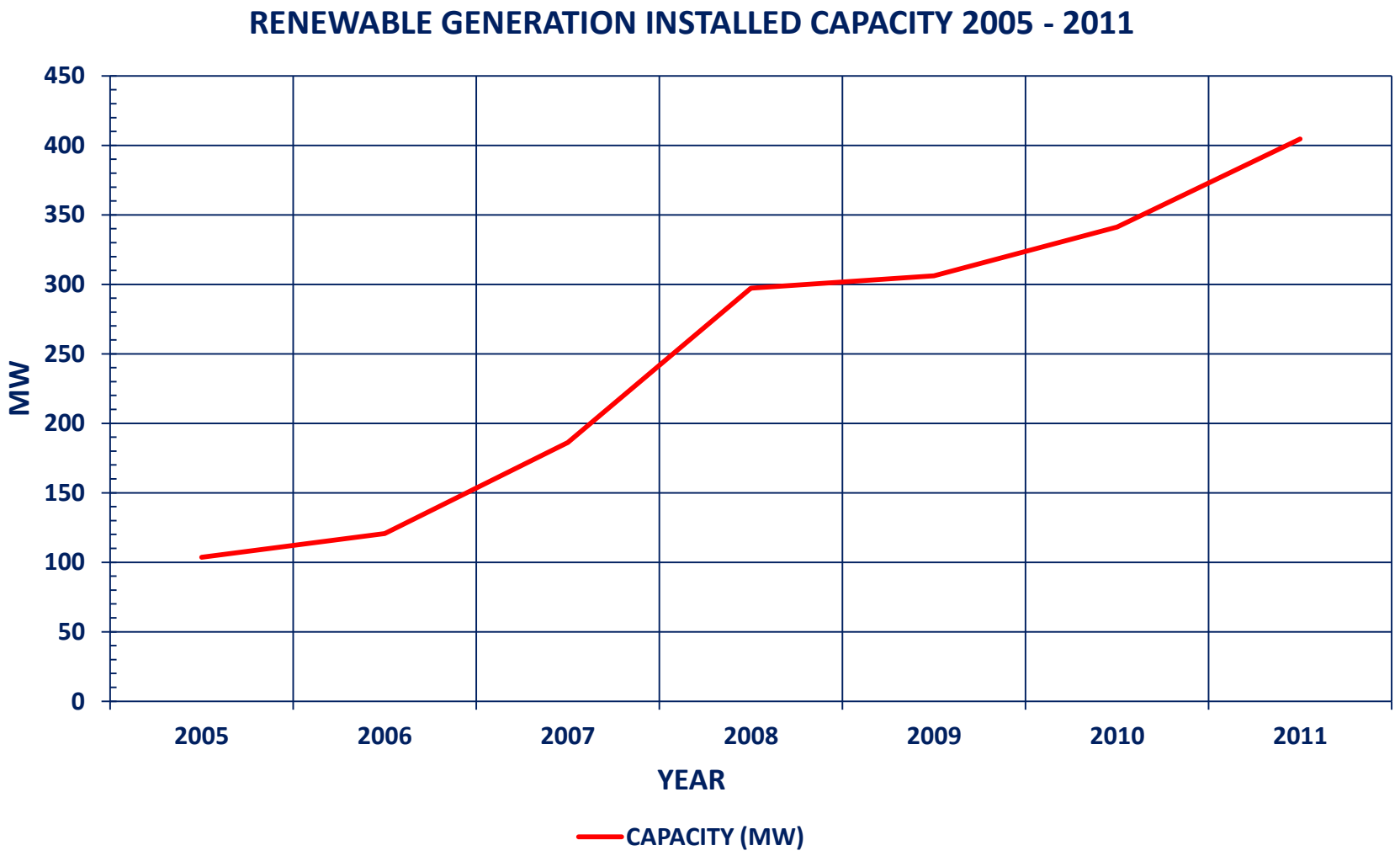
