Energy Storage in the Southeast

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We would like to thank the Energy Storage Program in the DOE Office of Electricity for its support in this work.

Objectives

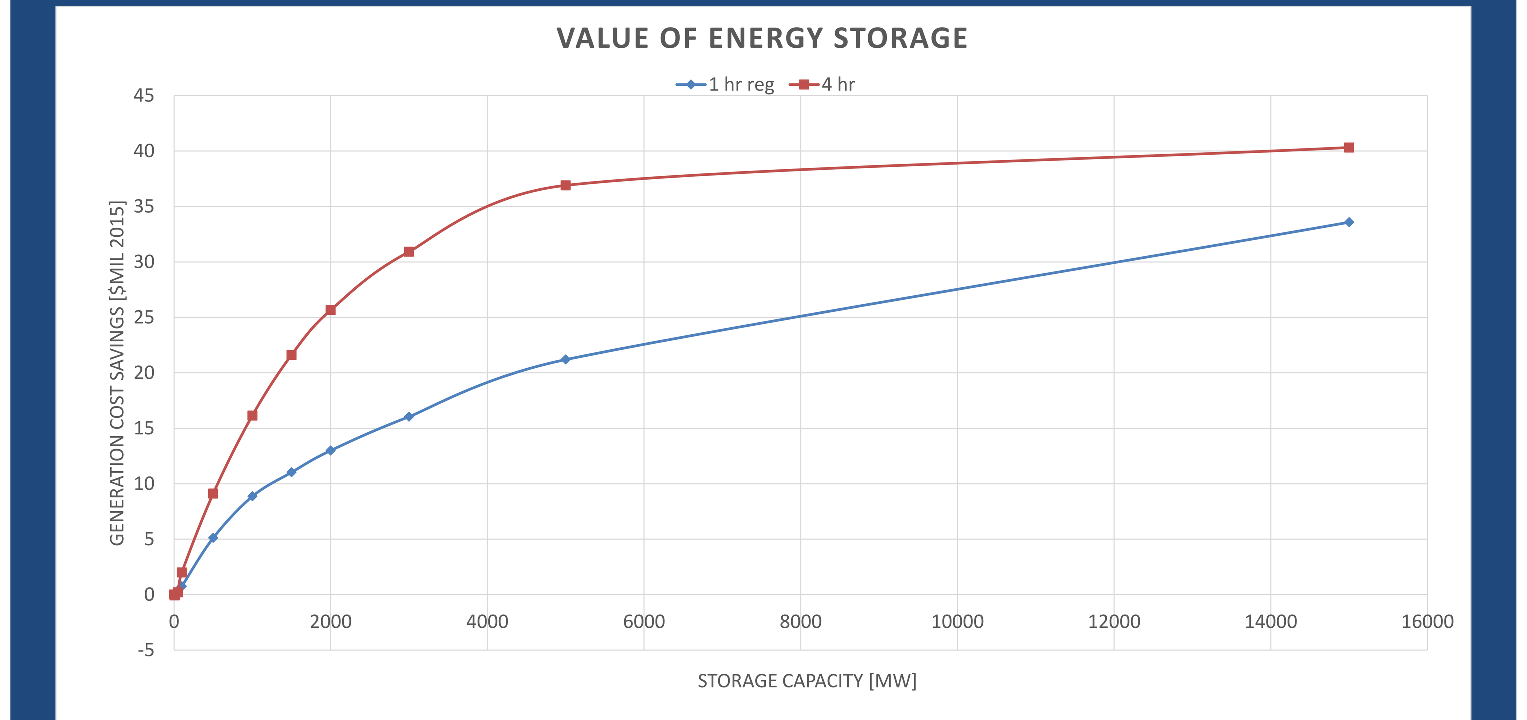
- Determine whether energy storage can reduce the costs of delivering electricity in a coal-heavy, vertically integrated system that does not expect significant renewables deployment. Is there a business case?
- Determine whether there is a business case for energy storage in the face of:
  - coal unit shutdowns
  - Increases in natural gas pricing
- How does a high resolution (5-10 min) model affect these results?
- Can regulation requirements be reduced from current rule of thumb? What role can energy storage play?

Study Methodology

- Develop a production cost model of the Southern Company's plant fleet (as planned in 2020).
- Evaluate whether the planned level of regulating reserves are appropriate.
- Dispatch plant fleet to meet projected 2020 load, observing reserve requirements.
- Conduct a storage value characterization to determine appropriate levels (capacity) of storage for scenario evaluation.
- Evaluate scenario options relative to reference system.
- Interpret results for the Southern Company system.

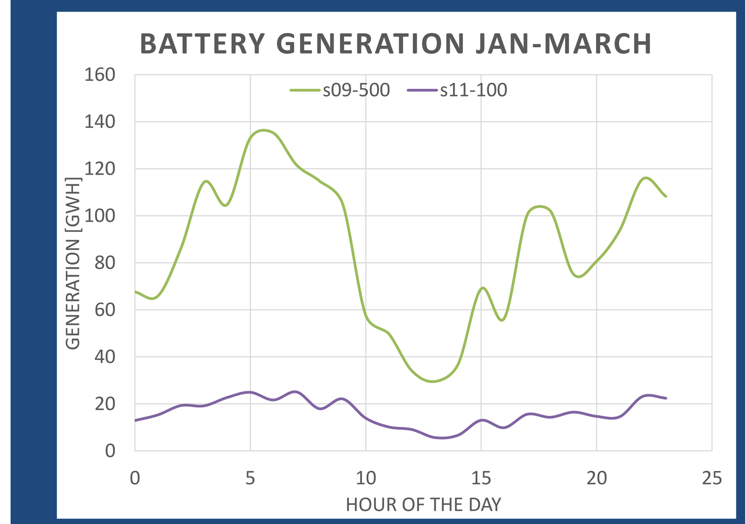
What is the value of energy storage in a coal-heavy vertically integrated system?

