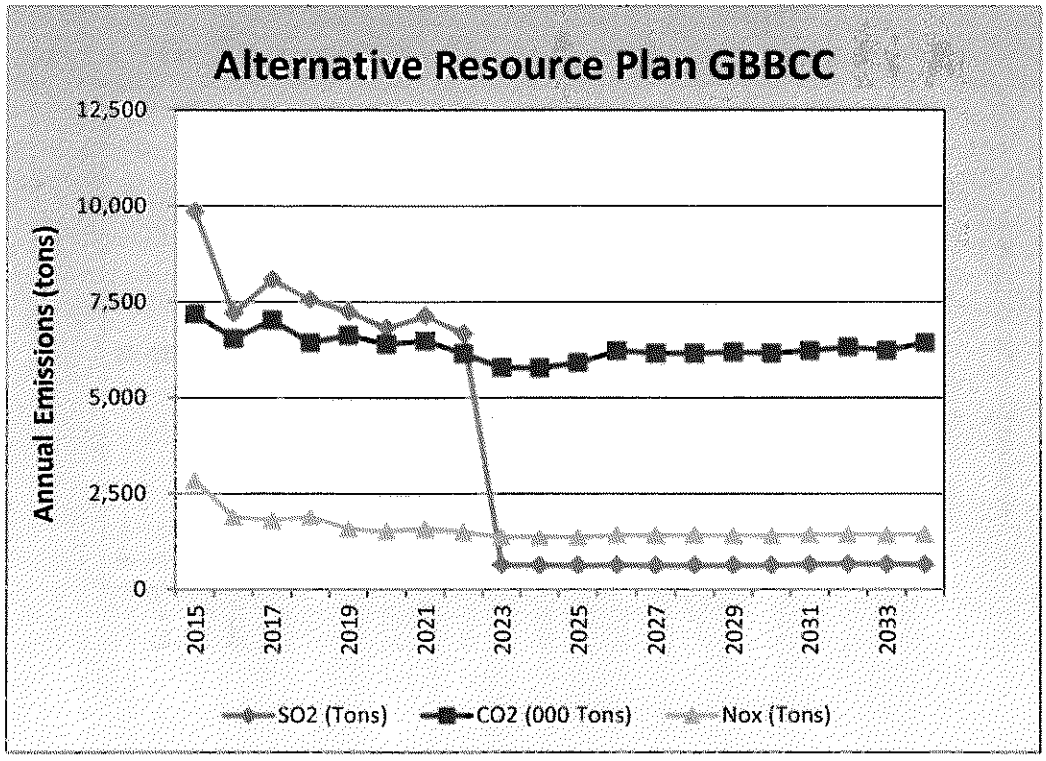


Chart 81: Annual Emissions GBBCD

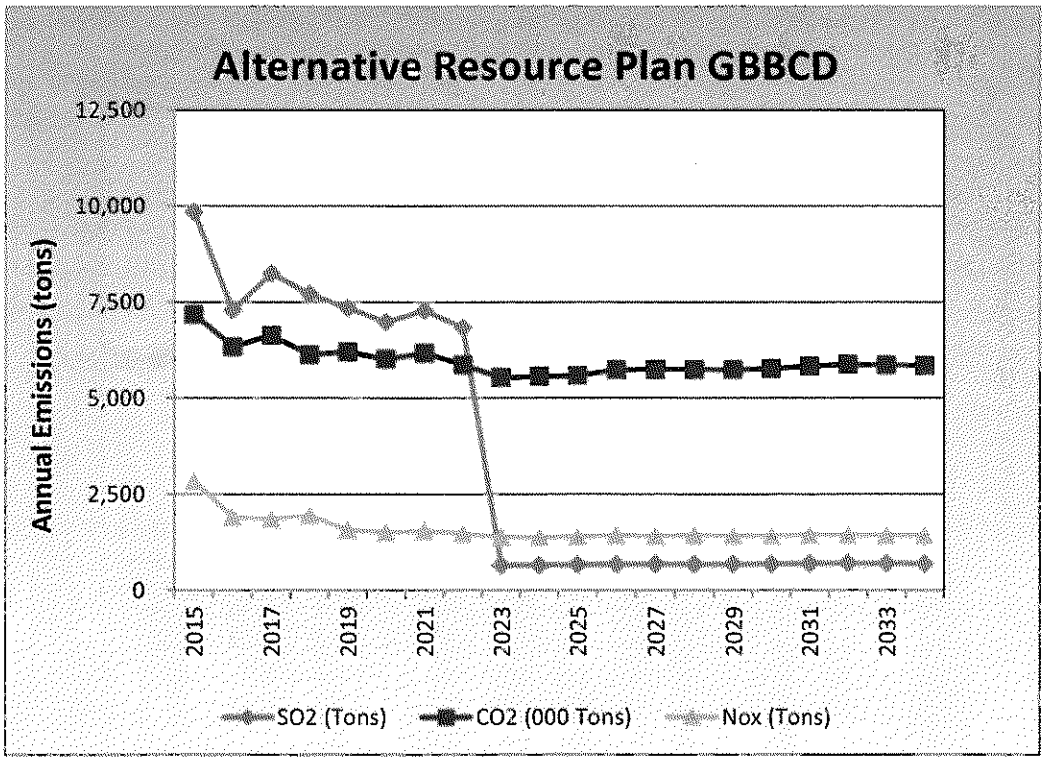


Chart 82: Annual Emissions GBBCF

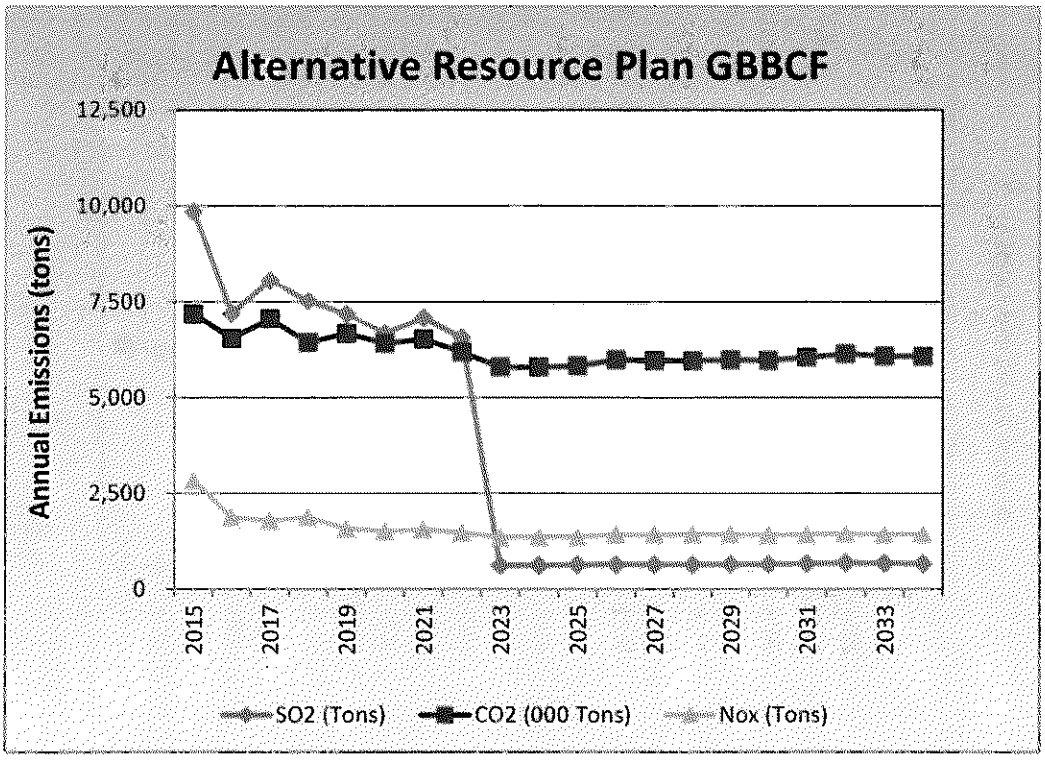


Chart 83: Annual Emissions GBBCG

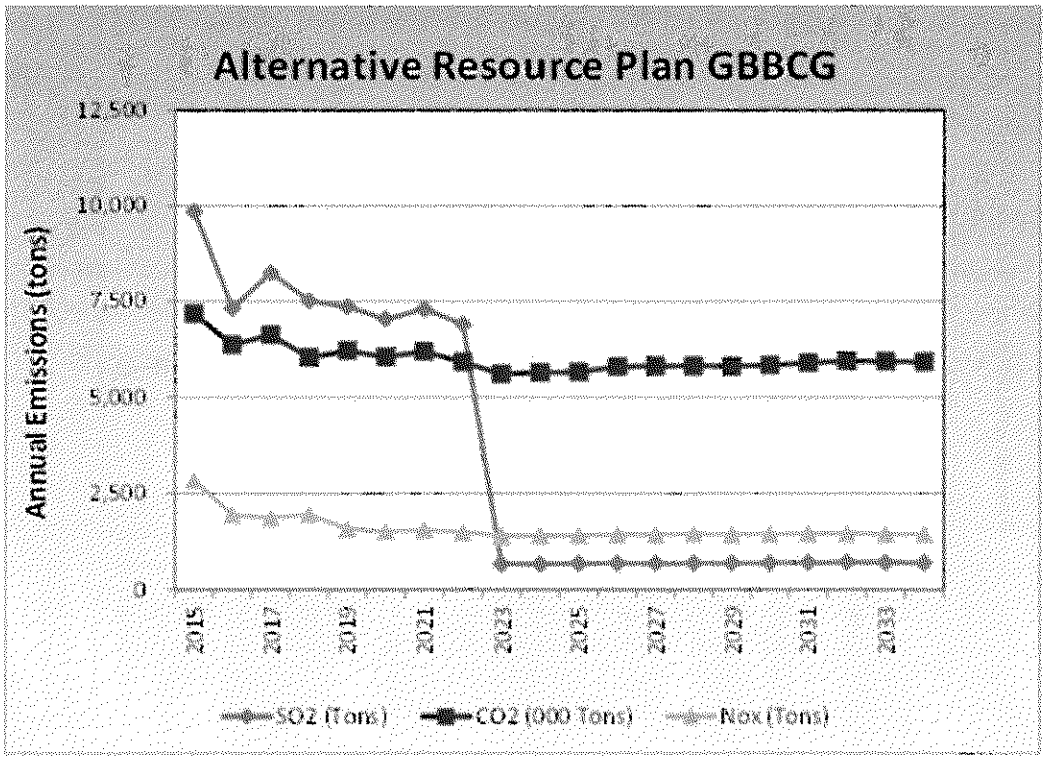


Chart 84: Annual Emissions GBBCW

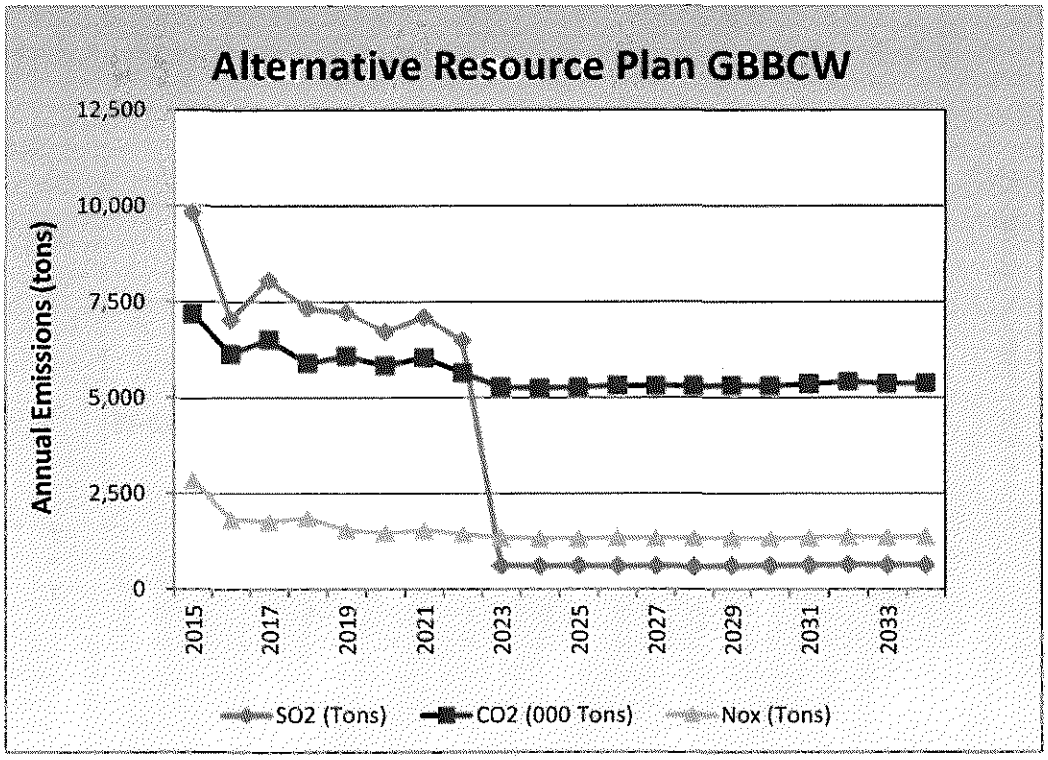


Chart 85: Annual Emissions GCBCA

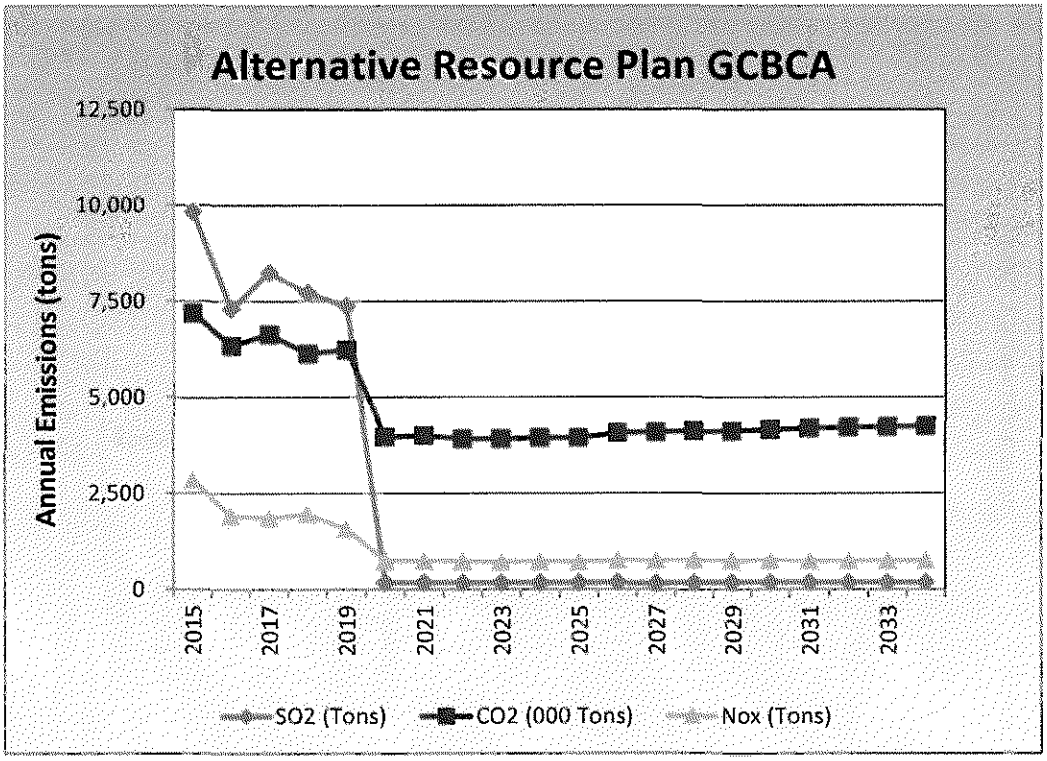


Chart 86: Annual Emissions GCBCB

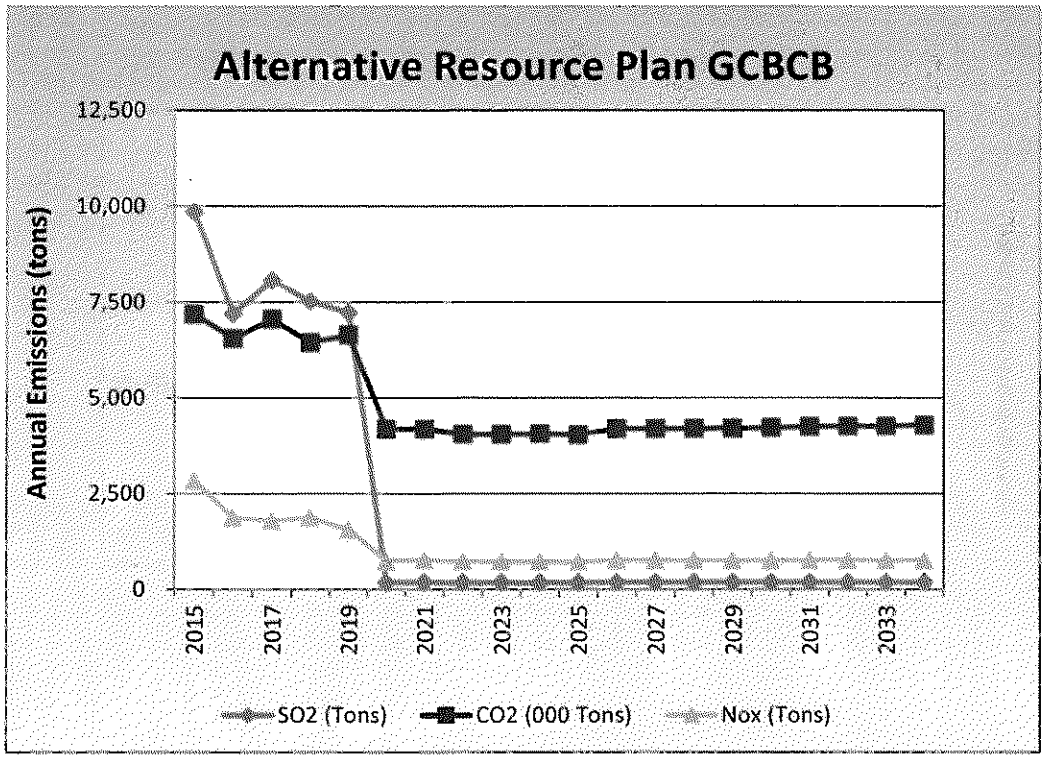


Chart 87: Annual Emissions GCBCG

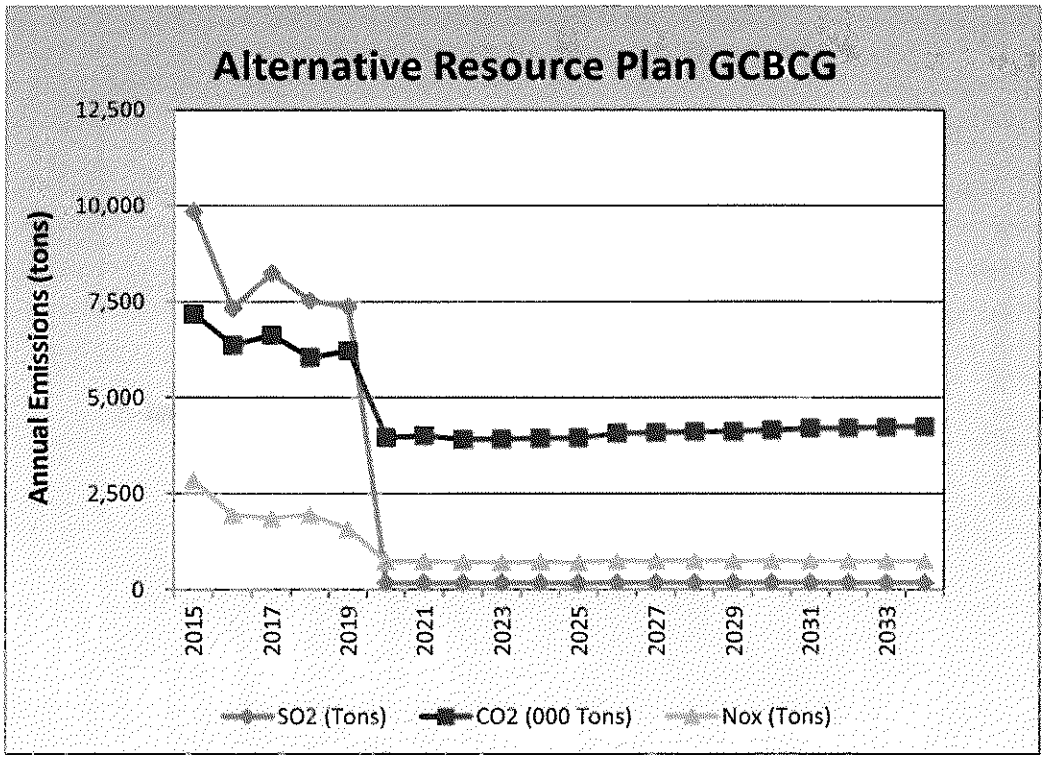


Chart 88: Annual Emissions GBBDA

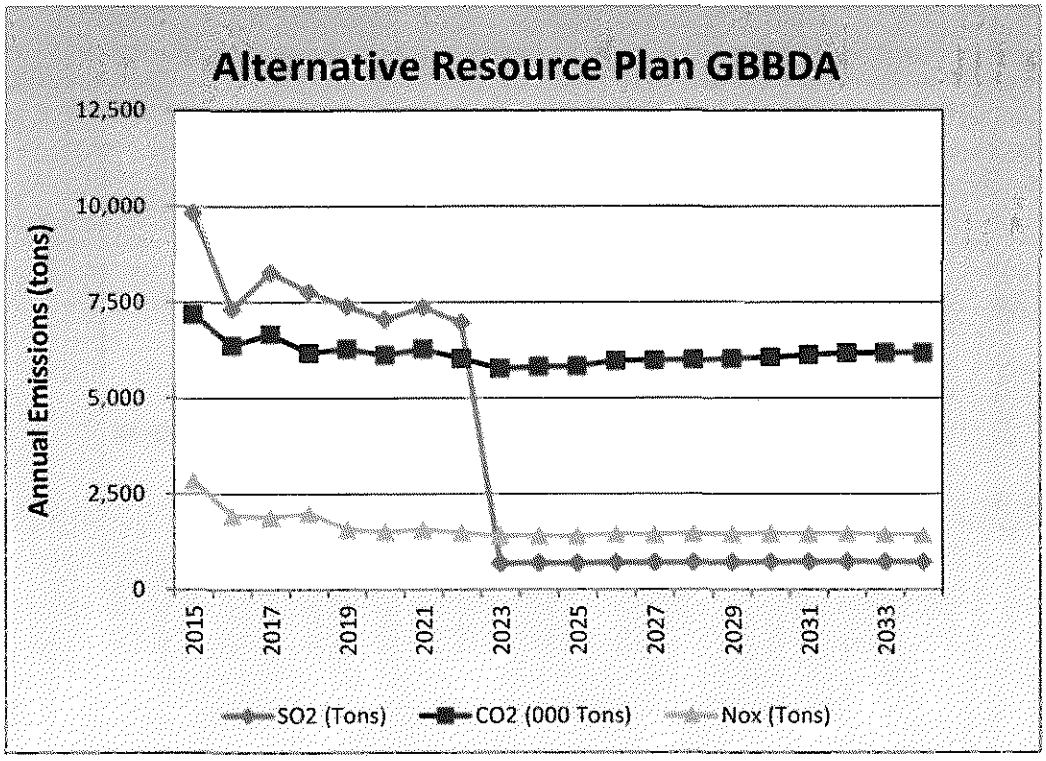


Chart 89: Annual Emissions GBBEG

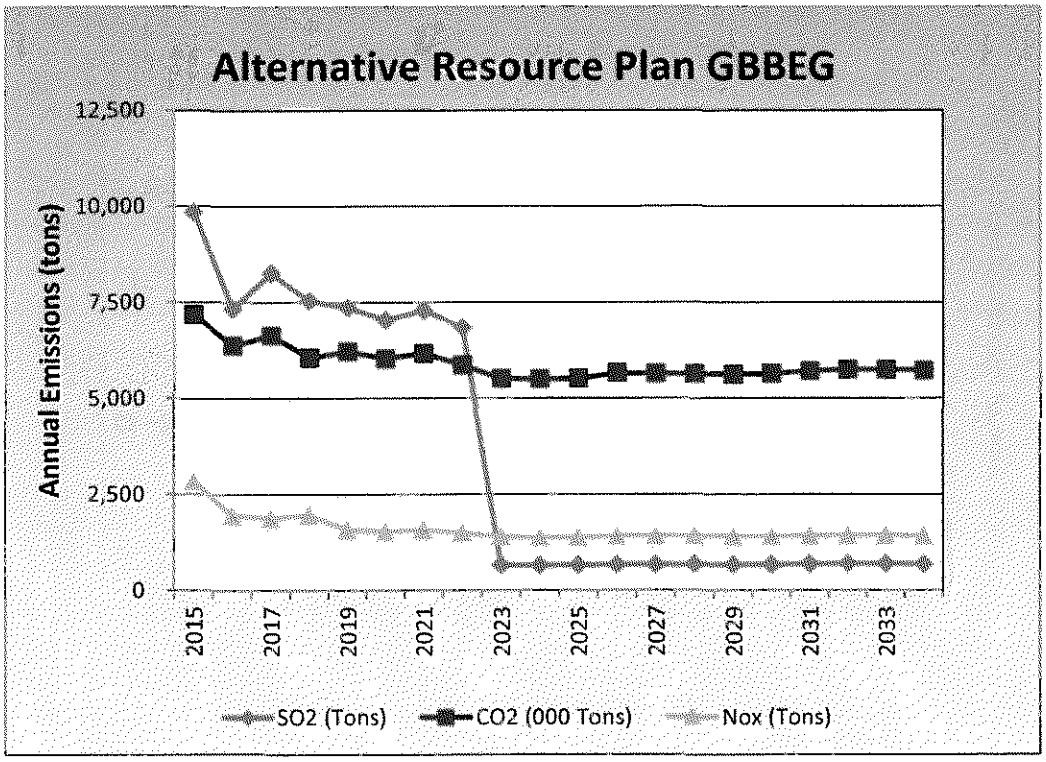


Chart 90: Annual Emissions GCBEB

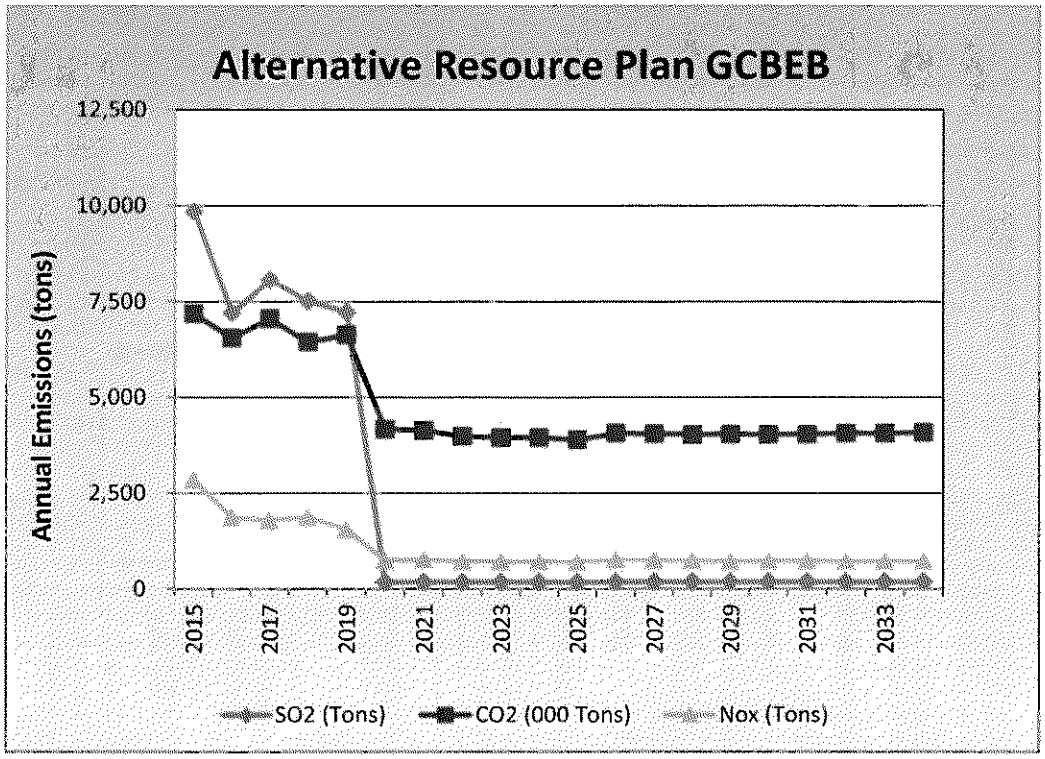
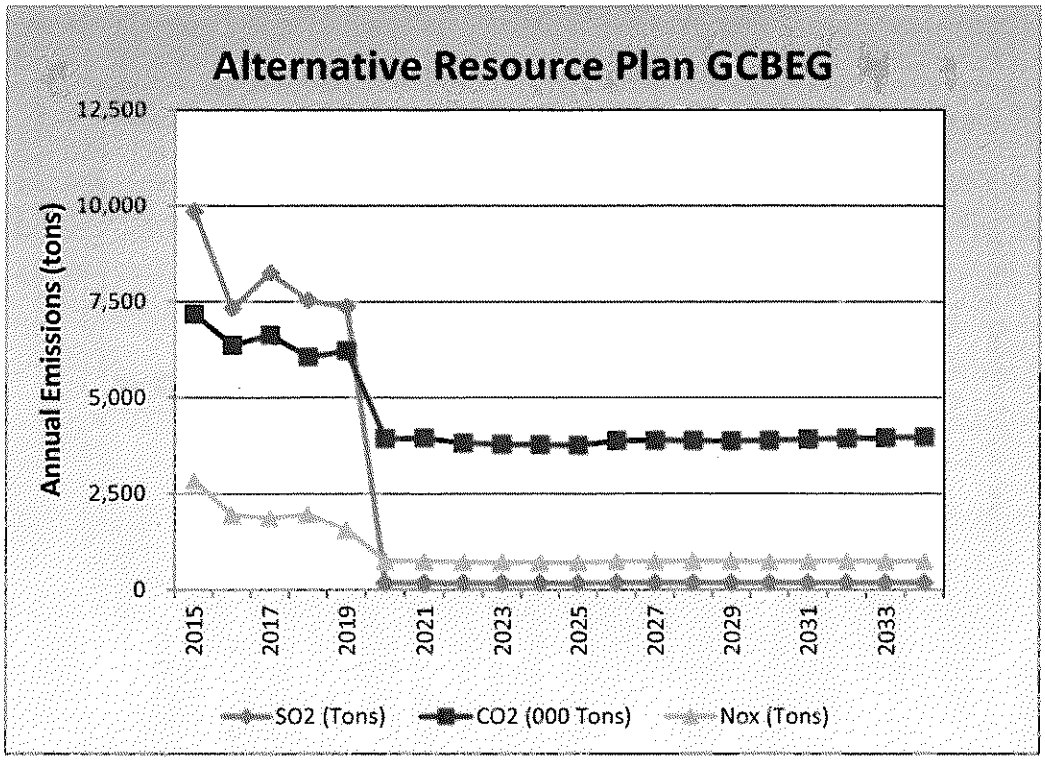


