PUBLIC DISCLOSURE

Georgia Power

Battery Storage Cost-Benefit Analysis

2022 Integrated Resource Plan

Overview

Georgia Power Company ("GPC" or the "Company") routinely evaluates forecasted conditions and technology advancements to identify opportunities that can provide customers with clean, safe, reliable, and affordable energy from a diverse fleet of generation resources. As a component of this planning process, the Company quantified numerous benefits that battery energy storage systems ("BESS") can provide customers. These benefits include production cost savings, capacity deferral value, and flexibility value. Overall, BESS technology can provide customers with significant benefits that are forecasted to increase as renewable penetration increases on the system.

The Company compared these benefits to the expected costs of a representative new stand-alone[1] 300 MW / 600 MWh BESS. This economic assessment aligns with the Company's expectations of the benefits that will be provided by the McGrau Ford Battery Facility discussed in the 2022 IRP Main Document. For the 2022 integrated resource plan ("IRP"), the Company is presenting the results of this cost benefit- analysis, which clearly demonstrate that appropriately adding stand-alone battery storage resources are in the best interest of customers, as shown in Table 1.

Table 1. BESS Cost/Benefit Results

NPVRR[2] (M$)	Result
MG0	REDACTED
MG20	REDACTED
$50	REDACTED
LG0	REDACTED
LG20	REDACTED
HG0	REDACTED
HG20	REDACTED

[1] This evaluation does not assume the BESS is directly connected to a renewable resource. Therefore, this cost-benefit analysis assumes a stand-alone BESS.
[2] Net Present Value including Revenue Requirements, 2027$

Chapter 1: BESS Value Streams

The Company considered the value streams as identified below for this cost benefit analysis. As the energy landscape continues to evolve and additional information becomes available, the Company will continue to complete these types of assessments, and consider additional value streams, to ensure it appropriately considers resource additions in the best interest of customers.

Flexibility Benefit

This value represents the production cost savings associated with operating reserves that are not captured in weather-normal or hourly integrated modeling. Flexible resources can quickly and efficiently provide this benefit to the system. This benefit is influenced by the amount of renewables on the system and is described in Chapter 5 of the 2022 IRP Main Document and in the Renewable Integration Study located in Technical Appendix Volume 1. This benefit is primarily provided by reducing the cost of uncertainty on system operations. As penetration levels of weather-dependent resources increase, less flexible resources, or resources that cannot start and stop quickly[3], require significant fuel cost to mitigate intermittency, weather impacts, forced outages, or general unpredictable system conditions. Battery storage resources are flexible and can start and stop quickly. They can also act as a load or generator depending on the state of charge. Therefore, system operators can utilize battery storage resources to mitigate these events and avoid the need to incur significant fuel costs. The flexibility benefit was determined using stochastic modeling, which is necessary because deterministic (or weather-normal) modeling does not fully represent uncertainty and associated reliability impacts.

Deferred Generation Capacity Benefit or Capacity Value

Deferred Generation Capacity Benefit, sometimes referred to as Capacity Value or Resource Adequacy Benefit, represents the amount of generation capacity that can be deferred or avoided by the addition of a battery storage resource. The amount of generation capacity deferred or avoided is dependent on the capacity equivalence of the battery resource. The value of generation deferral is based on the capacity needs of the Company.

[3] Coal units frequently have 24-hour startup times and 168-hour minimum up times. Therefore, coal units are commonly committed to provide operating reserves requiring they run at minimums, incurring fuel costs, because they cannot start quick enough to manage uncertainty otherwise.

Production Cost Savings

Production cost savings can be provided by a BESS. These resources both consume energy (“charging”) and deliver energy (“discharging”) in order to optimize system commitment and dispatch and provide production costs savings for customers. Generally, production costs savings can be attributed to the battery’s ability to provide energy arbitrage services and operating reserve services. A BESS can charge when energy prices are low and discharge when energy prices are high. The objective is to minimize total system production costs by improving the efficiency of the system.