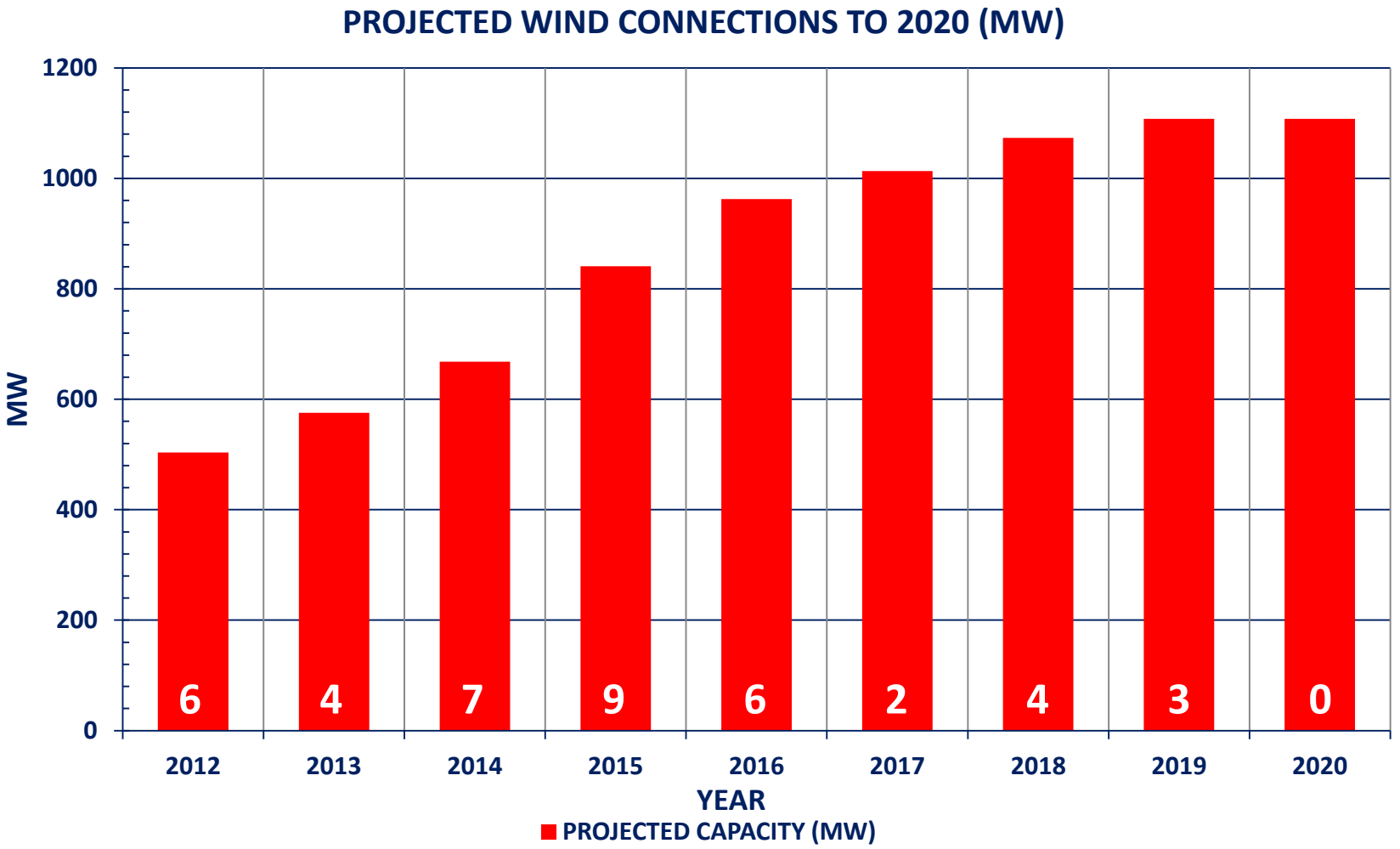
System Operator for Northern Ireland

