System Non-Synchronous Penetration

Calculation Update

Revision 1.0: Operational Policy

September 2025

EirGrid SONI

Disclaimer

EirGrid as the Transmission System Operator (TSO) for Ireland, and SONI as the TSO for Northern Ireland make no warranties or representations of any kind with respect to the information contained in this document. We accept no liability for any loss or damage arising from the use of this document or any reliance on the information it contains. Use of this document and the information it contains is at the user's sole risk.

Introduction

With increasing levels of installed non-synchronous generation capacity i.e. wind and solar, and further interconnection to the All-Island power system, it is necessary to measure and limit the System Non-Synchronous Penetration (SNSP) to ensure safe and prudent operation of the system. The purpose of this document is to clarify the latest definition of SNSP.

The definition of SNSP is based on the results of the Facilitation of Renewables (FoR) studies. If future studies show a change in the SNSP definition is required, this policy will be updated accordingly.

Context

The FoR studies identified a number of issues associated with operating the power system with high penetrations of non-synchronous sources (e.g. wind generation and interconnector imports). These issues include frequency stability, transient stability and voltage stability, following the loss of a large infeed or following a transmission fault. The SNSP metric was developed, based on analysis of the results of the studies, to provide a single constraint that captures the range of issues. Although the metric is an approximation, it is deemed a prudent constraint to apply in real-time operation.

System Non-Synchronous Penetration Definition

SNSP is a measure of the non-synchronous generation on the system at an instant in time. It is the ratio of the real-time MW contribution from non-synchronous generation (including BESS discharges and Interconnector imports) to demand (including BESS charges and Interconnector exports.) The equation to express SNSP as a percentage is thus formulated as follows:

$$\text{SNSP}(\%) = \frac{\text{Non Sync Gen} + \text{BESS Discharges} + \text{Interconnector Imports}}{\text{Demand} + \text{BESS Charges} + \text{Interconnector Exports}} \text{ x } 100$$

Where:

Non-Synchronous Generation = Total Large Scale Non-Synchronous Generation + Representation of Total Small Scale Non-Synchronous Generation

- Total Large Scale Non-Synchronous Generation = Total wind and PV generation on the All-Island system (and any additional sources of non-synchronous generation)
- Representation of Total Small Scale Non-Synchronous Generation is calculated as follows:

  SSGRep = (Installed Capacity of Small-Scale Wind Generation * Ratio of

Availability to Installed Capacity of Large-Scale Wind Generation * 0.6) + (Installed Capacity of Small-Scale PV Generation * Ratio of Availability to Installed Capacity of Large-Scale PV Generation * 0.8[1])

- Interconnector Imports = The sum of all importing interconnectors measured at the SEM end (e.g. Moyle MW flow is measured at Ballycronan More, EWIC MW flow is measured at Portan, and Greenlink MW flow is measured at Great Island)
- Interconnector Exports = The sum of all exporting interconnectors measured at the SEM end (i.e., Moyle MW flow is measured at Ballycronan More, EWIC MW flow is measured at Portan, and Greenlink MW flow is measured at Great Island)
- BESS Discharges = The power output of batteries currently contributing power to the system.
- BESS Charges = The power consumption of all batteries that are currently charging.
- Demand is measured in generated[2] terms and for the purposes of SNSP includes Turlough Hill pump demand. It is calculated as follows for real-time calculations:
    - Demand = All-Island System Generation (including non-synchronous generation) + Interconnector Imports – Interconnector Exports + BESS Discharges – BESS Charges
    - Where All-Island System Generation[3] represents the generation required to meet the System Demand and any Turlough Hill pump demand

Additional Notes:

- It is assumed that Turlough Hill is regarded as additional demand when pumping;
- Demand Side Units, when dispatched, result in an implicit reduction in Demand; and
- Aggregated Generating Units should be considered additional synchronous generation.

[1] This is a performance factor used to account for the difference in efficiencies between large-scale PV sites and small-scale PV sites. This figure has been set to 0.8 based on initial research. This figure will be reviewed in the future following a more detailed analysis of small-scale PV generation behaviour.

[2] Generated Power = Exported Power + Generator House Load

[3] This is an All-Island equivalent of the current EMS “System Generation”. For example, if the demand was 3,000MW and there were two pumps on load at 73 MW each, the System Generation would be approx. 3,146MW.