Operating reserves are the required amount of capacity either online or on standby and able to quickly respond to unplanned changes in system conditions. Operating reserves are commonly referred to as spinning and non-spinning reserves. Spinning reserves represent online generation able to increase output quickly in response to unplanned events. Non-spinning reserves represent the amount of capacity that are not online but able to come online quickly, typically within 10 minutes or less[4], to manage uncertainty and serve load reliably. Based on its level of charge, BESS can efficiently provide multiple services, such as operating reserves, with the ability to start and stop quickly (near instantaneously) depending on its available energy capacity (MWh). Additionally, production cost savings can be attained by the ability to dispatch available energy without the fuel costs associated with running at a minimum capacity or loading levels as commonly required by conventional generators, which must idle for extended periods to support grid operations. The energy and operating costs required to maintain a BESS at idle is expected to be lower than that of maintaining a conventional thermal generator at a minimum load while serving as spinning reserve.

[4] Per NERC Reliability Standard BAL-002-3 Disturbance Control Standard – Contingency Reserve for Recovery from a Balancing Contingency Event. Per NERC Glossary of Terms definition of Contingency Event Recovery Period as “A period that begins at the time that the resource output begins to decline within the first one-minute interval of a Reportable Balancing Contingency Event and extends for fifteen minutes thereafter”.

Chapter 2: BESS Cost Streams

In-Service Capital Costs

Installation capital costs include site, engineering, procurement, construction, and ownership costs.

Fixed Operating & Maintenance (“Fixed O&M”) Costs

Fixed O&M cost includes, but is not limited to, plant personnel salaries and benefits, payroll taxes, property insurance, home office and management support.

Variable Operating & Maintenance (“Variable O&M”) Costs

Variable O&M cost includes, but is not limited to, the costs required to mitigate battery degradation due to cycling over time.

Capital for Maintenance

Maintenance capital costs are the projected capital expenditures necessary to maintain reliable operation. These costs are based on, but are not limited to, new equipment parts from scheduled major maintenance, usually as specified in service agreements, working capital, and the augmentation required to mitigate battery calendar degradation.

Chapter 3: Analysis Assumptions & Methodology

Study Period and Useful Life

This evaluation assumes a BESS in-service date of January 1, 2027, and a useful life of 20 years.

Scenarios

The Company considers multiple views of the future price of natural gas, future pressure on the Company's CO_2 emissions, future cost and performance of generating technologies, and future electricity consumption. For B2022, the Company assembled these multiple views of those four areas into eleven scenarios. For more information on the scenarios, please see Chapter 7 in the 2022 IRP Main Document. The Company's studies were completed on seven scenarios, shown in Table 2, which focuses on the low, moderate, and high price of natural gas along with \$0/ton, \$20/ton, and \$50/ton carbon price scenarios. This set of scenarios provides a wide range of economic signals that sufficiently inform economic decisions.

Table 2. Natural Gas and Carbon Price Scenarios

Scenario	Natural Gas View	Greenhouse Gas Pressure View	Short Name
1	Moderate Price Path	\$0 fee	MG0
2	Moderate Price Path	\$20+ fee	MG20
3	\$50 CO_2 Price Path	\$50+ fee	\$50
4	Lower Price Path	\$0 fee	LG0
5	Lower Price Path	\$20+ fee	LG20
6	Higher Price Path	\$0 fee	HG0
7	Higher Price Path	\$20+ fee	HG20

Financial Assumptions

The financial assumptions used in this evaluation are summarized in Table 3.

Table 3. Financial Assumptions used in Evaluation

Capital Escalation	O&M Escalation	Discount Rate
REDACTED	REDACTED	REDACTED

Battery Storage Cost & Performance Assumptions

For each planning scenario, the BESS is evaluated using the McGrau Ford 2-hr BESS quote cost and performance characteristics shown in Table 4.