THE NEED FOR ITC AND CONSTRAINTS

RENEWABLE GENERATION



RENEWABLE GENERATION



DEVELOPER REQUIREMENTS

- **COMMON REQUESTS FROM DEVELOPERS:**
  - **FIRM ACCESS QUANTITIES**
  - **TIMELINES OF TRANSMISSION WORKS**
  - **LIKELY CONSTRAINTS/CURTAILMENTS PRE AND POST NETWORK REINFORCEMENT**
- **REQUIRED FOR DETAILED PROJECT FINANCIAL ANALYSIS**

SONI LICENCE

- **CONDITION 25 OF "LICENCE TO PARTICIPATE IN THE TRANSMISSION OF ELECTRICITY"**

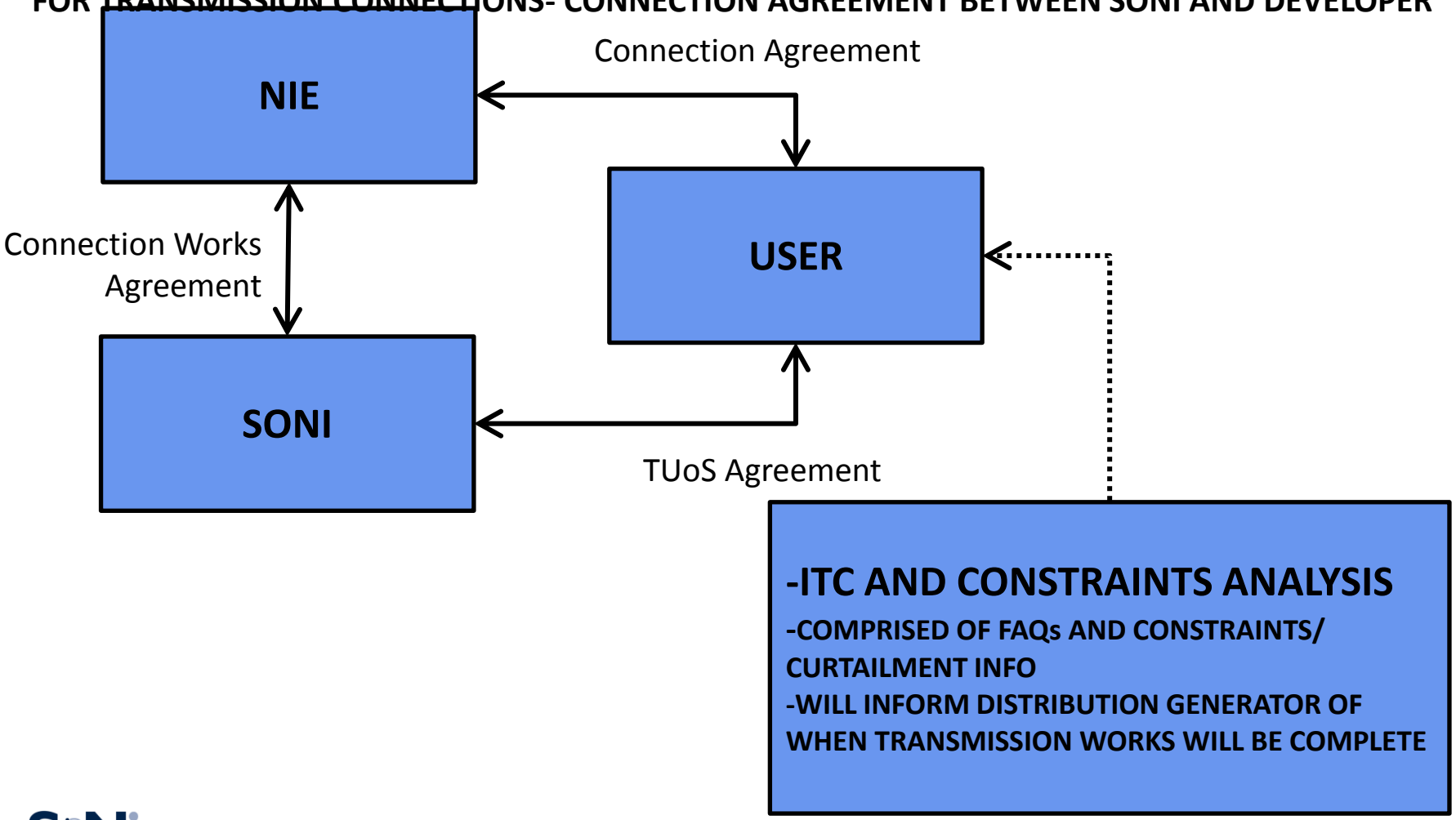
- **OFFER OF TERMS FOR THE USE OF THE ALL-ISLAND TRANSMISSION NETWORK**

  "On application by any eligible person, the Licensee shall offer to enter into a Use of System Agreement"

