

Future constraint levels for wind generation: development of scenarios

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Overview of Presentation

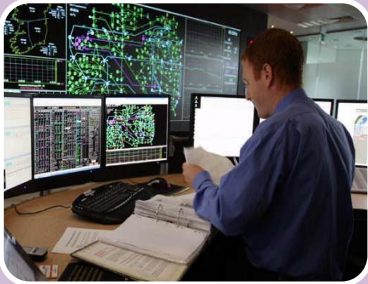
- Introduction
- Overview of constraints modelling
- Presentation of high-level results for the period 2011 - 2022.
 - Wind curtailment/constraint results
 - When does wind curtailment occur?
 - Wind generation and interconnection flows
 - Impact on conventional generation
 - 2020 RES-E results
- Future plans
- Future scenarios

Curtailement and Constraint



Curtailement and Constraint

- For the purposes of constraints modelling/reporting, the terms Curtailement and Constraint are used to refer to changes in generator output under different specific circumstances.



Curtailement

- Changes to generator output from the most economic dispatch in order to ensure that sufficient quantities of the system services necessary to run a safe and secure electricity system are available.
- At very high wind generation levels, further reduction of wind generator output may be required if wind generation levels still exceed demand.



Constraint

- Changes to generator output from the most economic dispatch due to transmission network limitations, specifically the overloading of transmission lines, cables and transformers.
- Constraint is location-specific and can be reduced by transmission network reinforcements.

Description of Constraints Modelling

Inputs

- Demand shape
- Generator characteristics
- Wind profiles
- Fuel prices
- Operational rules
- Transmission network

PROMOD

- Chronological Unit Commitment Economic Dispatch model
- 8760 hours modelled per year
- Minimise the system cost (fuel bill/operating costs) subject to constraints such as spinning reserve, generator capabilities, transmission network limitations etc.



Outputs

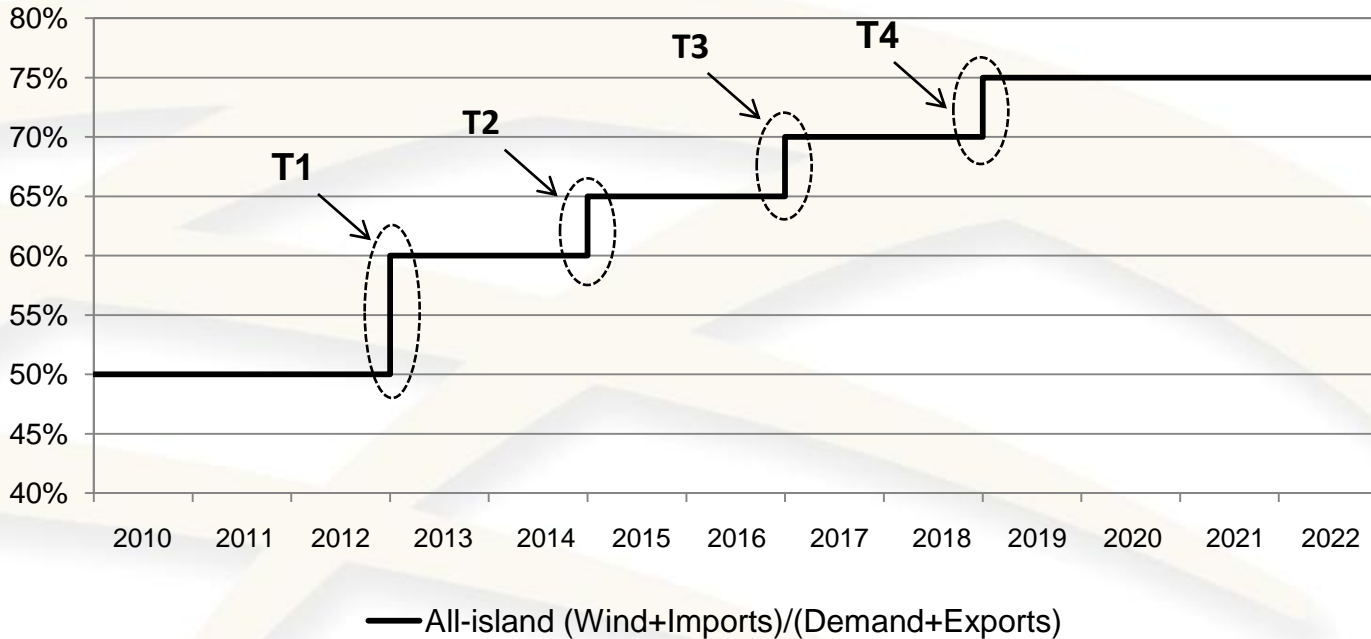
- Hourly generation pattern for each generator (No. of start-ups, loading patterns etc.)
- System/Fuel cost
- Fuel consumption by fuel type
- Emission quantities
- Transmission line loadings



