BEFORE THE STATE OF GEORGIA

PUBLIC SERVICE COMMISSION

IN RE:	
GEORGIA POWER COMPANY'S 2022 INTEGRATED RESOURCE PLAN	
AND	**Docket No. 44160**
GEORGIA POWER COMPANY'S APPLICATION FOR THE CERTIFICATION, DECERTIFICATION, AND AMENDED DEMAND-SIDE MANAGEMENT PLAN	**Docket No. 44161**

Direct Testimony of

Tyler Fitch

On Behalf of

Sierra Club

May 4, 2022

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I. INTRODUCTION AND QUALIFICATIONS

Q1. Please state your name, organization, and position.

A1. My name is Tyler Fitch. I am a Senior Associate with Synapse Energy Economics, Incorporated ("Synapse").

Q2. Please describe Synapse Energy Economics.

A2. Synapse is a research and consulting firm specializing in energy and environmental issues, including transportation electrification, electric generation, transmission and distribution system reliability, ratemaking and rate design, electric industry restructuring and market power, wholesale electricity markets, stranded costs, efficiency, renewable energy, environmental quality, and nuclear power. Synapse's clients include state consumer advocates, public utilities commission staff, attorneys general, state energy offices, environmental organizations, federal government agencies, and utilities.

Q3. Summarize your work experience and educational background.

A3. At Synapse, I conduct analysis and contribute to testimony and publications that focus on variety of issues relating to the electricity system, including: integrated resource planning; ratemaking and rate design; system resilience; plant economics in organized energy markets; and electric vehicle (EV) market formation.

Much of my work is informed by modeling analyses of the electricity system. These may include spreadsheet- or Python-based analysis, or analysis using industry-standard electricity system models, such as EnCompass or the National Renewable Energy Laboratory's System Advisor Model.

Before joining Synapse, I worked at Vote Solar, where I led regulatory intervention on rate design, valuation of distributed energy resources, and resource planning in the Southeast. In my capacity as regulatory director at Vote Solar, I provided expert testimony to public utilities commissions in Virginia, North Carolina, South Carolina, and Georgia. I hold a Master of Science from the University of Michigan and a Bachelor of Science in Environmental Sciences from the University of North Carolina at Chapel Hill. I provide a copy of my current resume, attached as Exhibit TF-1.

Q4. On whose behalf are you testifying in this case?

A4. I am testifying on behalf of the Sierra Club.

Q4. Have you testified previously before the Georgia Public Service Commission?

A4. Yes. I previously testified in Georgia Power Company's ("GPC," "Georgia Power," or the "Company") 2019 Base Rate Case, Docket # 42516.

Q5. Please provide an overview of your testimony in this proceeding.

A5. I evaluate Georgia Power Company's 2022 Integrated Resource Plan ("IRP," or "Plan") to determine whether the Company's evaluation of available resources is aligned with industry best practices. I also evaluate whether the resource pathway proposed by the Plan will ultimately meet Georgia ratepayers' energy needs as economically and reliably as possible. To assist in my evaluation of the Company's proposals, I present the results of a capacity expansion analysis on an alternative resource portfolio that can meet the Company's needs more economically and reliably.

Q6. How is your testimony structured?

A6. Section 2 briefly summarizes my findings and recommendations for the Commission.

In Section 3, I provide a brief overview of the Company's proposed IRP, its supporting analyses, and its contemplated investments.

In Section 4, I introduce the industry-standard EnCompass power system modeling software that I used in this proceeding to conduct independent modeling. I then present an overview of the modeling approach that I applied to this analysis.

In Section 5, I summarize the results of the Synapse EnCompass independent modeling analysis that evaluated an alternative resource portfolio to the one proposed by the Company in its IRP. I describe the results of that analysis, and contrast its results with the Company's proposed IRP. I conclude with a set of recommendations for the Commission based on the results of my analysis.

Q7. What documents and materials inform your evaluation of Georgia Power's 2022 IRP?

A7. I have reviewed the materials submitted as part of Georgia Power's 2022 IRP and the Company's workpapers supporting those filings. I have also reviewed Georgia Power's responses to discovery filed by Commission staff, plans of peer utilities, recent relevant events and issues, and industry and research publications.

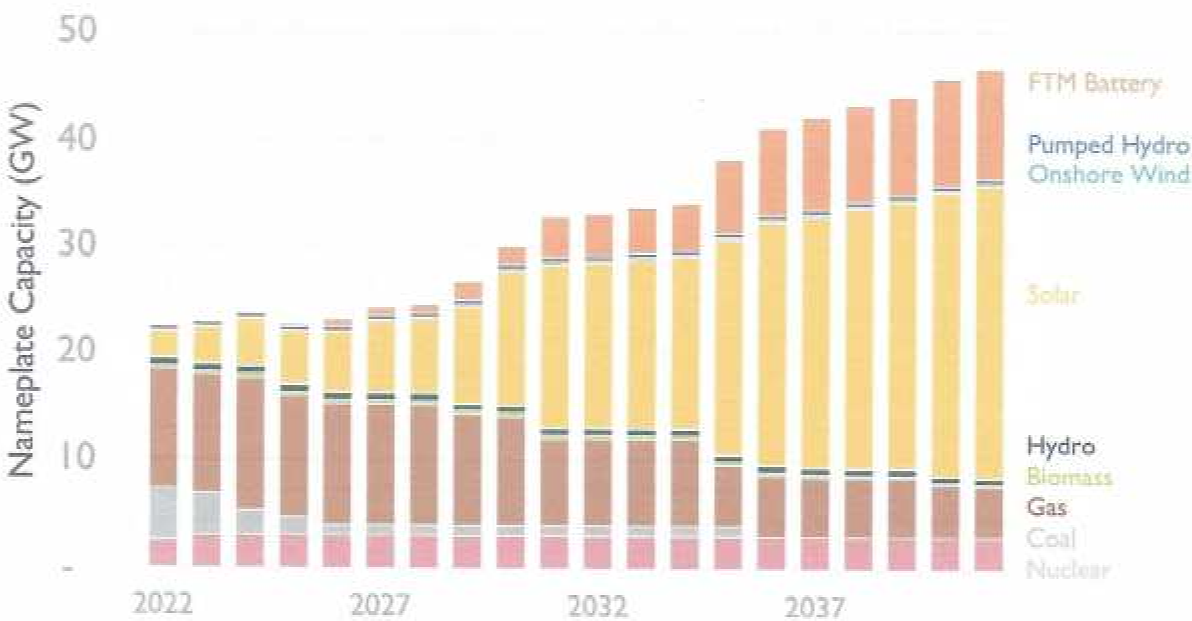
II. FINDINGS AND RECOMMENDATIONS

Q8. Please summarize your findings, based on your review of Georgia Power's 2022 IRP.

A8. Based on my review of Georgia Power's IRP and my own independent analysis, I find the following:

1. The resources proposed by Georgia Power in its IRP do not represent the most cost-effective pathway for Georgia ratepayers. I develop an alternative scenario using the industry-standard EnCompass electricity system model and identify a resource pathway that meets Georgia Power ratepayers' energy needs more cost-effectively than the Company's IRP, while meeting reliability requirements and avoiding incremental risk caused by additional gas investments. Figure 1 shows the Georgia Power system's total capacity over time by resource, according to the *Synapse Optimization* scenario developed in this analysis.

Figure 1. Synapse Optimization Capacity over Time



2. The *Synapse Optimization* scenario delivers service at a lower cost compared to the resources proposed in Georgia Powers's proposed Plan. This resource pathway is projected to save Georgia Power ratepayers [redacted] on a net present revenue requirement ("NPVRR") basis over the planning period, compared to a simulation of Georgia Power's proposed Plan. A summary of key results of my analysis is provided below in Table 1.

Table 1. Key Results, Georgia Power Proposal vs. Synapse Optimization

	Georgia Power Proposal	Synapse Optimization
NPV (2022-2041)	[redacted]	$52.6
2041 Emissions (million tons)	[redacted]	5.4
Incremental Gas Investment (MW)	[redacted]	0
Incremental Solar Investment (MW)	[redacted]	23,120
Incremental Storage Investment (MW)	[redacted]	10,000

Q9. Please summarize your recommendations for the Commission.

A9. To ensure that Georgia Power delivers affordable, reliable power for Georgia ratepayers, I recommend that the Commission take the following actions:

1. Double the Company's renewable energy and energy storage targets and immediately expand the Company's renewable energy and energy storage procurements, including the development of a firm timeline for energy storage procurement; and
2. Decline to authorize the Dahlberg 1, 3, and 5 power purchase agreement ("PPA") at this time.

