Technology Innovation Project

Project Brief

TIP 253: Technical Proposal Technical and Economic Feasibility Study for Compressed Air and Thermal Energy Storage in the Columbia River Basalt

Context

The greater Pacific Northwest (PNW) region possesses a very large wind resource capability for production of renewable wind energy, with significant potential value to the broader western interconnected grid. The rapid development of wind resources, however, is already overtaking the capability of the PNW power system to integrate and balance intermittent wind generation and to reliably transmit wind energy to loads across the western US. Interconnected capacity is expected to double by 2013. The power system is now experiencing unscheduled within-hour wind generation ramps exceeding 1,000 MW, stressing the capability of existing resources to balance generation with load. As operational difficulties also ramp, costs and environmental consequences climb accordingly. Hydroelectric generation, while blessedly beneficial, lacks the flexibility to store and shape energy production in intermittent fashion corresponding to wind patterns and operationally becomes increasingly degraded. Overgeneration events, with resulting system instability, are occurring all too often.

The solution? New, costly, likely underused transmission, with its accompanying environmental challenges – or grid-scale energy storage that takes advantage of highly accommodating nearby geological formations. Subsurface energy storage methods, with energy recovery capable of displacing fossil usage, generally appear to be an extremely promising option, both economically viable and technically feasible at the scale needed to address a significant fraction of the 100 MW-month and potentially up to 1100 MW-month overgeneration events BPA anticipates.

Description

The objective of this project is to complete a technical and economic feasibility study for two methods of subsurface energy storage that could be deployed in the Pacific Northwest to help manage overgeneration events. The first method is through compressed air energy storage (CAES). CAES plants have a theoretical potential to return as much as 80 to 90% of the energy used for storage and can be cycled quickly for short duration load shaping. Although considerable work on various CAES concepts has been done previously, with encouragingly positive results, surprisingly, there has been no published study of CAES implemented in flood basalts, which represent the predominant regional geologic formation within the Pacific Northwest east of the Cascade Mountain Range. The second method to be examined is sensible heat energy storage that would be recovered to produce electricity in an enhanced geothermal system. This method takes advantage of the excellent heat capacity characteristics of basaltic rocks and provides a longer-term storage and production option that nicely complements CAES. The feasibility study will assess both technical and economic viability of these options at up to 150 MW-month storage capacity commensurate with addressing a significant fraction of the overgeneration events anticipated by BPA.

Why It Matters

The principal benefit to BPA in performing this project is an early assessment of whether subsurface energy storage appears technically, and most critical, economically viable to help manage overgeneration events in the BPA system. Such an early assessment will help BPA focus future R&D efforts on those technologies and infrastructure improvements that have high probability and lowest cost and environmental impact in shaping energy supply and demand across BPA's operations.

Goals and Objectives

For both the compressed air energy storage and sensible heat energy storage options, the cost analysis will include a careful evaluation of the following:

1. Marginal return from electricity sales
2. Likely number and duration of storage cycles per year
3. Permitting and site monitoring requirements
4. Operation and maintenance costs

Deliverables

Deliverables on this project include quarterly progress reports and delivery of a draft technical report on the feasibility study, including recommended next steps and potential follow-on projects. All supporting data will be delivered in an electronic format acceptable to BPA. PNNL will retain sufficient budget at the end of the project to address review comments from BPA prior to issuance of the final technical report.

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Project Start Date: November 2011

Project End Date: September 2012

Funding

Total Project Cost:	$791,000
BPA Share:	$396,000
External Share:	$395,000
BPA FY2012 Budget:	$396,000

Participating Organizations

Pacific Northwest National Laboratory

For More Information Contact

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