Draft Operational Rule-set

- A draft operational rule-set, informed by the results from the Facilitation of Renewables workstream, was used.
- The rule-set covers:
 - Minimum conventional generation requirements
 - Operating reserve requirements
 - North-South Interconnection power flows
 - Limits on the instantaneous wind penetration
- Dispatch rule-set used is being consulted on by the SEM Committee.

Limits on the Instantaneous Wind Penetration



- T2** is dependent on the all-island penetration limit, which is determined by the capacity of the network to supply the demand. It is also dependent on the capacity of the network to supply the demand. It is also dependent on the capacity of the network to supply the demand. It is also dependent on the capacity of the network to supply the demand.

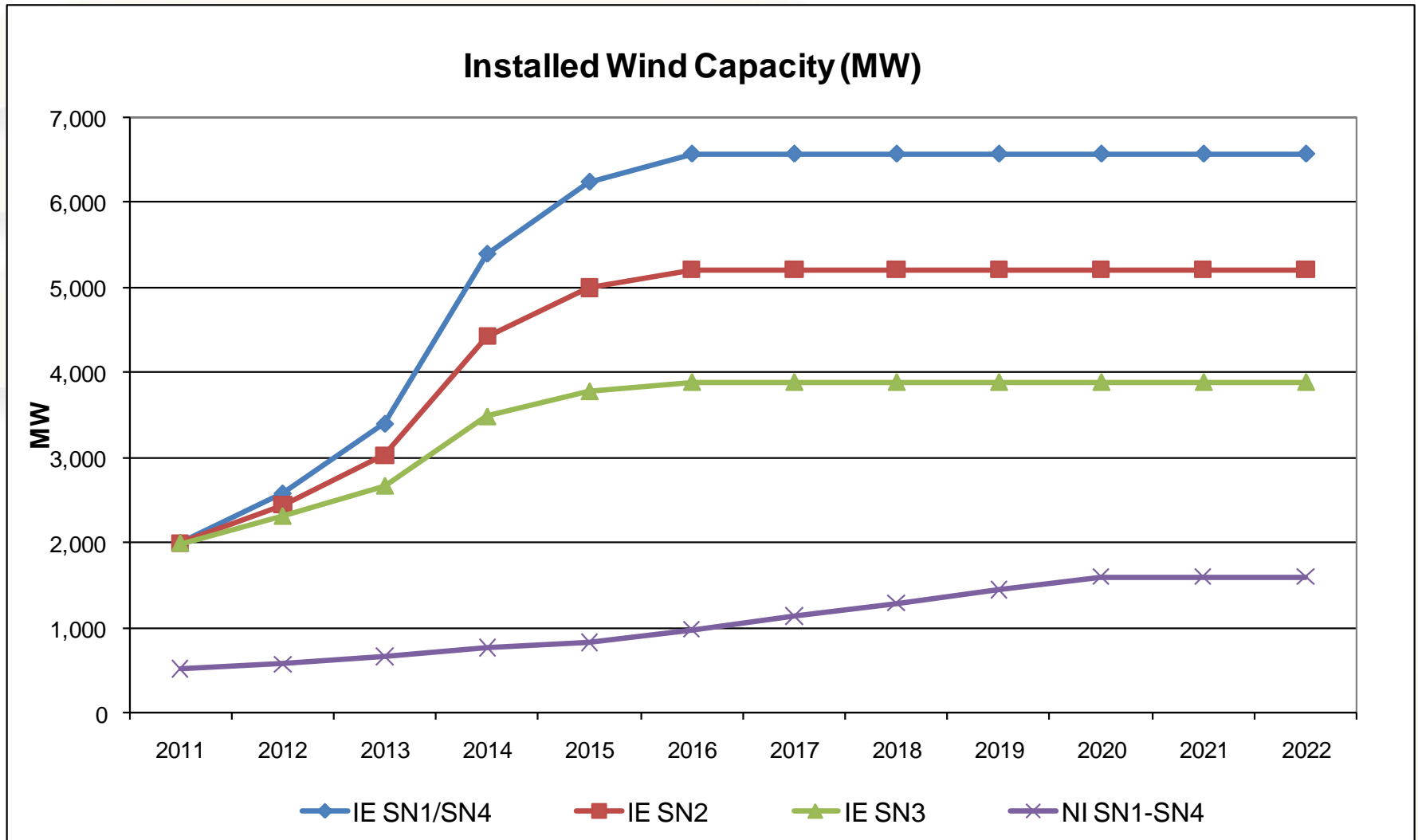
Scenarios

- Four scenarios were examined for each study year for the period 2011 through 2022.

Scenario	Gate 3 Wind (33%,66%,100%)	Fuel Price (Base Case, Alternative)
Scenario 1 (SN1)	100%	Base Case
Scenario 2 (SN2)	66%	Base Case
Scenario 3 (SN3)	33%	Base Case
Scenario 4 (SN4)	100%	Alternative