Further, I recommend that the Commission direct the Company to take the following actions regarding its 2022 IRP:

1. Use capacity expansion planning and economic optimization to develop the proposed resources on future IRPs based on industry-standard analytical methods like effective load carrying capability ("ELCC"), as opposed to the proposed IRP's current use of AURORA as a high-level and long-term planning tool only;
2. Consider multiple energy efficiency and demand-side management (DSM) cases in resource planning;
3. Prepare to retire Plant Scherer Unit 3 and Plant McManus as early as is practicable; and
4. Prepare to retire the Company's remaining coal fleet, including working to retire Plant Scherer Units 1 and 2 by 2028 and using a no-regrets approach to the retirement of Plant Bowen through the North Georgia Reliability Plan.

I provide full recommendations at the conclusion of my testimony.

III. BACKGROUND ON GEORGIA POWER RESOURCE PLANNING AND MODELING APPROACH

Q10. Please briefly summarize the IRP proposed by the Company in this proceeding.

A10. In accordance with Georgia's utility planning rules, Georgia Power is required to demonstrate that its proposed investments would be the most economical and reliable means of meeting its customers' energy needs. As a result, Georgia Power's IRP should contain studies that provide the technical and economic details necessary for resource planning, including the analytical aspects outlined below:

- Load forecasts, demand and reserve margin requirements for the 2022-20241 planning period.
- Characterizations of available resources according to economic, transmission, environmental, and reliability requirements; and
- Use of economic planning software to develop a least-cost resource pathway for meeting ratepayers' needs

As a result of these analysis the Company proposes several actions for approval by the Commission, including the following:

- Retirement dates of legacy coal and gas units, including Plant Bowen Units, Plant Wansley, Plant Gaston, and Plant Scherer Unit 3;
- Procurement of six power purchase agreements with total capacity 2,356 megawatts ("MW") for existing gas-fired generation;
- A deployment target of 6,000 MW of renewable generation by 2035 and the extension of several renewable development programs;
- Pilot projects for the Tall Wind demonstration project and an Integrated Hydrogen Microgrid Pilot; and
- A deployment target of 1,000 MW of storage capacity by 2030.

Q11. What are capacity expansion models and why are they critical to resource planning?

A11. Capacity expansion models like EnCompass use an articulated model of the energy system and an economic optimization algorithm to identify the best pathway for resource deployment, retirement and dispatch that meets all policy and reliability requirements at the least cost. The software allows utility planners to develop economically optimal, objective determinations of the least-cost way to meet ratepayer needs. Capacity expansion models are a hallmark of integrated resource planning processes across the country.[1]

Q12. Please describe the capacity expansion modeling included in the Company's 2022 IRP and summarize any concerns you have with its applicability to this proceeding.

A12. The Company includes the Southern Company Resource Mix Study (the "Resource Mix Study" or the "Study") as a part of its 2022 IRP filing. The Resource Mix Study uses the AURORA production cost model to generate high-level resource "roadmaps" for the Southern Company system as a whole.[2] However, I find that the Study's assumptions and modeling configuration substantially compromise its ability to provide insight in this proceeding. I identify the following concerns with the Study:

- The Resource Mix Study treats the entire Southern Company system as a unified area, without differentiating individual retail companies.[3] The Resource Mix Study does not appear to differentiate load, resources, reserve margin requirements, or transmission capabilities between the retail service territories. As a result, the Resource Mix Study's algorithm optimizes for least-cost across the Southern Company footprint, rather than Georgia Power specifically.
- Rather than identifying the most cost-effective resources for each individual service area based on its unique set of resources and requirements, the Resource Mix Study uses a relatively simple method of allocating actual resources deployed across retail companies.[4] The Company's method of allocation across retail companies occurs outside of AURORA's cost optimization, and the Company only provided Georgia Power resource allocations for one sensitivity in its IRP filing.
- The Resource Mix Study adds resources in abstract 300-MW "blocks," rather than in individual units. This results in resource deployments that are not implementable as modeled because of mismatches between the size of resource additions projected by the Resource Mix Study and the megawatt capacity of actual units. I further characterize the impact of the Study's 300-MW approach later in this testimony.

[1] Mai, T. et al. (2015, April). Implications of Model Structure and Detail for Utility Planning: Scenario Case Studies using the Resource Planning Tool. *National Renewable Energy Laboratory*. Retrieved at: https://www.nrel.gov/docs/fy15osti/63972.pdf.
[2] IRP Main Document, p. 10-63.
[3] Company Response to STF-JKA Data Request 2-18.
[4] *Ibid.*

- Investments proposed by the Company are "fixed" inputs in the Resource Mix Study, rather than selected by the Study as the most cost-effective set of resources.[5] While some resources should be "fixed" to reflect the reality of construction timelines, "fixing" resources further out in the IRP's planning period limits the Study's ability to select economically optimal resources or validate proposals made in the IRPs.

Combined, these issues render the Resource Mix Study's results too vague to provide insight into the Company's future resource planning and severely limit the Study's analytical value for validating the proposals made in the Company's IRP.

Q13. Do you have any recommendations to the Commission as a result of your review of the Company's Plan and economic analysis?

A13. The Company should use capacity expansion modeling in future proceedings that (a) is appropriately scoped and maximizes cost-effectiveness for Georgia Power, specifically; (b) uses actual generation units as the unit of allocation rather than abstract capacity "blocks," and (c) is used as an input into the Company's proposals, rather than as a long-term analysis that assumes that investments are accepted as proposed. I conducted capacity expansion modeling, described in the following sections, that implements this approach.

IV. OVERVIEW OF SYNAPSE'S MODELING APPROACH

Q14. Please introduce the modeling software you used to conduct energy system analysis for the purposes of your testimony.

A14. I and my team at Synapse used the EnCompass software, which is developed by Georgia-based Anchor Power Solutions. EnCompass is an integrated power system analysis tool that enables capacity planning and operations analysis at multiple spatial and temporal time scales. As a power system planning tool, EnCompass can handle a broad array of analyses, including:

- Hourly or sub-hourly production cost modeling, unit commitment, and economic dispatch;
- Market simulation and risk analysis, including stochastic and Monte Carlo approaches;
- Long-term integrated resource planning, including capacity expansion modeling; and
- Market forecasting for energy prices, ancillary services, capacity and reserves, and environmental program compliance.

[5] Georgia Power 2022 Integrated Resource Plan Technical Appendix ("IRP Technical Appendix") Volume 1, Southern Company Resource Mix Study, p. 6.

Synapse utilizes the EnCompass National Database, which is created and managed by Horizons Energy, as the starting point for our analysis. This database provides a comprehensive set of model inputs that Horizons Energy benchmarks against historical data across the United States.

Q15. Is EnCompass a widely adopted tool in the electric utility industry?

A15. Yes. Synapse was an early adopter of the EnCompass tool, and over the past few years several utilities have adopted the tool for their own resource planning processes. Here are a few examples of large utilities adopting EnCompass as their primary resource planning tool:[6]

- The Michigan Public Service Commission directed DTE Energy to convene stakeholders for a two-day technical conference to identify, evaluate, and select new IRP modeling software. DTE Energy eventually chose EnCompass, citing its transparency, analytical capability, and usability.
- Minnesota investor-owned utilities conducted an open model evaluation process to select IRP modeling software in 2018, and all four chose EnCompass as their modeling software of choice.
- Duke Energy Carolinas and Duke Energy Progress announced their transition to EnCompass in their 2020 Integrated Resource Plan filings.
- Xcel Energy uses the tool across its utilities in Minnesota, Colorado, New Mexico and Texas.
- Public Utility Company of New Mexico (PNM) transitioned to EnCompass several years ago.

A. Synapse Calibrated the EnCompass analysis using inputs from the Company's IRP.

Q16. How is the EnCompass analysis organized?

A16. My EnCompass analysis compares two scenarios:

- ***Georgia Power Proposal*:** The first scenario fixes all Georgia Power resource additions through 2041 as proposed in the Company's IRP and the Southern Company Resource Mix Study.[7] I also use operational and cost inputs directly from the Company's IRP. This scenario effectively "simulates" the Georgia Power IRP proposal, so that an apples-to-apples comparison can be made.

[6] *See* Anchor Power website: anchor-power.com

[7] Georgia Power IRP Technical Appendix Volume 1 – Southern Company Resource Mix Study.

- *Synapse Optimization*: In this scenario, I allowed the model's economic optimization algorithm to dynamically select future resource additions and economically retire existing resources to generate a least-cost resource portfolio that meets all reliability requirements. I also revised or updated several of the inputs from the *Georgia Power Proposal* scenario specifically to restrict incremental gas additions, deploy additional cost-effective energy efficiency, and update renewable resource cost and operational assumptions. I describe the model revisions used in the *Synapse Optimization* scenario in detail later in this section.

I designed the *Georgia Power Proposal* scenario to mimic the actual decisions proposed by the Company in its 2022 IRP. The results of this scenario provide a cost, deployment, and emissions baseline from which I could compare results from alternative scenarios. In the *Synapse Optimization* scenario, by contrast, I allowed the model to select an economically optimal outcome using an updated set of input assumptions.