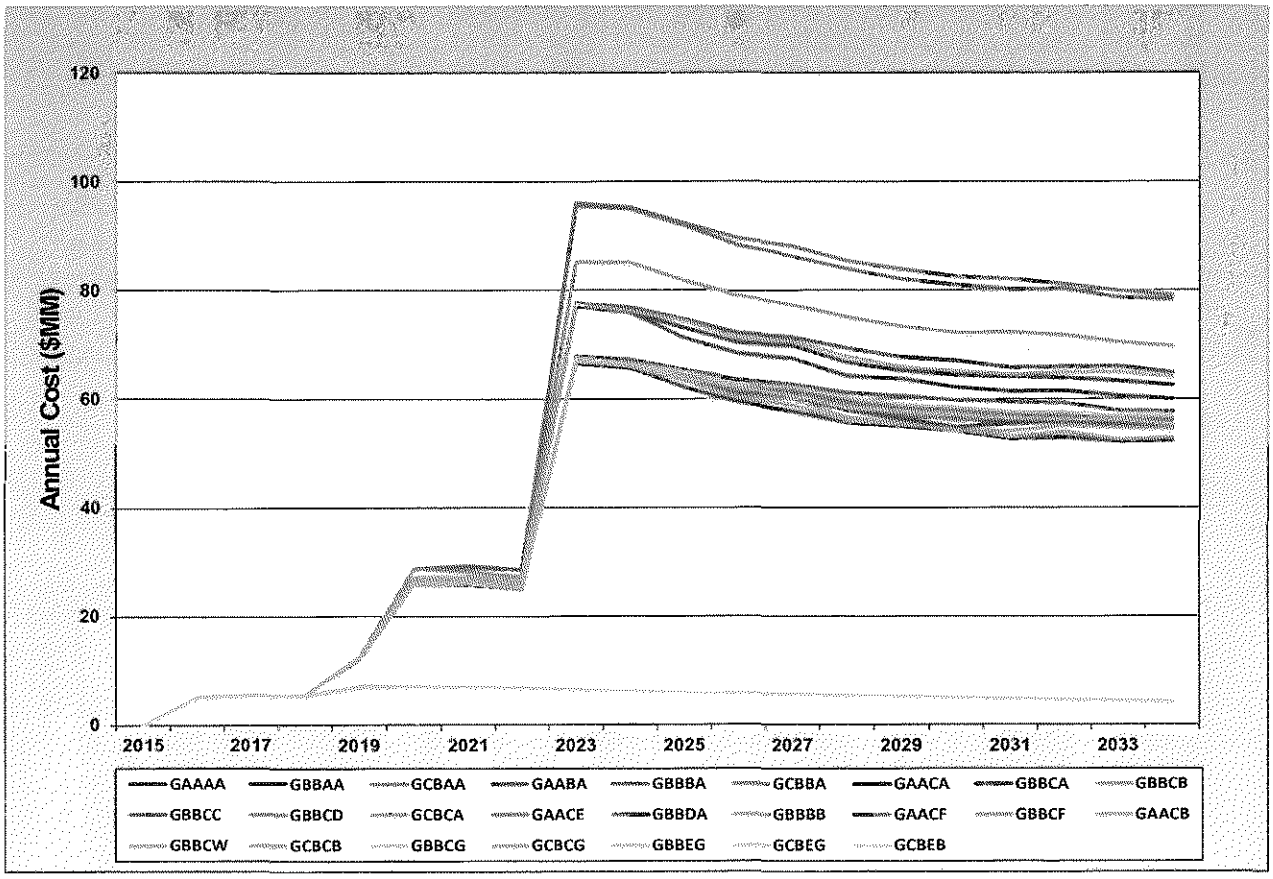
Chart 91: Annual Emissions GCBEG



8. Annual probable environmental costs; and

The following table shows the annual probable environmental cost of each plan on an expected value basis.

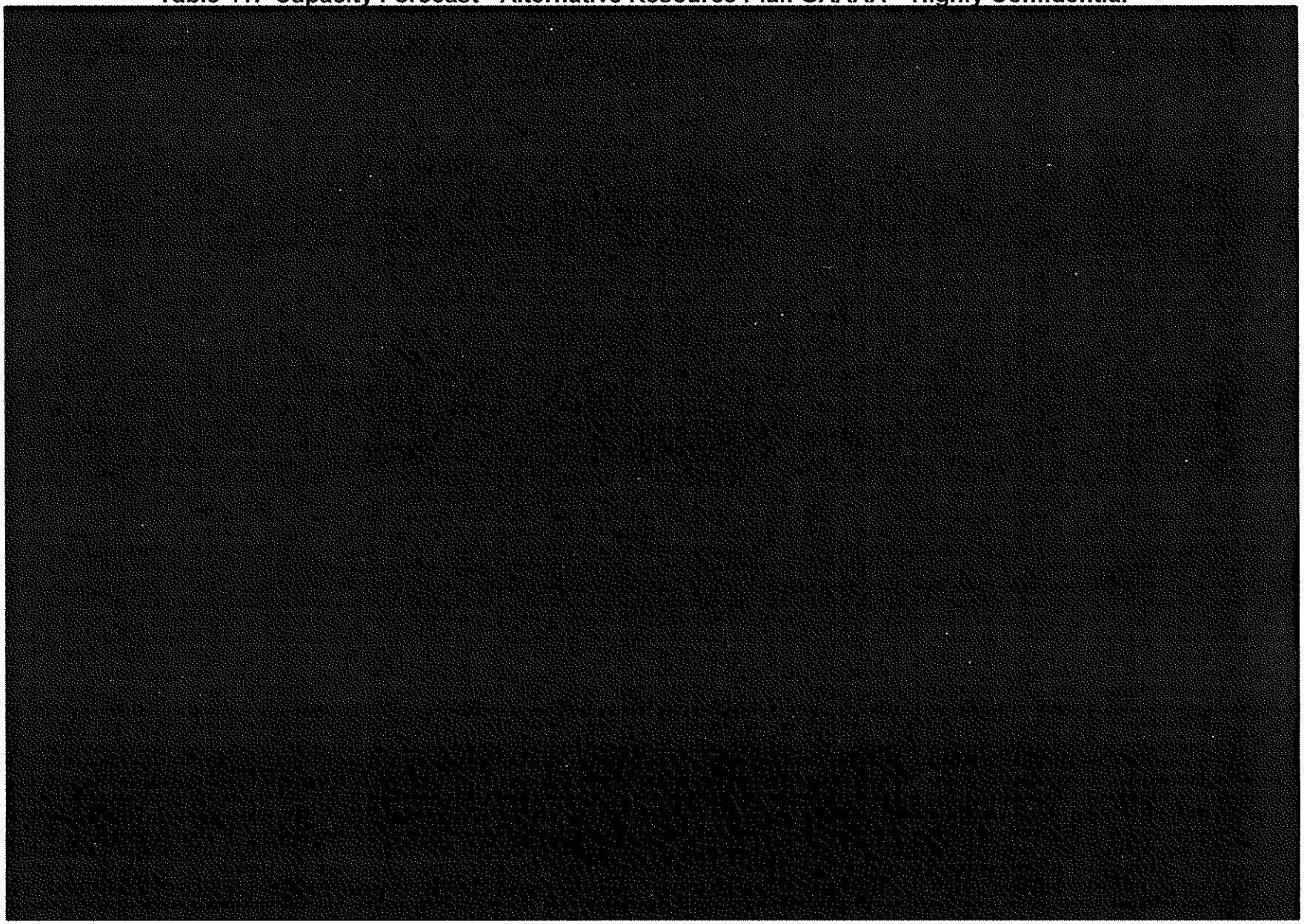
Chart 92: Probable Environmental Costs



9. Public and highly-confidential forms of the capacity balance spreadsheets completed in the specified format;

The following tables provide the GMO forecast of capacity balance for the next 20 years for each of the Alternative Resource Plans discussed elsewhere in this document.

Table 41: Capacity Forecast - Alternative Resource Plan GAAAA **Highly Confidential**



HC

Table 42: Capacity Forecast - Alternative Resource Plan GBBAA **Highly Confidential**

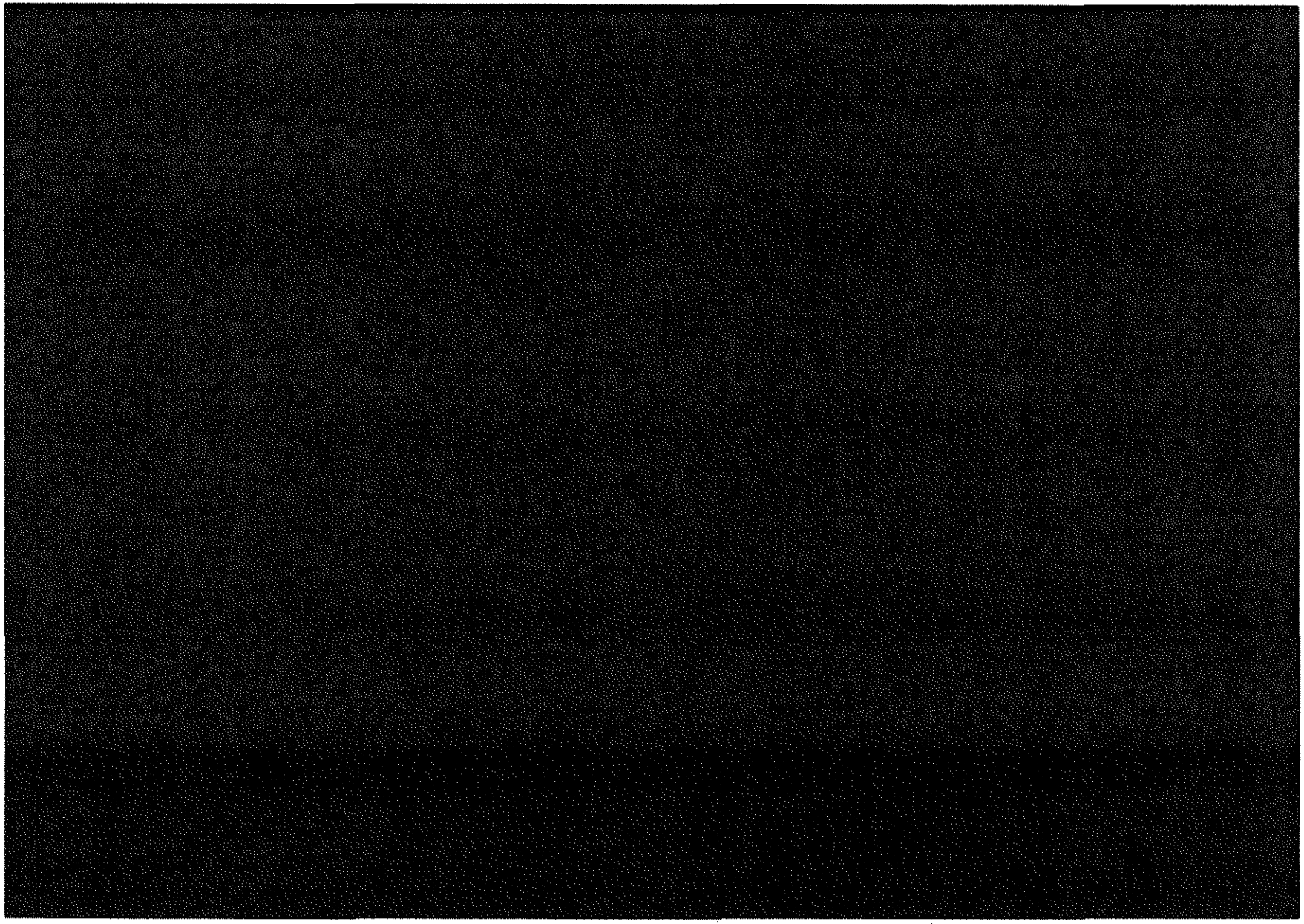


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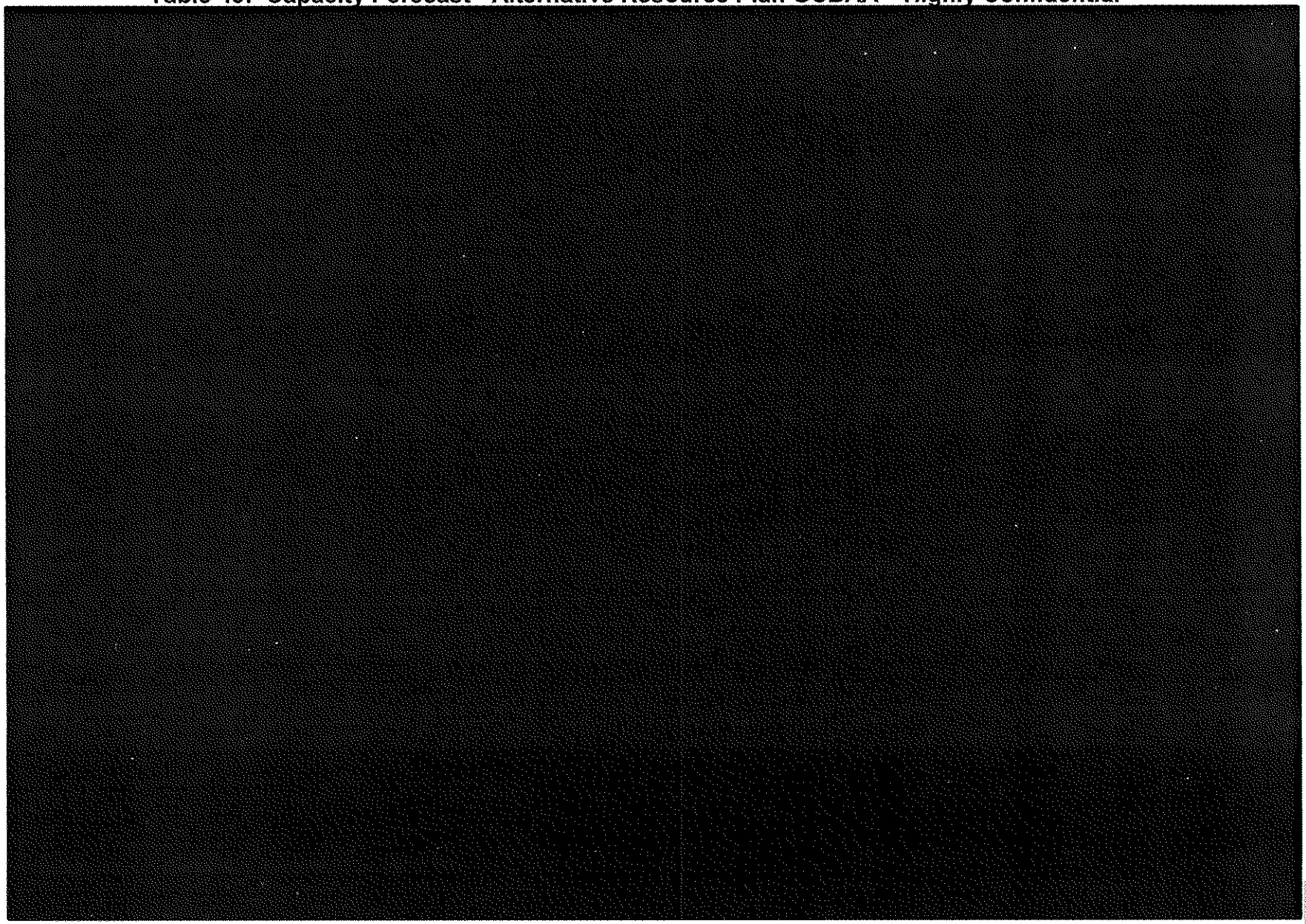
Table 43: Capacity Forecast - Alternative Resource Plan GCBAA **Highly Confidential**



HC

Table 44: Capacity Forecast - Alternative Resource Plan GAABA **Highly Confidential**

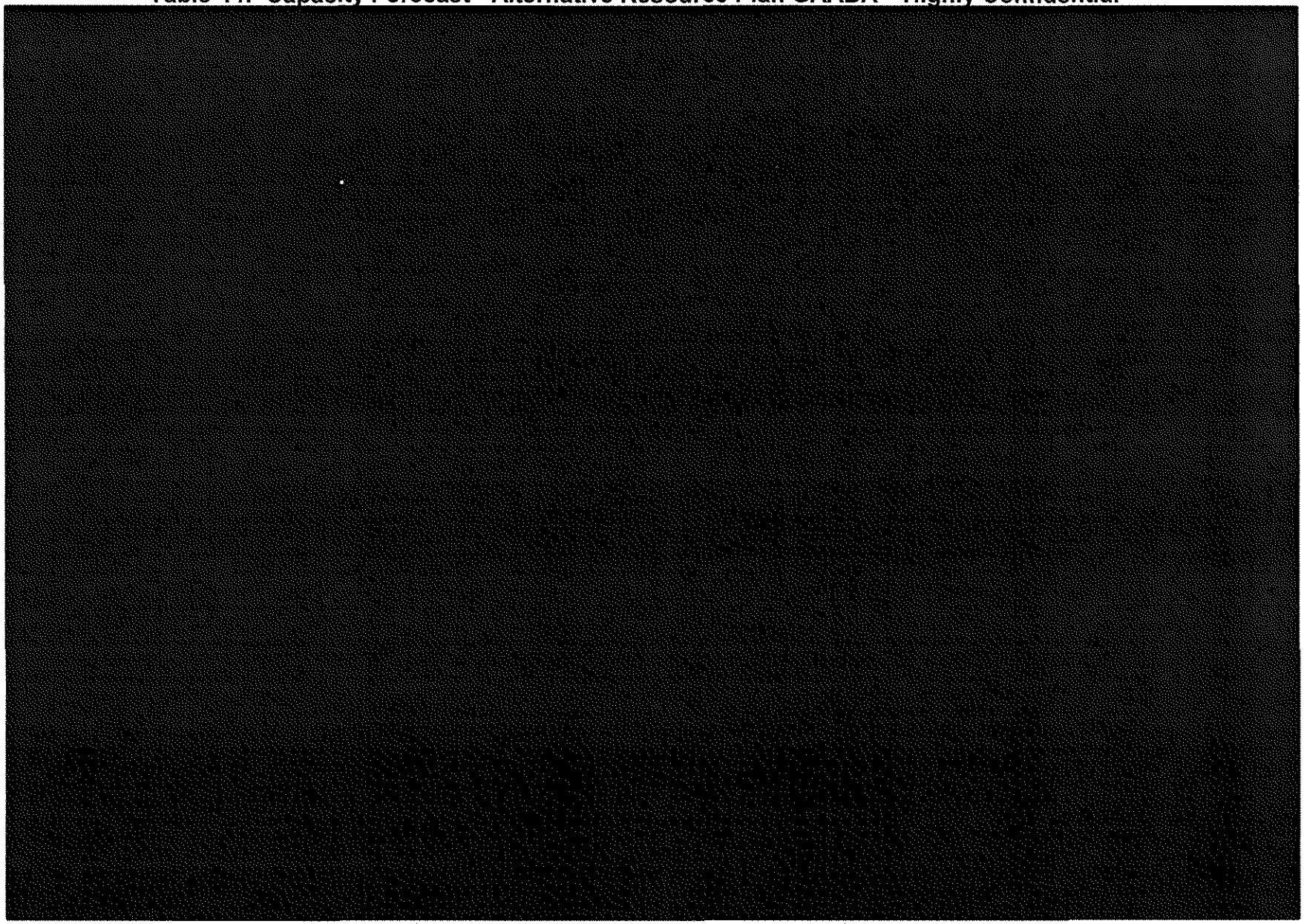


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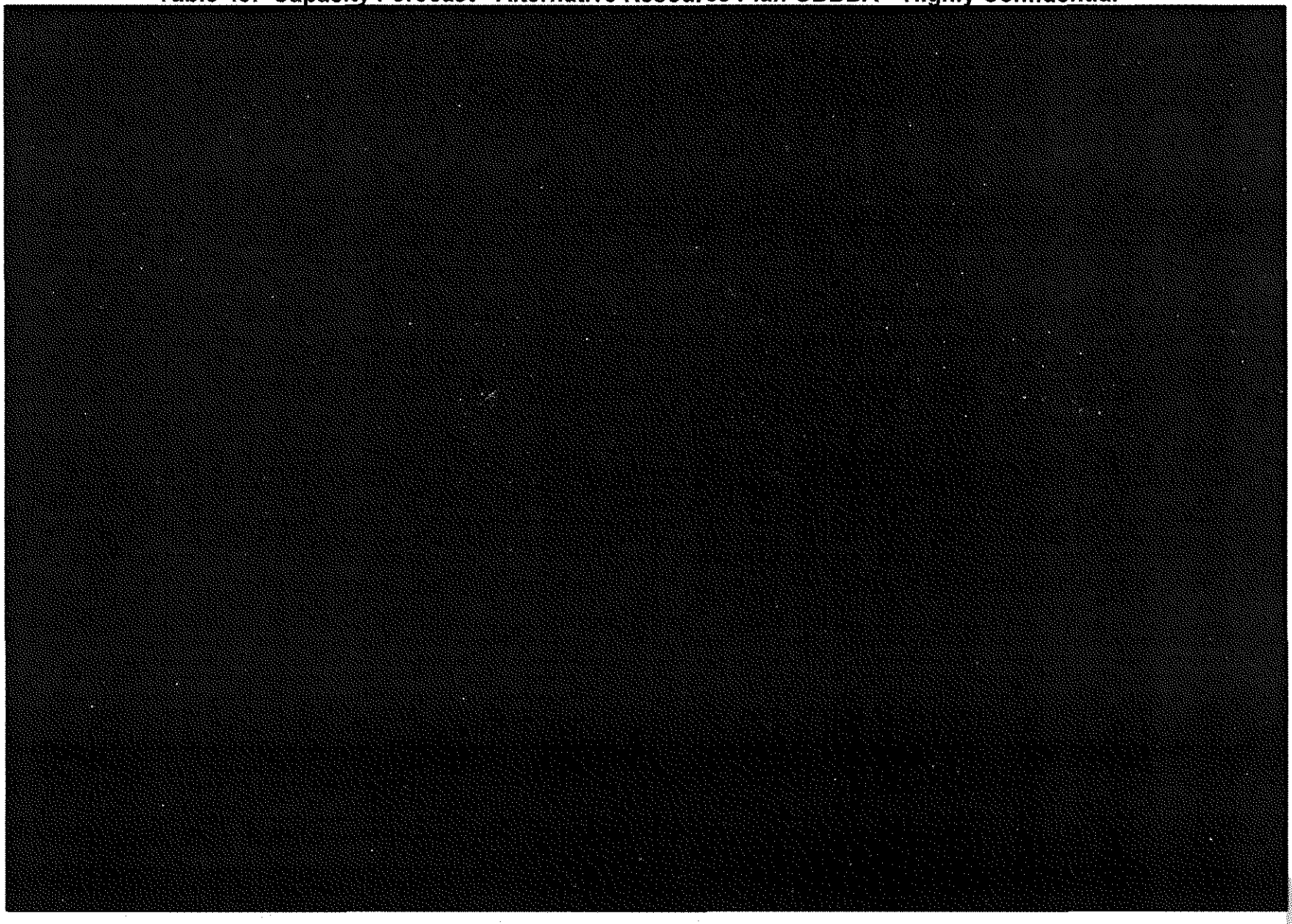
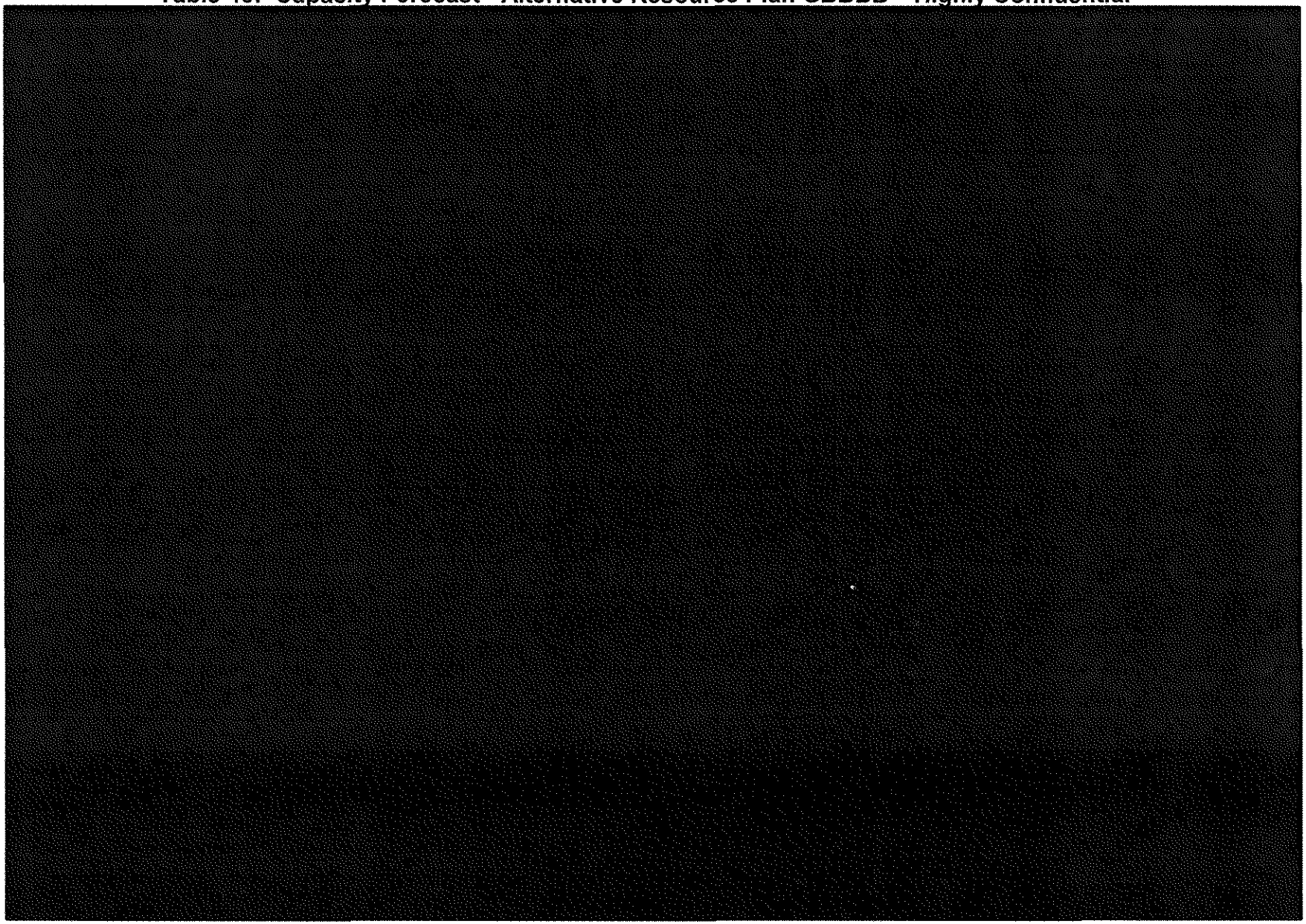
Table 45: Capacity Forecast - Alternative Resource Plan GBBBA **Highly Confidential**



HC

Table 46: Capacity Forecast - Alternative Resource Plan GBBBB **Highly Confidential**



HC

Table 47: Capacity Forecast - Alternative Resource Plan GCBBA **Highly Confidential**