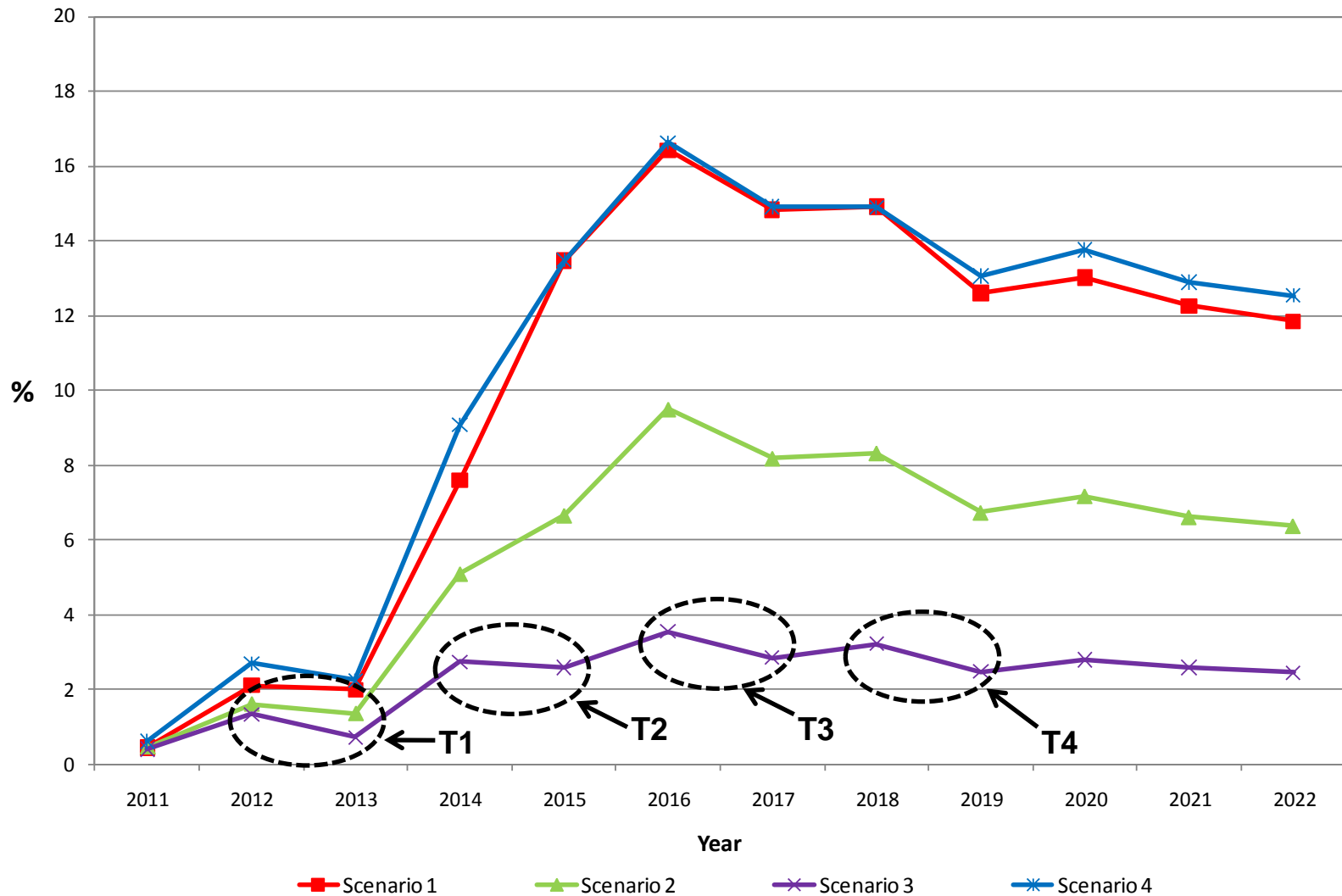
Installed Wind Capacity

- All IE generation added based on an estimate of