Q17. Please detail the input assumptions used in the Synapse analysis that were taken from the Georgia Power 2022 IRP and the Resource Mix Study.

A17. The EnCompass model integrates key inputs directly from the IRP and Resource Mix Study:

- **Hourly Demand Curve**: Imported directly from the Company's load forecast.[8]
- **Monthly and Annual Load Forecast**: Imported directly from the Company's load forecast.[9]
- **Reserve Margin Requirements**: 16.25 percent summer and 26 percent winter margin, as defined in the Company's Reserve Margin Study.[10] To best imitate actual conditions, the model also applied the 0.5 percent reserve margin reduction for 2022-2024 described in the IRP main document.[11]
- **Existing Resources**: Imported from "Attachment A. Planned and Committed Resources" of the IRP Main document.[12] To maintain consistency between the scenarios and analysis within the proposed IRP, both scenarios assume that Plant Vogtle Units 3 and 4 come online July 1, 2022 and April 1, 2023, respectively.[13]

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8 [redacted]
9 *Ibid.*
10 IRP Technical Appendix Volume 1, Reserve Margin Study, p. 13.
11 IRP Main Document, p. 1-2.
12 IRP Main Document, p. A-137 – A-146.
13 IRP Main Document, p. A-137, n 44.

- **Available Resources**: Operational and cost assumptions are identical to the economic specifications articulated in the Southern Company Resource Mix Study.[14]
- **Firm Capacity Ratings**: Southern Company Incremental Capacity Equivalence ("ICE") factors as identified in the Resource Mix Study.[15]
- **Solar Integration Costs**: Average integration cost used in the Company's "Illustrative Costs and Benefits of Utility Scale Tracking Solar in Georgia."[16]
- **Coal Prices**: Minemouth "Moderate" coal prices for [redacted] and [redacted] from the Southern Company Resource Mix Study.[17]
- **Gas Prices**: Natural gas cost "Moderate" projection from the Southern Company Resource Mix Study.[18]
- **Carbon Risk**: A carbon dioxide risk case of $20/ton starting in 2025, which is the low assumption used by Georgia Power for carbon risk in its IRP.[19]
- **Energy Efficiency Deployment and Costs**: "Proposed" case costs, measures, and load impacts directly from IRP DSM Program Documentation.[20]

Q18. How did Synapse's EnCompass analysis implement the Georgia Power service territory as an integrated part of the Southern Company System?

A18. Georgia Power is part of Southern Company's pooled dispatch system. Southern Company centrally coordinates economic dispatch and retail companies are effectively able to procure economic non-firm energy from their Southern Company neighbors. However, each retail company is responsible for procuring its own firm capacity to meet reserve margin requirements.[21] To ensure that existing resources could meet all capacity requirements of Georgia Power's load, this EnCompass analysis does not allow any firm capacity transactions between Southern Company retail companies, nor does it allow capacity or energy transactions between Georgia Power and neighboring systems.

To approximate Southern Company's pooled dispatch, this analysis includes a non-firm market purchase option for the Georgia Power system using an hourly SERC-Southeast market price

[14] *See:* IRP Technical Appendix Volume 1, Southern Company Resource Mix Study, p. 15.
[15] *Ibid.*
[16] IRP Technical Appendix Volume 3, 5 – Renewable Cost Benefit Framework, 3 – 2022 TS IRP Solar Analysis UT.
[17] IRP Technical Appendix Volume 1, Southern Company Resource Mix Study, p. 10-11
[18] *Ibid.* p. 9.
[19] IRP Main Document, p. 7-40.
[20] IRP Technical Appendix Volume 2 – DSM Program Documentation – 3 2022 IRP DSM Case Summary Data MG0
[21] *See:* IRP Main Document, Attachment G: Summary of the System Pooling System

forecast generated by the Horizons National Database. This purchase option is capped at 1 gigawatt ("GW") capacity,[22] does not count toward Georgia Power firm capacity requirements, and is not available during peak hours in either the winter or summer seasons.

Q19. Are there any major data inputs used in the *Georgia Power Proposal* scenario that were not provided by the Company?

A19. Yes. This analysis sets fixed operating and maintenance ("FO&M") and ongoing capital expenditure costs for the Company's existing coal resources using a study conducted by the engineering firm Sargent & Lundy for the US Energy Information Administration ("US EIA") and published in February 2020.[23] Given the sensitivity of coal unit economics to these costs, the Synapse team felt it was most appropriate to use a consistent, vetted, and empirically-based approach to projecting future costs for these units.

Q20. What specific steps did you take to mimic the resource additions and retirements contemplated in the Georgia Power 2022 IRP in the *Georgia Power Proposal* Scenario?

A20. Resource additions implemented in the EnCompass analysis are based on those approved in the Commission's 2019 IRP Order[24] and explicit proposed resources within the Company's 2022 IRP.[25] A specific list of proposed and planned resources within the *Georgia Power Proposal* scenario is shown in Table 2 below.

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[22] Transmission capacity between Southern Company retail companies was not apparent from available materials; The Southern Company system is treated as a single area in the Reserve Margin Study provided in the Company's filing.

[23] Sargent & Lundy (2018, May). Generating Unit Annual Capital and Life Extension Costs Analysis: Final Report on Modeling Aging-Related Capital and O&M Costs. Prepared for US EIA. Retrieved at: https://www.eia.gov/analysis/studies/powerplants/generationcost/pdf/full_report.pdf.

[24] *See:* IRP Main Document, Chapter 3

[25] *See:* IRP Main Document, p. 1-12 – 1-15.

Table 2. Planned Resource Additions, Georgia Power Proposal

Procurement	Name	Resource Type	Approved or Proposed?	Nominal Capacity (MW)	Operational Year (PPA length)
2022/2023 Utility Scale Renewable RFP	5 projects	Utility-scale solar	Approved	970	2023
--	Mossy Branch	Lithium-ion battery storage	Approved	65	2023
2023/2024 Utility Scale RFP	None given	Utility-scale solar	Approved	1,030	2024
2022-2028 Capacity RFP	None given	Biomass	Approved	60	2024
2022-2028 Capacity RFP	Harris Unit 2	Gas Combined-Cycle	Proposed	660	2024 (10 years)
2022-2028 Capacity RFP	Wansley Unit 7	Gas Combined-Cycle	Proposed	598	2024 (10 years)
2022-2028 Capacity RFP	Monroe Units 1 & 2	Gas Combustion Turbine	Proposed	309	2024 (15 years)
2022-2028 Capacity RFP	Dahlberg Units 2 & 6	Gas Combustion Turbine	Proposed	152	2025 (10 years)
2022-2028 Capacity RFP	Dahlberg Units 8 – 10	Gas Combustion Turbine	Proposed	228	2025 (10 years)
2025 Distributed Solar RFP	None given	Distributed solar	Proposed	200	2025*
--	McGrau Ford Battery Facility	Lithium-ion battery storage	Proposed	265	2026
2025 Utility Scale Renewable RFP	None given	Utility-scale solar	Proposed	1,050	2027*
2022-2028 Capacity RFP	Dahlberg Units 1, 3, 5	Gas Combustion Turbine	Proposed	228	2028 (10 years)
2025 Utility Scale Renewable RFP	None given	Utility-scale solar	Proposed	1,050	2029*

**: Operational date is approximated.*

Resources highlighted in green are identified as those approved in the Commission's 2019 IRP Order. Resources highlighted in blue are proposed in the 2022 IRP.

Unit retirement dates in the *Georgia Power Proposal* scenario reflect those proposed in the 2022 IRP. Planned unit retirements as proposed in the Company's IRP[26] and reflected in the EnCompass analysis are provided in Table 3 below.

[26] *Ibid.*

Table 3. Planned Resource Retirements, Georgia Power Proposal

Resource	Resource Type	Nominal Capacity (MW)	Retirement Year
Wansley Units 1–2	Coal	933	2022
Boulevard	Oil CT	14	2022
Wansley Unit 5A	Oil CT	32	2022
Bowen Units 1–2	Coal	1,432	2027
Gaston Units 1–4	Steam Turbine	460	2028
Gaston A	Oil CT	10	2028
Scherer Units 1–3	Coal	648	2028
Bowen Units 3–4	Coal	1,768	2035

Q21. How does the *Georgia Power Proposal* integrate the results of the Resource Mix Study?