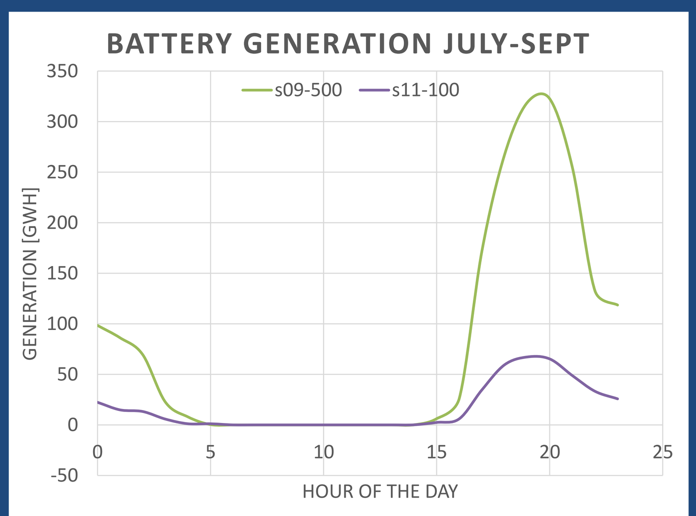
Value of Storage



Storage value characterization for a 1 hour and 4 hour energy storage system.

Initial Results

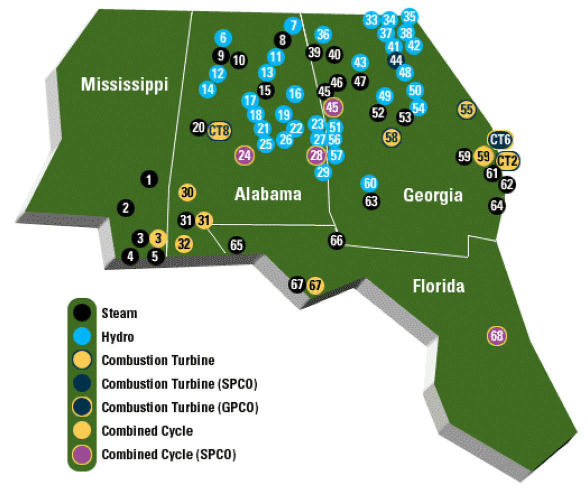




Daily average operational profile for a 500 MW, 4 hour battery.

	Type	Capacity (MW)	Storage (hrs)	AC-AC eff (%)	Generation (GWh)	Generation Cost Savings ($ mil)	Generator Start & Shutdown Cost Savings ($mil)	Total Cost Savings ($mil)	Price ($/MWh)
s1	psh	800	8	81%	1,726	(13.7)	(7.6)	(21.3)	1.9
s2	psh	800	16	81%	1,630	(26.5)	(8.1)	(34.6)	3.2
s3	psh	1600	8	81%	3,302	(22.4)	(13.6)	**(36.0)**	0.1
s4	psh	3200	8	81%	5,679	(33.1)	(18.9)	**(52.0)**	(1.5)
s5	caes	800	8	74%	1,519	(7.0)	(7.6)	(14.5)	1.6
s6	cryogen	800	8	50%	261	1.1	(5.6)	(4.5)	1.6
s7	cryogen	800	16	50%	272	1.2	(5.7)	(4.5)	0.9
s8	flywheel	100	0.25	85%	35	0.1	(0.2)	(0.1)	4.1
s9	battery	500	4	90%	748	(7.0)	(4.7)	**(11.8)**	2.6
s10	battery	500	7	75%	952	(4.2)	(5.1)	(9.3)	1.9
s11	battery	100	4	90%	164	(1.6)	(0.9)	(2.5)	3.0
s12	battery	100	1	90%	74	(0.5)	(1.1)	(1.6)	3.4
s13	psh	1600	8	81%	3,364	(22.8)	(13.6)	**(36.4)**	0.8
	battery	100	1	90%					
s14	psh	1600	8	81%	4,278	(25.1)	(16.4)	**(41.5)**	(0.9)
	caes	800	8	74%					
s15	psh	3200	8	81%	6,061	(35.4)	(20.4)	**(55.8)**	(2.7)
	battery	500	4	90%					
s16	flywheel	100	0.25	85%	773	(7.3)	(5.2)	(12.4)	0.4
	battery	500	4	90%					

Initial scenario run results relative to reference. (Values in parentheses are negative or savings.)



SOUTHERN COMPANY
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System Setup

- 2020 Southern Company System
- 2020 Forecast Load | 40.1 GW peak
- 42 GW system
- 0.5% Wind

Assumptions

- No forced dispatch order
- 2020 fuel price projections
- Start costs based on APTECH TEPPC estimations
- Reserve services
  - Regulation: 500 MW
  - Spinning: 650 MW
  - Spinning + Quick Start > 1250 MW

Scenarios

- Pumped storage
- CAES
- Cryogen cold storage
- Adv. LA/Li-Ion batteries
- Flywheels
- Combinations of above

Next Steps

- Further analyze initial results to inform:
  - Regulation reserve analysis
  - High resolution modeling
  - Sensitivity analysis
- Overall economic business case analysis.

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SAND No. 2011-XXXXP