shallow connection leadtimes

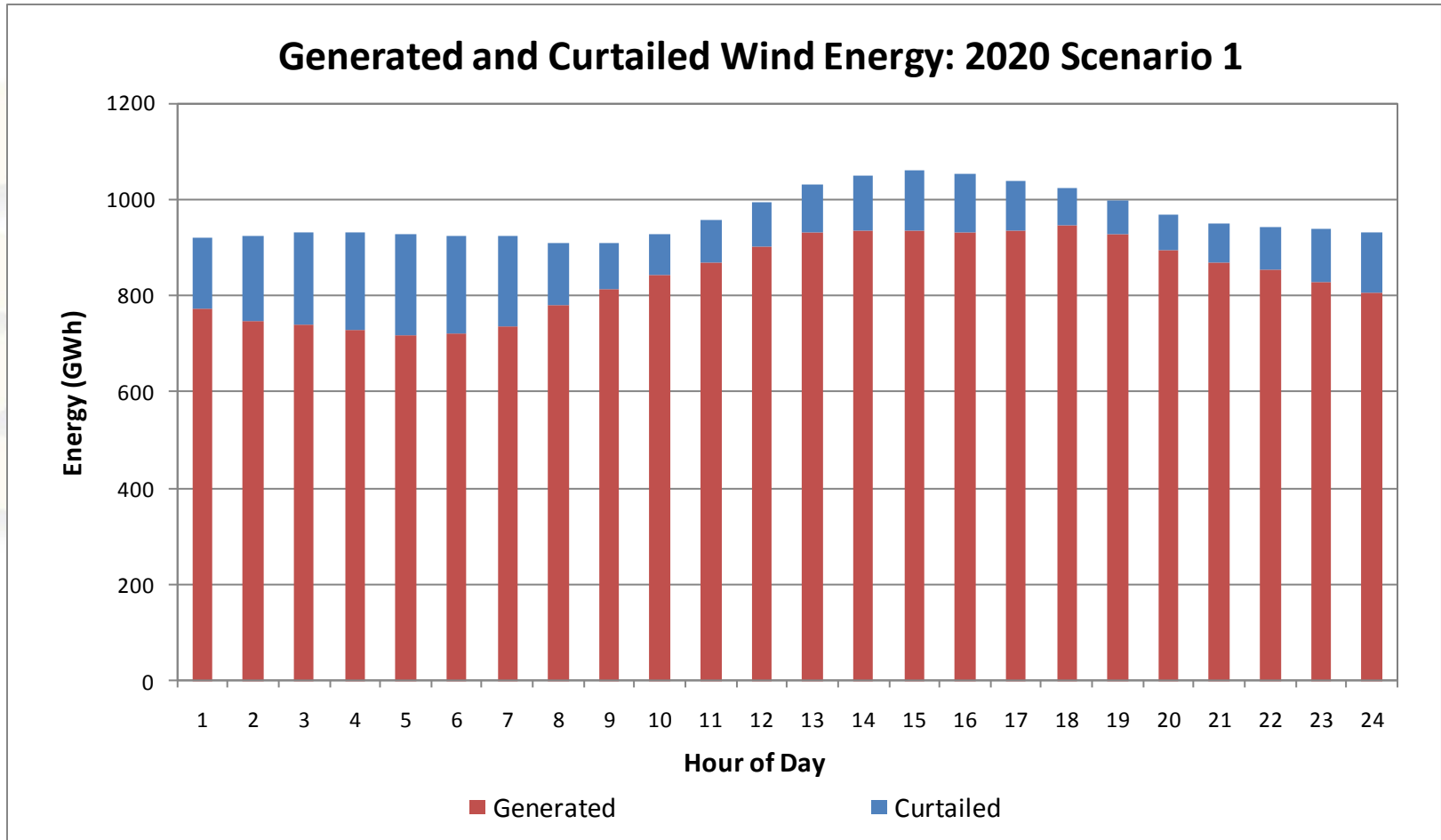


PGOR System Wind Curtailment Results