A21. The *Georgia Power Proposal* scenario adapts results from the Resource Mix Study based on the resources allocated to the Georgia Power system under the mid- level gas forecast and low carbon risk forecast ("MG0").[27] While the EnCompass analysis includes consideration of carbon risk through Georgia Power's $20 per ton carbon price projection, the *Georgia Power Proposal* scenario uses resources allocations from "MG0" case because it was the only scenario for which Georgia Power-specific allocations were provided.[28] The "MG0" allocations were used only to specify the size and timing of resource deployment in the *Georgia Power Proposal* scenario, rather than any costs included in the modeling analysis. The Resource Mix Study's "MG20" scenario, which did integrate carbon risk, [redacted]

Implementing the Resource Mix Study allocations into EnCompass analysis presented some difficulty because the Resource Mix Study used 300-MW generic resource "blocks" rather than individual units, which were then allocated across the Southern Company retail operating companies.[30] For modular resources like solar and storage technologies, implementation of these "blocks" is relatively straightforward, but some adaptation was needed for conventional fossil resources where nameplate capacity for a single unit is frequently greater than 600 MW. [redacted]

[27] IRP Technical Appendix Volume 1 – Resource Mix Study – PD Capacity Expansion Plans.
[28] IRP Technical Appendix Volume 1, Southern Company Resource Mix Study, p. 16.
[29] [redacted]
[30] Georgia Power Company Response to Data Request STF-JKA-2-18.

shows adapted resource unit counts to approximate the Resource Mix Study deployment for fossil resources.[31]

Table 4.

	[redacted]		[redacted]		[redacted]	
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]				
[redacted]	[redacted]	[redacted]				
[redacted]	[redacted]	[redacted]				
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[redacted]			[redacted]	[redacted]	[redacted]	
[redacted]			[redacted]	[redacted]		
[redacted]			[redacted]			
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

The cumulative capacity implemented in EnCompass is larger than the allocated capacity for each unit in order to ensure that resource adequacy was maintained. In each case, the capacity surplus in EnCompass is smaller than the size of a single unit of that resource type [redacted].[32]

Q22. Does the EnCompass *Georgia Power Proposal* scenario include consideration of the procurement targets announced by the Company in its 2022 IRP, including 1,000 MW of energy storage systems by 2030[33] and 6,000 MW of incremental renewable capacity by 2035[34]?

A22. While renewable commitments like those of the Company perform an important function as declarations of intended future action and signals to market actors, the announced targets alone are not sufficient for detailed economic analysis in the context of resource planning. Alone, the targets represent a desired end state; the IRP provides the means by which the Company will reach that end state. This will ultimately happen through firm plans to issue requests for proposals ("RFPs"), deploy resources, and sign onto power purchase agreements. Rather than make assumptions about

[31] [redacted]

[32] *See:* IRP Resource Mix Study, p. 15.

[33] IRP Main Document, p. 11-72.

[34] *Ibid.*

how the Company might implement these targets, this analysis relies on what the Company has explicitly stated it will do through the 2022 IRP and projections of the Southern Company Resource Mix Study it sponsored alongside the Plan.

The IRP includes placeholder deployments in the 2028-2035 plan years that assume 750 MW of solar deployment annually;[35] those deployments are included in the *Georgia Power Proposal* scenario. No specific deployments are provided for the 1,000-MW storage goal, and therefore it is not reflected in the *Georgia Power Proposal* scenario.

B. The *Synapse Optimization* Scenario Uses Industry-Standard Renewable Energy Inputs, Models Cost-Effective Energy Efficiency, and Restricts Incremental Gas Capacity.

Q23. What is the purpose of the *Synapse Optimization* scenario?

A23. The *Synapse Optimization* scenario provides an improved, alternative approach to resource planning as opposed to the *Georgia Power Proposal* scenario in two key ways. First, the *Synapse Optimization* scenario revises several key input and assumptions, including the restriction of additional gas capacity on the Georgia Power system. Second, rather than modeling a combination of the Company's proposed investments and purchases and the adapted results of a Southern Company analysis, the *Synapse Optimization* scenario allows the EnCompass economic optimization algorithm to select economically optimized resources for the Georgia Power system from 2025 to 2041. Together, the adjustments in the *Synapse Optimization* scenario allows for fair economic comparison between the predominantly gas-powered *Georgia Power Proposal* scenario and a renewables-led, economically optimal alternative.

Q24. Please describe the economic optimization deployed in the *Synapse Optimization* scenario in greater detail.

A24. In the *Synapse Optimization* scenario, the EnCompass model is allowed to select new sources starting in 2025 to allow for reasonable procurement and construction times. To allow for economically optimal selection, proposed resource additions by the Company after 2025, which include the distributed and utility-scale renewable RFPs, McGrau Ford Battery Facility and the Dahlberg 1, 3, and 5 power purchase agreement, are not included in the *Synapse Optimization* scenario. The economic optimization is also allowed to economically retire existing resources when

[35] IRP Main Document, p. A-145.

doing so would be economically beneficial for the system as a whole while avoiding reliability impacts to the transmission system as described in the Company's Unit Retirement Study.[36]

Q25. What assumptions are revised in the *Synapse Optimization* scenario?

A25. The *Synapse Optimization* scenario used the following alternative inputs to those used in the *Georgia Power Proposal* scenario:

- **Load Forecast**: Included costs and energy and demand savings associated with the high energy-efficiency case labelled as "Aggressive" in the Company's Plan.[37]
- **Renewable Resource Cost Trajectories**: Cost trajectories were taken from the National Renewable Energy Laboratory's Annual Technology Baseline ("NREL ATB").[38] NREL ATB's cost projections are greater than the GPC $25 per megawatt-hour power purchase agreement in the earlier years, but cost-effectiveness improvements yield prices slightly below the $25 level in the later years.
- **Renewable Resource Effective Load Carrying Capability**: Used the results of the ELCC Study[39] conducted by the Company and submitted as part of its IRP in this proceeding to determine "firm" capacity for renewable and battery storage resources.[40]
- **Gas Resources**: Incremental gas-fired units were not available as selectable resources.
- **Solar Integration Costs**: Solar integration costs were adjusted downward to $2.00/MWh[41] to account for storage penetration in the *Synapse Optimization* runs.

A summary of inputs used between the *Georgia Power Proposal* scenario and the *Synapse Optimization* scenario is provided below in Table 5.

[36] IRP Technical Appendix Volume 2, Unit Retirement Studies.

[37] IRP Technical Appendix Volume 2, DSM Program Documentation – 3 – 2022 IRP DSM Case Summary Data MG0.

[38] See: National Renewable Energy Laboratory ("NREL") Annual Technology Baseline ("ATB") 2021, https://atb.nrel.gov/electricity/2021/index.

[39] Georgia Power IRP Technical Appendix Volume 1 – Study of Renewable Capacity Values Using the ELCC Methodology in the Southern Company System ("ELCC Study").

[40] IRP Technical Appendix Volume 1, ELCC Study, Table IV-1.

[41] The $2.00 per megawatt-hour value is a conservative adaptation of the results of Portfolio 3 of the Renewable Integration study. It slightly under-estimates costs for solar resources below 5,000 MW of aggregate deployment and slightly over-estimates costs for solar resources above 5,000 MW of aggregate deployment.

Table 5. Key Input Summary, Georgia Power Proposal and Synapse Optimization

Scenario	Georgia Power Proposal	Synapse Optimization
Load Forecast	GPC IRP Load Forecast	GPC IRP Load Forecast with "Aggressive" EE/DSM[42]
Reserve Margin	GPC IRP Default: 16.25% summer, 26% winter	GPC IRP Default: 16.25% summer, 26% winter
Solar PPA Costs	Southern Resource Mix Study ($25/MWh)	NREL ATB 2021 Advanced
Storage Costs	Southern Resource Mix Study	NREL ATB 2021 Advanced
Solar / Wind / Storage Firm Capacity	GPC Incremental Capacity Equivalence ("ICE")	GPC Effective Load Carrying Capability ("ELCC")
Solar Integration Costs	GPC Renewable Integration Study, Portfolio 1 Average ($3.36/MWh)[43]	Adapted from GPC Renewable Integration Study, Portfolio 3 (BESS)
New Resources	GPC IRP and Southern Resource Mix Study	Economically Optimized 2025-2041
Resource Retirements	GPC IRP Proposed Retirement Dates	Economically optimized within transmission constraints
Non-Georgia Power resources	Non-firm SoCo import	Non-firm SoCo import
Incremental Gas?	Yes	No
New-Build Gas Costs	Resource Mix Study	Not applicable

Q26. Please expand on the *Synapse Optimization* scenario's revisions to the Georgia Power load forecast.

A26. In the *Synapse Optimization* scenario, I assumed that the Company and its ratepayers achieve a high penetration of energy efficiency and demand-side management ("EE/DSM") across several measures in the residential, commercial, and industrial sectors, as contemplated in the IRP's "Aggressive" case. The EnCompass analysis included incremental load impact, incremental reduction of peak demand, and incremental costs of pursuing additional energy efficiency as provided by the Company in the Technical Appendices to its IRP.[44] The Company's calculations show that the "Aggressive" case yields Total Resource Costs benefits in every year, with 10-year NPV benefits greater than twice that of the "Proposed" case.[45] In the context of resource planning,

[42] The *Synapse Optimization* load forecast assumes that incremental EE/DSM reductions persist but do not continue to accumulate after the end of the "Aggressive" scenario in 2034. Incremental costs and incremental demand reduction are held constant across scenarios 2035-2041.

