2050 Transmission Study: Offshore Wind Analysis

Transmission Planning

MARCH 21, 2025

Figures

Section 1: Study Overview

The New England power system is experiencing an unprecedented shift in the ways electricity is produced and consumed. Five of the six New England states have committed to reducing their carbon dioxide emissions by at least 80% by 2050, prompting ongoing changes to the grid. The expected shift toward mostly renewable, carbon-free power generation, coupled with increased electrification of heating and transportation, will radically transform supply and demand.

Among ISO New England's responsibilities as a Federal Energy Regulatory Commission (FERC)-authorized Regional Transmission Organization is ensuring the regional power system continues to operate reliably as system conditions change. Transmission planning seeks to make sure system reliability is maintained, which enhances the region's ability to support a robust, competitive wholesale power market by moving power from various internal and external sources to the region's load centers.

Peak demand for electricity is expected to increase significantly by 2050, and the resources that must meet this demand will likely be located in different geographical areas than the natural gas-fueled plants that meet the bulk of today's demand. This shift will change the region's transmission needs. The 2050 Transmission Study: Offshore Wind Analysis continues the ISO's pioneering look at how New England's transmission system may be affected by changes to the power grid by investigating how hypothetical injections of offshore wind farms might reliably interconnect to the region.

1.1 Study Background & Objectives

In October 2020, the New England States Committee on Electricity (NESCOE) released the New England States' Vision for a Clean, Affordable, and Reliable 21st Century Regional Electric Grid. This vision statement recommended that ISO New England work with stakeholders to conduct a comprehensive long-term regional transmission study, eventually titled the 2050 Transmission Study (referred to here as the "initial study"). Published in February 2024, the initial study identified

These objectives are the basis of this report, and later sections detail related assumptions, inputs and results.

1.2 Overview of Key Findings

This section details the study's key findings. It is important to note that these findings are based solely on N-1 DC thermal steady-state analysis, which helps provide high-level information about system constraints. Neither the initial study nor this subsequent offshore wind analysis includes the more detailed analyses of an interconnection study.

Connecting some of the initial study's hypothetical future offshore wind further south could reduce necessary upgrades.

- Relocating some offshore wind POIs from Maine to the Boston area may lead to significant transmission cost savings.
- The system will still need upgrades on the North-South and Maine-New Hampshire transmission interfaces.

Around 9,600 megawatts (MW) of additional offshore wind may be able to interconnect in New England without new transmission infrastructure. Assuming they successfully complete a full interconnection study involving more detailed analysis:

- Up to 38% of the existing major coastal substations in New England studied may be electrically suitable for a 1,200 MW offshore wind interconnection without constructing any new transmission infrastructure AND without upgrading any existing transmission infrastructure to address thermal concerns.[4]
- Up to 86% of the existing major coastal substations in New England studied may be electrically suitable for a 1,200 MW offshore wind interconnection without constructing any new transmission infrastructure; however, some of these require upgrades to existing infrastructure to address thermal concerns.
- A much smaller subset of these substations may be able to accommodate a 2,000 MW wind farm without any new transmission infrastructure.

Depending on location, approximately eight 1,200 MW wind farms (9,600 MW total) may be able to operate simultaneously at full output without new transmission infrastructure or significant curtailment.

Relocates one original Gulf of Maine wind farm POI from Orrington, ME to Ward Hill, MA

Table 1: Reduction in Electricity Flow Over ME-NH and North-South Interfaces by Season

	Summer Flows for Initial Study Locations (MW)[7]	Summer Flows Post-Relocation (MW)	Reduction in Flow of Electrical Power		Winter Flows for Initial Study Locations (MW)	

Table 2: Roadmap Revisions for 51 GW and 57 GW 2050 Scenarios

	51 GW Scenario Changes	57 GW Scenario Changes
AC Roadmap	**8% fewer miles of overhead 115 kV line rebuilds and 70% fewer miles of overhead 345 kV line rebuilds.** Wadengp	**5% fewer miles of add l’ saagd verhead 1’O Ʒ**

Instead of the 13 snapshots for 2035/2040/2050 used in the initial study, this analysis explores six 2033 snapshots: three loads under two different transfer scenarios. The load levels are shown in Table 3. The West-East transfer scenario models system conditions when generation minus load is higher in the West than the East, while the East-West transfer scenario models system conditions when generation minus load is higher in the East than the West. The most-limiting snapshot for a particular POI sets the MW limit for the amount of generation that may be able to connect for that POI in this study.

Load and generation forecast data for 2033 is less uncertain than projections for 2050. Examining a closer point in time also provides a useful intermediate point to help the region envision how to progress from the system of today to a system more similar to that of the initial study's 2050 endpoint.