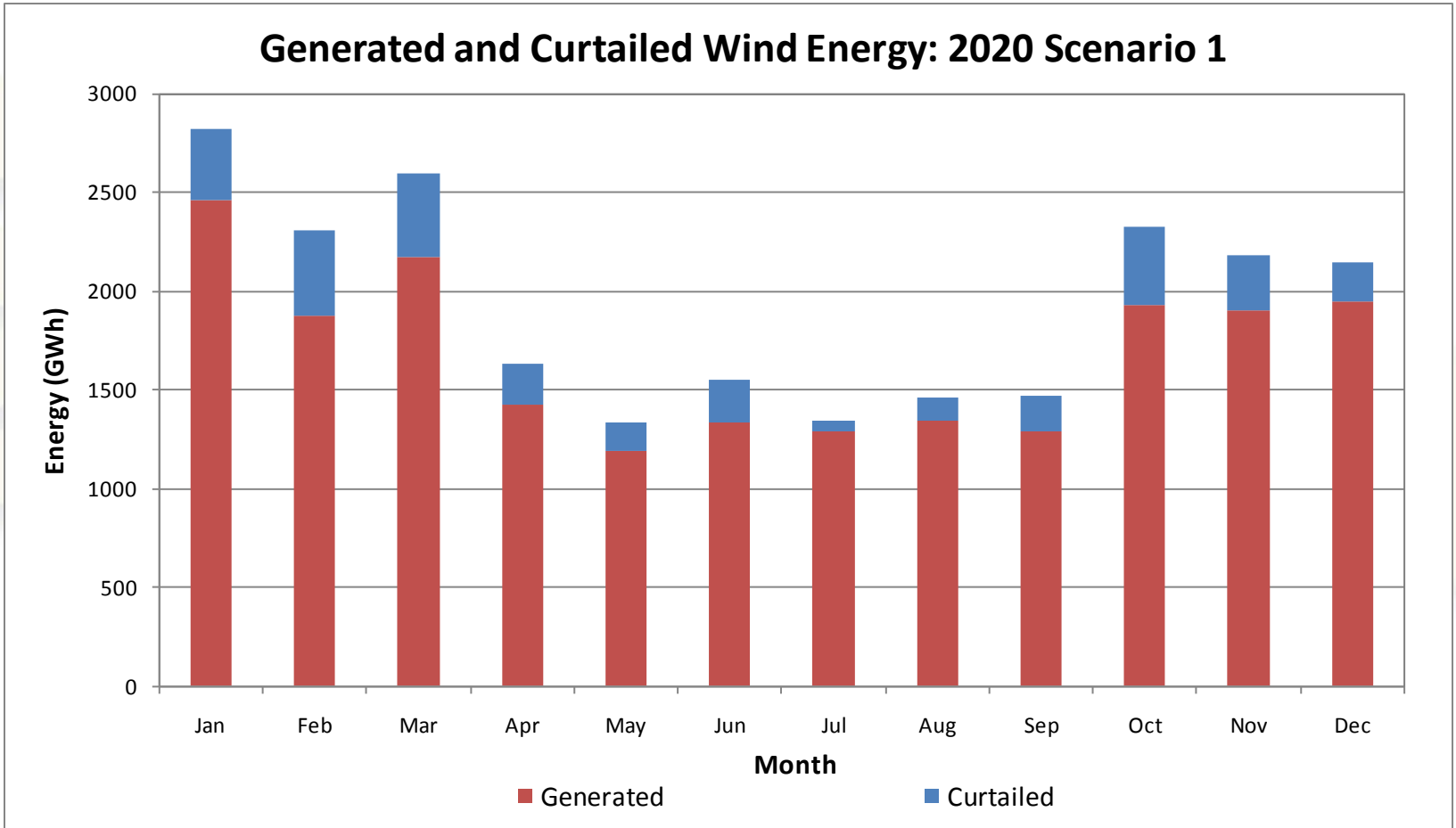
Ireland Wind Curtailment Level - Scenarios 1, 2, 3 & 4



Wind Curtailment: Time of Day?