[43] The Company uses $3.36/MWh as a simplifying assumption for integration costs in its "Illustrative Costs and Benefits of Utility Scale Tracking Solar Generation in Georgia," provided in IRP Technical Appendix Volume 2 – Renewable Cost Benefit Framework.

[44] IRP Technical Appendix Volume 2 - 1 DSM Program Documentation.

[45] *Ibid.*

this metric indicates that the "Aggressive" EE/DSM case provides greater long-term net benefits to the system as a whole. This update expands energy efficiency investment, consistent with least-cost planning principles, and trades short-term costs in the model for long-term reductions in total energy and seasonal peak demand requirements.

Q27. How were winter demand reductions from EE/DSM estimated in the EnCompass analysis?

A27. DSM Program Documentation that the Company provided in the IRP Technical Appendix Volume 2 did not appear to include potential demand savings for the identified energy efficiency cases specific to the winter season.[46] Given the Georgia Power system's specific characteristics—a seasonal resource adequacy regime with a high reserve margin in the winter months and low "firm" winter capacity values for solar resources—estimating winter demand reduction allows EE/DSM to play the critical role of meeting winter peak requirements and avoiding costly over-building of supply-side resources.

To estimate winter demand reductions for this analysis, I used findings from a nation-wide study of energy efficiency potential by experts at the Lawrence Berkeley National laboratory published in the academic journal *Joule* in August 2021.[47] That study found that a balanced approach to EE/DSM in the Southeast would save roughly 8 MW of winter demand for every 10 MW of summer demand reduction in the commercial and industrial sector, and 6 MW of winter demand reduction for every 10 megawatts of MW demand reduction for the residential sector.[48] The Synapse team applied these winter-summer ratios to the Company's existing demand reduction figures to estimate winter demand reduction. Annual energy savings were assumed to evenly spread across the entire year, weighting each month by energy use.

Q28. Please expand on the *Synapse Optimization* scenario's renewable resource cost trajectories.

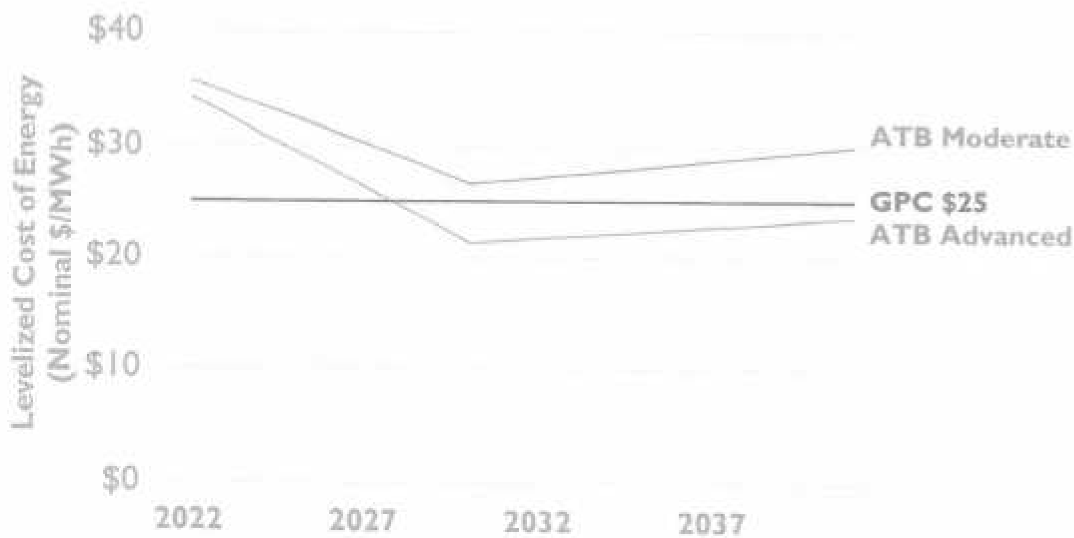
A28. The *Synapse Optimization* scenario used cost projections from the National Renewable Energy Laboratory's 2021 Annual Technology Baseline ("NREL ATB") for utility-scale solar and 4- and 8-hour battery storage candidate resources. The NREL ATB is an industry-standard benchmark for

[46] *Ibid.*
[47] Langevin, J. et al. (2021, August). US building energy efficiency and flexibility as an electric grid resource. *Joule*. Retrieved at: https://www.sciencedirect.com/science/article/pii/S2542435121002907.
[48] Langevin et al., p. 10, Fig. 4.

technology cost projections that is regularly cited by grid planners and regulators[49] as well as utilities.[50]

I selected the "Advanced" trajectory for wind, solar, and storage resources in the *Synapse Optimization* Scenario. In particular, the NREL ATB Advanced series best fits the low-cost solar energy already achieved in Georgia. Figure 2 shows the trajectory of NREL ATB cost projections versus the Company's static $25 per megawatt-hour power purchase agreement cost projection.[51] The *Synapse Optimization* scenario uses NREL ATB Advanced cost projections for Class 5 solar resources to set year-one PPA costs for solar resources, which increase at inflation over the term of the PPA.

Figure 2. Levelized Cost of Solar Energy, Georgia Power PPA vs. 2021 NREL ATB



[49] *See:* Midcontinent Independent System Operator (April 27, 2020). "MISO Futures Whitepapers, MTEP21." https://cdn.misoenergy.org/20200427%20MTEP%20Futures%20Item%2002b%20Futures%20White%20Paper443656.pdf; *and* South Carolina Public Service Commission (December 23, 2020). Order Rejecting Dominion's Integrated Resource Plan. Docket No. 2019-226-E. Retrieved at:
https://dms.psc.sc.gov/Attachments/Order/a4b59f43-e545-43bd-9f35-a846b7602c39.
[50] *See:* Duke Energy (March 22, 2020). Carolinas Carbon Plan Stakeholder Meeting 3; Retrieved at: https://desitecoreprod-cd.azureedge.net/_/media/pdfs/our-company/carolinas-carbon-plan/meeting-3-meeting-materials.pdf?la=en&rev=d7c4cdf8cd694f56b503fb66fc1cf58b; *and*
Xcel Energy. 2020-2034 Upper Midwest Integrated Resource Plan. Retrieved at:
https://www.xcelenergy.com/staticfiles/xe-responsive/Company/Rates%20&%20Regulations/The-Resource-Plan-No-Appendices.pdf.
[51] IRP Technical Appendix, Volume 1 – Southern Company Resource Mix Study, p. 14.

While the pace of cost declines has slowed somewhat for utility-scale solar in the last several years, cost declines are still outpacing the pace of inflation. The most recent Lazard analysis calculates utility-scale solar's cost decline as, on average, 8 percent per year over the past 5 years.[52] In 2020, a significant portion of the cost of utility-scale solar still came from "soft," non-hardware or labor costs;[53] NREL experts projected that continued cost declines will come in part from installation efficiencies,[54] which are often a product of learning-by-doing. Georgia Power's projected 6,000 MW of additional renewables will continue to provide opportunities to achieve learning-by-doing cost declines. Figure 2 shows that the NREL ATB projection expects solar prices to continue cost declines through 2030, and then to continue declining in cost at a pace slower than inflation through the end of the planning period.

Q29. Do you have any projections about the impact of the US Commerce Department's recent launch of an investigation into solar panel production in four Southeast Asian countries?[55]

A29. The U.S. Department of Commerce's decision is causing short-term uncertainty in the solar industry and delayed projects across the country, but at this time the investigation appears unlikely to radically shift the trajectory of solar deployment in the United States. Tariffs on solar technology imports have been a feature of the industry since 2012, with meaningful but marginal impacts on aggregate solar deployment. The impacts on existing project timelines seen in March-April 2022 can best be attributed to the risk and uncertainty around retroactive application of any potential tariffs. Ultimately, financial analyst firm Raymond James "does ***not*** anticipate an adverse outcome" to the solar industry [emphasis original],[56] and Southern Company anticipates a delay, rather than a reduction, in its current solar development pipeline.[57] An industry brief produced by Raymond

[52] Lazard (2022). Levelized Cost of Energy, Levelized Cost of Storage, Levelized Cost of Hydrogen 2022. Retrieved at: https://www.lazard.com/perspective/levelized-cost-of-energy-levelized-cost-of-storage-and-levelized-cost-of-hydrogen/.

[53] Feldman, D. et al. (2020). U.S. Solar Photovoltaic System and Energy Storage Cost Benchmark: Q1 2020. NREL. Retrieved at: https://www.nrel.gov/docs/fy21osti/77324.pdf.