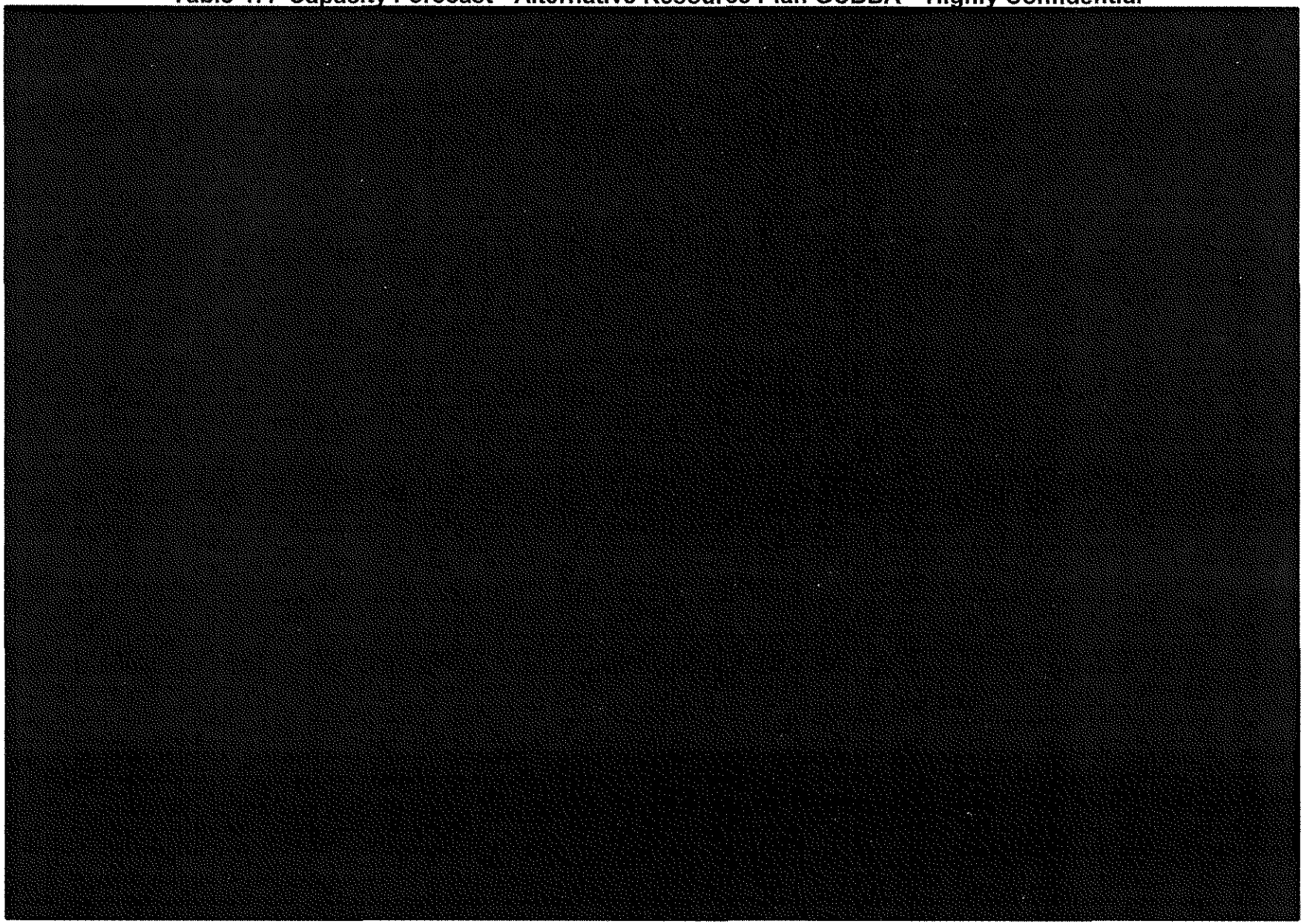


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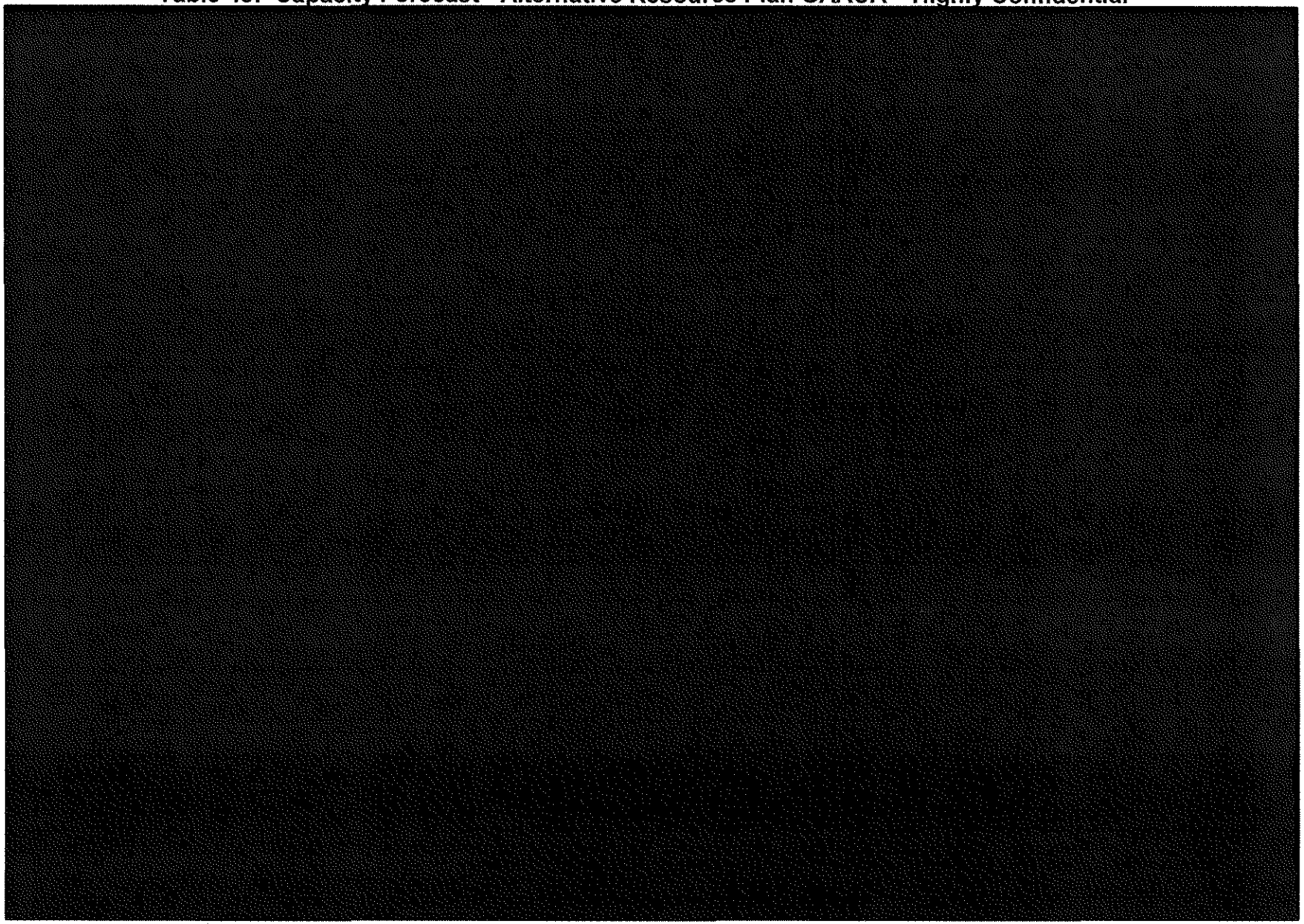
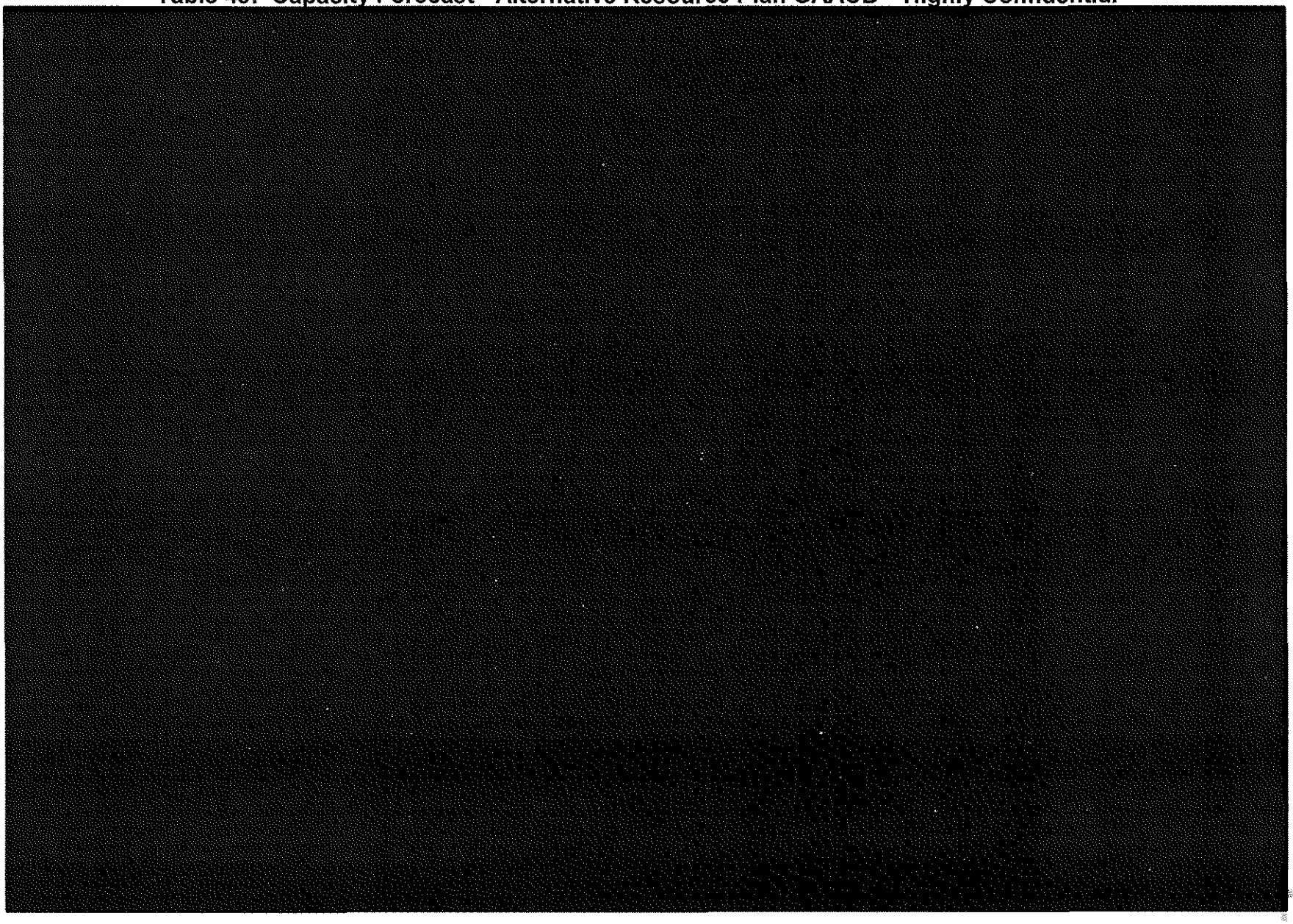
Table 48: Capacity Forecast - Alternative Resource Plan GAACA **Highly Confidential**



HC

Table 49: Capacity Forecast - Alternative Resource Plan GAACB **Highly Confidential**



HC

Table 50: Capacity Forecast - Alternative Resource Plan GAACE **Highly Confidential**

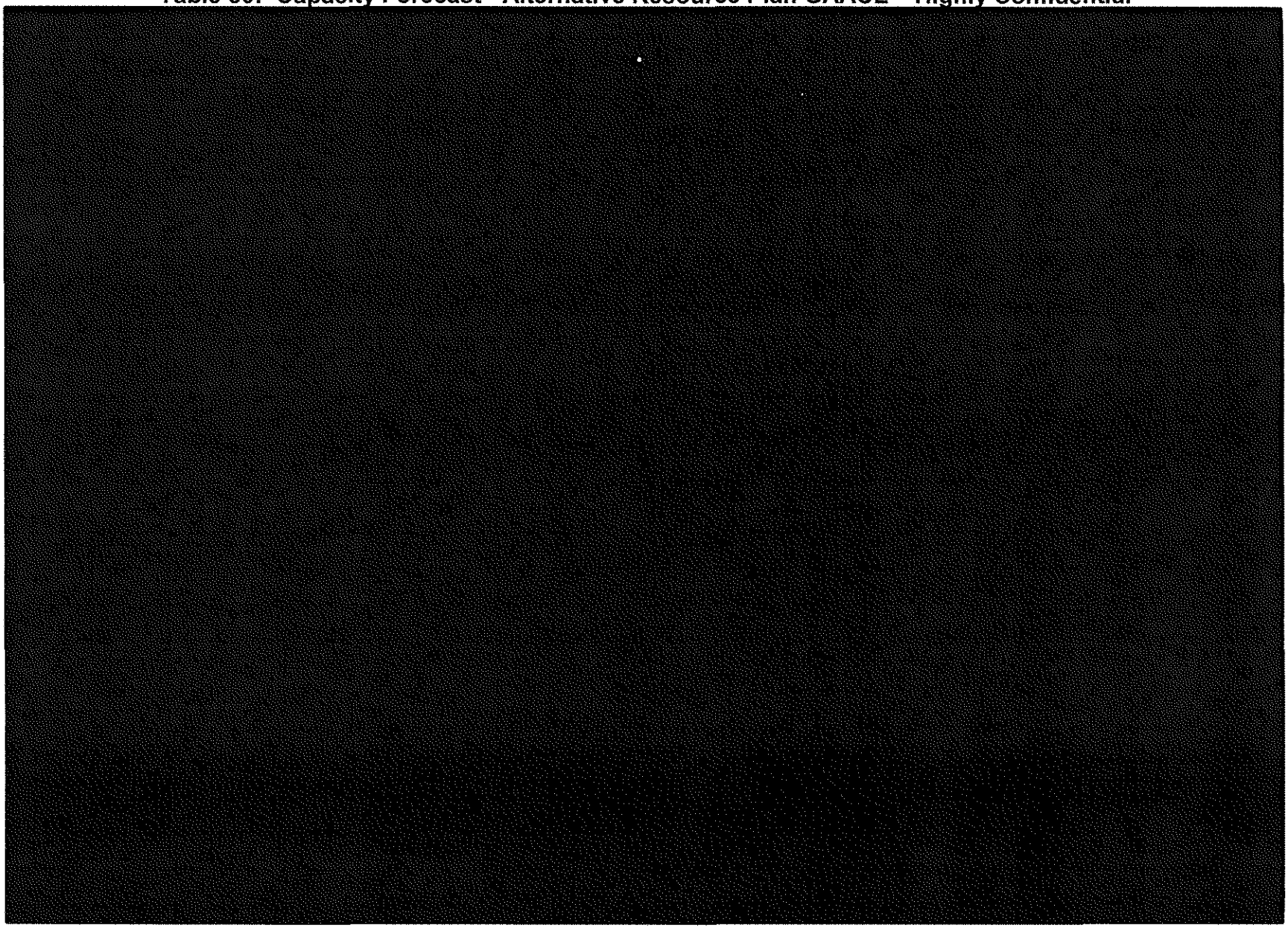


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Table 51: Capacity Forecast - Alternative Resource Plan GAACF **Highly Confidential**

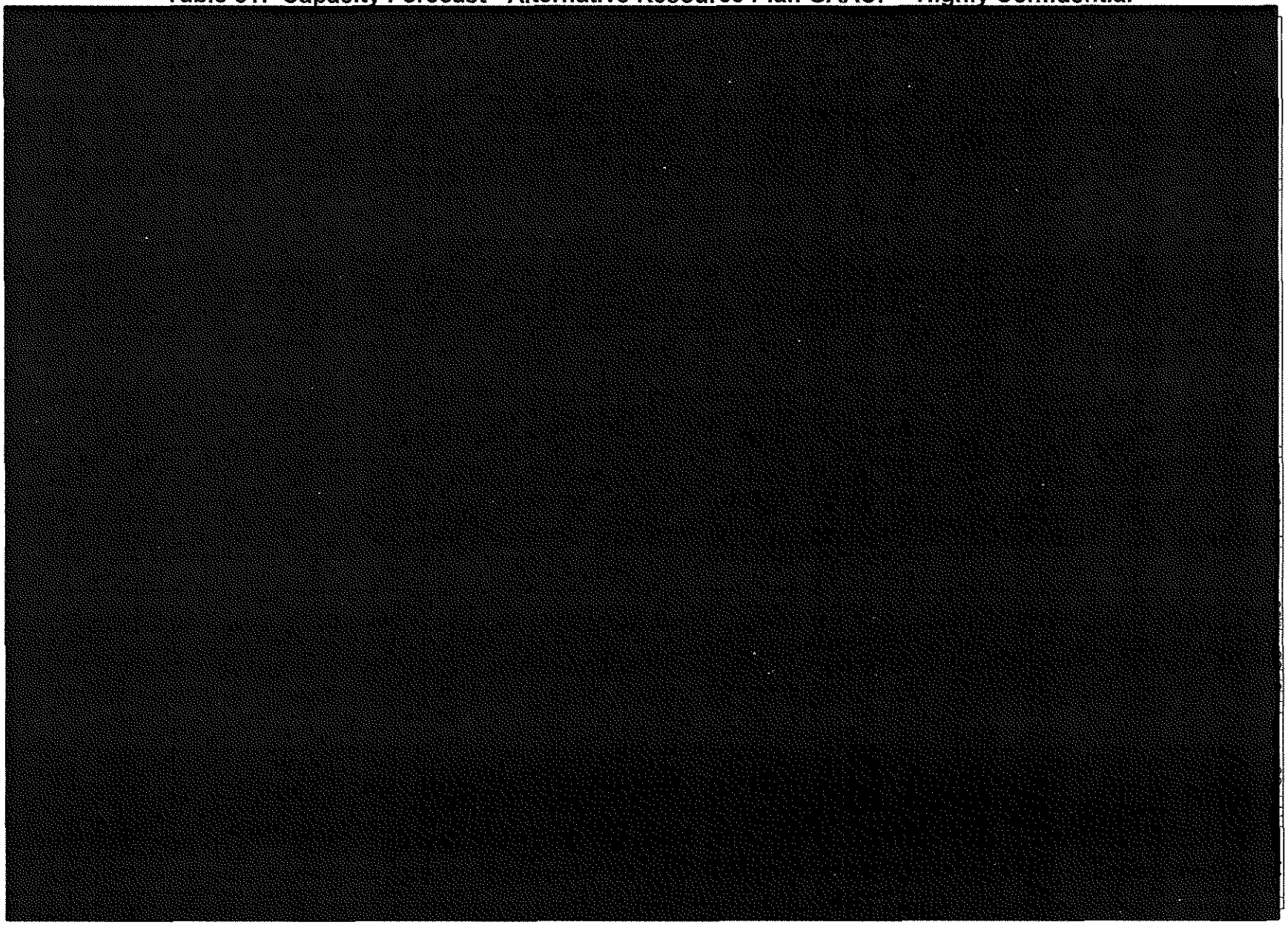

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Table 52: Capacity Forecast - Alternative Resource Plan GBBCA **Highly Confidential**

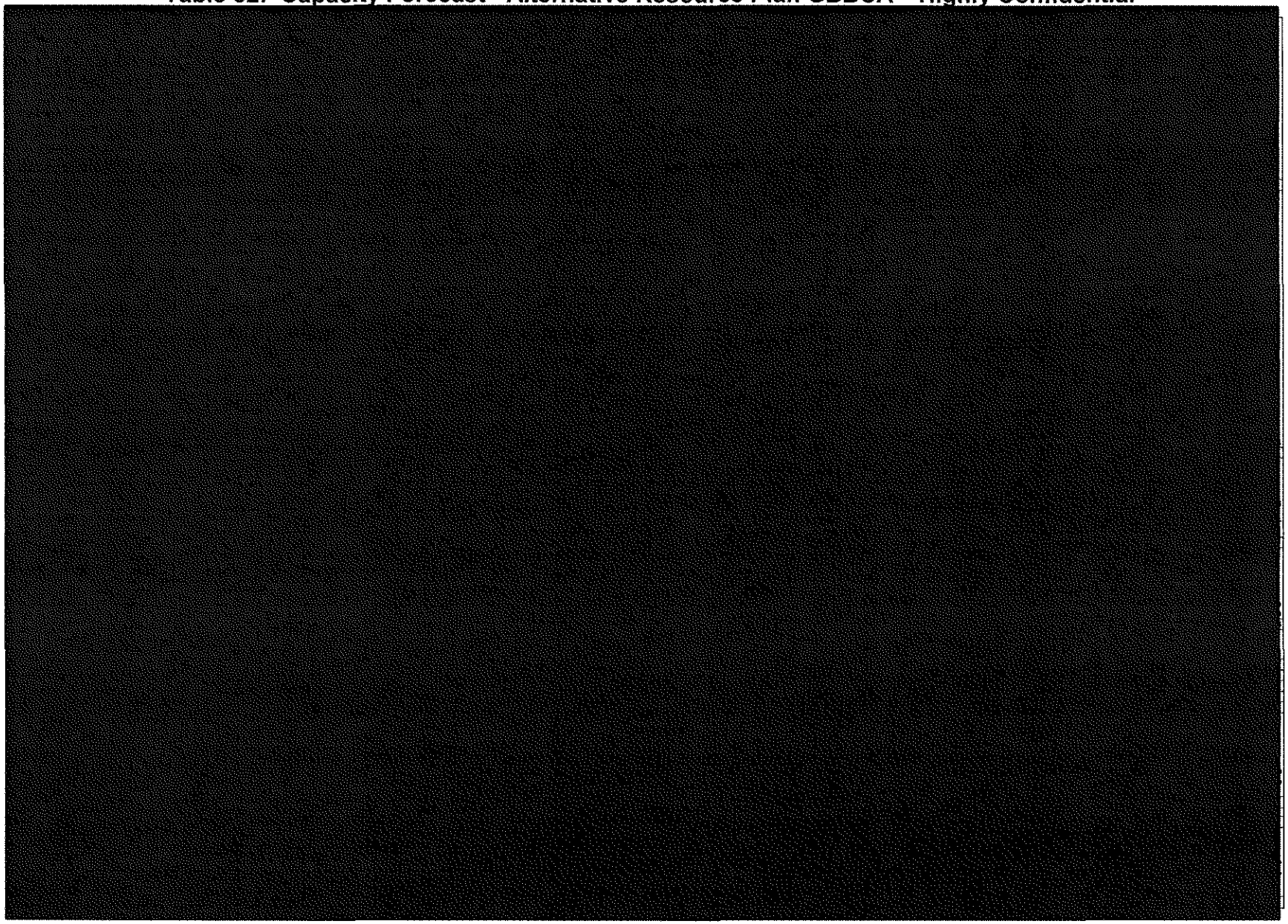

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Table 53: Capacity Forecast - Alternative Resource Plan GBBCB **Highly Confidential**

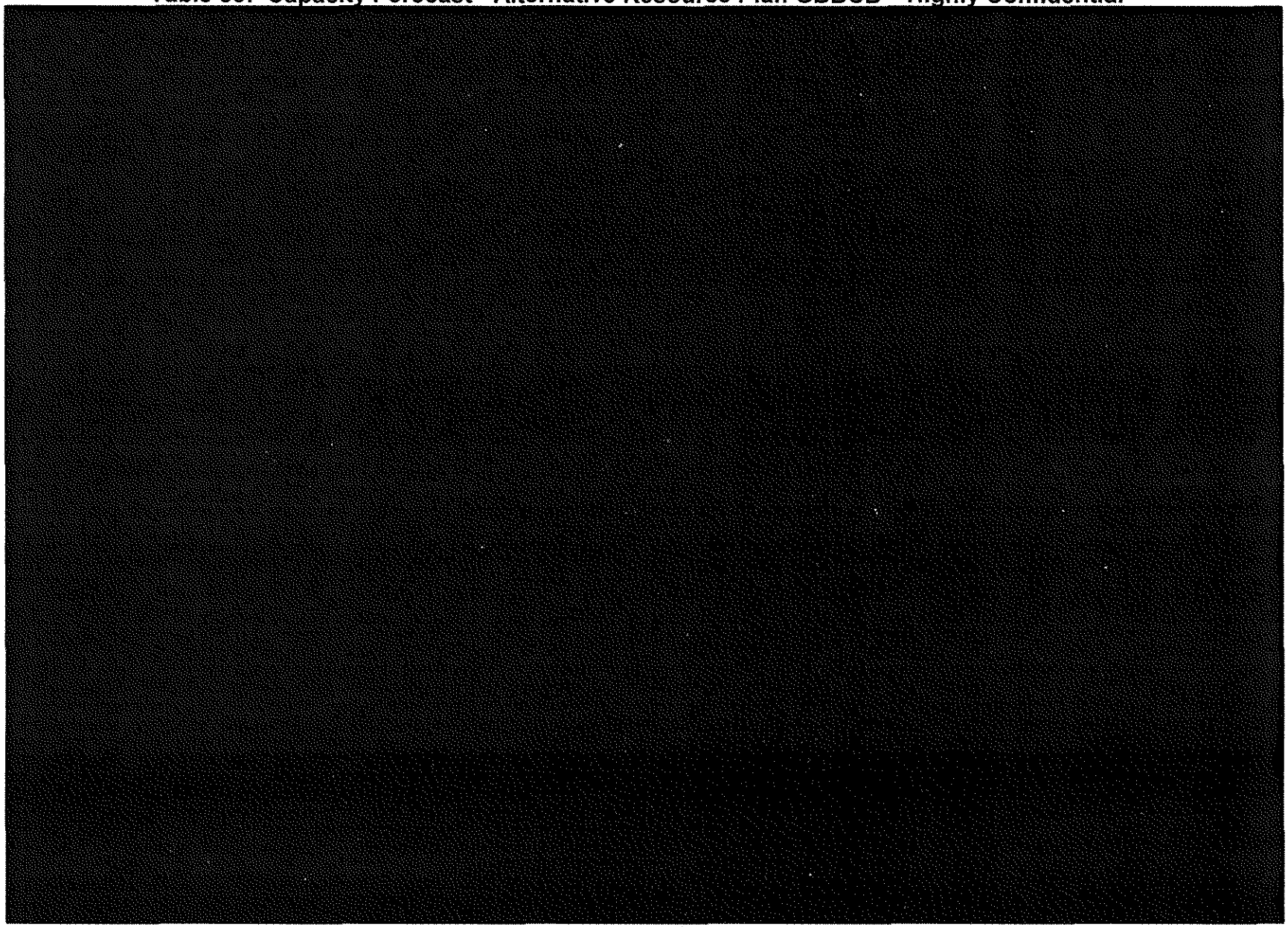

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Table 54: Capacity Forecast - Alternative Resource Plan GBBCC **Highly Confidential**

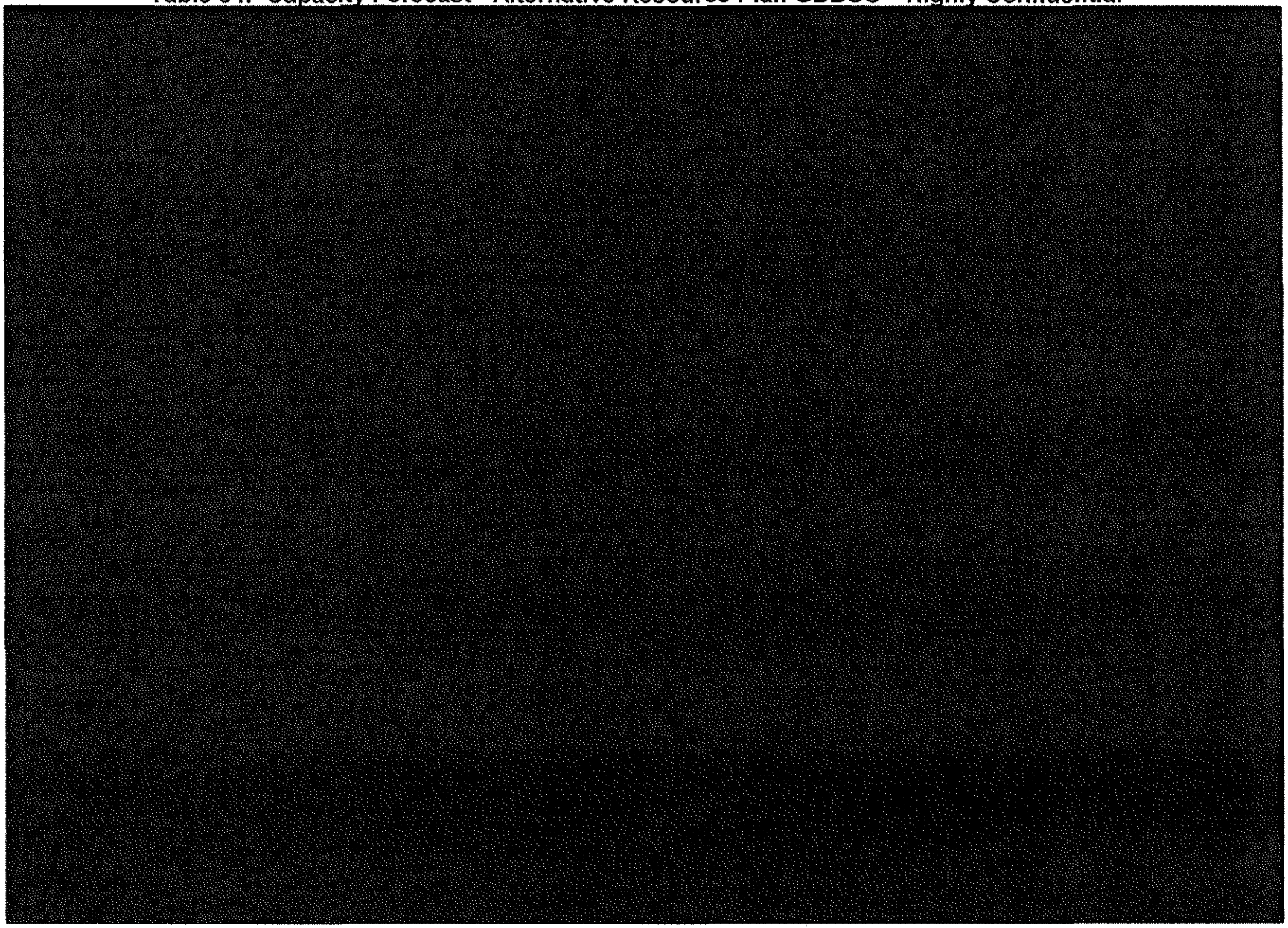

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Table 55: Capacity Forecast - Alternative Resource Plan GBBCD **Highly Confidential**