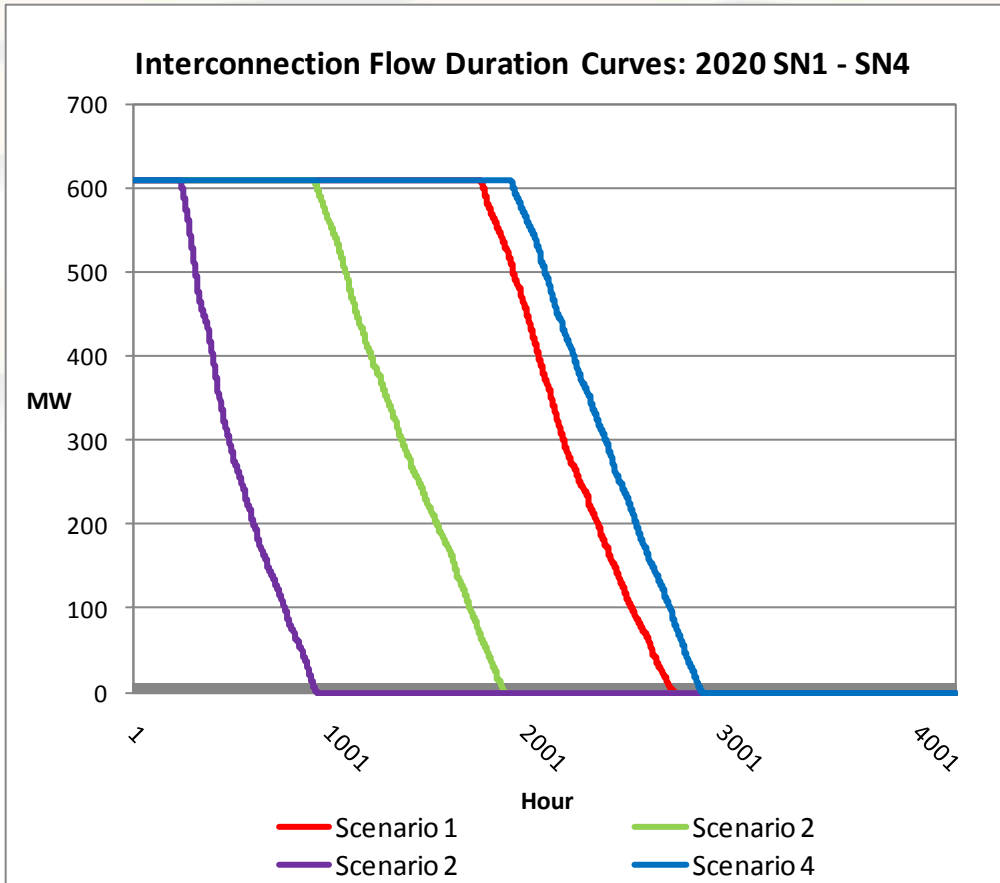


Wind Curtailment: Time of Year?