[54] NREL (2021). Annual Technology Baseline: The 2021 Electricity Update. Retrieved at: https://www.nrel.gov/docs/fy21osti/80095.pdf.

[55] Gheorghiu, I. (2022, March). Commerce Department kicks off 1-year solar tariff investigation on panels imported from Southeast Asia. *UtilityDive*. Retrieved at: https://seia.org/sites/default/files/2022-03/CommerceAuxinDecision.pdf.

[56] Raymond James (2022, April). Energy Stat: As U.S. Commerce Dept. Debates Yet Another Solar Tariff, We Are Reminded That Protectionism Has a Price. Retrieved at: https://raymondjames.bluematrix.com/sellside/EmailDocViewer?encrypt=661eefbb-0694-40cf-8c26-f090f0b1b927&mime=pdf.

[57] Saul, J. (2022, April). Southern Sees Solar Project Delays Caused by U.S. Tariff Probe. *Bloomberg*. Retrieved at: https://www.bloomberg.com/news/articles/2022-04-28/southern-sees-solar-project-delays-caused-by-u-s-tariff-probe.

James on the US Commerce Department's investigation is provided with this testimony as Exhibit TF-2.

In any case, the *Synapse Optimization* scenario's earliest year for economically selecting new-build projects is 2025, at which time the utility-scale solar industry will have more certainty. Further, the relative premium between the NREL ATB 2021 solar forecast and the Company's $25-per-megawatt-hour PPA assumption in the years 2025-2028 effectively internalize any short-term price shocks compared to the *Georgia Power Proposal* scenario.

Q30. Expand on your use of Georgia Power's calculated effective load carrying capability instead of Georgia Power's incremental capacity equivalence ("ICE").

A30. Effective load carrying capability and incremental capacity equivalence are both methods of determining the ability for any given resource to contribute to meeting a system's capacity needs. These are most often used for energy-limited or variable resources such as battery storage, solar, or wind resources, although some methodologies can be used with conventional, dispatchable resources as well. Both methods use a probabilistic model to identify the impact to reliability caused by the addition of a single reference amount of a given resource; ICE compares each resource against a hypothetical combustion turbine, while ELCC adds the reference resource and the *removes* hypothetical firm capacity until the system returns to its original reliability level. Especially for renewable and energy-limited resources, a resource's marginal 'firmness' can also vary by how much of that resource is already on the system.

Historically, Georgia Power has used the ICE method, although the ELCC method is widely recognized as the more common method for determining firm capacity.[58] Crucially, ELCC methodologies such as the one conducted in Georgia Power's ELCC Study are able to capture interactions between variable and energy-limited resources.[59] As modern energy systems integrate more of these resources, capturing these interaction effects will be crucial to understanding the system's resource adequacy. A white paper by Energy & Environmental Economics further describing the ELCC methodology is attached to this testimony as Exhibit TF-3.

Pursuant to an agreement with Commission Staff, the Company conducted an ELCC Study as a part of its 2022 IRP,[60] but it declined to use the results of the more common firm capacity

[58] *See: EThree (2020) Capacity and Reliability Planning in the Era of Decarbonization* (Retrieved at: https://www.ethree.com/wp-content/uploads/2020/08/E3-Practical-Application-of-ELCC.pdf); *and* IRP Technical Appendix, Volume 1 – ELCC Study, p. 5.
[59] EThree, p. 5.
[60] IRP Technical Appendix, Volume 1 – ELCC Study

accreditation method in its planning analyses. A comparison of the outcomes of the Company's ICE and ELCC studies is provided below in [redacted]

Table 6. [redacted]

[redacted]	[redacted]		[redacted]	
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

The *Synapse Optimization* scenario uses the results of the more ELCC methodology because it is more commonly used and captures critical portfolio effects of a high-renewables, high-storage system.

Q31. Please expand on the *Synapse Optimization* scenario's decision to exclude incremental gas units from the pool of available resources 2025-2041.

A31. Incremental gas resources carry substantial volatility and risk. The recent conflict in Ukraine and ensuing instability of global gas markets underscores the risks today, as well as the potential for future shocks and stresses. Fuel price risks are asymmetrically borne by ratepayers because of the 'pass-through' nature of fuel costs, and in the interest of pursuing a balanced approach to resource planning the *Synapse Optimization* scenario was designed to minimize those risks. Effectively, the *Synapse Optimization* scenario provides a viable alternative to the *Georgia Power Proposal* scenario that does not include the same exacerbation of fuel cost risks caused by incremental investment in gas assets.

[redacted]

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[61] *See:* IRP Technical Appendix, Volume 1 – ELCC Study, Table IV-1 and workpapers; *and* Company Response to STF-JKA Data Request 2-4.

[62] IRP Technical Appendix Volume 1 – Resource Mix Study.

[redacted]

Figure 3[redacted]

[redacted]

Q33. How does EnCompass ensure simulated power systems maintain resource adequacy and reliability?

A33. EnCompass models load on a chronological, hourly basis, and enforces a capacity reserve margin requirement where firm capacity must meet Georgia Power's reserve margin in the summer and winter seasons for all years, 2022-2041. For all periods in both scenarios, the modeled power system does not violate capacity reserve requirements and serves 100 percent of load.

[63] US Energy Information Administration ("US EIA"), (2020, February). Capital Cost and Performance Characteristic Estimates for Utility Scale Electric Power Generating Technologies. Table 2, Column 15. Retrieved at: https://www.eia.gov/analysis/studies/powerplants/capitalcost/pdf/capital_cost_AEO2020.pdf

V. ENCOMPASS ANALYSIS SHOWS THAT THE SYNAPSE OPTIMIZATION SCENARIO IS MORE COST-EFFECTIVE THAN THE GEORGIA POWER PROPOSAL SCENARIO

Q34. Please summarize the resources selected by the *Synapse Optimization* scenario.

A34. Total installed capacity over time for the *Synapse Optimization* scenario is shown below in Figure 4. The *Synapse Optimization* scenario economically selects just over 9 GW of photovoltaic (PV) solar power through 2031, which increases gradually to more than 23 GW of new solar power by 2041 to bring the system's total solar capacity to over 27 GW. This substantial build-out of solar energy is supported by an expansion of battery storage, which reaches about 3 GW of mostly 4-hour storage by 2031 and climbs to more than 10 GW of a combination of 4-hour and 8-hour storage by 2041 (4- and 8-hour storage are both represented as front-of-meter or "FTM" storage in Figure 4). The system also economically selected a single 150-MW onshore wind project in 2029.

Figure 4. Synapse Optimization Capacity over Time, 2022-2041

While these solar deployment numbers are large relative to the level of solar PV currently deployed in Georgia, they are aligned with national trends. As of March 2022, ERCOT reported that it expects to add 15 GW of new solar development between 2022 and 2023 alone, reaching almost 40 GW of total solar deployment by 2025.[64] S&P Global Market Intelligence projected in late 2021

[64] ERCOT Capacity Changes by Fuel Type – March 2022. Retrieved at: https://www.ercot.com/gridinfo/resource.

that 44 GW of solar would be deployed in the United States in 2022 alone.[65] While short-term supply chain concerns described above have affected that projection, it is still a strong signal of the continued acceleration in solar deployment. Deployment of solar and storage in the second half of the planning period is broadly consistent with the assumption of the Company's Unit Retirement Study, which assumes after the expiration of the gas PPAs proposed in this IRP that the default energy and capacity resource will be solar plus storage.[66]

Q35. How did existing fossil resources perform in the *Synapse Optimization* scenario?

A35. In the *Synapse Optimization* scenario, the EnCompass model retires several existing coal- and gas-fired units before their proposed retirement dates (an "economic" retirement). Table 7, below, shows each resource economically retired with the *Synapse Optimization* scenario.

Table 7. Economic Retirements, Synapse Optimization Scenario

Year	Name	Resource Type	Capacity (MW)
2022	McManus Units 3A and 4A	Gas Turbine	110
2023	McManus Unit 4B	Gas Turbine	55
2024	Scherer Unit 3	Coal	504
2024	McManus Units 3B and 4C	Gas Turbine	110
2025	McManus Unit 4D	Gas Turbine	55
2027	McManus Unit 4E	Gas Turbine	55

Based on the retirements identified by the *Synapse Optimization* scenario, the Plant McManus oil-fired combustion turbines are simply not the least-cost resources available for serving the capacity and energy value they deliver. Although the Company's IRP identifies 2030 retirement dates for most of the McManus units, earlier retirement dates for some or all of these units would save money for Georgia ratepayers.