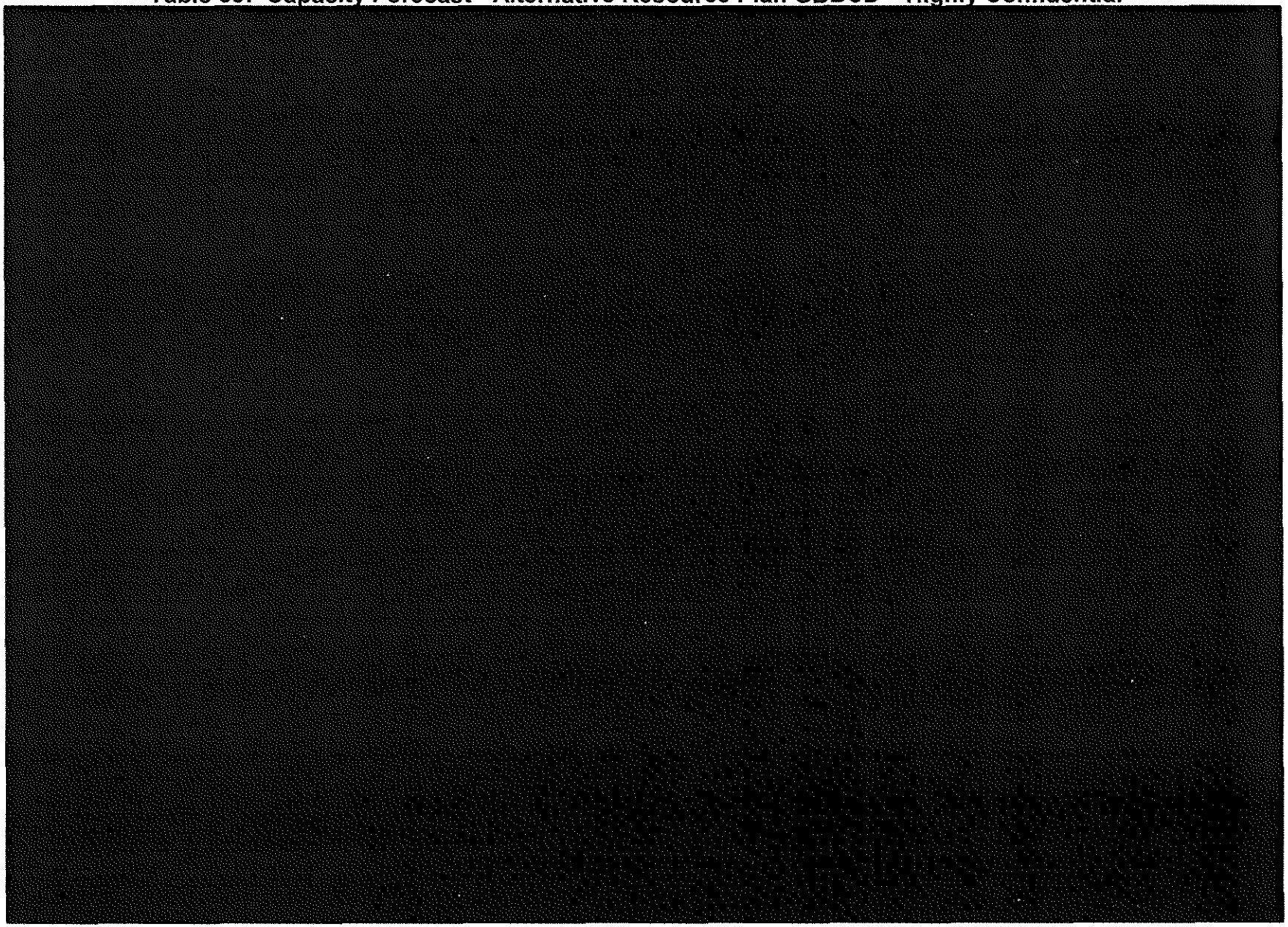

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Table 56: Capacity Forecast - Alternative Resource Plan GBBCF **Highly Confidential**

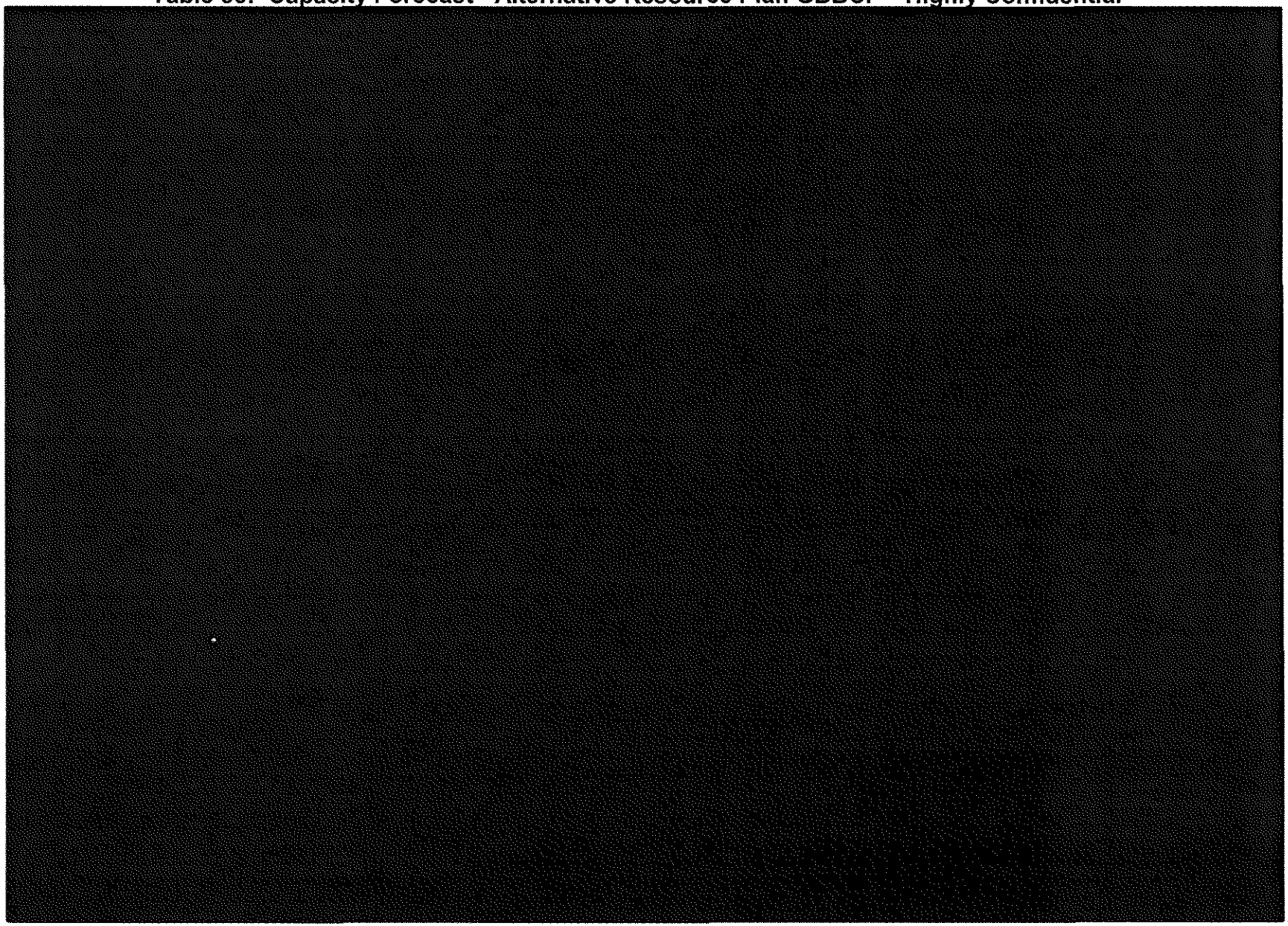

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Table 57: Capacity Forecast - Alternative Resource Plan GBBCG **Highly Confidential**

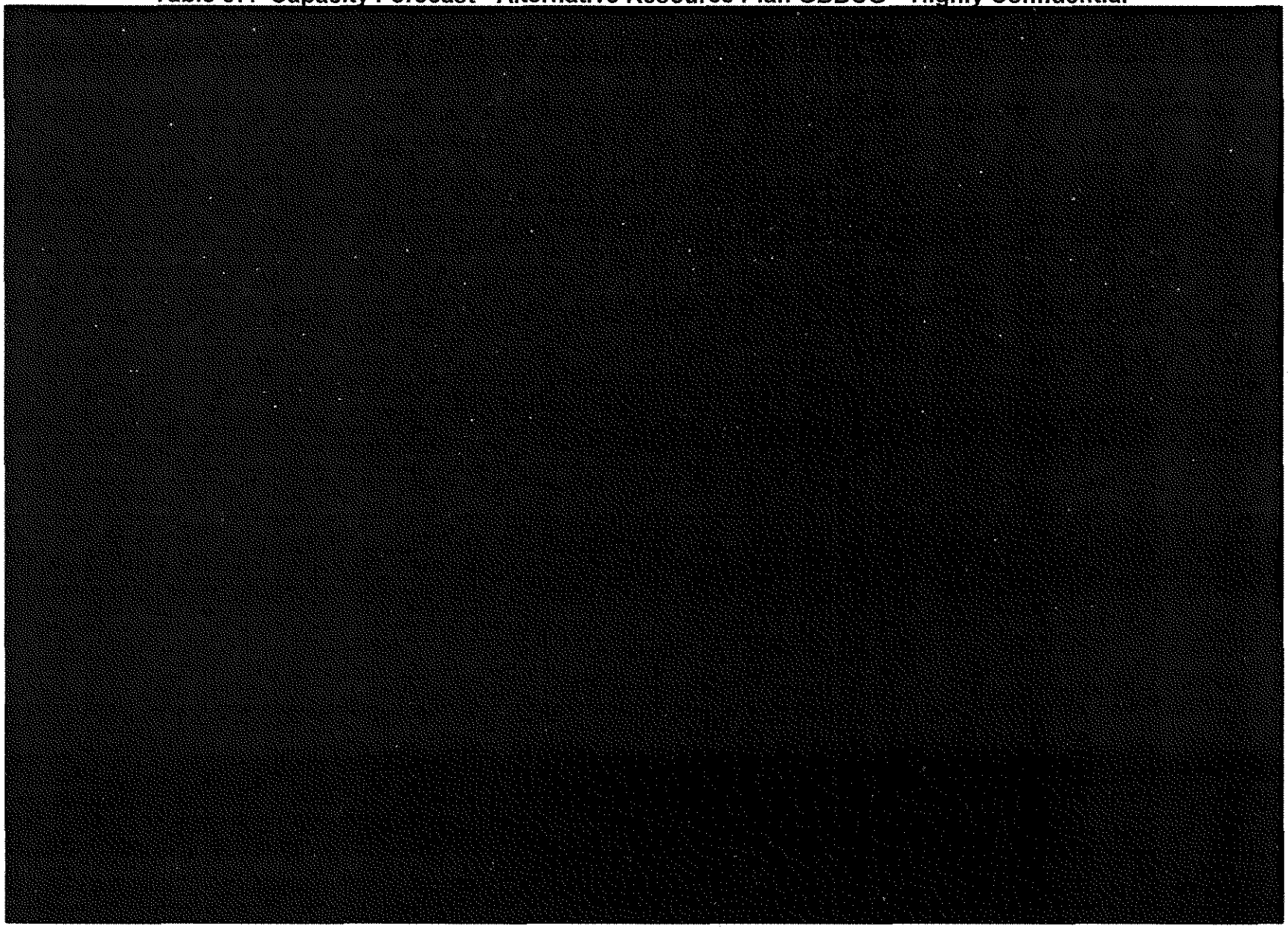

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Table 58: Capacity Forecast - Alternative Resource Plan GBBCW **Highly Confidential**

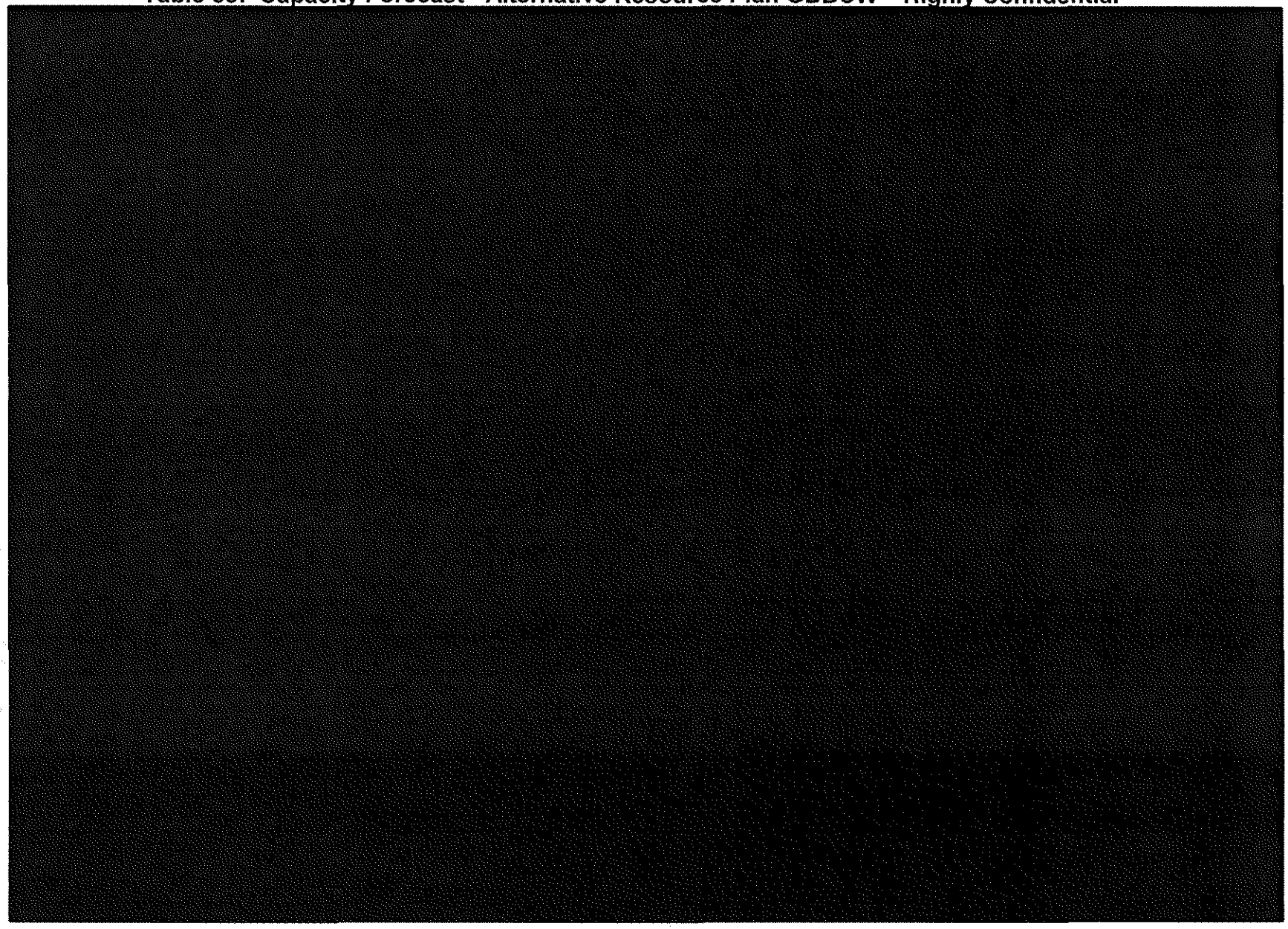

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Table 59: Capacity Forecast - Alternative Resource Plan GCBCA **Highly Confidential**

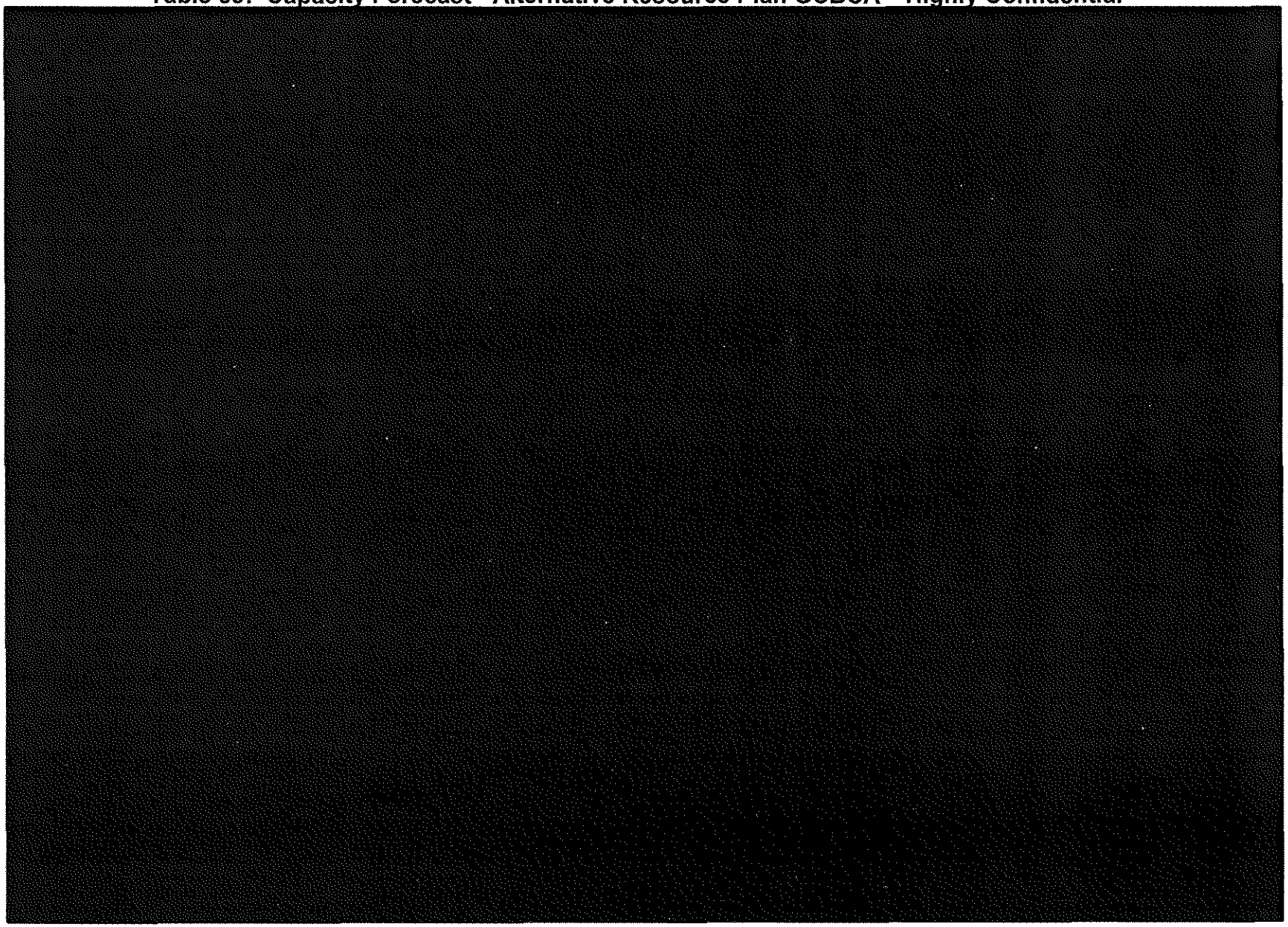

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Table 60: Capacity Forecast - Alternative Resource Plan GCBCB **Highly Confidential**

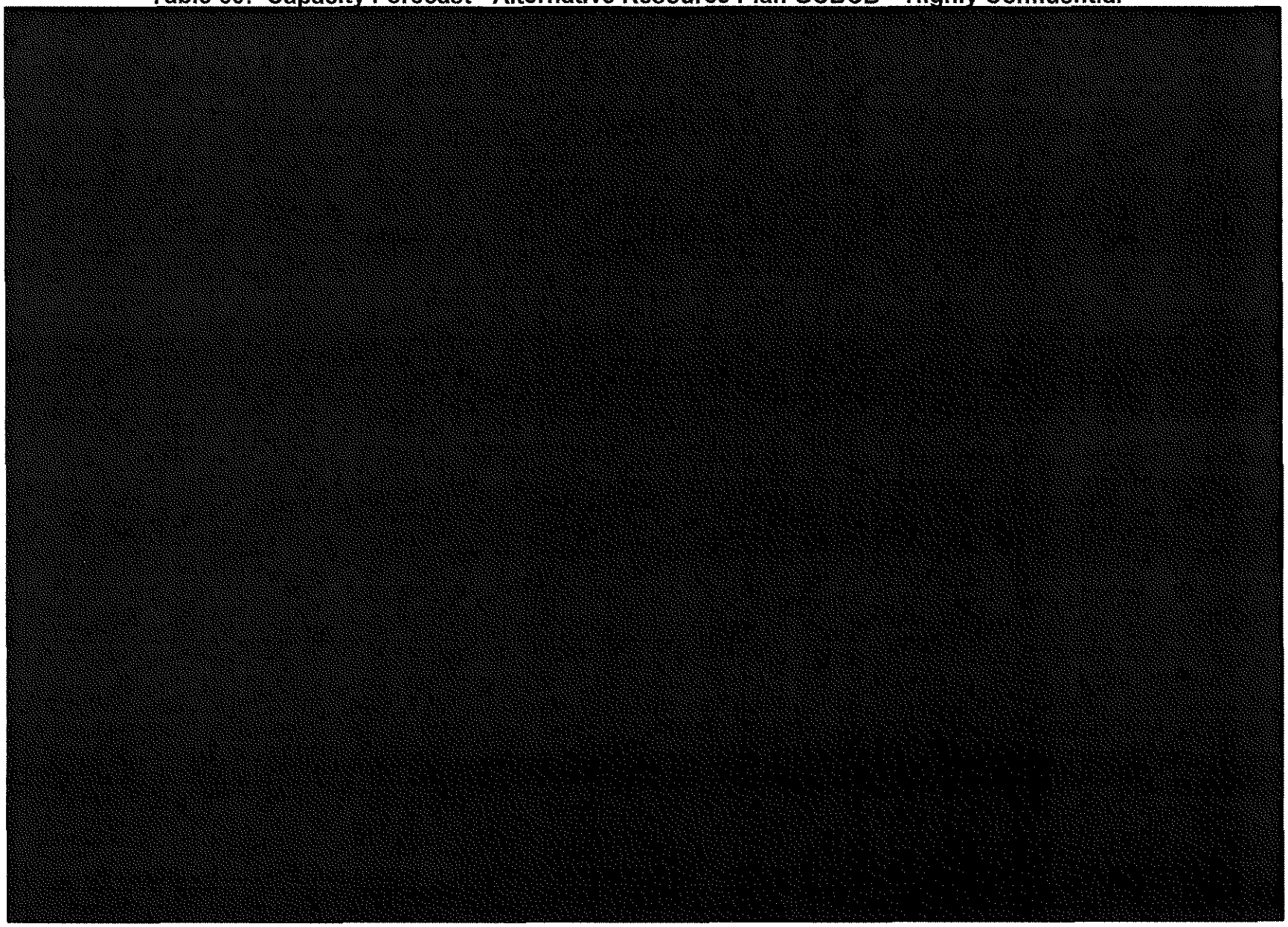

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Table 61: Capacity Forecast - Alternative Resource Plan GCBCG **Highly Confidential**

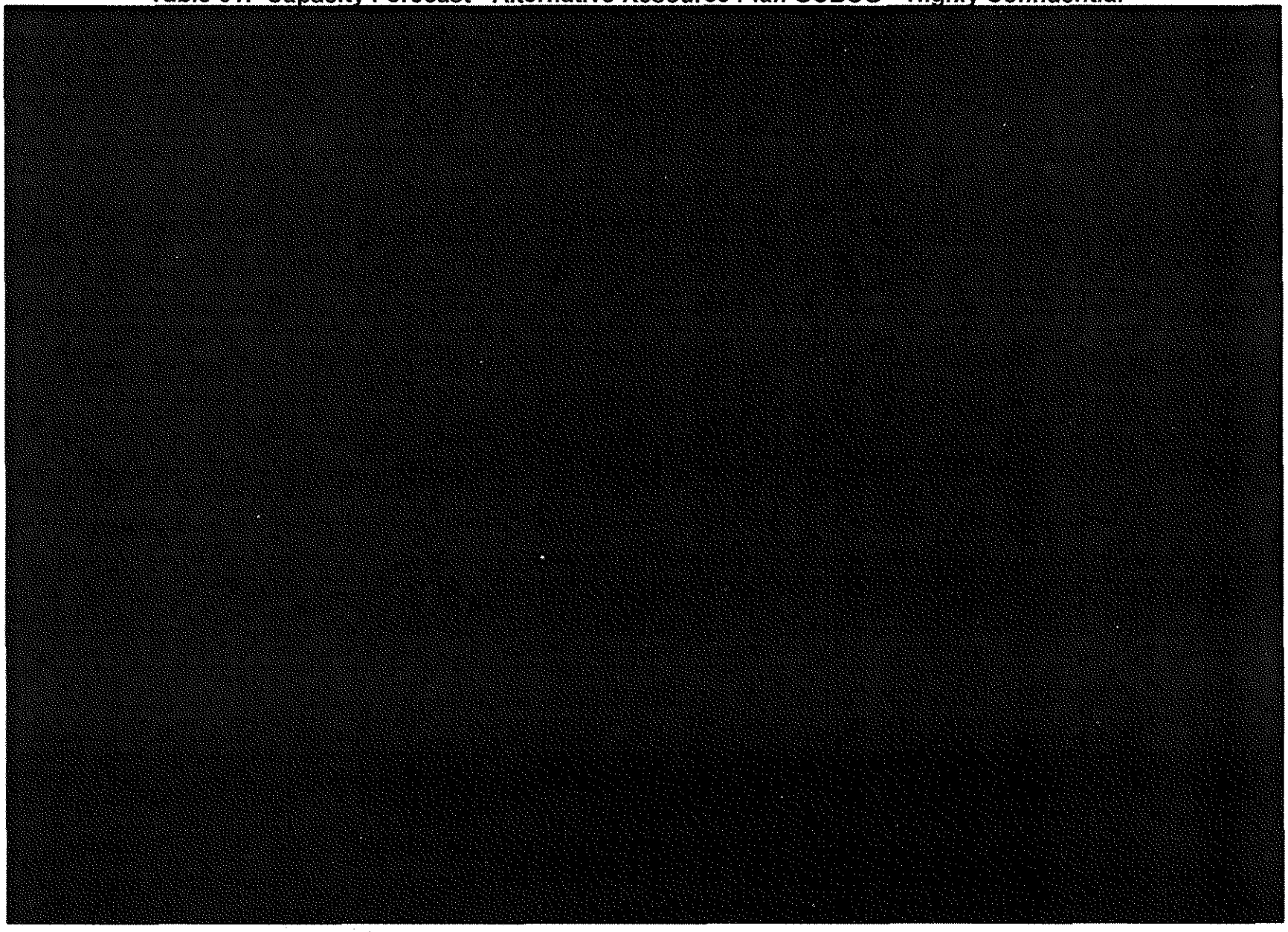

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Table 62: Capacity Forecast - Alternative Resource Plan GBBDA **Highly Confidential**

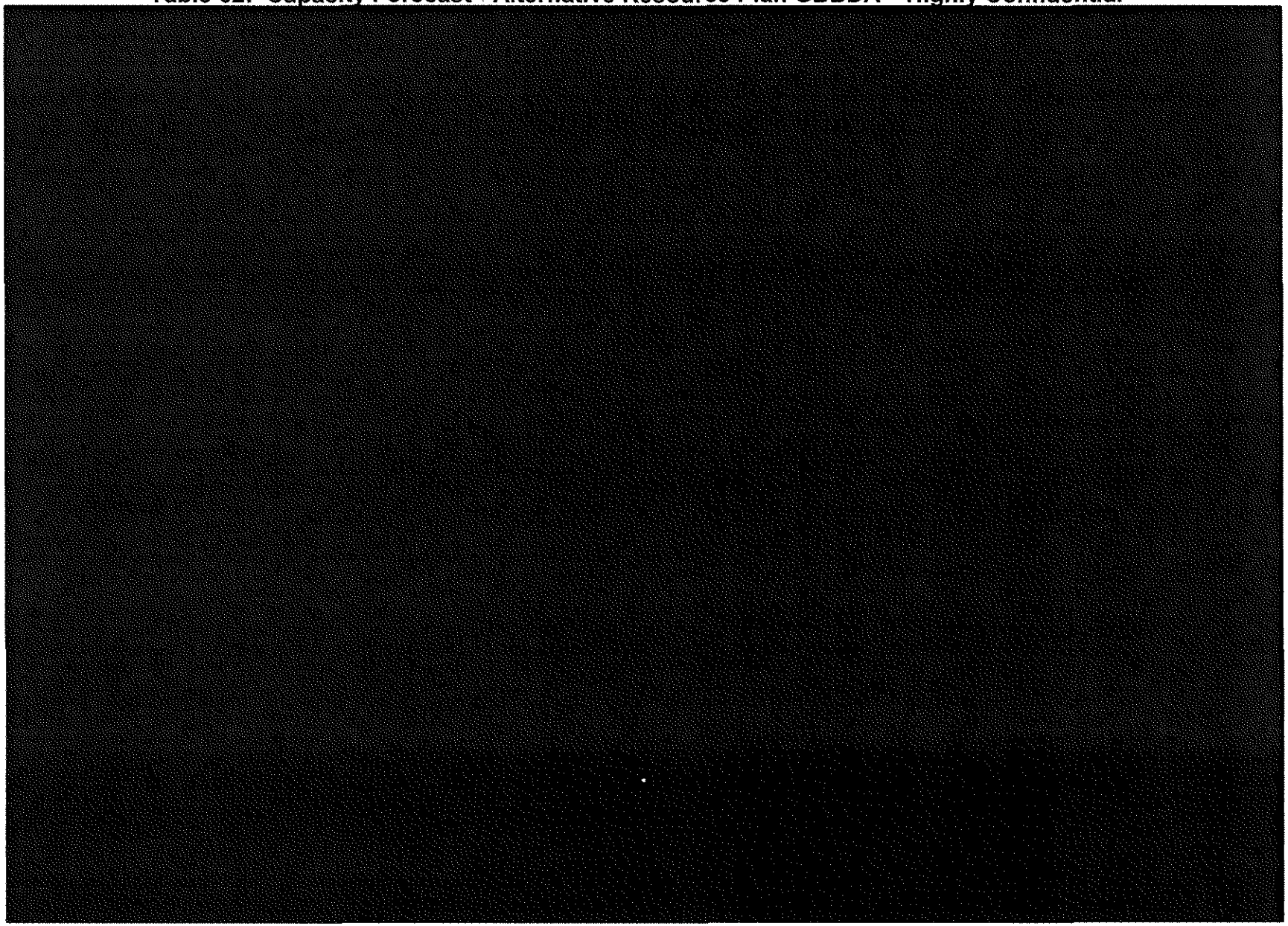

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Table 63: Capacity Forecast - Alternative Resource Plan GBBEG **Highly Confidential**

