Pathways to Commercial Liftoff

Long Duration Energy Storage (LDES)

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Pathway to Commercial Liftoff

To realize its full potential and play a leading role on the grid, LDES must achieve a state in which it is fully sustained by private financing with development in three areas: 1) significant improvements in technology cost and performance, 2) market recognition of LDES's full value, and 3) gigawatt-scale manufacturing and deployment capacity.

Of the total deployed storage capacity on the grid today (excluding Pumped Storage Hydropower (PSH)), the vast majority employs lithium-ion batteries and is not designed to support LDES capacity (defined as 10+ hours of dispatch). As the dominant electrochemical stationary energy storage solution for sub-10-hour systems, it will be important to track lithium-ion battery metrics to understand when other technologies with LDES functionality – such as compressed air energy storage (CAES), flow batteries, and hydrogen – become economically viable alternatives.

To be on track to deploy the amount of storage required by 2050, LDES capacity on the grid should ramp up to approximately 6-15 GW by 2030. Concurrently, the U.S. should develop at least 3 GW of annual LDES manufacturing and deployment capacity by 2030, increasing to 10-15 GW by 2035.

This increase in deployments would promote necessary technoeconomic improvements by 2030, namely cost reductions of at least 45-55% and a 7-15% improvement in round trip efficiency (RTE). Market reforms that recognize LDES value of $50-$75 per kilowatt-year would help mobilize $9-12B of private capital across the full LDES value chain.

Market Status

	Metric	Value	2030 Target	2050 Target
Metrics for LDES Liftoff	Total Deployed Utility Scale LDES Capacity Source: BNEF 2024 Q2	2.36 MW[1]	6,000 - 15,000 MW	225,000 - 460,000 MW
	LDES Levelized Cost of Storage (LCOS) Source: PNNL 2023, DOE 2024	$100-280/MWh[2]	$50/MWh[3]	-
	Private Capital Mobilized Across LDES Value Chain Source: Westly Group 2024 Q2	~$5B[4]	$9-12B	$220-335B
	Lithium-ion CapEx (10-hour system) Source: S&P Global Commodity Insights 2024	$2,004/kW[5]	-	-
	Number of Utilities Incorporating LDES in IRPs[6] Source: Wood Mackenzie 2023	4	-	-
Metrics for All Energy Storage	Total Deployed Utility Scale Storage Capacity Source: BNEF 1H 2024 Energy Storage Market Outlook	~44,442 MWh	-	-
	Share of Total Utility Scale Storage Deployment Lithium-ion Source: BNEF 2024 Q2	98%[7]	-	-
	Lithium-ion (LFP) LCOS Source: PNNL 2023	$150-190/MWh	-	-
	Domestic Lithium-ion Manufacturing & Deployment Capacity Source: BNEF 2024 Q2	160,000 MWh	-	-

1. Excludes historical PSH 2. LCOS of 10-hour 100MW multidisciplinary systems 3. DOE Long Duration Storage Shot target of $50/MWh by 2030 4. Cumulative since 2013 Q1 - 2024 Q2 5. Average of 8-hour & 12-hour duration lithium ferrophosphate (LFP) systems. 2026 target for all types of LDES technologies is $1,000/kW 6. Integrated Resource Plans, # of IRPs incorporating all durations of storage is 72 7. Includes sub-10-hour duration systems; excludes historical PSH share of deployments

Possible Near-term Actions

1. Develop risk reduction mechanisms, including loan guarantees, loan-loss guarantees, inflation protection, insurance, return guarantees/securitizing decarbonization tech investment
2. Increase access to integrative modeling tools and valuation frameworks for regulators, ISOs, and commercial customers to evaluate their LDES needs with relation to resource adequacy and reliability
3. Disseminate analyses that provide transparency on technology cost and performance with respect to relevant use cases to help investors, regulators and policymakers quickly adapt their portfolios
4. Provide financial support, e.g., grants and loans, for LDES technology advancement across the research, development, demonstration, and deployment (RDD&D) spectrum