Electric Reliability and Security for the West

2022 Long-Duration Storage Assessment Scope

May 2022

Introduction and Purpose

Assessment Introduction and Purpose:

The Long-Duration Energy Storage (LDES) Assessment will analyze how long-duration storage technologies that inject and withdraw energy could address some of the reliability issues seen in the 2020–2021 Study Program 2040 Clean Energy Scenarios Study and the Variability in Loads and Resources Study. The studies identified some challenges in attaining a clean energy contribution to the generation mix exceeding 80% in the Western Interconnection. For this follow-up assessment, WECC and the LDES Advisory Group will determine whether the identified challenges can be mitigated by employing clean LDES in the resource mix.

Background

WECC's Scenarios Work Group (SWG) conducted a series of assessments for horizon year 2040 as part of the 2020–2021 WECC Study Program. That 2040 Clean Energy Scenarios Study found a critical need for emerging clean energy technologies on the path to a 100% clean energy future. After the study report was published, WECC was approached by Strategen and the Western Interconnection Regional Advisory Body (WIRAB) to determine whether WECC was interested in conducting a follow-up study focused on one or two emerging technologies that have extensive development support and funding.

Assessment Leadership

The LDES assessment will be led by WECC with Stan Holland as technical lead, Mike Bailey as subject matter expert (SME), and Kirha Quick as project manager. In addition, the LDES Advisory Group will provide technical guidance for the assessment.

Key Reliability Questions

The initial LDES assessment will focus on the key reliability questions listed below.

1. What performance characteristics (e.g., energy availability, peak availability, dispatchability, multi-day availability, recharging time, standby losses, storage losses) are needed for the portfolio of LDES resources to reliably support 100% electric decarbonization?
2. Which LDES technologies could reasonably be expected to be commercially available within a 20-year planning horizon?

3. How would each of these technologies be expected to perform with respect to a set of to-be-established, preferred performance metrics?
4. How do flexibility needs change as the resource mix changes?

Assessment Requirements

To complete the analytical portion of this assessment, specific tools and data are required:

- **Tools**
  - A production cost simulation tool to perform an hourly dispatch solution that matches resources and loads across the whole interconnection. WECC will run the initial study using GridView.
  - Capacity expansion tools, to the extent that other organizations have the tools and are able to perform analysis for this assessment. Capacity expansion would likely focus on generation, not transmission.
  - Other as-yet-unidentified modeling tools that may also be needed to understand more fully how LDES technologies might perform.
- **Models and Data**
  - An existing production cost model dataset (2040 Clean Energy Futures Assessment) that can be easily modified to study the key reliability questions.
  - Other datasets as needed to support other tools used in the analysis.
  - Models to represent each LDES technology that is considered.

Assessment Approach

This assessment will evaluate specific technologies themselves and not the infrastructure needed to support them (e.g., fuel transportation).

1. The first phase will address the first reliability question: What performance characteristics are needed for LDES technologies? The outcome of this phase will document the desired performance metrics for each technology considered. The resource mix will be modified to replace the emerging clean technology resources with LDES resources and consider the need for charging.
2. In the second phase, the LDES team will develop study cases to model each of the LDES technologies selected for the analysis. The result of this phase will be modeling results that can be used to compare each of the technologies to predefined metrics.
3. The first and second phases of this work will result in a written analysis of the overall project.

Suggested Performance Metrics

Metric	Description
Dispatchability	Ability to change a resource’s output up or down within an hour to respond to changes in loads
Availability	Duration in hours or days during which the resource can be dispatched
Startup time	Time required to bring the resource from zero output to availability for dispatch to the Bulk Electric System (BES)
Ramping	The energy output rate (MW/min) and duration (hours during which this rate can be sustained)
Minimum up/down times	Minimum time (hours) that a unit must be kept operating after starting and the minimum time (hours) that a unit that is shut down must remain at zero output
Load following	A resource that can automatically increase or decrease its output in response to changes in load
Peak shaving or smoothing	A resource that can reduce maximum daily peak demand or reduce variations in hourly peaks
System Restoration	The time required to restore stable operation of the BPS after a partial or complete shutdown
Ancillary Services	Those services that are necessary to support the transmission of capacity and energy from resources to loads while maintaining reliable operation of the Transmission Service Provider's transmission system in accordance with good utility practice
Degradation	The reduction of the maximum capacity of any applicable energy storage system over time as a result of repeated charging/discharging cycling
Maximum recharge rate	The maximum rate (MW/hour) at which an energy storage resource can replace energy
Cost per MWH	The cost ($/MWh) for either generating energy or delivering it to load
Cost per Installed MW	The capital cost ($/MW) for producing energy with a generating resource including construction, permitting, and other costs
Flexibility to variability ratio constraint	The ability of a resource to vary its output in response to changes in load, expressed as supply variability (MW/min) divided by load variability (MW/min)