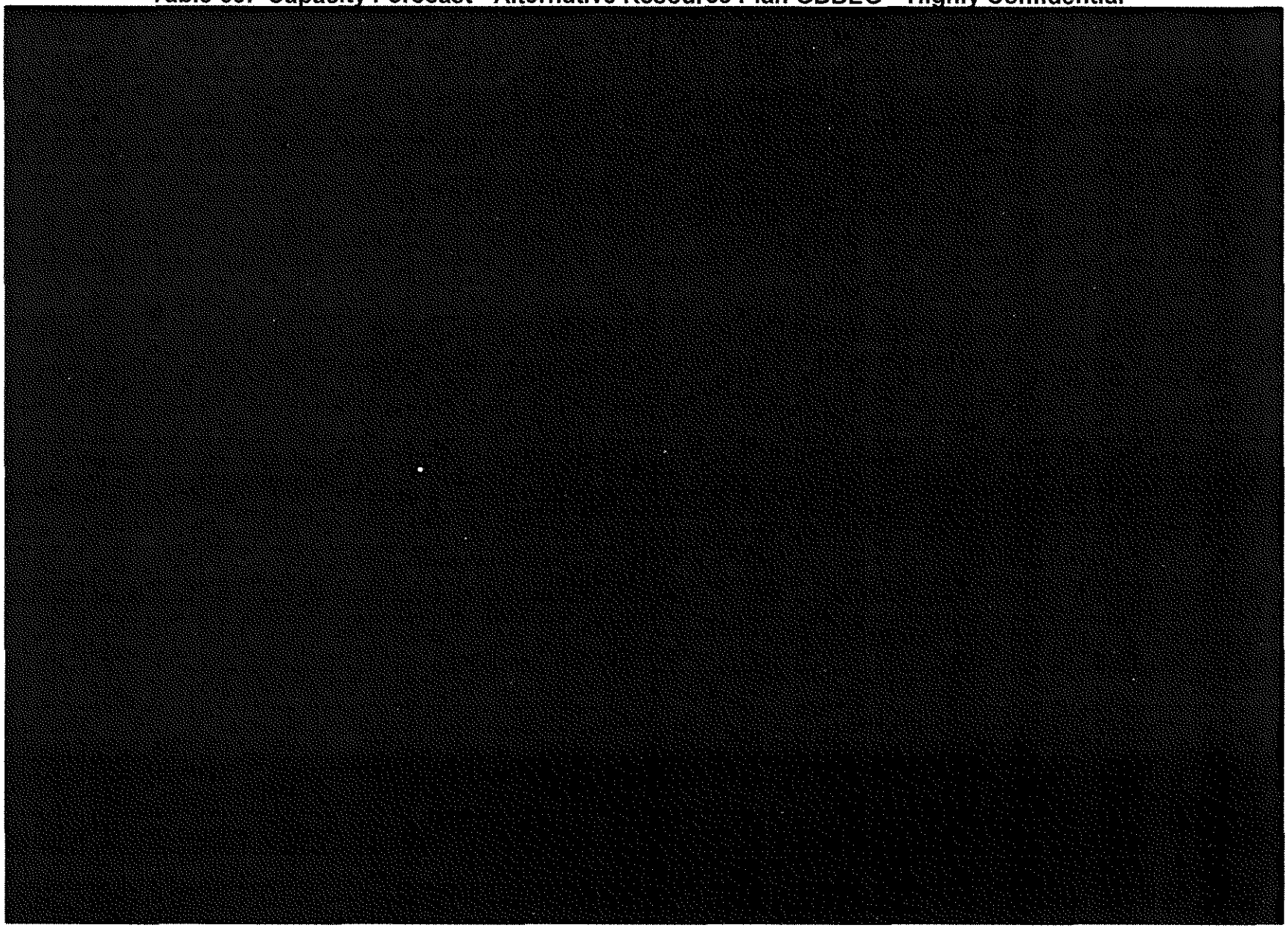

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Table 64: Capacity Forecast - Alternative Resource Plan GCBEB **Highly Confidential**

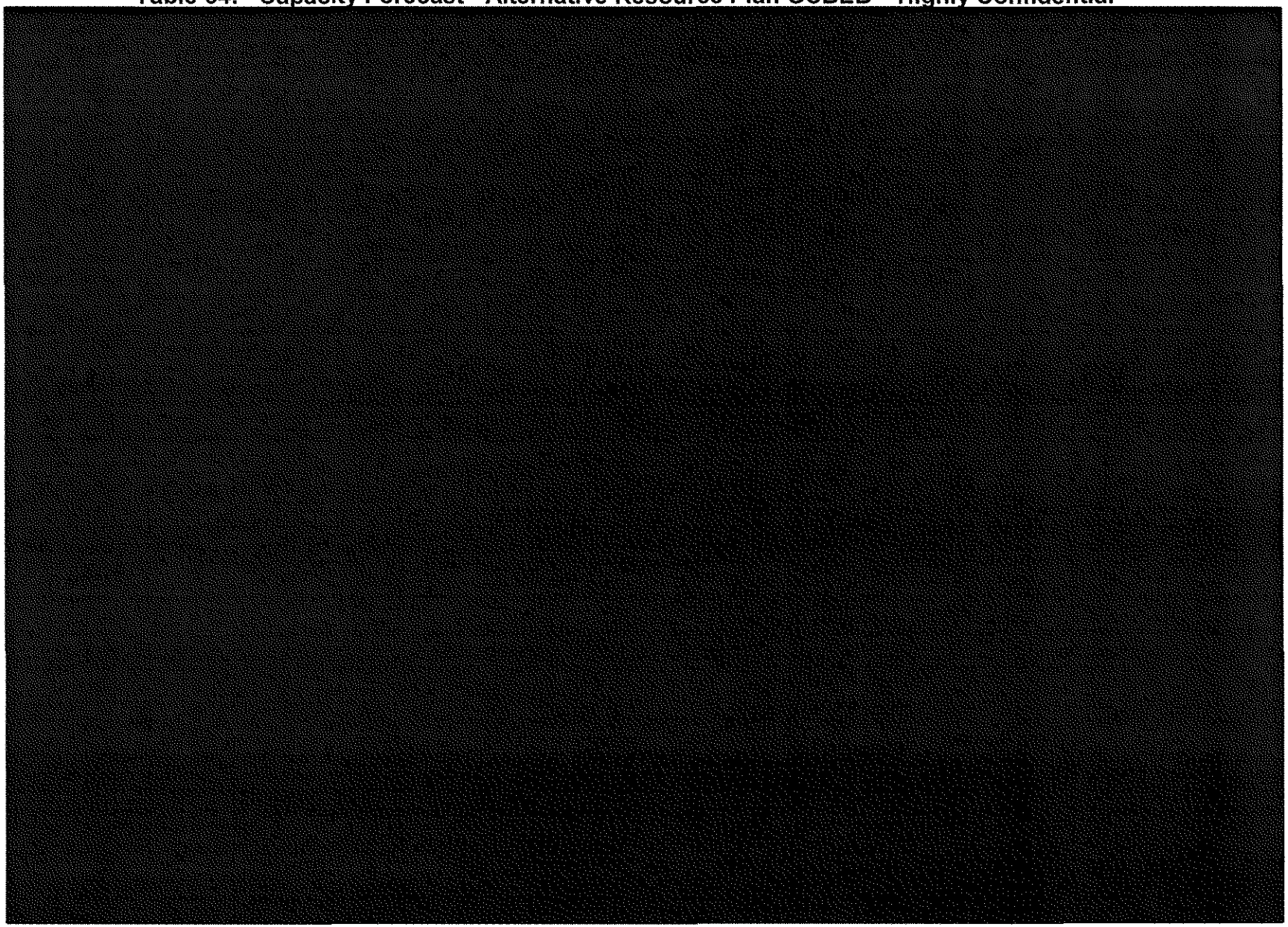

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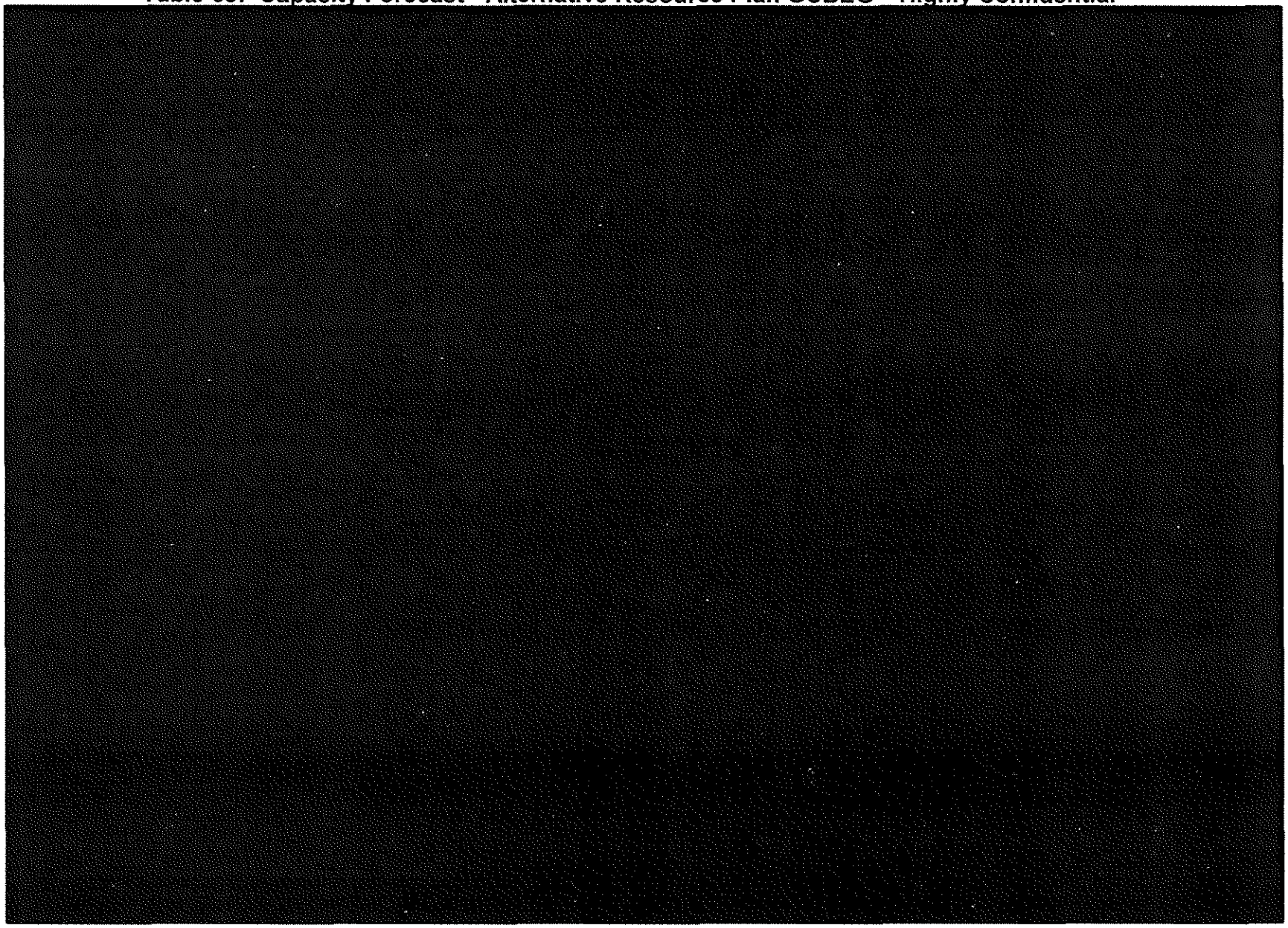
Table 65: Capacity Forecast - Alternative Resource Plan GCBEG **Highly Confidential**



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(C) The analysis of economic impact of alternative resource plans, calculated with and without utility financial incentives for demand-side resources, shall provide comparative estimates for each year of the planning horizon—

Each year of the planning period, all alternative plans are simulated with DSM expensed in the year spent. Summary results for this analysis are provided in the following Section.

1. For the following performance measures for each year:

A. Estimated annual revenue requirement;

B. Estimated annual average rates and percentage increase in the average rate from the prior year; and

C. Estimated company financial ratios and credit metrics; and

The following tables detail performance measures of each alternative resource plan, with and without incentive payments for DSM expenditures on an expected value basis.

Table 66: Economic Impact of Alternative Resource Plan GAAAA ** Highly Confidential **

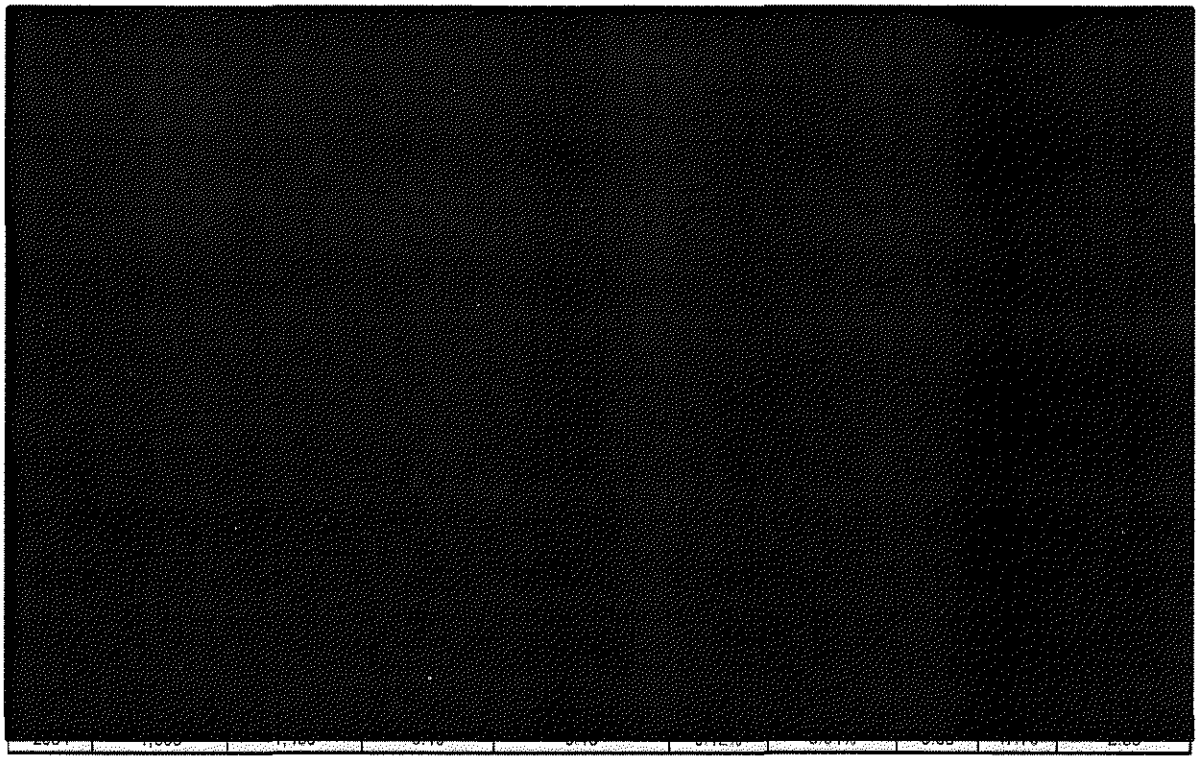

Table 67: Economic Impact of Alternative Resource Plan GBBAA ** Highly Confidential **

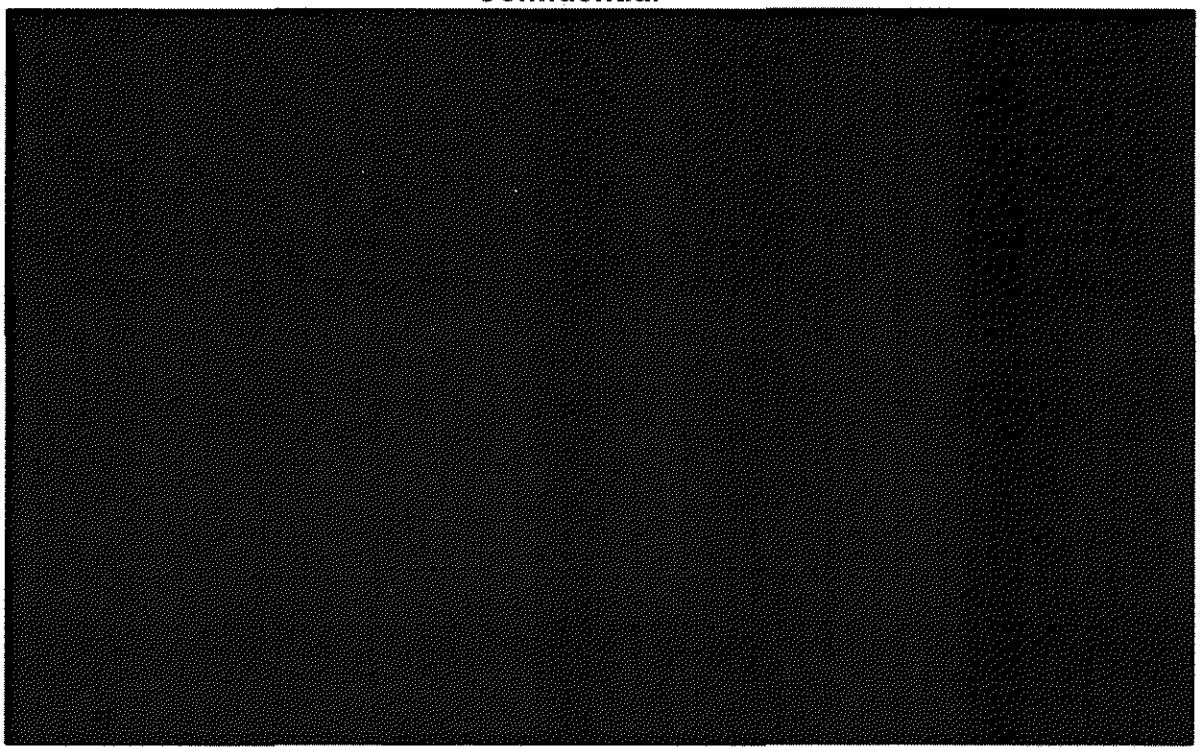

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Table 68: Economic Impact of Alternative Resource Plan GCBAA ** Highly Confidential **

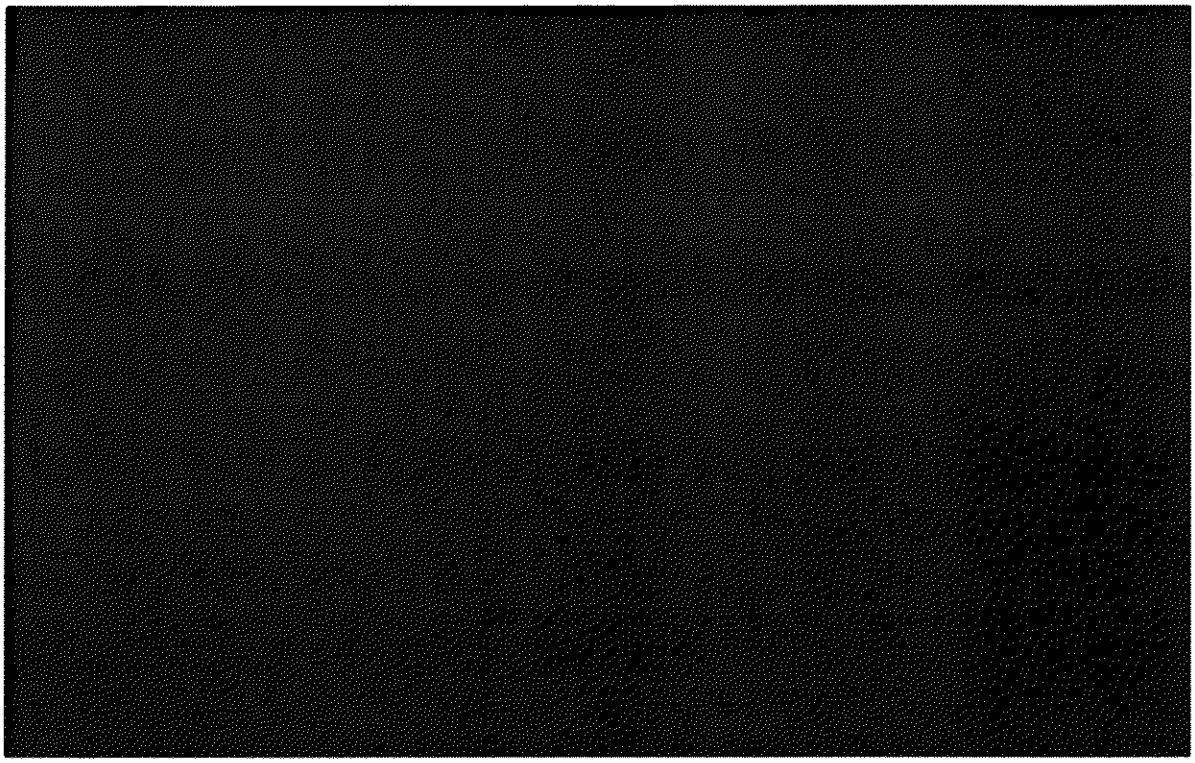

Table 69: Economic Impact of Alternative Resource Plan GAABA ** Highly Confidential **

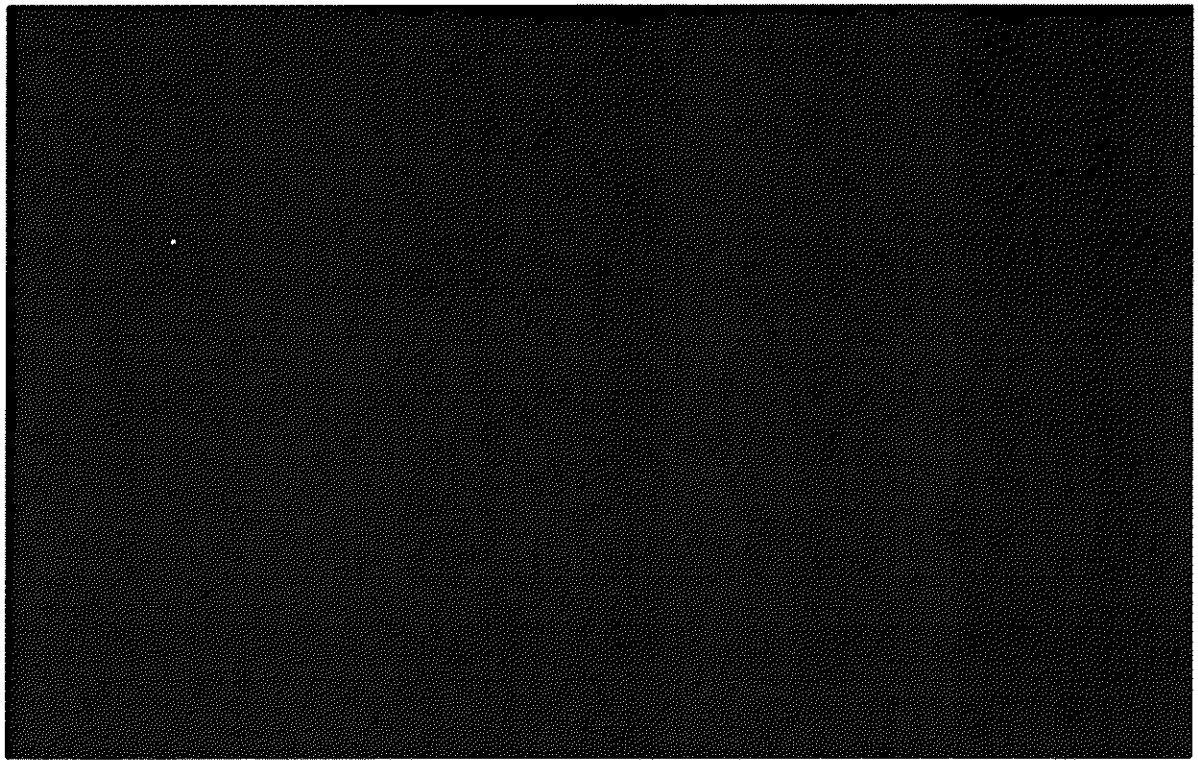

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Table 70: Economic Impact of Alternative Resource Plan GBBBA ** Highly Confidential **

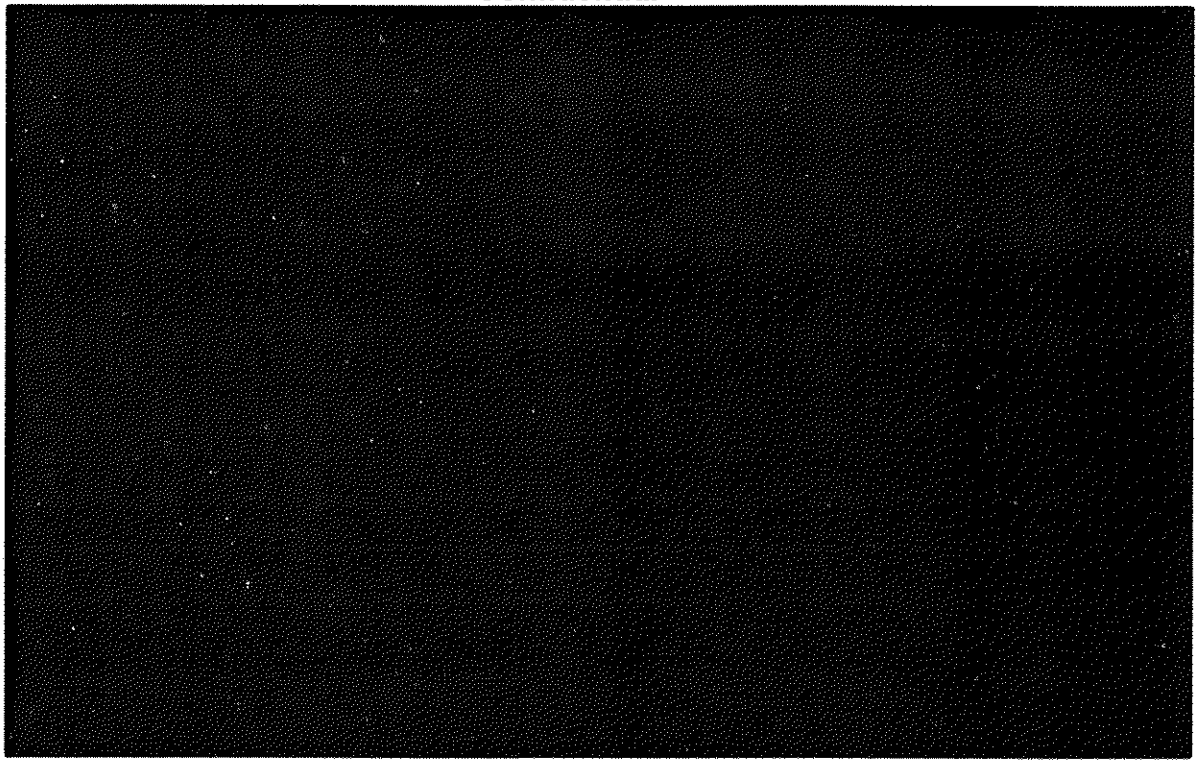

Table 71: Economic Impact of Alternative Resource Plan GBBBB ** Highly Confidential **

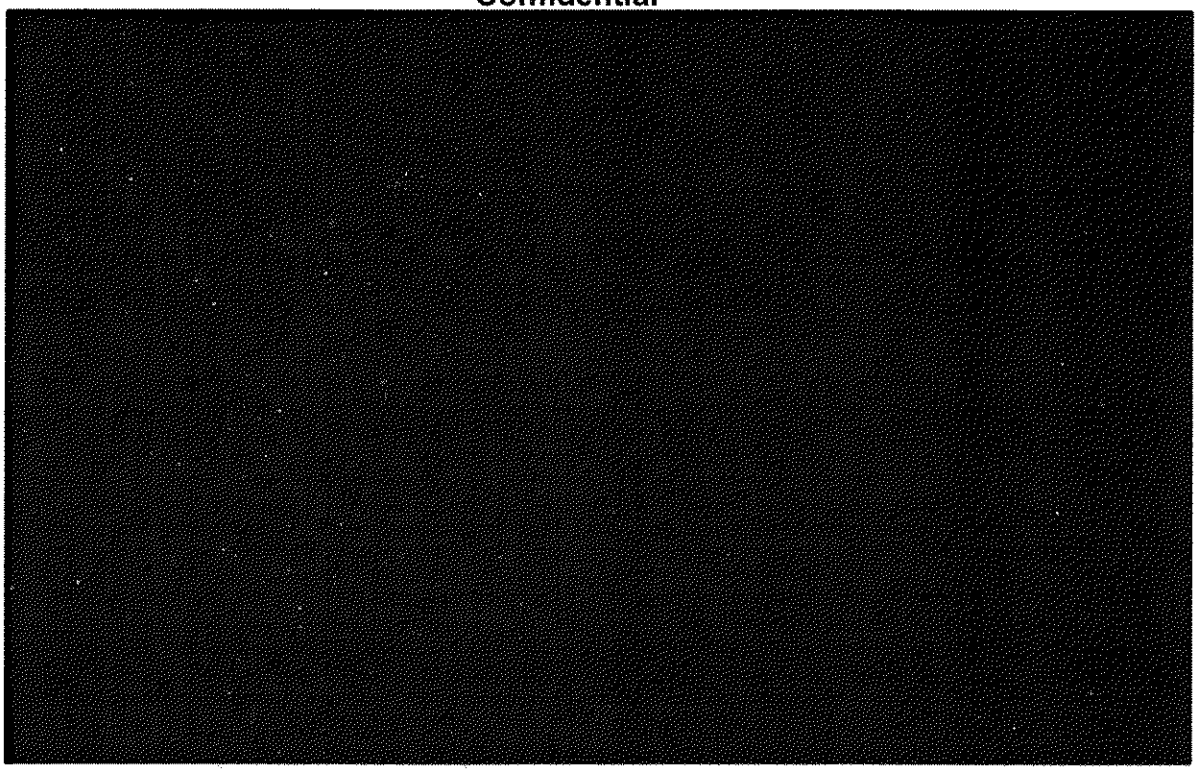

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Table 72: Economic Impact of Alternative Resource Plan GCBBA ** Highly Confidential **

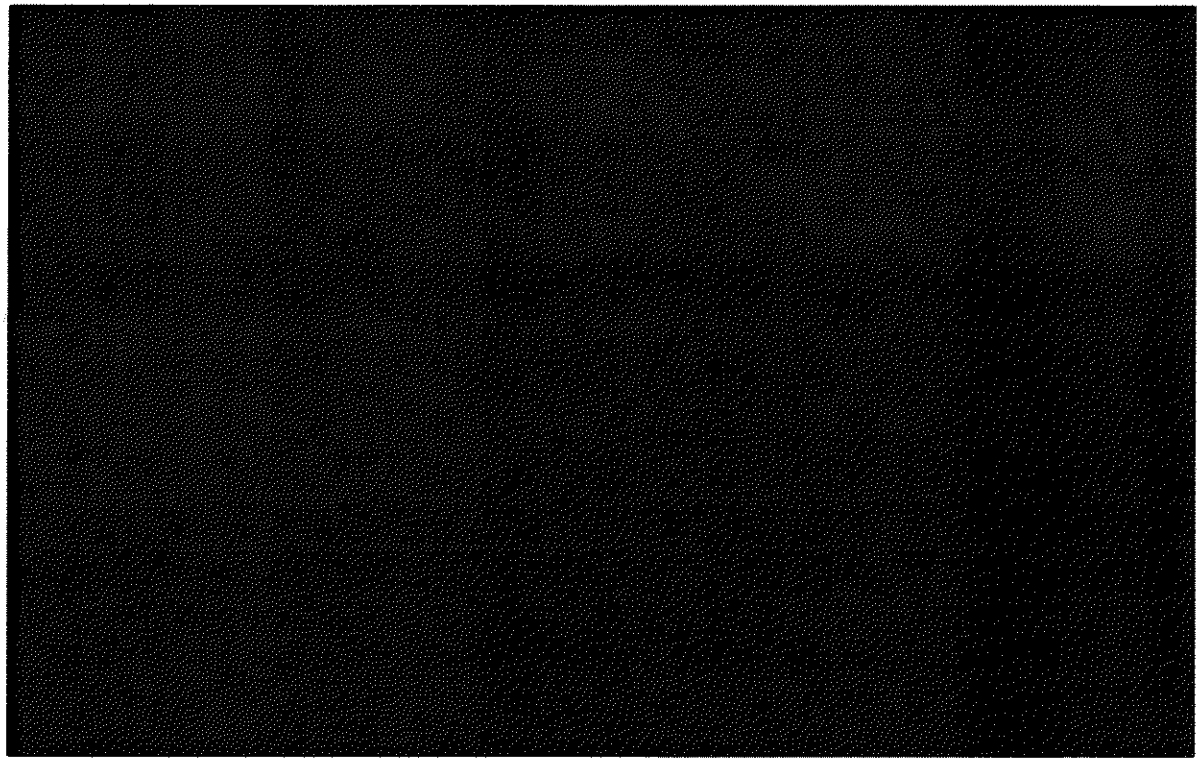

Table 73: Economic Impact of Alternative Resource Plan GAACA ** Highly Confidential **