Exports on East-West and Moyle

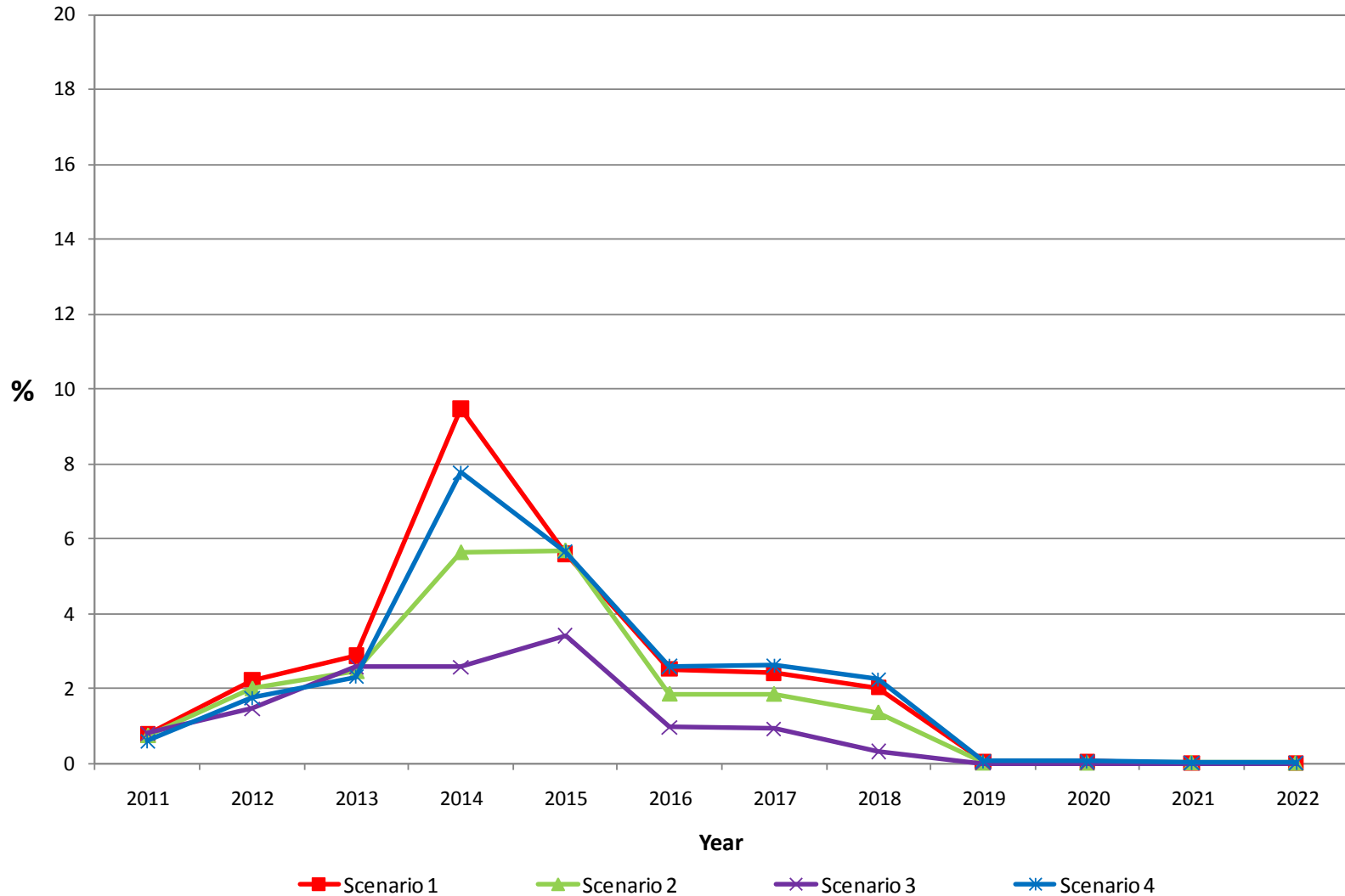
- At hours of excess wind generation, the East-West (530MW) and Moyle (80MW) Interconnectors are used to export wind generation that would otherwise be curtailed, up to their combined capacity of 610MW.
- At all other hours, zero flow on the interconnectors is assumed.