Suggested Reporting Metrics

Metric	Description
Availability of "charging" resources	The period during which clean energy resources are available to provide charging energy, defined as the hours of surplus supply at a specified output in megawatts
Unserved load	Quantity (MWh) and times (hours) when load cannot be served
Operating Reserve Violations	Quantity (MWh) and times (hours) when operating reserves cannot be met
Intrinsic/Extrinsic Value of LDES resources	Value of LDES resources beyond the energy production cost (e.g., the value of operational flexibility and the cost of load loss in the absence of operational flexibility)
Curtailment of variable energy resources (VER)	Quantity (MWh) and times (hours) when VER must be curtailed
Locational Marginal Prices (LMP)	LMPs during the year including times when VER are curtailed. LMP is defined as the marginal cost of supplying the next megawatt of demand.
Transmission Congestion	Constraints on the ability of a transmission system to carry the desired megawatt flow. WECC reports locations and hours when transmission path flows are at 75%, 90%, and 95% of their rated capacities (based on normal limits)
Storage Utilization	Measurement of utilization of storage portfolio, including • State of Charge (percentage of total MWh capability used), hourly • Percentage of hours of year charging (annual metric) • Percentage of total hours of year discharging (annual metric) • Charge and discharge (MWh) by month MWh-days of storage (MWh of energy stored x duration of time stored)
Storage Operational Costs	Measurement of the operational costs associated with use of the storage portfolio, including • Total energy consumed (MWh), price ($/MWh) and total cost ($) • Total energy returned to grid (MWh), price ($/MWh) and total value ($) • Percentage of total energy lost to Roundtrip Efficiency (RTE) losses or losses over time Net change from no-LDES base case, including • Net impacts on transmission congestion

Metric	Description
	• Net impacts on curtailment • Net impacts on LMPs Net impact on total cost of energy (and AS if modeled)
Seasonal Energy Arbitrage	Storing or producing energy during specific seasons of the year based on when prices for storing or producing are most favorable

Project Plan

Study Task	Responsible Party	Duration
Project Initiation		
Create stakeholder advisory group	WECC staff	2/15/22–4/25/22
Develop study scope	WECC staff, LDESAG	3/28/22–5/31/22
Set meeting schedule	WECC staff, LDESAG	4/1/22–5/31/22
Determine assessment schedule	WECC staff, LDESAG	4/1/22–5/31/22
Phase I—Technology Performance and Characteristics		
Select LDES technologies to be studied	LDESAG	6/1/22–6/30/22
Identify performance characteristics for LDES and CFT technologies	LDESAG	6/1/22–6/30/22
Collect data on performance characteristics for each technology	LDESAG	6/1/22–6/30/22
Begin drafting the written assessment, report to capture input assumptions	LDESAG	6/1/22–6/30/22
Phase II—Modeling		
Identify needed data and finalize modeling approach	LDESAG	6/1/22–8/31/22
Review 2040 Clean Energy Futures cases	WECC staff	6/1/22 - 6/24/22
Create study cases	LDESAG	7/15/22–8/31/22
Complete study cases and run analysis	LDESAG	9/1/22–11/15/22

Study Task	Responsible Party	Duration
Complete written assessment that includes modeling and performance characteristics	WECC staff, LDSAG	11/16/22–1/13/23
	Prepare for Publishing	
Tech edit	WECC staff	1/16/23–1/31/23
Review by Executive Team	WECC staff	2/1/23–2/17/23
Address Executive Team	WECC staff	2/21/23–2/28/23
Final publishing check points	Communications	3/1/23–3/17/23
Publish		3/17/23–3/24/23