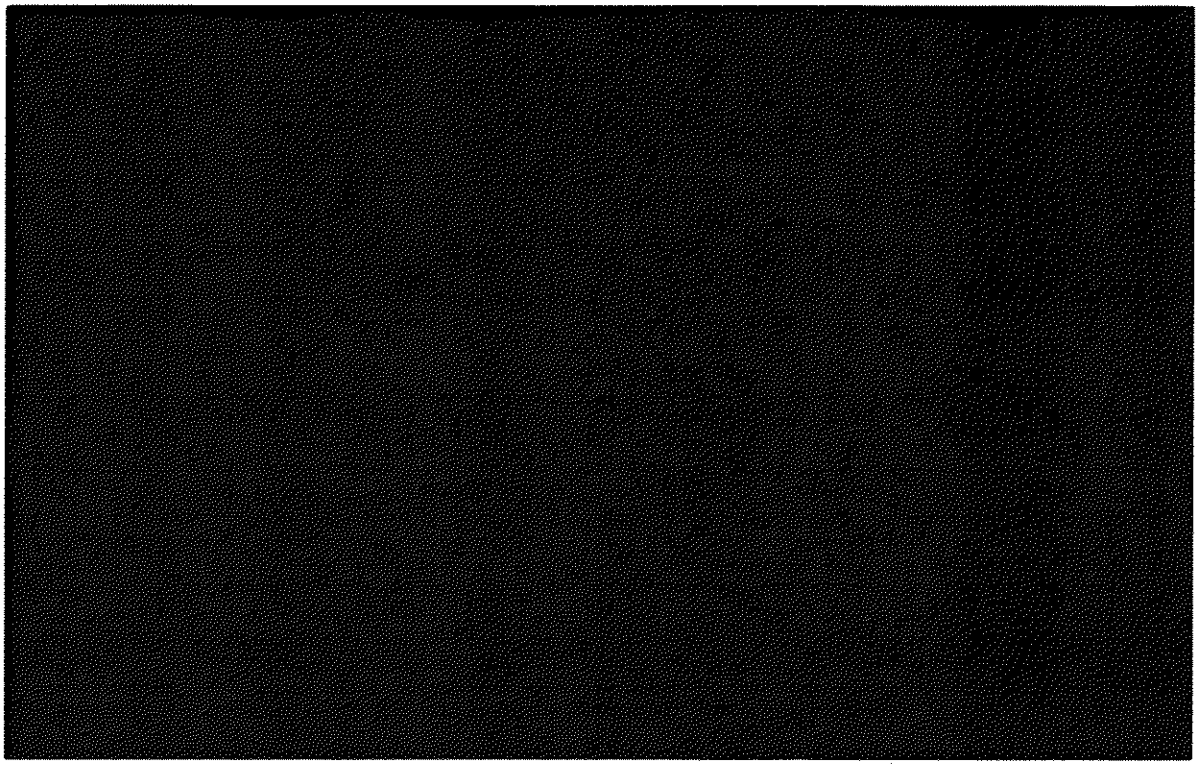

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Table 74: Economic Impact of Alternative Resource Plan GAACB ** Highly Confidential **

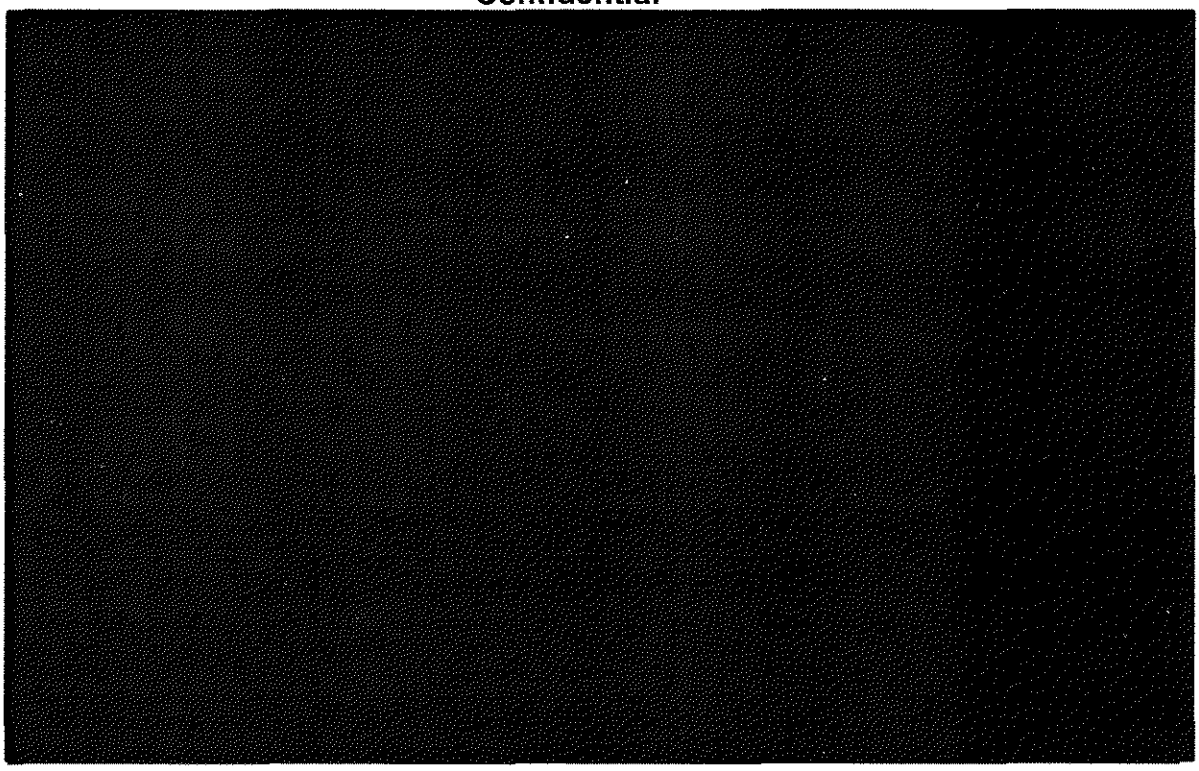

Table 75: Economic Impact of Alternative Resource Plan GAACE ** Highly Confidential **

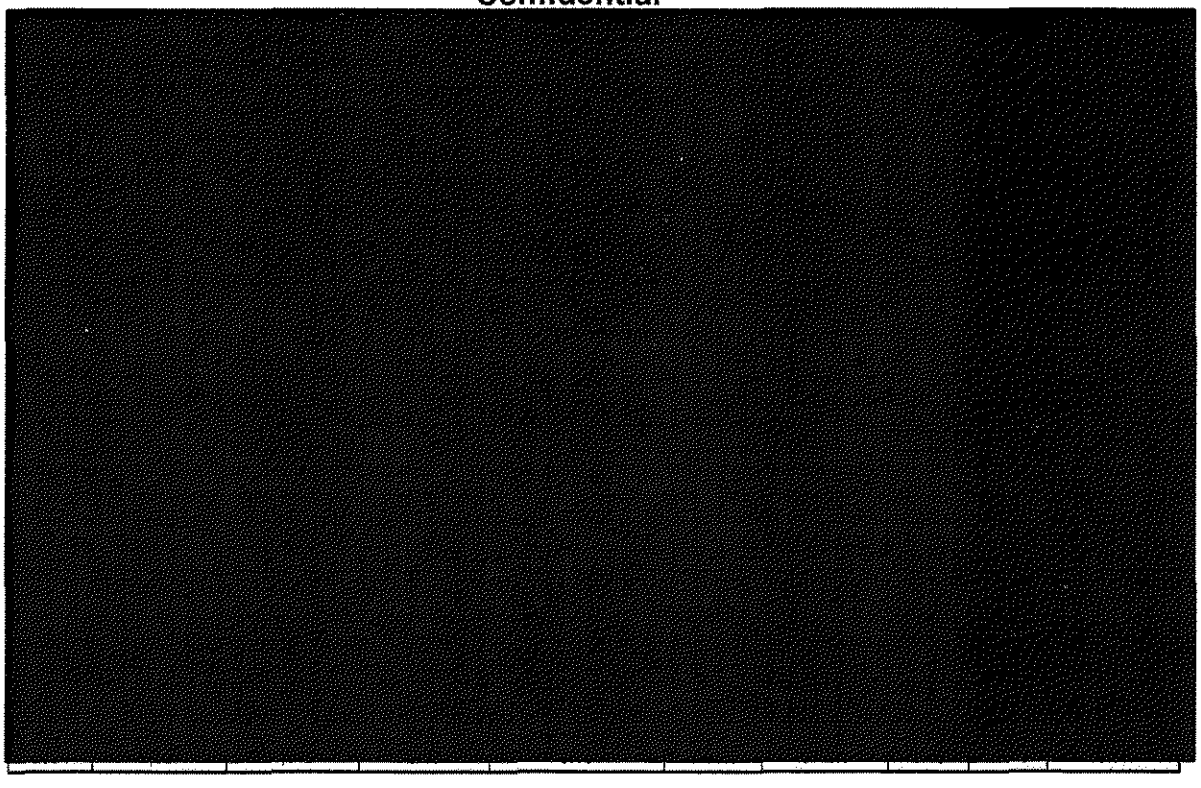

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Table 76: Economic Impact of Alternative Resource Plan GAACF ** Highly Confidential **

Table 77: Economic Impact of Alternative Resource Plan GBBCA ** Highly Confidential **

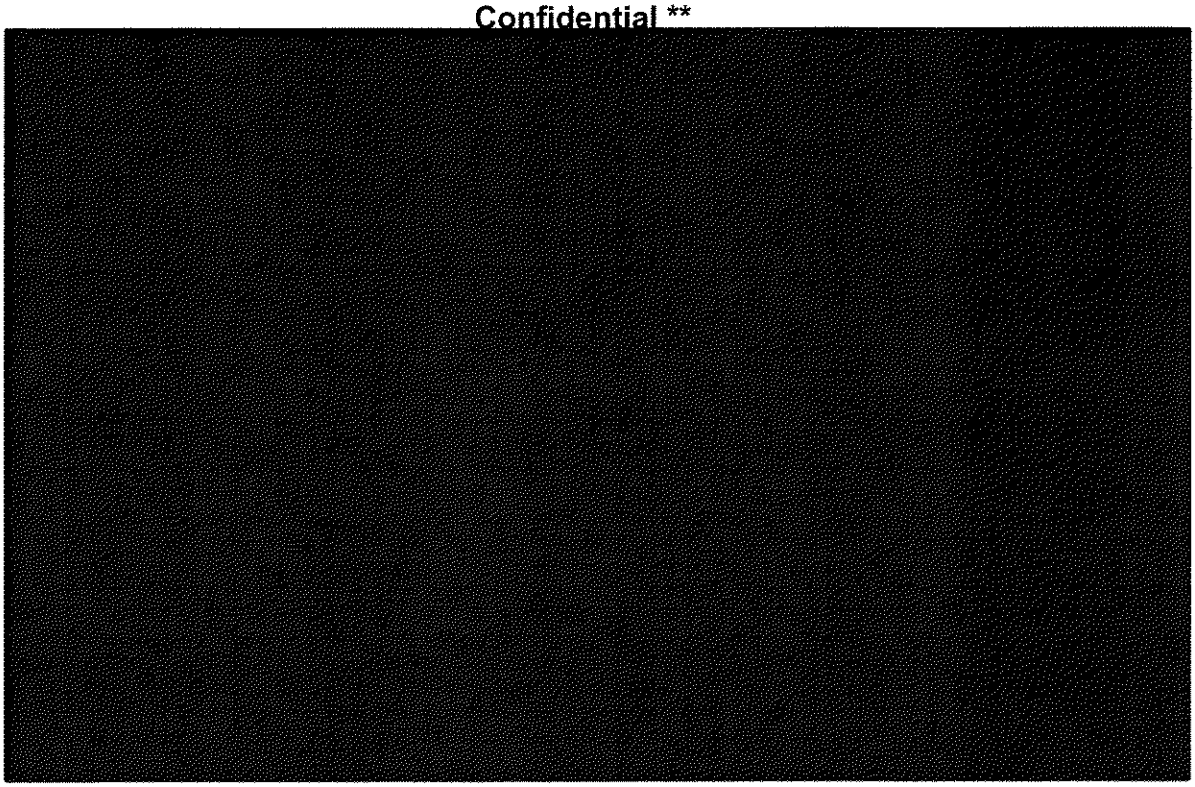

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Table 78: Economic Impact of Alternative Resource Plan GBBCB ** Highly Confidential **

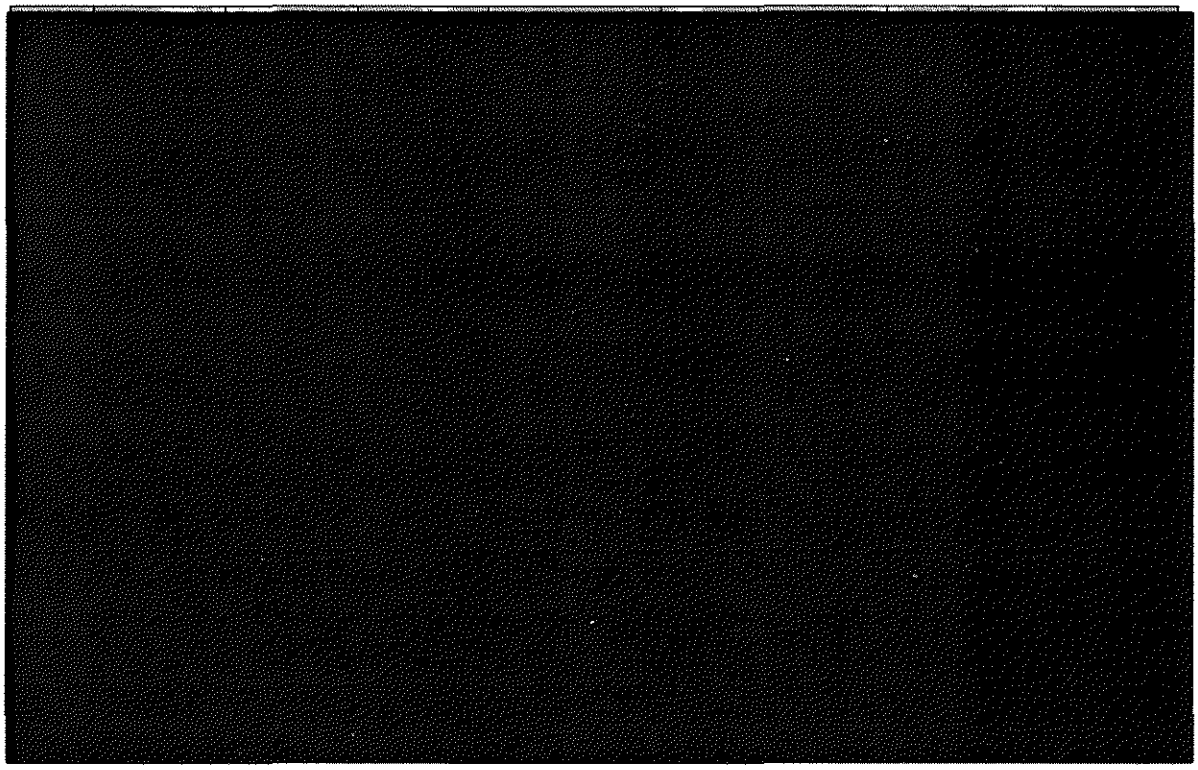

Table 79: Economic Impact of Alternative Resource Plan GBBCC ** Highly Confidential **

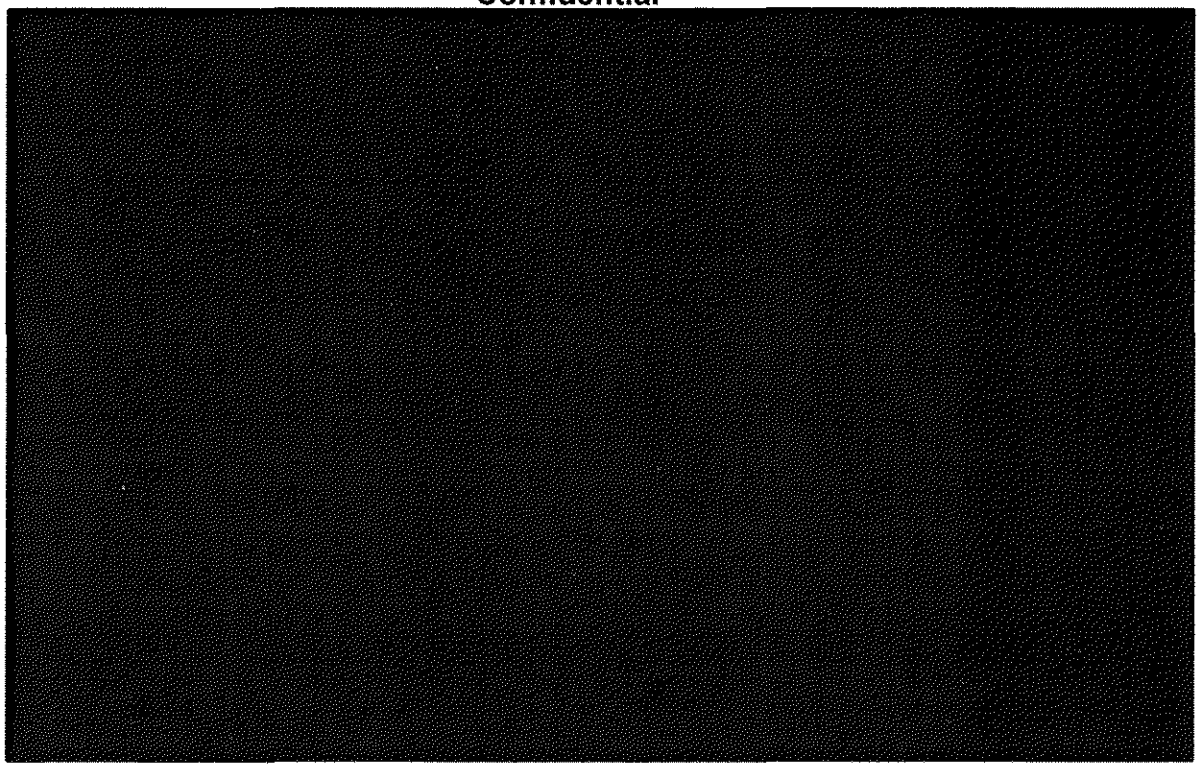

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Table 80: Economic Impact of Alternative Resource Plan GBBCD ** Highly Confidential **

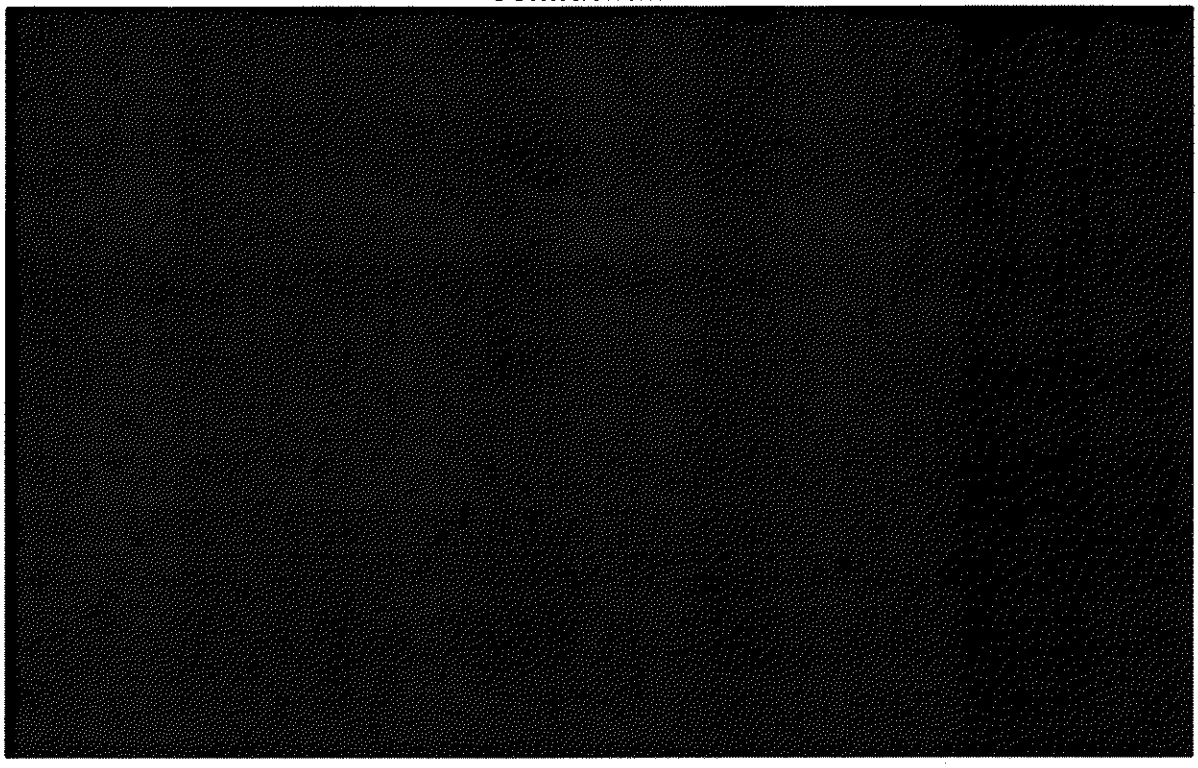

Table 81: Economic Impact of Alternative Resource Plan GBBCF ** Highly Confidential **

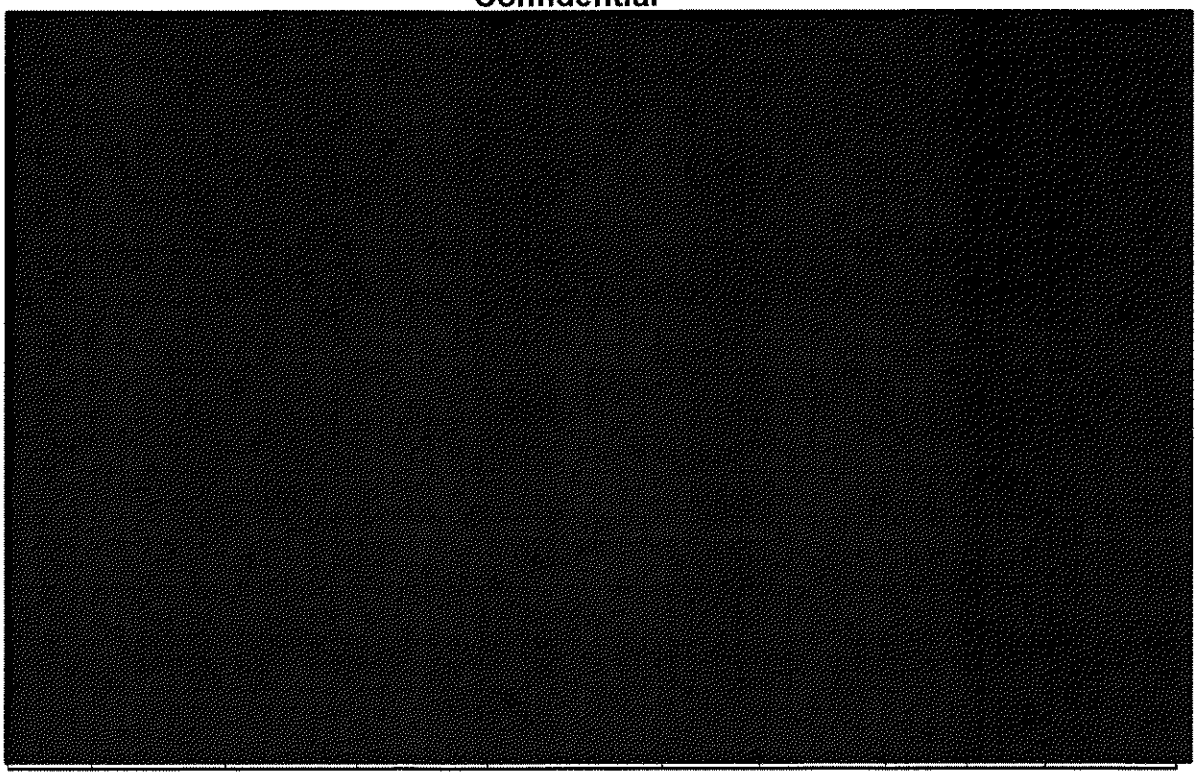

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Table 82: Economic Impact of Alternative Resource Plan GBBCG ** Highly Confidential **

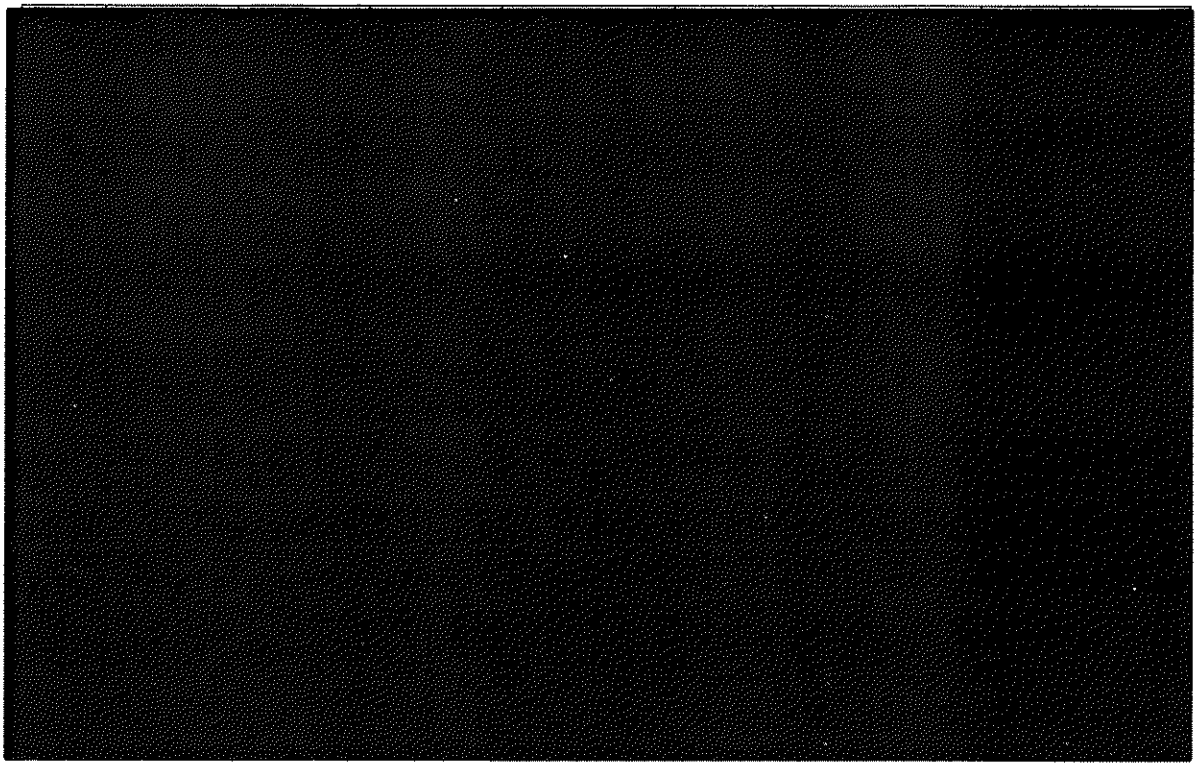

Table 83: Economic Impact of Alternative Resource Plan GBBCW ** Highly Confidential **

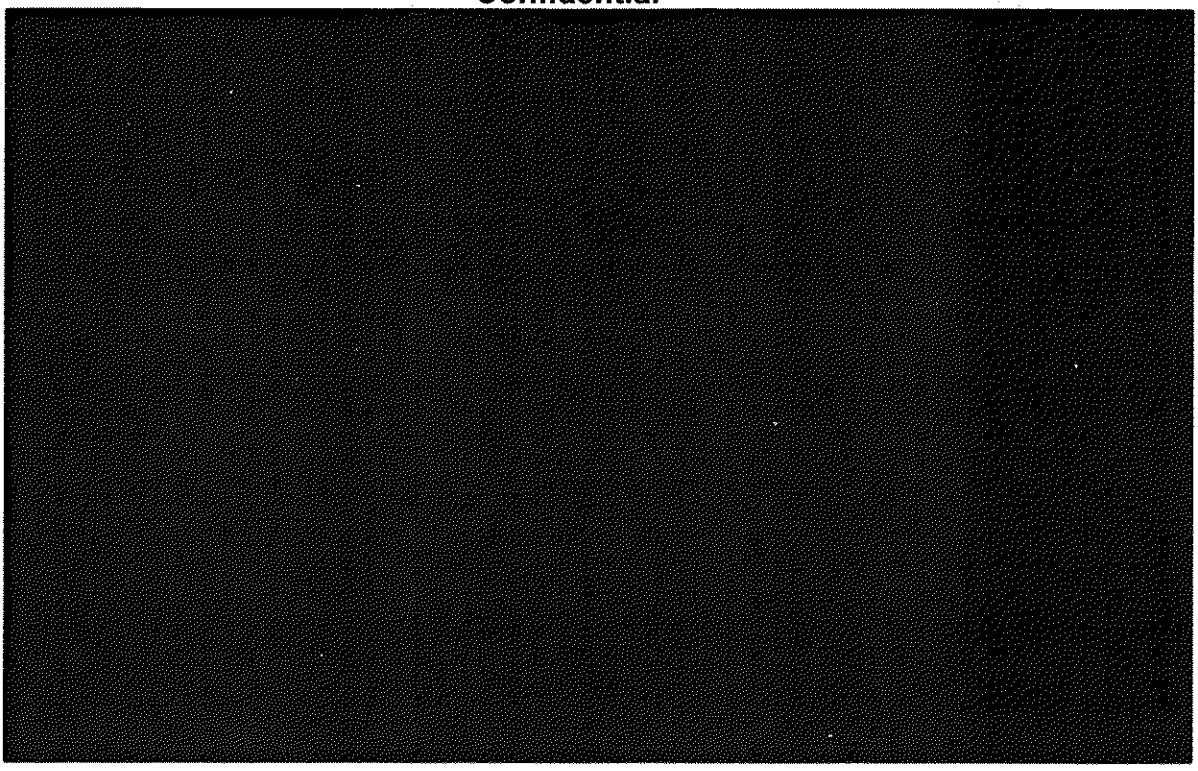

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Table 84: Economic Impact of Alternative Resource Plan GCBCA ** Highly Confidential **