Georgia Power's Unit Retirement Study identifies "Projected Earliest Transmission Retirement Dates"[67] for several legacy units to represent the earliest possible year that the unit could be retired without causing transmission or reliability issues. Although the Unit Retirement Study does not provide a substantive justification for the selection of these years, the *Synapse Optimization* scenario adopts these "Earliest Retirement Dates" as a conservative measure to ensure that *Synapse Optimization* results are useful to the Commission. [redacted]

[65] S&P Global Intelligence (2021, October). The Big Picture: 2022 Electric, Natural Gas an Water Utilities Outlook. Retrieved at: https://pages.marketintelligence.spglobal.com/rs/565-BDO-100/images/The-Big-Picture-Energy-2021.pdf.
[66] IRP Technical Appendix Volume 2 – Georgia Power Unit Retirement Study, p. 6.
[67] IRP Technical Appendix Volume 2 – Unit Retirement Studies, p. 9.

[redacted]

But continued operation of many of the Company's aging units carries substantial economic risk. In the *Synapse Optimization* scenario, each of the Bowen units accumulate over $90 million of net losses on an energy-only basis for each year they continue to operate. [redacted] pulling insights from the results of the *Synapse Optimization* scenario, these units are likely to continue to add unnecessary costs to ratepayer bills until they are retired and replaced.

For Plant Scherer Unit 3, where no transmission constraint has been identified, the Company should seek to retire this unit as early as practicable. For the other legacy units for which transmission and reliability issues have been identified, the Company should produce analyses that justify these "Earliest Transmission Retirement Dates," assess alternative transmission solutions and determine whether unit retirement could be further accelerated. In the case of Plant Bowen, the North Georgia Reliability & Resilience Action Plan (proposed in the Company's Plan to identify necessary transmission projects and potential renewable replacement capacity for the Bowen units) should seek to develop transmission projects and issue RFPs with the goal of retiring all four units as expeditiously as possible. "Locking in" any of these resources for transmission and reliability purposes could exacerbate ratepayer costs as opposed to the short-term potential cost of replacing these resources and addressing any transmission issues. The Company should not move forward with installing effluent limit guidelines ("ELG") retrofits on Plant Bowen Units 3 and 4 until the Company affirmatively determines via the North Georgia Resilience & Reliability Action Plan that no combination of distributed resources and transmission projects is capable of addressing reliability & transmission issues.

Q36. What is the effect on EnCompass analysis results when these retirement constraints are not applied?

A36. My EnCompass analysis also ran a *Synapse Optimization* scenario that did not apply the retirement constraints for legacy coal units identified in the Unit Retirement Study. In that sensitivity run, the

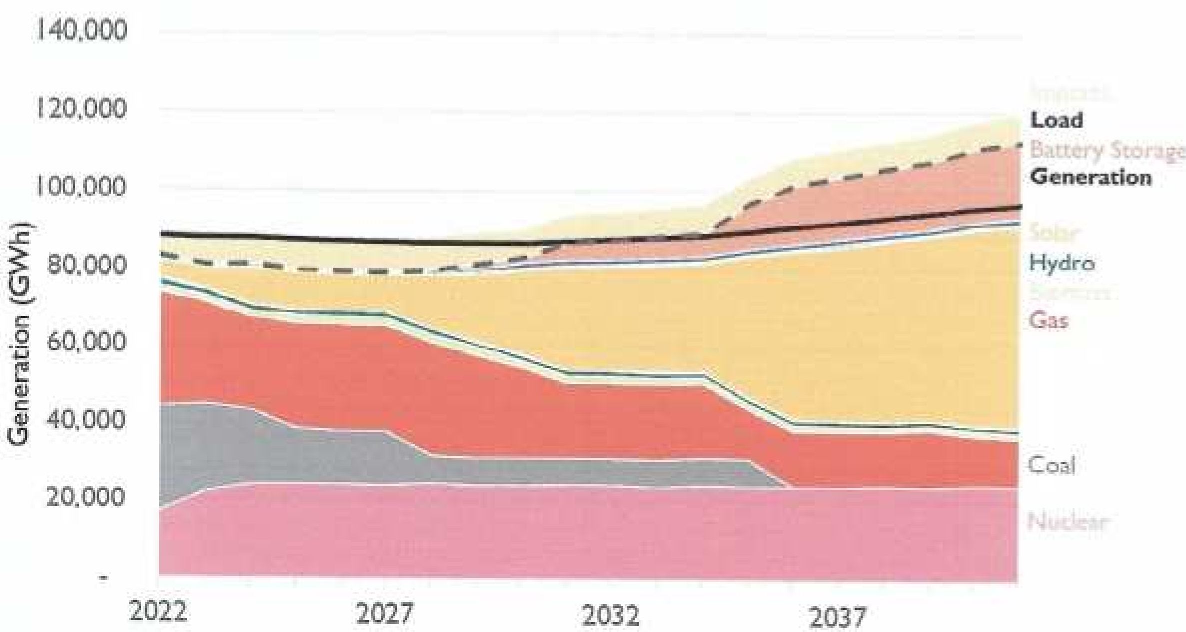
[68] IRP Technical Appendix Volume 2 – Unit Retirement Studies, p. 11-16.

EnCompass optimization built additional solar and storage resources in the mid-2020s, then economically retired two Plant Bowen units in 2024, an additional Bowen Unit in 2026, and all units of Plant Scherer in 2025. The scenario consequentially saves an additional [redacted] million on an NPV basis through 2030 compared to the *Georgia Power Proposal* scenario. These results confirm that these units are not economic, and continued reliance on them incurs additional costs to ratepayers. In the interests of serving ratepayers as cost-effectively as possible, the Company should identify transmission and generation interventions to accelerate the retirement of these units as expeditiously as possible.

Q37. Please describe the generation mix of the *Synapse Optimization* scenario over time.

A37. In terms of actual generation, the Georgia Power system undergoes a significant transformation in the *Synapse Optimization* scenario. In 2022, coal and gas resources provide [redacted] of total generation, with nuclear power providing [redacted] and solar providing [redacted]. 2031 marks the first year that solar generation outpaces coal and gas generation in the *Synapse Optimization* scenario, with solar generation representing 31 percent of the mix and coal and gas representing 30 percent. By the end of the planning period, battery storage discharge compromises just over 20 percent of total generation plus imports and solar represents just under half of total generation. Figure 5 shows the generation mix by resource of the *Synapse Optimization* scenario over time.

Figure 5. Synapse Optimization Generation Mix, 2022-2041



Q38. How does the generation and capacity mix differ in the *Georgia Power Proposal* scenario from the *Synapse Optimization* scenario in terms of generation and capacity mix?

A38. The scenarios yield substantially different resource deployment outcomes. For comparison, [redacted] below shows nameplate capacity over time for the *Georgia Power Proposal* scenario.

Figure 6.

[redacted]

[redacted]

[redacted]

Figure 7.

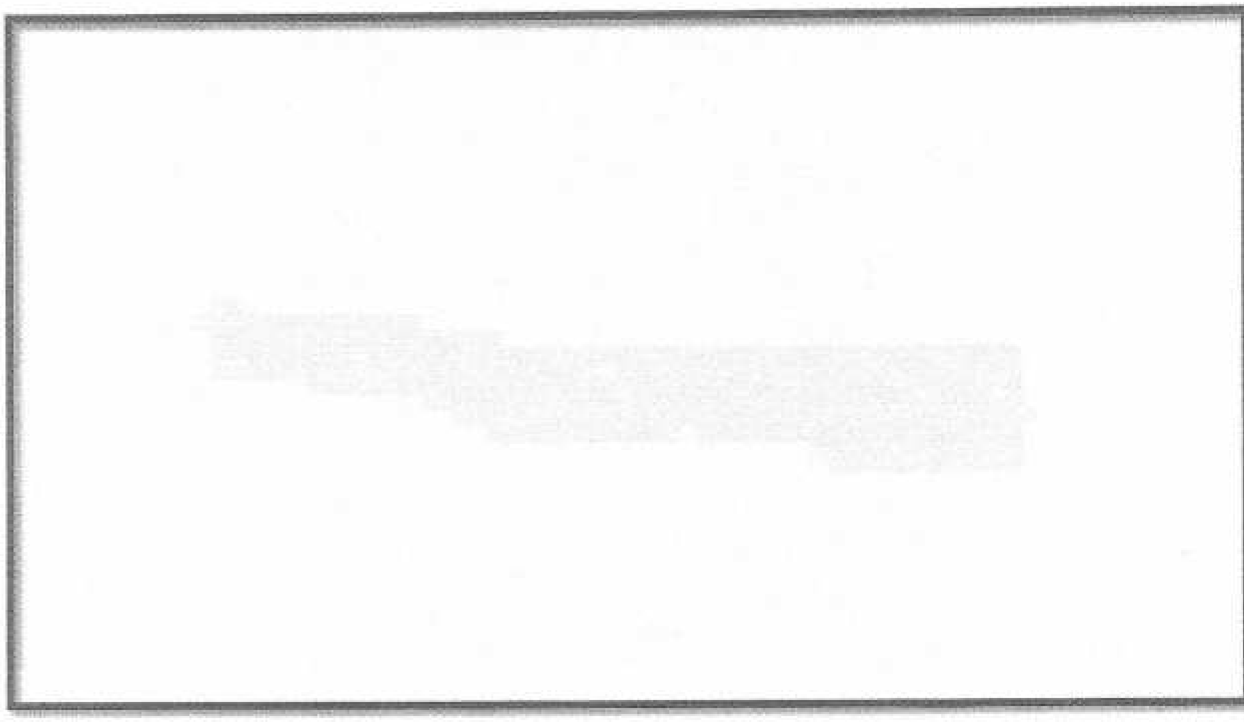


Table 8 below, compares the total incremental capacity added during the planning period for each of the two scenarios.