Figure 3: Points of Interconnection Analyzed in Offshore Wind Screening

2. **Assemble relevant data on these POIs from System Impact Studies (SISs) and other sources.**
3. **Adjust the six snapshots to stress any relevant interfaces for each POI based on its location.**
4. **Add an injection of 1,200 MW at the relevant POI, designed to represent a single offshore wind generator. Note that no modeling parameters used for this were specific to offshore wind, so this could represent a 1,200 MW injection from any resource type.**
5. **Increase the size of the wind generator progressively while simultaneously reducing non-nuclear, non-offshore wind generation to maintain balance between generation and load on the system until a thermal constraint appears.**
6. **Record total MW reached for each POI in the most limiting snapshot.**

    If this total is less than 2,400 MW (representing two 1,200 MW offshore wind farms), progressively apply possible upgrades (line rebuilds with higher-capacity conductors, transformer additions, or any of the roadmap solutions listed in the initial study) until a

Table 4: Summary of Single POI Results

	POIs that can support 1,200 MW [illegible]	POIs that can support 2,000 MW without upgrades[15]	POIs that can support two 1,200 MW wind farms without upgrades[16]
[illegible]	[illegible]	[illegible]	1
New Hampshire	0	0	0
Boston	[illegible]	[illegible]	[illegible]

Results show what system constraints related to these POIs would cause significant curtailment of offshore wind output.

Since the multiple POI analysis models many potential offshore wind farms operating simultaneously, it may provide a better estimate of the total amount of future offshore wind that can be interconnected without constructing new transmission than the single POI analysis.

It is important to note that while this analysis captures the "big picture" of regional offshore wind possibilities, other combinations of POI MW injections not examined in this analysis may also be possible. Interconnection studies identify the actual upgrades required to interconnect projects and take into account resources in the interconnection queue along with POIs specified in related Interconnection Requests. Strong coordination within the region is essential to ensure that offshore wind is built in an organized and efficient manner.

The steps for multiple POI analysis are as follows:

> **Identify POIs from the single POI analysis that could accommodate 1,200 MW or more of injections for $100 million or less in upgrades.**
> **Test different combinations of these POIs over the six snapshots by adding discrete**

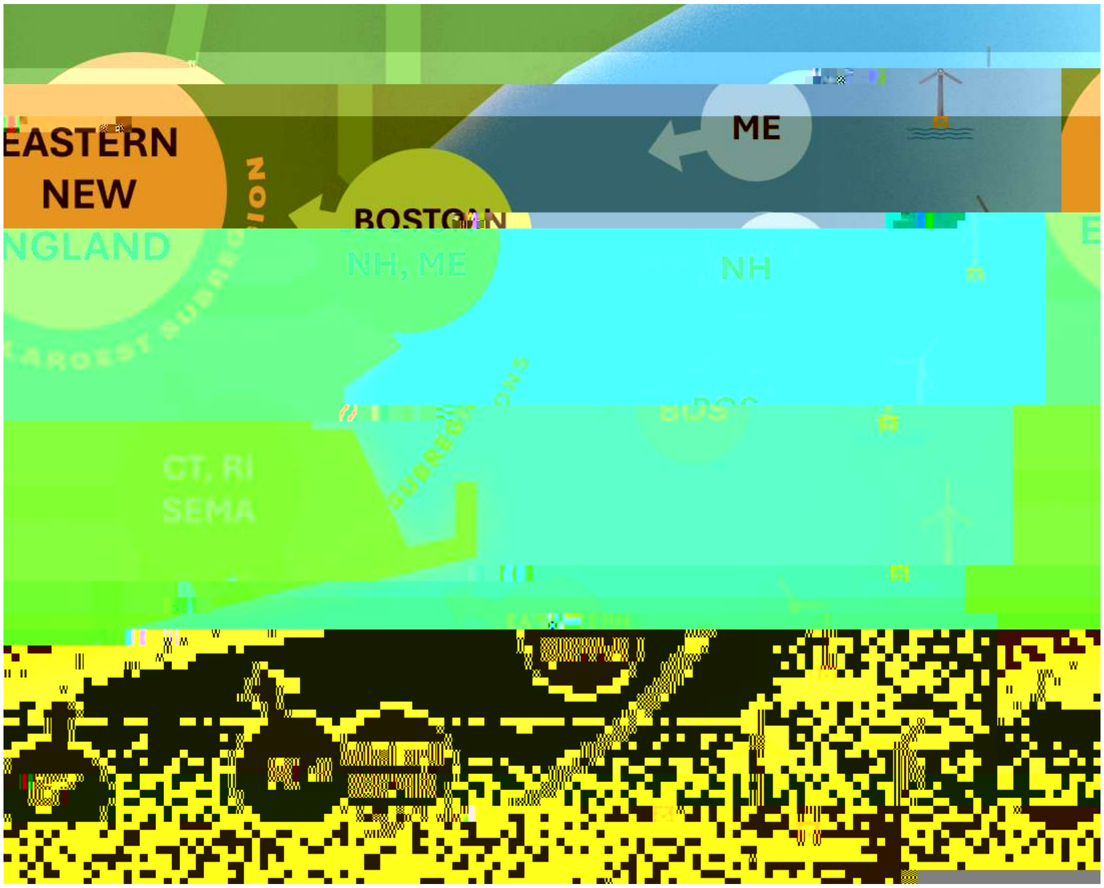

Figure 5: Progression of Steps in Multiple POI Analysis[17]

3.5 Multiple POI Detailed Findings

Multiple POI results, illustrated in Table 5, show how much offshore wind may be able to operate simultaneously across various sub-regions of New England. Combining several subregions to look at all eastern New England shows that up to eight 1,200 MW wind farms (9,600 MW total) could potentially interconnect without transmission upgrades and without significant curtailment. High level results are shown in Table 5.

Table 5: Summary of Multiple POI Results

Smallest Subregions	Number of 1,200 MW wind farms possible without any upgrades	Total injection of offshore wind possible without any upgrades
Connecticut	**2**	