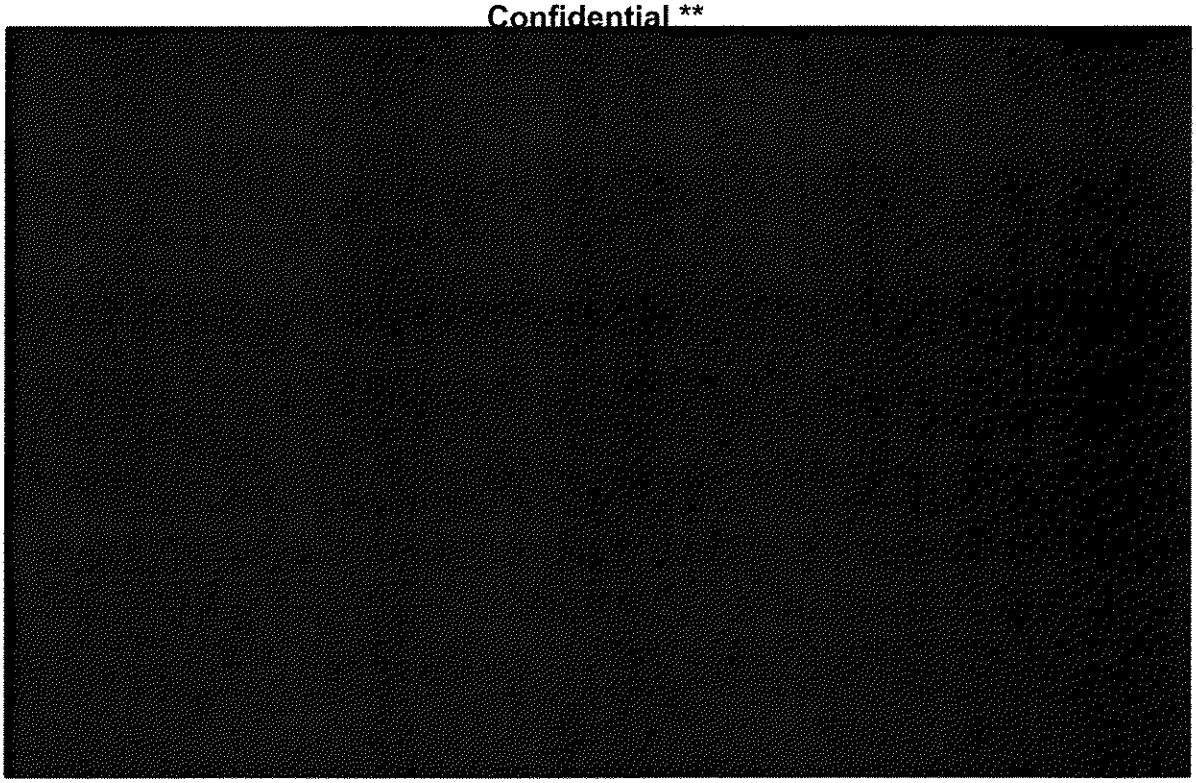

Table 85: Economic Impact of Alternative Resource Plan GCBCB ** Highly Confidential **

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Table 86: Economic Impact of Alternative Resource Plan GCBCG ** Highly Confidential **

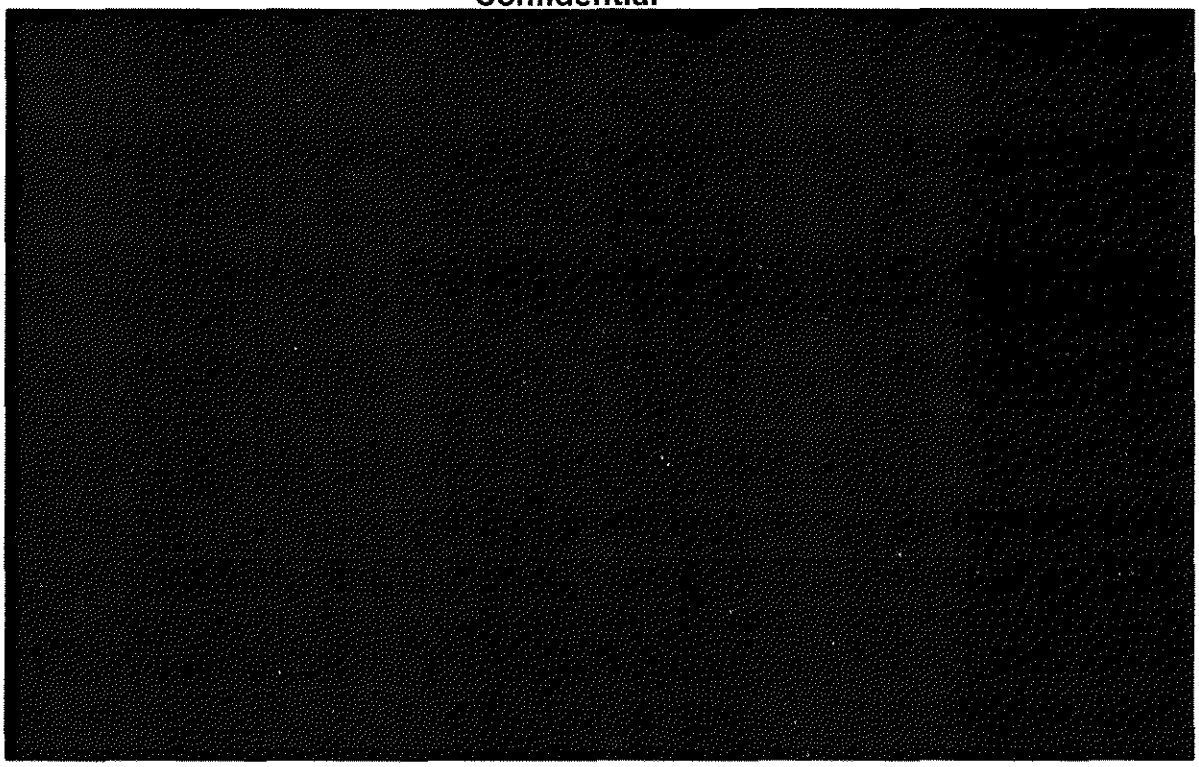

Table 87: Economic Impact of Alternative Resource Plan GBBDA ** Highly Confidential **

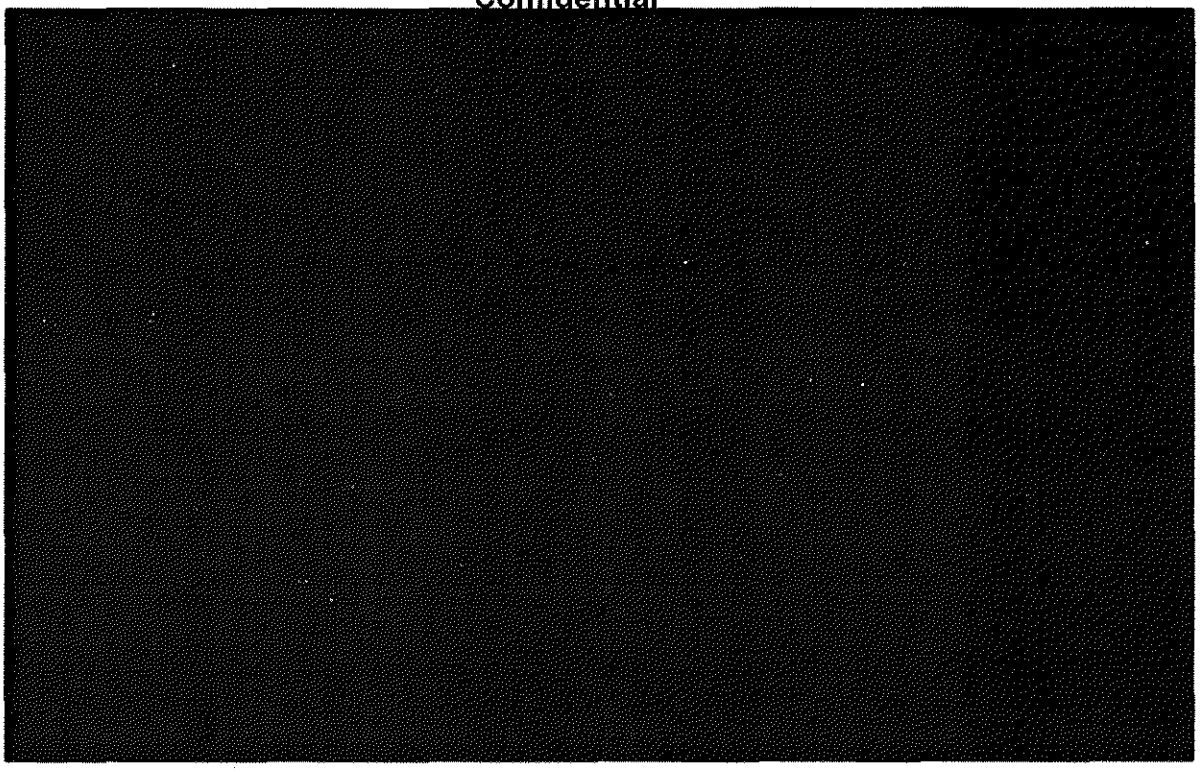

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Table 88: Economic Impact of Alternative Resource Plan GBBEG ** Highly Confidential **

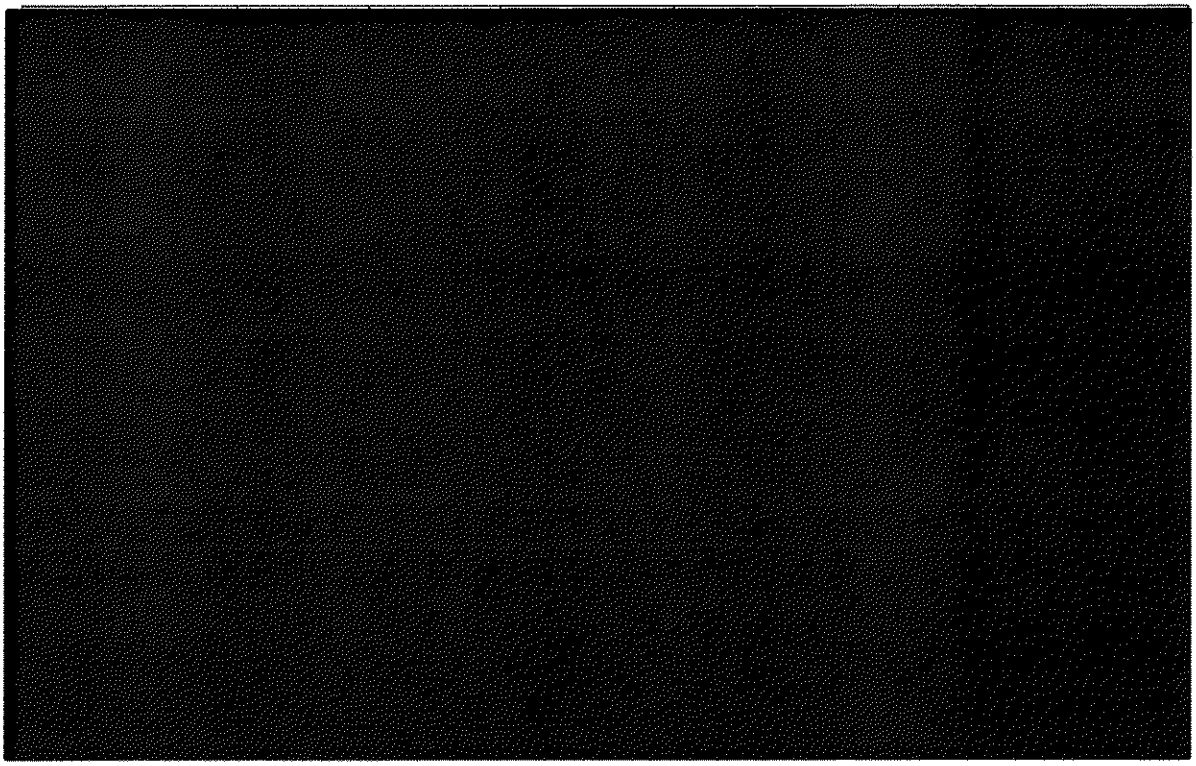

Table 89: Economic Impact of Alternative Resource Plan GCBEB ** Highly Confidential **

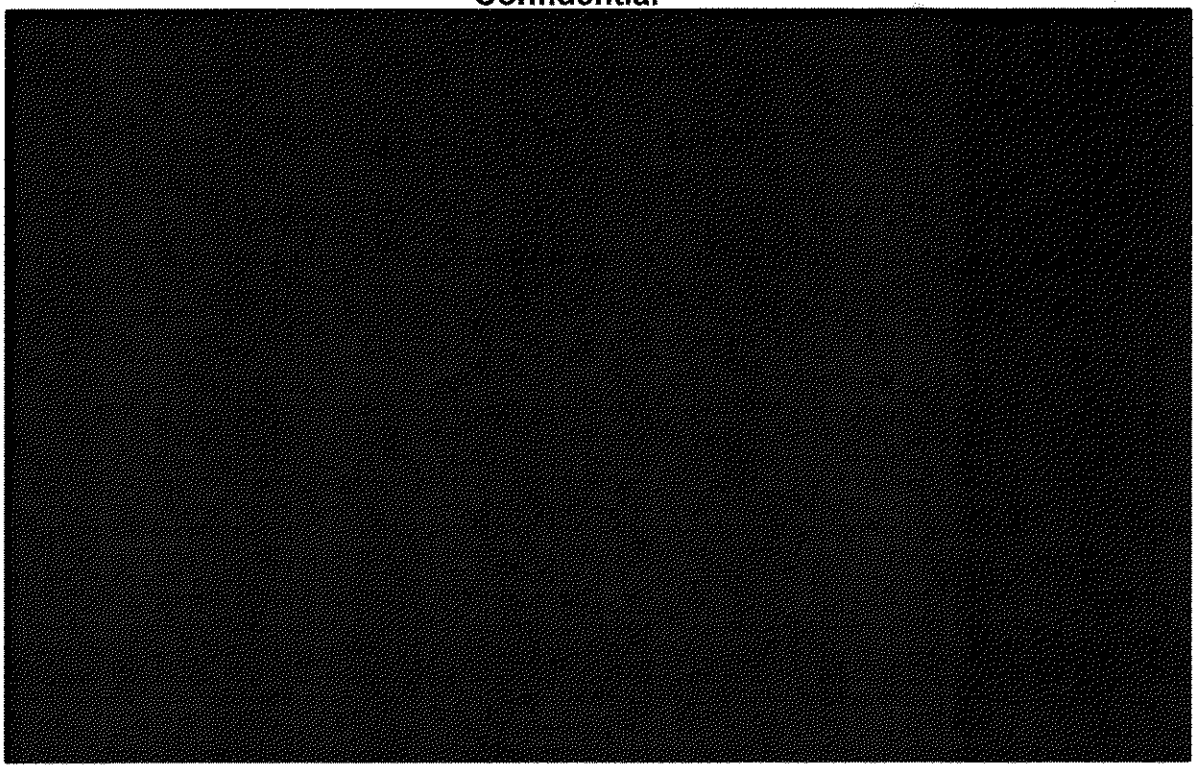

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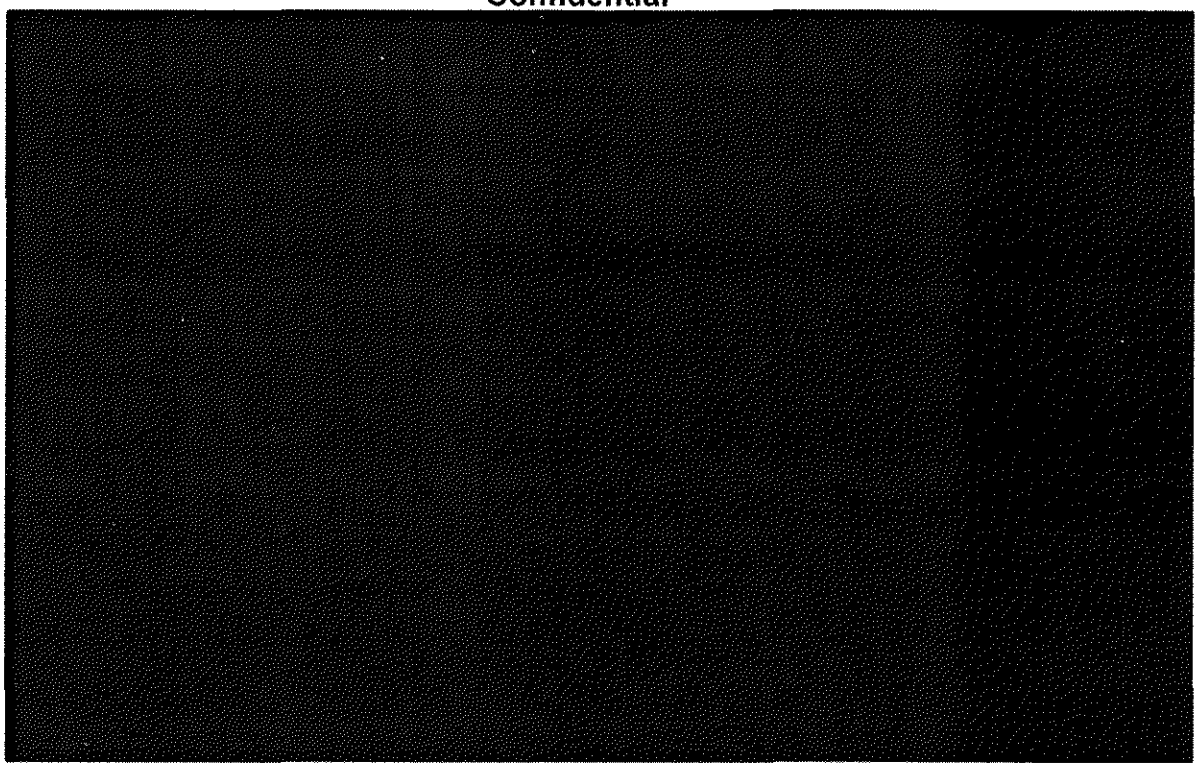
Table 90: Economic Impact of Alternative Resource Plan GCBEG ** Highly Confidential **



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2. If the estimated company financial ratios in subparagraph (4)(C)1.C. are below investment grade in any year of the planning horizon, a description of any changes in legal mandates and cost recovery mechanisms necessary for the utility to maintain an investment grade credit rating in each year of the planning horizon and the resulting performance measures in subparagraphs (4)(C)1.A.–(4)(C)1.C. of the alternative resource plans that are associated with the necessary changes in legal mandates and cost recovery mechanisms.

The expected values of alternative plan performance ratios do not materially change below current conditions. The expectations would be that the investment rating of the company is not at risk from the choice of any particular alternative resource plan.

(D) A discussion of how the impacts of rate changes on future electric loads were modeled and how the appropriate estimates of price elasticity were obtained;

Rate calculation is performed in this analysis on a perfect rate making basis. Total revenue requirement is calculated which requires exogenous load forecast(s) as an input. In other words, rates are an output of the perfect rate making process.

Where rate elasticity is used in the IRP process is in the development of the load forecast. This is documented in the response to rule 22.030(7)(A)1. in Volume 3 of this filing.

(E) A discussion of the incremental costs of implementing more renewable energy resources than required to comply with renewable energy legal mandates;

Rule 240.060(3)(A)2 requires the company to study a larger build of renewable resources beyond the current Missouri RPS standard requirement. To meet this requirement and review the potential impact of a proposal to increase RES

requirements in Missouri, the company included a plan which increased the renewable portfolio for the company and is described in detail in Section 3 of this Volume.

The results of this analysis are detailed throughout this Volume and in Volume 7. A summary review shows that increasing the amount of wind in the current company portfolio generally increases the NPVRR of the alternative resource plan.

(F) A discussion of the incremental costs of implementing more energy efficiency resources than required to comply with energy efficiency legal mandates;

At the current time, there is no specifically target legal mandate for energy efficiency. However this analysis reviews different levels of energy efficiency. These alternative plans are included in the integrated analysis results presented elsewhere in this volume.

(G) A discussion of the incremental costs of implementing more energy resources than required to comply with any other energy resource legal mandates; and

At this time no other legal resource mandates exist. None are contemplated in this analysis.

(H) A description of the computer models used in the analysis of alternative resource plans.

The MIDAS™ model provides hourly chronological dispatch of all system generating assets including unit commitment logic that simulation the actual operation of the utility system resources. The model contains all unit operating variables required to simulate the units. These variables include but are not limited to, heat rates, fuel costs, variable operation and maintenance costs, sulfur

dioxide emission allowance costs, scheduled maintenance outages, forced and derate outages rates each on a per unit basis.

The model can also simulate capacity and energy purchases from or sales to a market in either a firm transaction or as a spot market transaction. In the case of market based transactions, all can be conducted with the impact of environmental credits factored in. The level of purchases or sales can also be limited to any range desired. For this IRP, the Company has limited the ability to purchase firm sales to a level consistent with the company's current operating methods and market conditions.

This model met all conditions of previous rule 22.070 (7) (B), and was used for all previous IRP integrated analysis filings.

SECTION 5: UNCERTAIN FACTORS

(5) The utility shall describe and document its selection of the uncertain factors that are critical to the performance of the alternative resource plans. The utility shall consider at least the following uncertain factors:

The company began developing a list of potential critical uncertain factors to consider in the alternative resource plans by including items required per Rule 4 CSR 240-22.060(5). In addition, the selection of critical uncertain factors considered previously filed IRP stipulations and agreements, the order from the Contemporary Issues process in Case EO-2015-0041, and internal company management concerns. The following table shows the consolidated list of uncertain factors considered by the company.

Table 91: Uncertain Factors

UNCERTAIN FACTOR	RULE	DEFAULT STATE	TEST STATES
Load Growth	060(5)(A)	MID	HIGH, LOW
Interest Rates/Credit Market Conditions	060(5)(B)	MID	HIGH, LOW
Legal Mandate Changes	060(5)(C)	RES	STANDARD
Relative Fuel Prices	060(5)(D)		
Natural Gas		MID	HIGH, LOW
Coal		MID	HIGH, LOW
Siting and Permitting Costs	060(5)(E)	MID	HIGH, LOW
Construction Capital Costs	060(5)(F)	MID	HIGH, LOW
Purchased Power Costs	060(5)(G)	MID	HIGH, LOW
Emission Allowance Markets	060(5)(H)		
CO2		NONE	MARKET EXISTS
SO2		MID	HIGH, LOW
NOX		MID	HIGH, LOW
Fixed O&M	060(5)(I)	MID	HIGH, LOW
Expected Forced Outage Rate (EFOR)	060(5)(J)	MID	HIGH, LOW
DSM Load Impacts	060(5)(K)	MID	HIGH, LOW
DSM Utility Marketing & Delivery Costs	060(5)(L)	MID	HIGH, LOW
Market Import/Export Limits		MID	HIGH, LOW

The Company compiled information concerning the risks listed in 22.060 (5) from subject matter experts within the company. The experts were requested to provide mid, high and low scenario forecasts for their particular risk.

The company utilized the Ventyx System Optimizer Model™[CapEx™] to provide a preliminary test of each state of the uncertain factors. CapEx™ is a linear program based model that chooses the least-cost expansion plan given a known load growth and other fixed market factors. Once a load growth forecast and market is defined, the model is allowed to pick from the available supply, DSM and retirement options to develop the least-cost expansion plan.

The company executed test runs for each sensitivity to determine if the resulting least-cost expansion plan constituted different choices of DSM, supply or retirements. If the model did not materially change its expansion plan by changing sensitivity, that factor was not deemed to be a Critical Uncertain Factor. However, if the model chose different options, such as different technologies or foregoing DSM programs, then that factor would be deemed a Critical Uncertain Factor and was incorporated within the Risk Analysis Decision Tree.

(A) The range of future load growth represented by the low-case and high-case load forecasts;

The high, mid and low load growth cases compliant with and described in Rule 22.030 (7) and 22.030(8) were used in the CapEx™ model. The CapEx™ results demonstrated that load growth is a critical uncertain factor. Load growth sensitivity was passed onto the integrated analysis.

(B) Future interest rate levels and other credit market conditions that can affect the utility's cost of capital and access to capital;

The company tested high and low long term cost of capital to model the sensitivity of CapEx™ plans to changes in these factors. When the adjusted cost of capital rates were input into the CapEx™ model, no material changes occurred to the optimal expansion plan. Therefore the cost of capital was not deemed to be a critical uncertain factor and not included in the integrated analysis.

(C) Future changes in legal mandates;

Future changes to legal mandates would include the potential of a Federal Renewable Energy Standard. For the purposes of modeling, the company assumed the federal requirements would be similar to the Missouri Renewable Energy Standard (RES) requirements except that they would apply on a national level. The Federal standard would not require the Company to acquire additional renewable resources beyond the requirements of the Missouri rules. However, the entire country would be required to acquire additional renewable resources causing an adjustment to power market prices. When adjusted market prices were input into the CapEx™ model, no material changes occurred to the optimal expansion plan. Therefore the Federal renewable standard was not deemed to be a critical uncertain factor and not included in the integrated analysis.

(D) Relative real fuel prices;

NATURAL GAS PRICES

High and low natural gas price forecast scenarios were developed as inputs into the CapEx™ model. The optimized expansion plans for the high and low cases are sufficiently different to require adding natural gas price risk as a critical uncertain factor. Natural gas price forecast development is detailed in Volume 4, Supply-Side Analysis.

COAL PRICES

High and low delivered coal price forecast scenario was modeled in CapEx™. No material changes were identified in the model's optimal expansion plans. This risk was not included in the integrated analysis. Coal price forecast development is detailed in Volume 4, Supply-Side Analysis.

(E) Siting and permitting costs and schedules for new generation and generation-related transmission facilities for the utility, for a regional transmission organization, and/or other transmission systems;

Siting and permitting costs are incorporated into the cost of construction risk detailed in 22.060 (5) (F).

(F) Construction costs and schedules for new generation and generation-related transmission facilities for the utility, for a regional transmission organization, and/or other transmission systems;

The company determined high and low construction cost estimates for each supply technology that passed the preliminary screening process and was moved into the integrated resource analysis. These high and low construction costs scenarios were modeled in CapEx™. The resulting optimal expansion plans did not materially change for either the high or the low construction cost estimates. Construction cost was not identified as a critical uncertain factor, and this risk was not included in the integrated analysis.

Construction cost risks vary by technology. Detailed information for each of the resource options identified can be viewed in Volume 4.

(G) Purchased power availability, terms, cost, optionality, and other benefits;

High and low purchased power availability was simulated with a high and low cost for the capacity terms of the contracts. High and low purchased power availability scenarios were modeled in CapEx™. No material changes were identified in the model's optimal expansion plans. Purchased power availability was not identified as a critical uncertain factor. This risk was not included in the integrated analysis.

(H) Price of emission allowances, including at a minimum sulfur dioxide, carbon dioxide, and nitrogen oxides;

SO_2 credit price forecast development is detailed in Volume 4, Supply-Side Analysis. High and low SO_2 credit price forecasts were simulated in the CapEx™ model. Resulting optimal expansion plans did not change as this cost was

varied. SO_2 credit prices are not considered a critical resource factor and were not used as part of the integrated analysis.

NO_X credit price forecast development is detailed in Volume 4, Supply-Side Analysis. High and low NO_X credit price forecasts were simulated in the CapEx™ model. Resulting optimal expansion plans did not change as this cost was varied. NO_X credit prices are not considered a critical resource factor and were not used as part of the integrated analysis.

CO_2 credit price forecast development is detailed in Volume 4, Supply-Side Analysis. The default assumption is that there will be no CO_2 emissions credit market over the 20-year integrated resource planning period. The impact of including a cost for a CO_2 emission credits market was tested in the CapEx™ model. The resulting optimal expansion plan showed sensitivity to having a CO_2 emissions credit market. Therefore, CO_2 credit prices were included in the integrated analysis as a critical uncertain factor.

(I) Fixed operation and maintenance costs for new and existing generation facilities;

High and low Fixed O&M costs were simulated in the CapEx™ model. Resulting optimal expansion plans did not change as this cost was varied. Therefore, fixed O&M costs were not considered a critical resource factor and were not used as part of the integrated analysis.

(J) Equivalent or full- and partial-forced outage rates for new and existing generation facilities;

High and low equivalent forced outage rates were simulated in the CapEx™ model. Resulting optimal expansion plans did not change as this factor was varied. Therefore, equivalent forced outage rates were not considered a critical resource factor and were not used as part of the integrated analysis.

(K) Future load impacts of demand-side programs and demand-side rates:

High and low load impacts of DSM were simulated in the CapEx™ model. Resulting optimal expansion plans did not materially change as this factor was varied. Therefore, load impacts of DSM were not considered a critical resource factor and were not used as part of the integrated analysis.

(L) Utility marketing and delivery costs for demand-side programs and demand-side rates; and

High and low marketing costs of DSM were simulated in the CapEx™ model. Resulting optimal expansion plans did not change as this factor was varied. Therefore, marketing costs of DSM were not considered a critical resource factor and were not used as part of the integrated analysis.

(M) Any other uncertain factors that the utility determines may be critical to the performance of alternative resource plans.