Table 4. McGrau Ford 2-hr BESS Quote Performance Characteristics

Capacity (MW)	Duration (Hours)	Service Life (Years)	Round-Trip Efficiency	In-Service Capital ($/kW-yr 2027$)	Maintenance Capital ($/kW-yr 2027$)	Fixed O&M ($/kW-yr 2027$)	Variable O&M ($/MWh 2027$)
300	2	20	REDACTED	REDACTED	REDACTED	REDACTED	REDACTED

Flexibility Benefit

For this analysis, the Company assumed that the amount of renewables is likely to increase over time. Therefore, the Company evaluated a range of flexibility benefit to account for varying levels of renewable (or solar) penetration. While the Company plans to add another 6,000 MW of renewables by 2035 in addition to what the Company has been previously authorized, the Company's specific request in the 2022 IRP is 2,300 MW of renewables.

Utilizing the regression line yielded from the static data points in the flexibility study, a range of flexibility benefits for discreet levels of anticipated Georgia Power solar penetration were assumed, as shown in Table 5.

Table 5. Flex Benefit

Year	Assumed GPC Solar (MW)	Flex Benefit[5] ($/kW-yr Nominal $)
2027	4,695	$1.64
2028	5,445	$3.50
2029	6,195	$5.61
2030	6,945	$7.97
2031	7,695	$10.58
2032	8,445	$13.45
2033	9,193	$16.57
2034	9,917	$19.83
2035-2046	10,565	$22.94

Capacity Benefit

Capacity benefit is applied using 90% capacity equivalence of the battery's rated capacity at the ECC of a CT ($/kW-year) beginning in 2029, the Company's year of need.

Production Cost Savings

Production cost savings are determined by conducting two production cost evaluations in Aurora for the duration of the study period. The model will choose the most economical way to utilize the battery each hour, either by allowing it to provide energy arbitrage or operating reserve services.

The first production cost evaluation (i.e., the base case) is conducted without any changes to the model. The second production cost evaluation (i.e., the change case) is conducted after inserting a 300 MW 2-hr BESS. The production cost difference between the base case and change case is used as the production cost savings benefit.

[5] These results are consistent with the Company's Renewable Integration Study. Changes in gas prices, carbon costs or constraints, or system mix could impact these results. For this analysis, the Company only considered the results provided in the Renewable Integration Study, but larger benefits may be possible.

Chapter 4: Asset Valuation Results

The asset valuation results, calculated as the sum of the battery's total costs and benefits, are presented in Table 6 and Figures 1 and 2. Current results show that the battery is a cost-effective proposal for the Company's customers in all scenarios.

Table 6. Net Benefit for Each Scenario

NPV 2027 M$			
LG0	MG0	HG0	
REDACTED	**REDACTED**	**REDACTED**	
LG20	MG20	HG20	$50
REDACTED	**REDACTED**	**REDACTED**	**REDACTED**

REDACTED

Figure 1. Cumulative NPV Cost Benefit for the MG0 Scenario

REDACTED

Figure 2. Summary of Costs and Benefits for the MG0 Scenario

Key Observations

The current results demonstrate that BESS is a cost-effective resource addition. This BESS cost benefit analysis is indicative of the McGrau Ford 2-hr BESS being added to the Southern Company electric system based on the system's projected B2022 resource plan. These currently quantified BESS benefits will evolve as the Southern Company electric system's resource mix changes, and consistent with normal IRP processes, these analyses will continue to be updated with the best available information as procurement activities continue.

1. BESS are likely to provide net benefits to customers assuming current expected technology costs.
2. Traditional benefits, capacity value and energy arbitrage benefit, do not sufficiently account for all the positive economics of BESS on the system.
3. Providing critical grid reliability services, such as operating reserves and/or flexible capacity, are key benefits for BESS that reduce system production costs.
4. BESS cost declines, tax incentives, or similar changes are likely to improve economics.
5. BESS benefits are likely to increase with solar penetration.
6. BESS benefits are likely to increase with carbon pressure.