Abstract:

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Regenerative Air Energy Storage with Waste Heat Recovery for Wind Energy Integration in NS

The Nova Scotia Wind and Energy Storage project is a research initiative that project involves the development of wind energy converters (WEC), and a regenerative air energy storage (RAES) system. The WEC-RAES system will be co-located alongside an industrial waste heat source. The project is being developed in Nova Scotia and interconnected on a medium voltage distribution grid.

According to utility regulations, the installed capacity of non-dispatchable renewable energy generators (such as WEC) must be lower than the estimated minimum annual load (MAL) at the substation for the distribution grid they are interconnected to. By incorporating energy storage, however, the installed capacity of non-dispatchable generation can be increased beyond the MAL. The ESS buffers the output of the WEC and ensures it does not exceed the MAL, thus avoiding a reversal in electricity flow through the distribution substation. RAES is investigated as the ESS due to the unique opportunity to leverage a waste heat source. It will charge using WEC generated power that exceeds the MAL and discharge when the WEC output drops below the MAL. It will use waste heat to boost its efficiency and power during expansion. The integrated energy system will be the first of its kind and provide an invaluable research facility.

This research will evaluate the wind and energy storage system and determine an optimal energy and power configuration for the RAES system. A time series numerical model is developed to simulate operation of the WEC-RAES system based on measured climactic data from NS. The research also analyzes the economics of the system, the effectiveness of using waste heat, and also the benefits of varying the installed WEC capacity.