The MIDAS ™ Model assumes interregional transfers of power are possible and power is allowed to flow freely in the model to help lower overall system costs and reduce the resultant market clearing price for wholesale power. The constraint of this power flow was simulated in the CapEx™ model to determine if a reduction in transfers of power would impact the expansion plan. The resulting optimal expansion plans did not materially change as this factor was varied. Therefore, interregional transfers of power were not considered a critical resource factor and were not used as part of the integrated analysis.

SECTION 6: CRITICAL UNCERTAIN FACTORS ASSESSMENT

(6) The utility shall describe and document its assessment of the impacts and interrelationships of critical uncertain factors on the expected performance of each of the alternative resource plans developed pursuant to 4 CSR 240-22.060(3) and analyze the risks associated with alternative resource plans. This assessment shall explicitly describe and document the probabilities that utility decision makers assign to each critical uncertain factor.

To summarize the results described in Section 5 above, 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 CO2 credit prices. These risks, and the associated probabilities used to model this IRP Filing are represented in this figure 1 below. The probabilities for both load and natural gas are the same as used on all filings since the last triennial filing in 2012 – with Mid 50% and High and Low states at 25% weighted probabilities. For CO2, the decision states are now modeled as a 40% probability there will be a CO2 credit market and 60% probability that no CO2 credit market will exist. The weighted endpoint probability is the product these three weighted probabilities

Figure 1: Decision Tree Probabilities

Endpoint	Load Growth	Natural Gas	CO_2	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%

In order to assess the full range of risks, each possible combination of covariant risk is simulated. Subject matter experts within the company have assigned risk distributions to each of the three drivers. These risks are used to develop an overall distribution of risk using every combination of risk factors. A cumulative risk distribution is then derived from the joint probability calculation of each scenario component risk that defines the scenario.

The Company has used all combinations of identified risk drivers in its analysis. This includes scenarios that exhibited both strong positive and strong negative correlations among risk drivers. By using regression methods, the Company tested the effects of all extreme risk drivers and the cases of strong positive and strong negative correlations. The results of the regression studies are conclusive. Even if strong correlations existed in the long run [either positive or

negative], they have no statistically significant impact on plan performance results.

Results of the company correlation study are presented in the following table of regression results.

Table 92: Regression Study Results

Regression Statistics	
Multiple R	0.92
R Square	0.84
Adjusted R Square	0.83
Standard Error	257.25
Observations	270.00

	df	*SS*	*MS*	*F*
Regression	8	89,425,958.29	11,178,244.79	168.91
Residual	261	17,272,411.88	66,177.82	
Total	269	106,698,370.17		

	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	10,128.80	50.73	199.66	0.00
CO2	1,064.74	38.35	27.76	0.00
HGas	125.93	69.13	1.82	0.07
LGas	(193.56)	60.63	(3.19)	0.00
HLoad	147.91	60.63	2.44	0.02
LLoad	(139.81)	60.63	(2.31)	0.02
Load/Gas(+)	28.19	74.26	0.38	0.70
Load/Gas(-)	(28.00)	74.26	(0.38)	0.71
GAS/CO2	69.22	66.42	1.04	0.30

SECTION 7: CRITICAL UNCERTAIN FACTOR PROBABILITIES

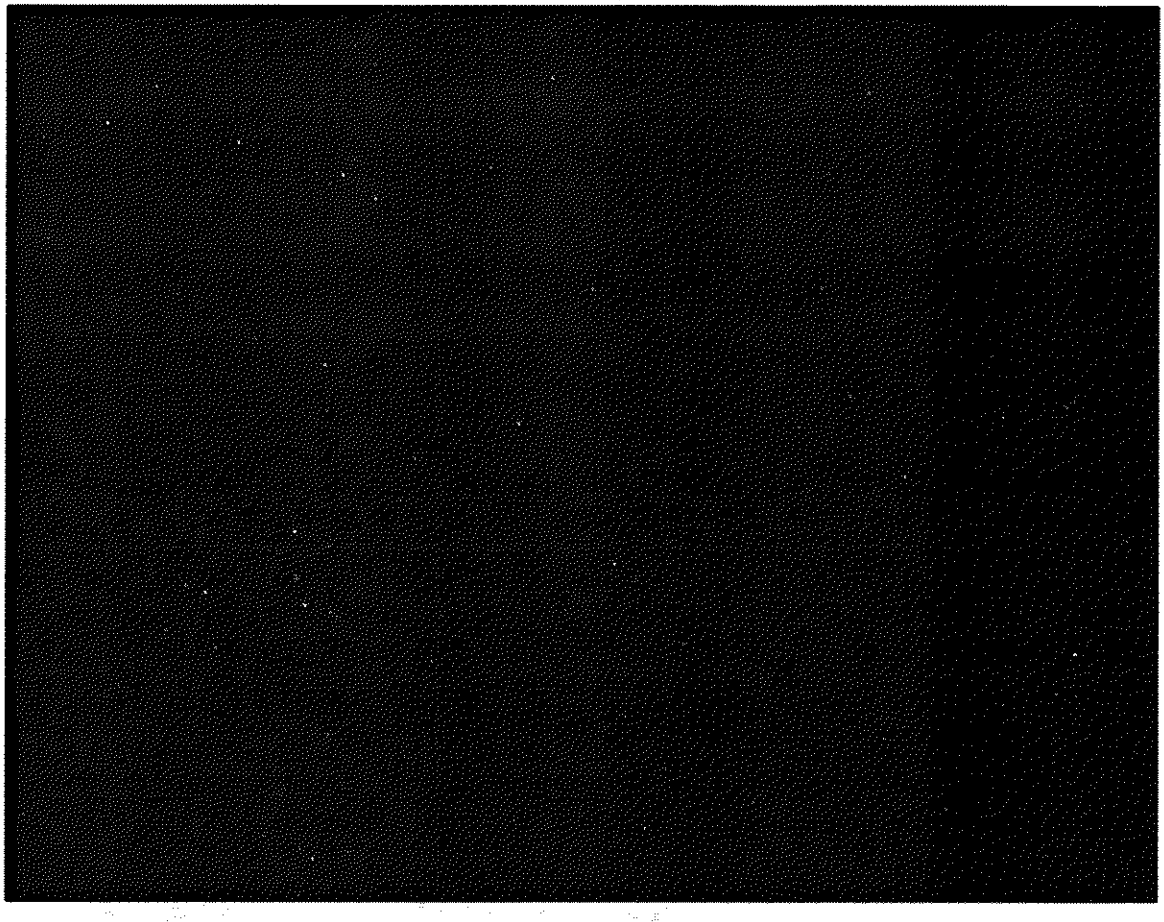
(7) The utility decision-makers shall assign a probability pursuant to section (5) of this rule to each uncertain factor deemed critical by the utility. The utility shall compute the cumulative probability distribution of the values of each performance measure specified pursuant to 4 CSR 240-22.060(2). Both the expected performance and the risks of each alternative resource plan shall be quantified. The utility shall describe and document its risk assessment of each alternative resource plan.

Each risk factor has a probability distribution developed by the company subject matter expert. These probability distributions have been combined to produce overall joint probabilities for critical factor combinations.

(A) The expected performance of each resource plan shall be measured by the statistical expectation of the value of each performance measure.

A table of the expected value of each performance measure is provided below.

Table 93: Expected Value Plan Performance Measures ** Highly Confidential **



(B) The risk associated with each resource plan shall be characterized by some measure of the dispersion of the probability distribution for each performance measure, such as the standard deviation or the values associated with specified percentiles of the distribution.

The standard deviation of each performance measure by plan is detailed in the table below.

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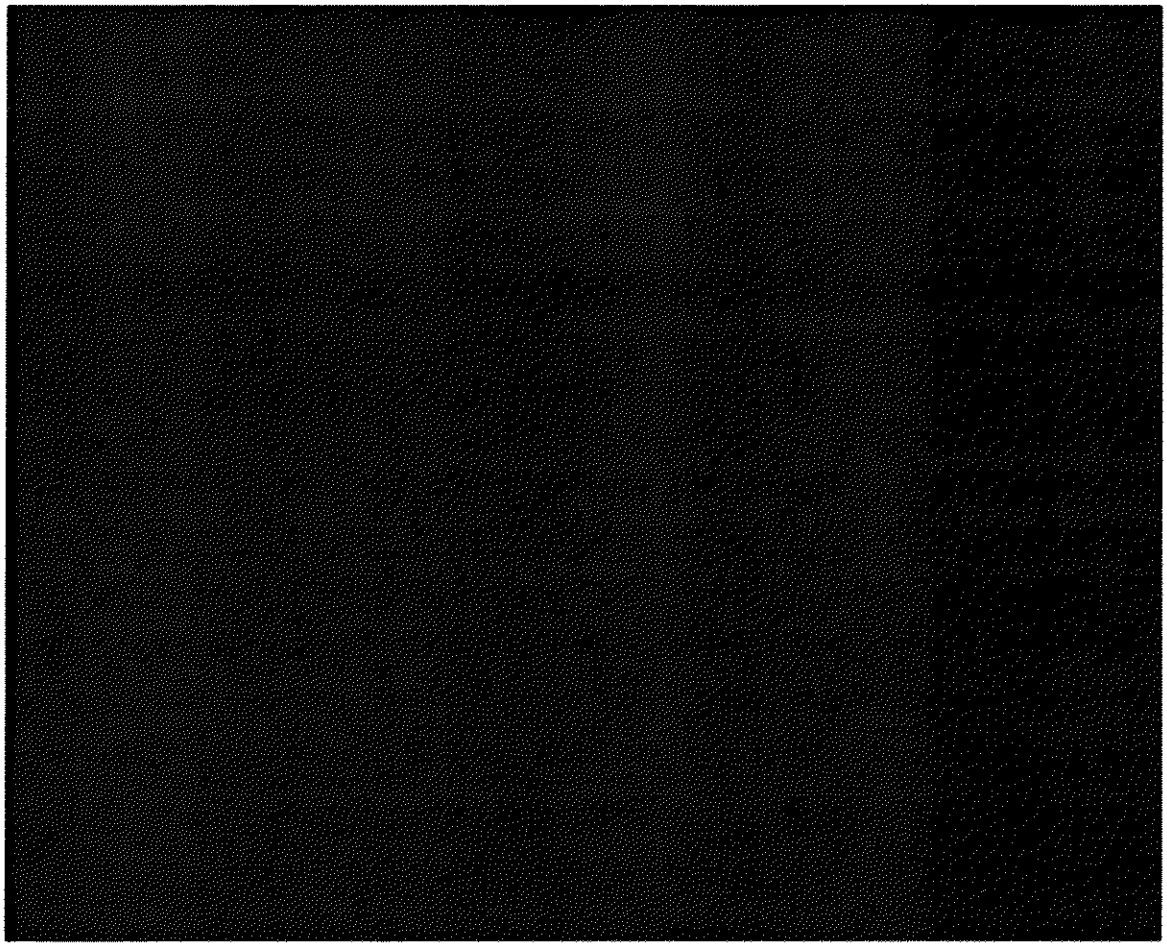
Table 94: Standard Deviation Plan Performance Measures ** Highly Confidential **



Note: Several performance measures are not affected by the individual scenario risk and therefore exhibits no standard deviation.

(C) The utility shall provide—

1. A discussion of the method the utility used to determine the cumulative probability—

For the overall risk analysis, the company assumed independence of the three critical uncertain factors for this long term analysis. The individual scenarios utilized a joint probability of the probabilistic occurrence of each risk component that defined the scenario. This method and its statistical performance is described in Section 6 of this Volume.

HC

A. An explanation of how the critical uncertain factors were identified, how the ranges of potential outcomes for each uncertain factor were determined, and how the probabilities for each outcome were derived; and

The method for determining whether or not a risk was an uncertain factor is detailed in Section 5 of this Volume. The risk distribution of each driver was determined by the company subject matter expert.

B. Analyses supporting the utility's choice of ranges and probabilities for the uncertain factors;

Supporting documentation for the choice of probabilistic range is in Volume 3 for the load growth risk and Volume 4 for Natural Gas and CO_2 credit price risk.

2. Plots of the cumulative probability distribution of each distinct performance measure for each alternative resource plan;

Chart 93: Cumulative Probability - NPVRR

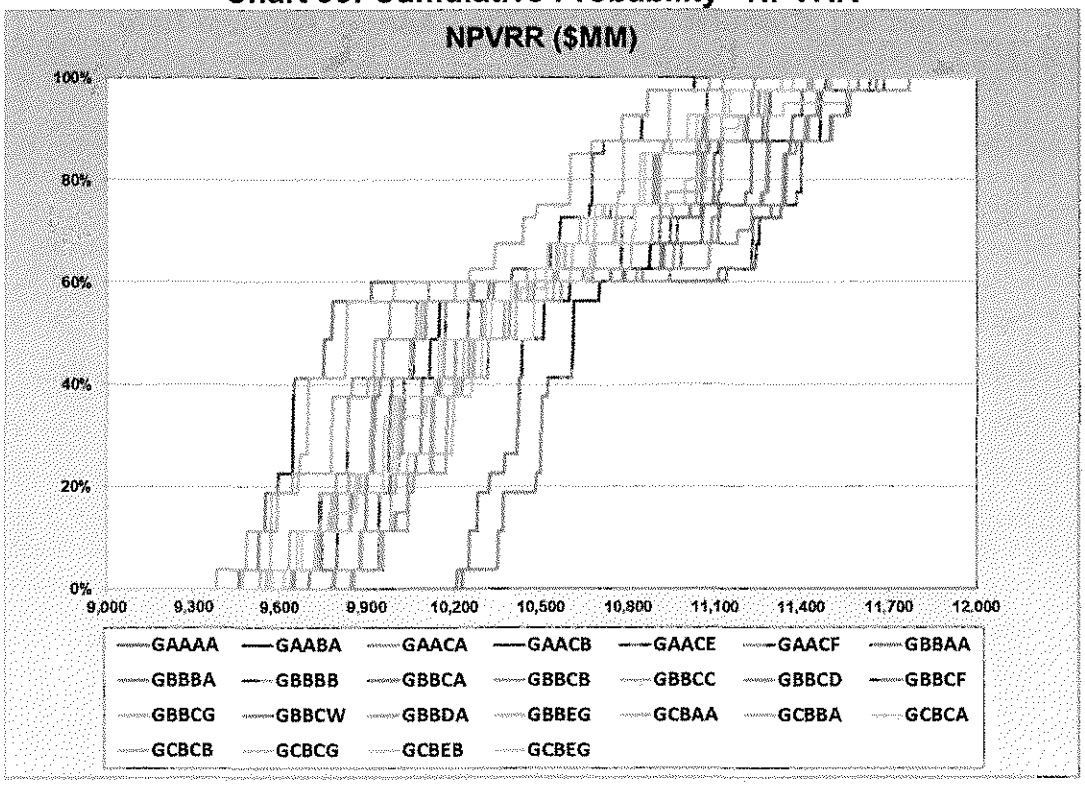


Chart 94: Cumulative Probability - PEC

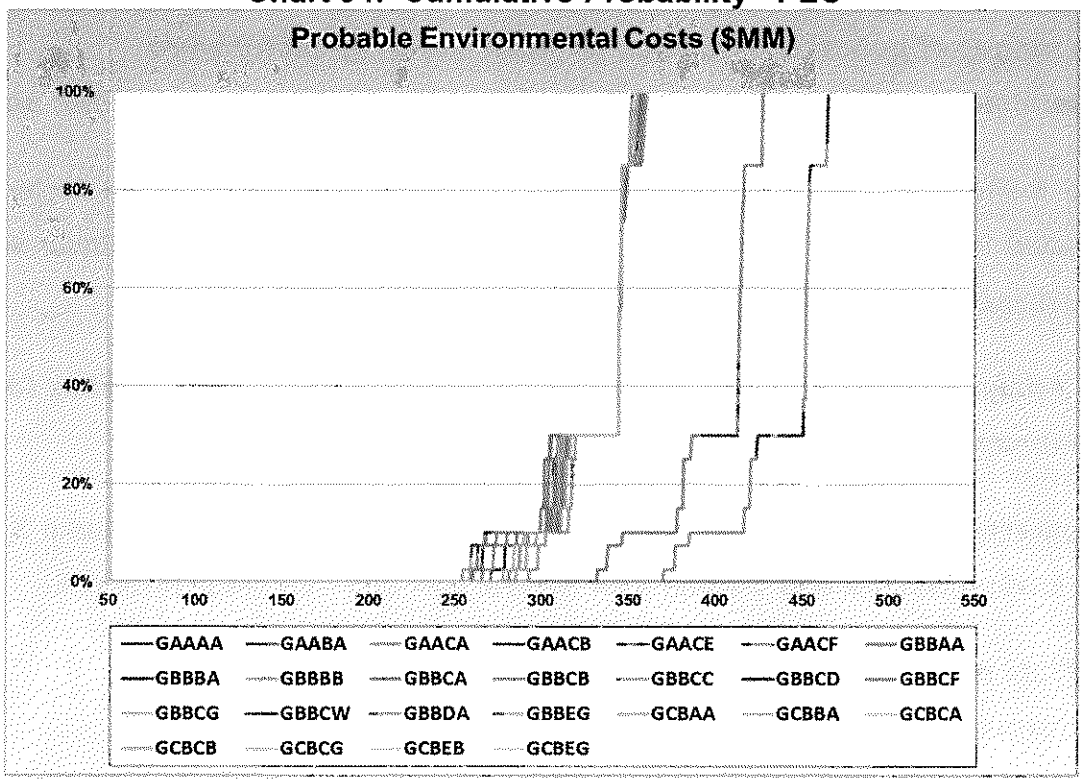


Chart 95: Cumulative Probability - Annual Average Rate

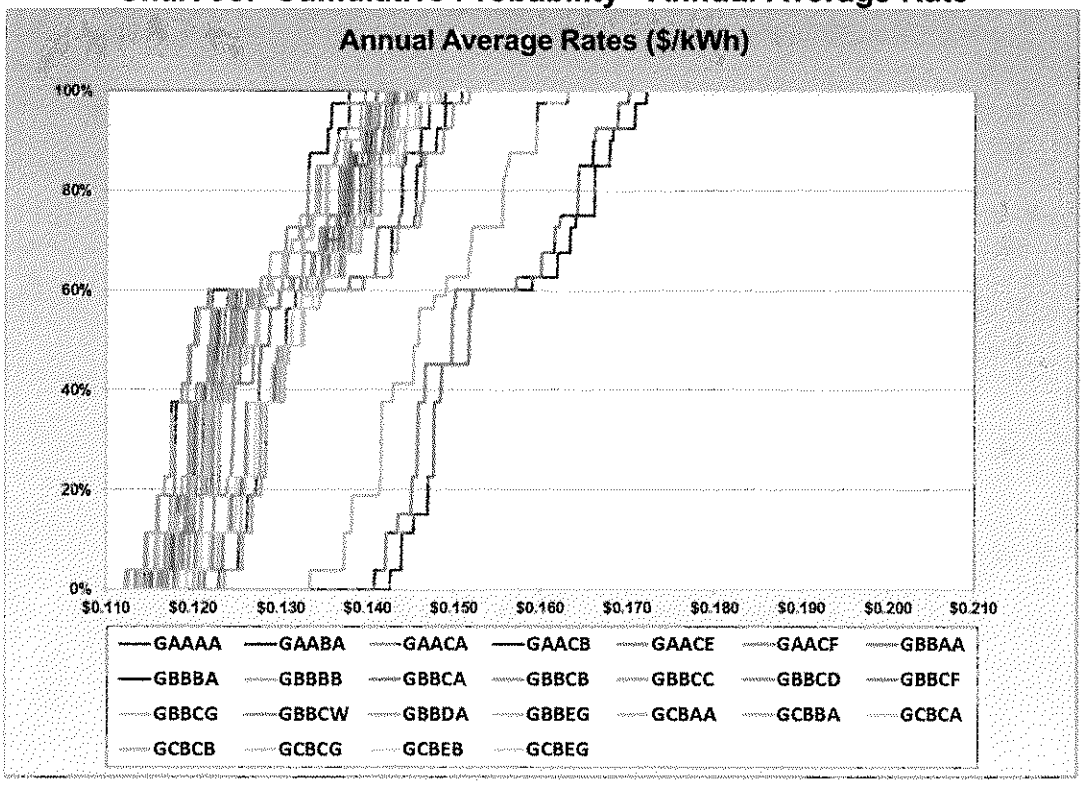
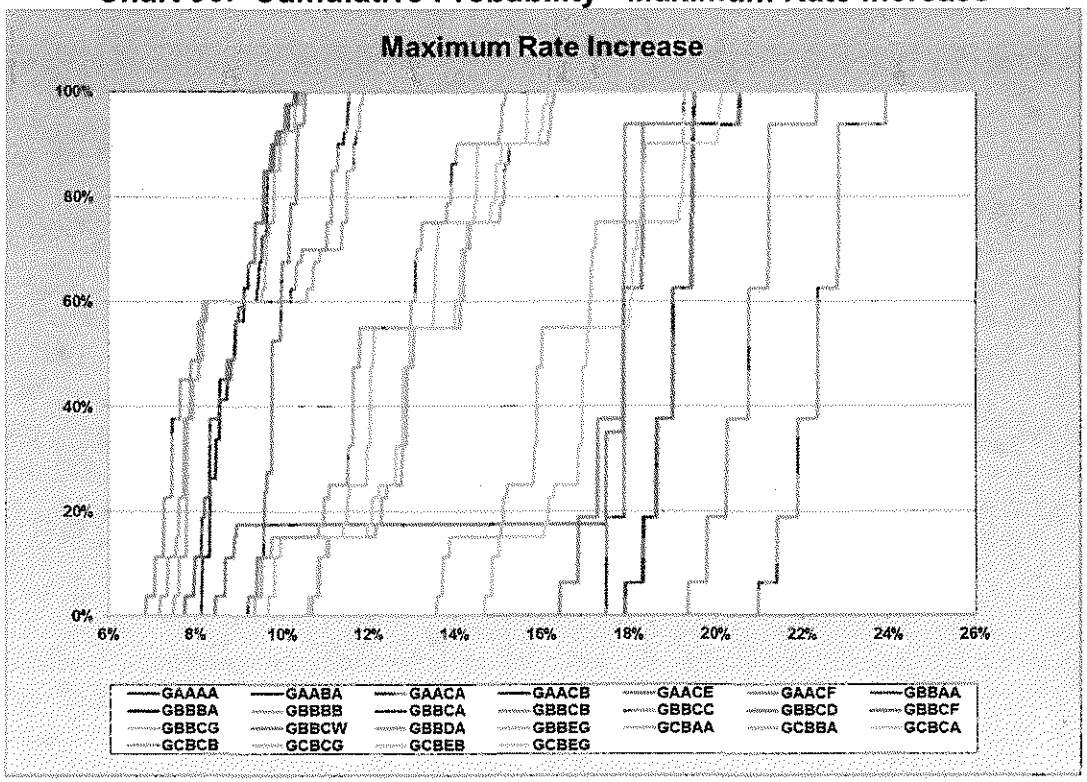


Chart 96: Cumulative Probability - Maximum Rate Increase



Values for all other performance measures do not vary enough over the range of scenarios to allow for graphical display.

3. For each performance measure, a table that shows the expected value and the risk of each alternative resource plan; and

Table 95: Expected Value Plan Performance Measures ** Highly Confidential **

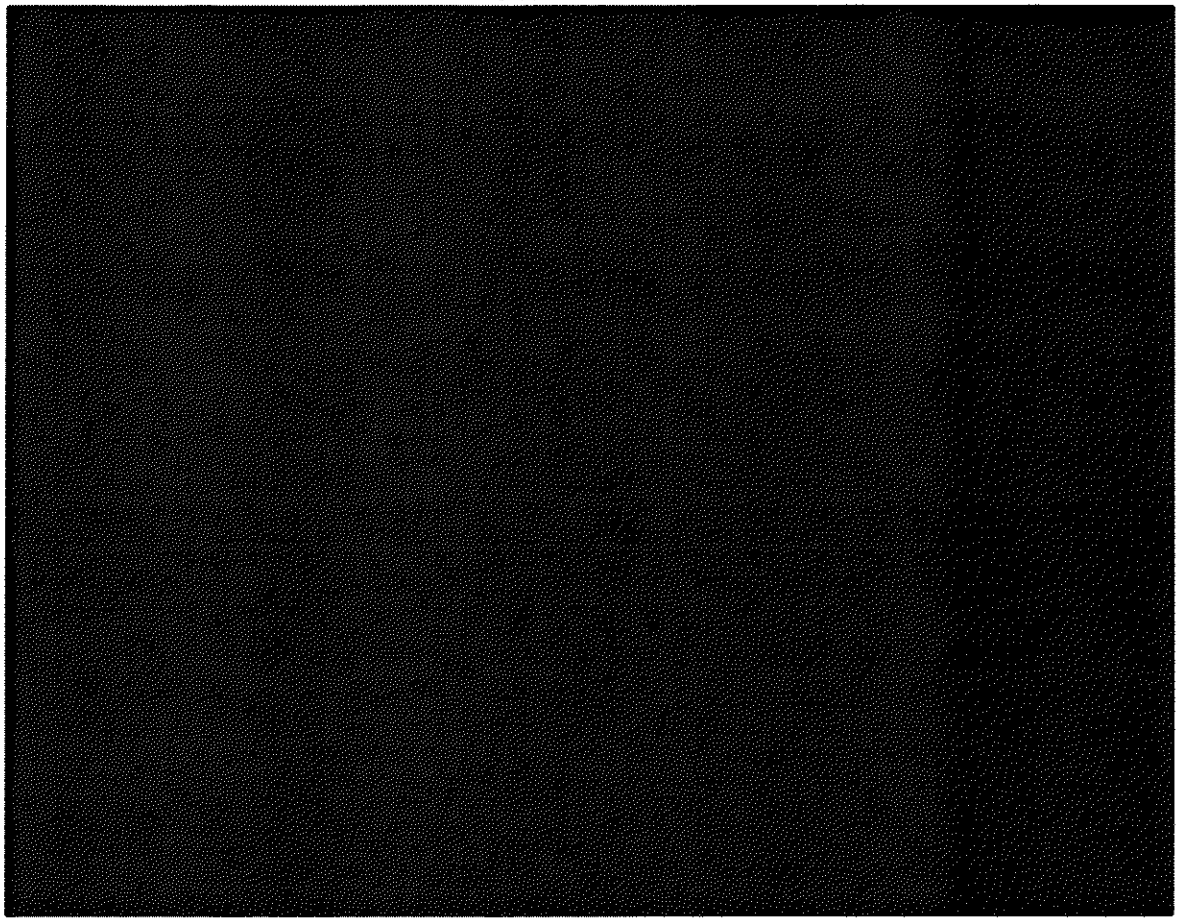


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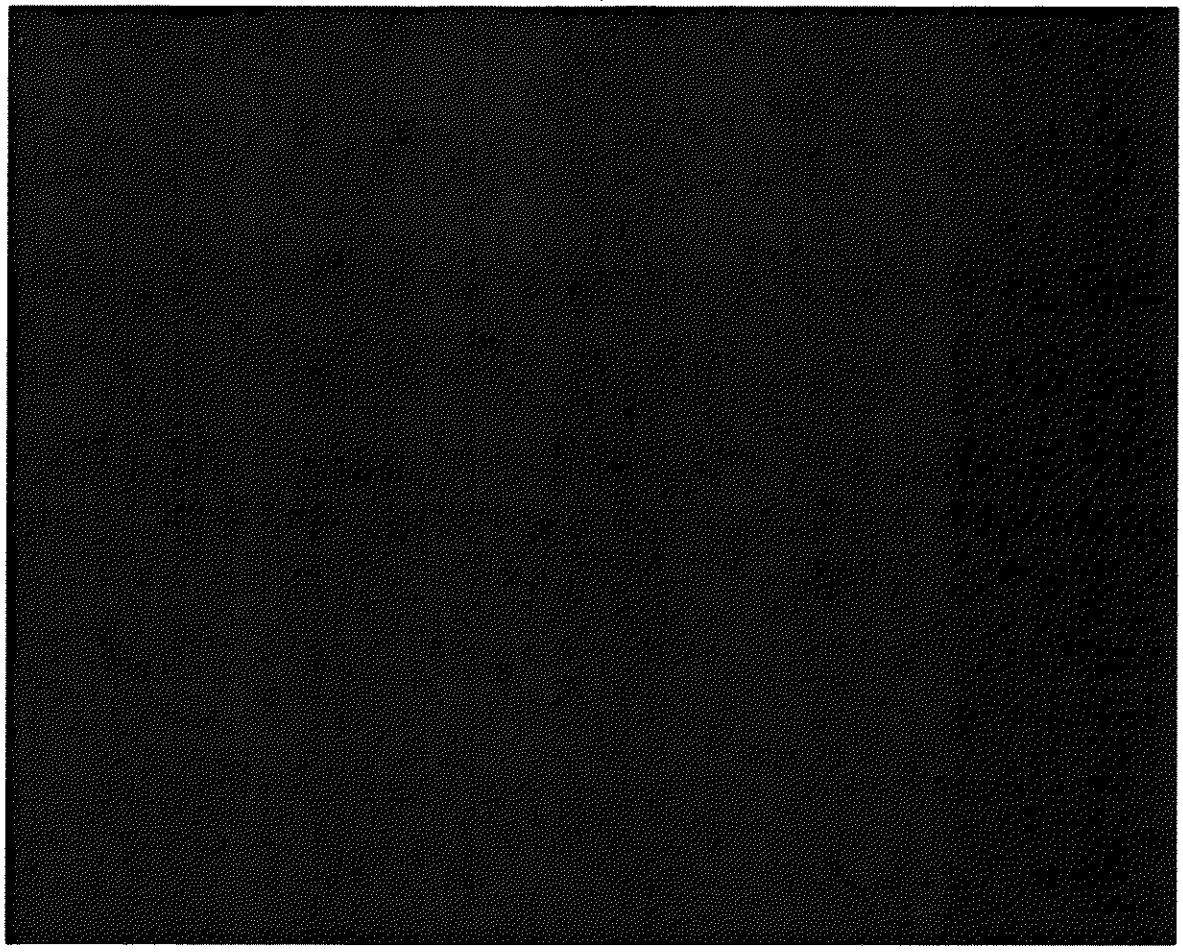
Table 96: Standard Deviation Plan performance Measures ** Highly Confidential **



Note: Several performance measures are not affected by the individual scenario risk and therefore exhibits no standard deviation.

4. A plot of the expected level of annual unserved hours for each alternative resource plan over the planning horizon.

There was no unserved energy in any of the alternative resource plans.

HC