Table 8. Total Incremental Resources by Scenario

Scenario	Georgia Power Proposal	Synapse Optimization
	2031	
Total New Gas Capacity (CC, CT, CT + SCR) (MW)	[redacted]	0
Total New Solar Capacity (MW)	[redacted]	9,300
Total New Storage Capacity (MW)	[redacted]	3,000
	[redacted]	
Total New Gas Capacity (CC, CT, CT + SCR) (MW)	[redacted]	0
Total New Solar Capacity (MW)	[redacted]	23,120
Total New Storage Capacity (MW)	[redacted]	10,000

Q39. Please compare the economic outcome for each of the scenarios.

A39. In

Table 9, I summarize the cost, in net present value of revenue requirements ("NPVRR") terms, for each of the scenarios using the Company's weighted average cost of capital as a discount rate for consistency with other calculations of revenue requirement. I also present a few key emissions outputs. As a note, these costs are calculated to represent a portion of the Company's total revenue requirement, but do not represent all components of the revenue requirement that might be calculated in a rate case.

Table 9. Net Present Value Revenue Requirement and Carbon Emissions by Scenario

Scenario	Georgia Power Proposal	Synapse Optimization
2022-2041 NPVRR ($B)	[redacted]	$ 52.5
2041 projected carbon emissions (million tons)	[redacted]	5.4
Cumulative Carbon Emissions, 2022 – 2041 (million tons)	[redacted]	324.3

Table 9 shows that the *Synapse Optimization* scenario is more cost-effective over the entire planning period, saving ratepayers [redacted] on a net-present value basis. On an undiscounted basis, the *Synapse Optimization* scenario incurs over [redacted] less in fuel costs over the planning period.

Q40. Did you conduct any sensitivity analysis in EnCompass to validate your results?

A40. Yes. To validate my results, I ran a sensitivity scenario without Georgia Power's $20 carbon price and allowed both scenarios to re-optimize dispatch and resource deployment. In that analysis, the *Synapse Optimization* scenario still saves ratepayers [redacted] million over the course of the planning period compared to the *Georgia Power Proposal* scenario. This result confirms that solar- and storage-led resource deployment is competitive on a pure economic basis with incremental gas investments and represents a "no-regrets" approach to resource planning. To ensure that differences in renewable cost assumptions were not driving results, I also ran a *Georgia Power Proposal* scenario with renewable cost assumptions from the *Synapse Optimization* case; while these did cause an incremental decrease in overall costs for the *Georgia Power Proposal* scenario, the *Synapse Optimization* scenario remained the more cost-effective portfolio over the planning period.

Q41. Are there other factors that the Commission should consider in evaluating the Company's plan?

A41. Yes. There are multiple categories of economic value result from of the Company's resource deployment decisions that may not be captured in a capacity expansion modeling scenario; these include externalities due to local air pollution and economic development and tax base value.

Resources also have risk profiles that can affect future economics. Additional environmental compliance requirements on existing and potential future gas-fired resources could affect economic performance of those units in the future, potentially causing additional cost to ratepayers due to sunk costs in un-economic generation. Given the highly modular nature of solar and battery storage resources and the absence of a need for fuel, renewable and battery resources are less likely to lead to these kinds of sunk costs.

Q42. Do you have any conclusions based on the results of the EnCompass analysis?

A42. The *Synapse Optimization* results show that, even without relying on neighboring energy systems, a power system driven by variable, zero-fuel cost energy and backed by battery technologies that are commercially available today can not only meet all energy and capacity requirements, but also provide more cost-effective power than conventional resource planning approaches and resources. The Company's IRP identifies solar as "currently the most cost-effective energy resource addition available in Georgia,"[69] and credible economic modeling shows costs continuing to decline. Modeling and resource decisions should maximize rather than constrain cost-effective zero-fuel resources. The EnCompass analysis presented here shows that this approach can deliver the same quality of service at more affordable rates for Georgia ratepayers.

Q43. Based on the results of this analysis, do you have any recommendations to the Commission regarding the Company's 2022 IRP?

A43. Based on the results of this EnCompass analysis, I recommend the Commission take the following actions to continue to ensure economical and reliable energy for Georgia ratepayers:

- **Direct the Company to use economic optimization analysis to justify its resource proposals in future IRPs.** The Company's proposed IRP relies, in part, on a Southern-Company-wide resource study using the AURORA economic planning software. However, the Resource Mix Study uses the Georgia Power IRP's proposed investments as an input to its analysis, effectively "locking in" these resources to any economic optimization analysis.[70] As a result, the AURORA results do not provide a meaningful justification for the proposed investments in the Plan. The Company should use capacity expansion planning as a tool to assist in developing its proposals, rather than as a "generic roadmap" for hypothetical resources.[71] The Company should also use the more common and insightful ELCC as its chosen capacity accreditation method in future IRPs.
- **Double the Company's 6,000 MW solar procurement target and direct the Company to expand its proposed 2025 renewable RFP.** The Company's solar procurement commitments represent an important market signal to Georgia's solar industry, and the Commission should approve the Company's target as a baseline for future solar procurement. However, in the same 2028-2035 period in which the *Georgia Power Proposal* scenario procured those 6 GW of solar power, the economically optimized *Synapse Optimization* scenario procured 14 GW. In line with EnCompass analysis results, the Company should double its solar target to 12,000 MW by 2035. In the short term, the Commission should direct the Company to lift its cap on its proposed 2025 renewable RFPs and avail itself of as much cost-effective solar as is available in current and future procurements.

[69] IRP Main Document, p. 13-90.
[70] IRP Technical Appendix Volume 1, Southern Company Resource Mix Study, p. 6.
[71] Georgia Power Company Response to Data Request STF-JKA-2-18.

- **Double the Company's 1,000 MW battery storage target and direct the Company to accelerate its procurement of battery energy storage and move quickly to develop its operational capabilities for dispatching storage assets.** While the Company's target of 1,000 MW by 2030 represents an important signal to the storage industry, EnCompass analysis shows that battery storage should play a substantially greater role on the Georgia Power grid by the end of this decade, increasing to 3,000 MW of storage by 2031 in the *Synapse Optimization* scenario. The Commission should double the Company's target, then direct the Company to move from the hypothetical procurement described in in the proposed IRP[72] to concrete plans for issuing RFPs and procuring resources.
- **Direct the Company to consider multiple EE/DSM cases in resource planning.** In the context of resource planning, energy efficiency is a cost-effective resource that provides both energy and capacity benefits. Expanding EE/DSM is in the best interest of Georgia Power ratepayers as a whole.
- **Decline to authorize the Dahlberg 1, 3, and 5 PPA.** EnCompass analysis shows that the 2028 Dahlberg PPA is not necessary to meet the Company's reserve margin targets, and the *Synapse Optimization* scenario meets near-term resource needs more cost-effectively than the *Georgia Power Proposal* scenario. The Commission should reject the proposed PPA for Plant Dahlberg units 1, 3, and 5 at this time; if the Commission finds procurement of these resources necessary, it can re-visit combustion turbine procurement in the 2025 IRP cycle.
- **Direct the Company to begin preparations to retire Plant Scherer Unit 3 and all Plant McManus units as early as practicable.** These units are not economic, and there are no strong reliability justifications for keeping them online. The Commission should direct the Company to prepare to retire the Plant McManus units and work with the other owners of Plant Scherer to prepare for the units retirement.
- **Direct the Company to make preparations to retire the remaining legacy coal fleet.** For units where the Company has identified a transmission or reliability constraint, the Company should produce an analysis justifying that constraint. The Company should make preparations to work with other ownership stakes to prepare to retire Plant Scherer Units 1 and 2 by 2028, and the North Georgia Reliability & Resilience Action Plan should not move forward with Plant Bowen Units 3 and 4's ELG retrofits until the transmission analysis and RFP confirm that an ELG retrofit is the best option for Georgia ratepayers.

[72] IRP Main Document, p. 13-94.

Q44. Does that conclude your testimony?

A44. It does.