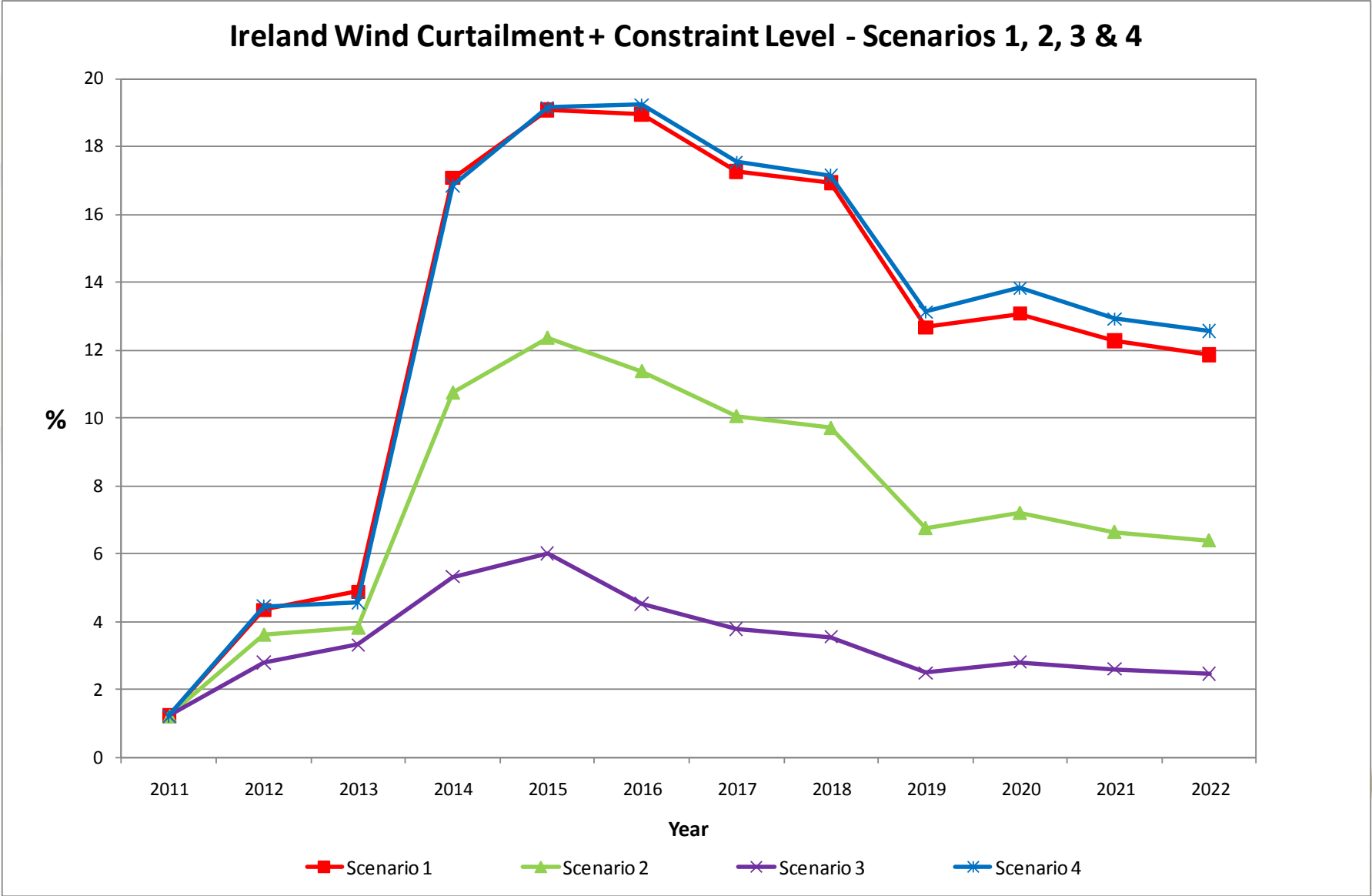
	SN1	SN2	SN3	SN4
Exported Energy (TWh)	1.4	0.8	0.3	1.5
% of All-Island Wind	6	4	2	6

PGOR System Wind Constraint Results

Ireland Wind Constraint Level - Scenarios 1, 2, 3 & 4



PGOR System Wind Curtailment + Constraint Results



Impact on Conventional Generation

Scenario	2011 Total Start-Ups	2020 Total Start-Ups
100% Gate 3 Wind	2,529	4,179
66% Gate 3 Wind	2,534	4,100
33% Gate 3 Wind	2,557	4,054

Indicative IE 2020 RES-E Energy

Indicative IE 2020 RES-E Energy	2020 SN1 (100% Gate 3 Wind)	2020 SN2 (66% Gate 3 Wind)	2020 SN3 (33% Gate 3 Wind)	2020 SN4 (100% Gate 3 Wind)
Installed Wind Capacity (GW)	6.6	5.2	3.9	6.6
Available Wind Energy (TWh)	18.5	14.7	10.9	18.5
Max Possible Wind Penetration (%)	55%	44%	33%	55%
Max Possible RES-E Penetration (%)	60%	48%	37%	60%
Wind Curtailment & Constraint (%)	13%	7%	3%	14%
Resulting Wind Penetration (%)	48%	41%	32%	48%
Resulting RES-E Penetration (%)	53%	45%	36%	52%

Future Plans

- The Possible Generator Output Reductions (PGOR) report for a Gate 3 Area will be published when all offers in an area have been issued.
 - Area K, Area D and Area H2 PGOR reports have already issued.
 - Workshops on curtailment/constraint levels will be held to answer more detailed queries on Area results.
- If the final dispatch rules differ from the draft set employed => Re-run of constraints model is required.
- Possible re-run of constraints model starting in Q3 2011.

Future Scenarios

- Potential additional scenarios to be studied could cover:
 - Take-up of connection offers
 - Windfarm build-out rate/timing
 - Treatment of non-controlled wind farms
 - Changes to timing of network roll-out
 - Multi-year wind profiles
 - Further interconnection
- Potential additional scenarios to be studied will be discussed at the Gate 3 Liaison Group. The dependencies are:
 - Whether a re-run is required due to a change in dispatch rules
 - Resources

Questions?

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