- **OFFER OF TERMS FOR CONNECTION TO THE ALL-ISLAND TRANSMISSION NETWORK**

RELATIONSHIPS
FOR DISTRIBUTION CONNECTED USERS

FOR TRANSMISSION CONNECTIONS- CONNECTION AGREEMENT BETWEEN SONI AND DEVELOPER



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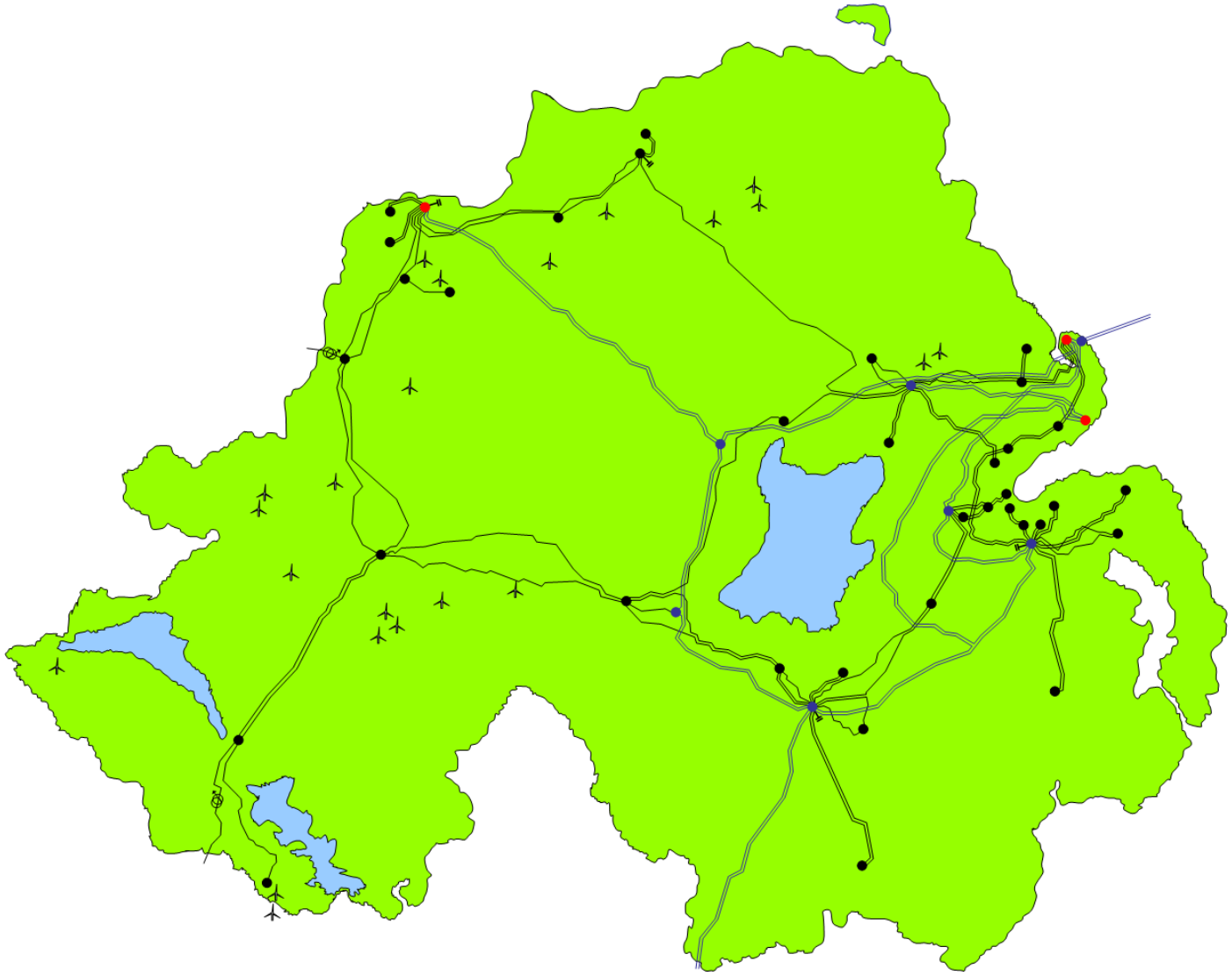
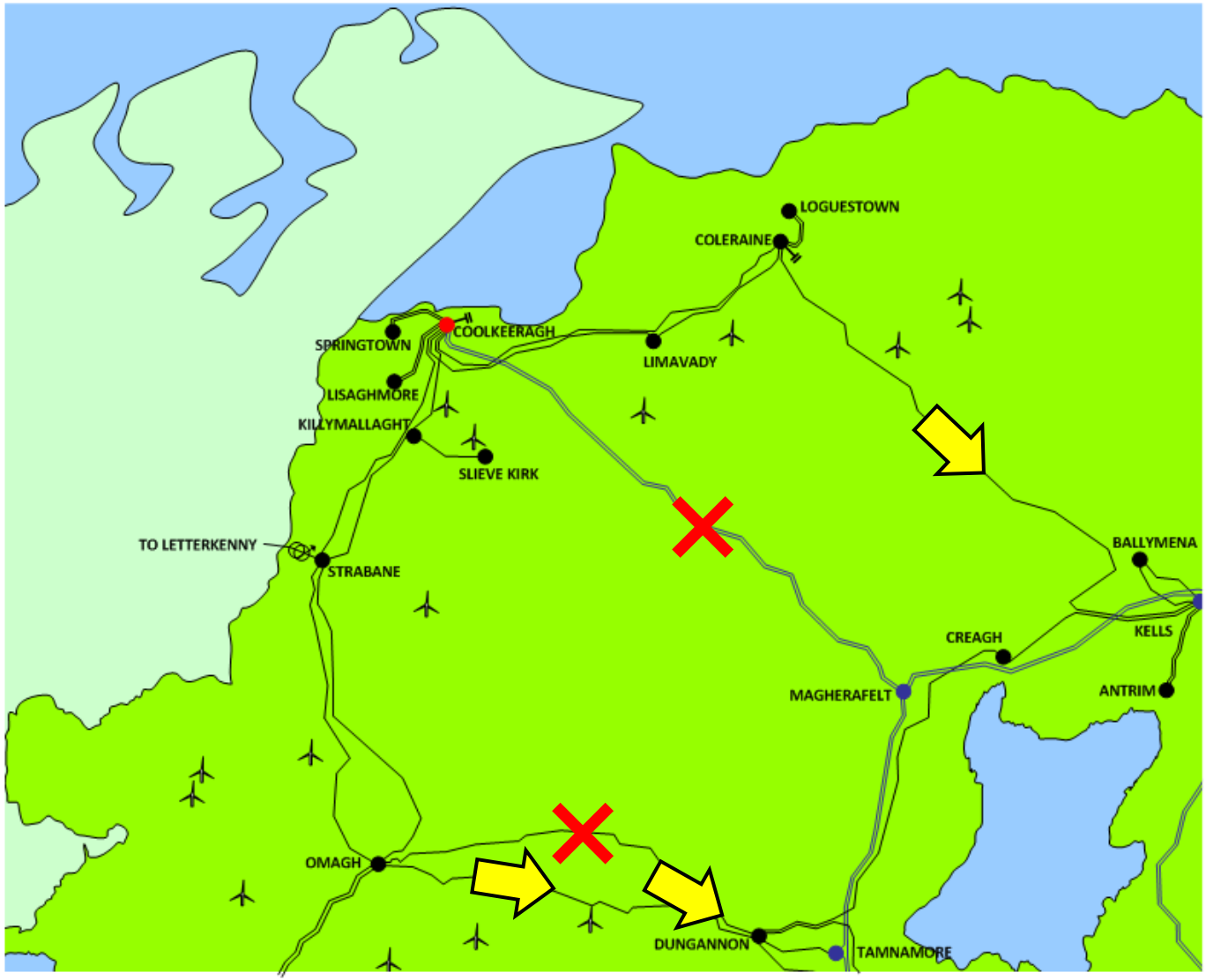
INCREMENTAL TRANSFER CAPABILITY

METHODOLOGY

PRESENT NI NETWORK



CONSTRAINED REGION

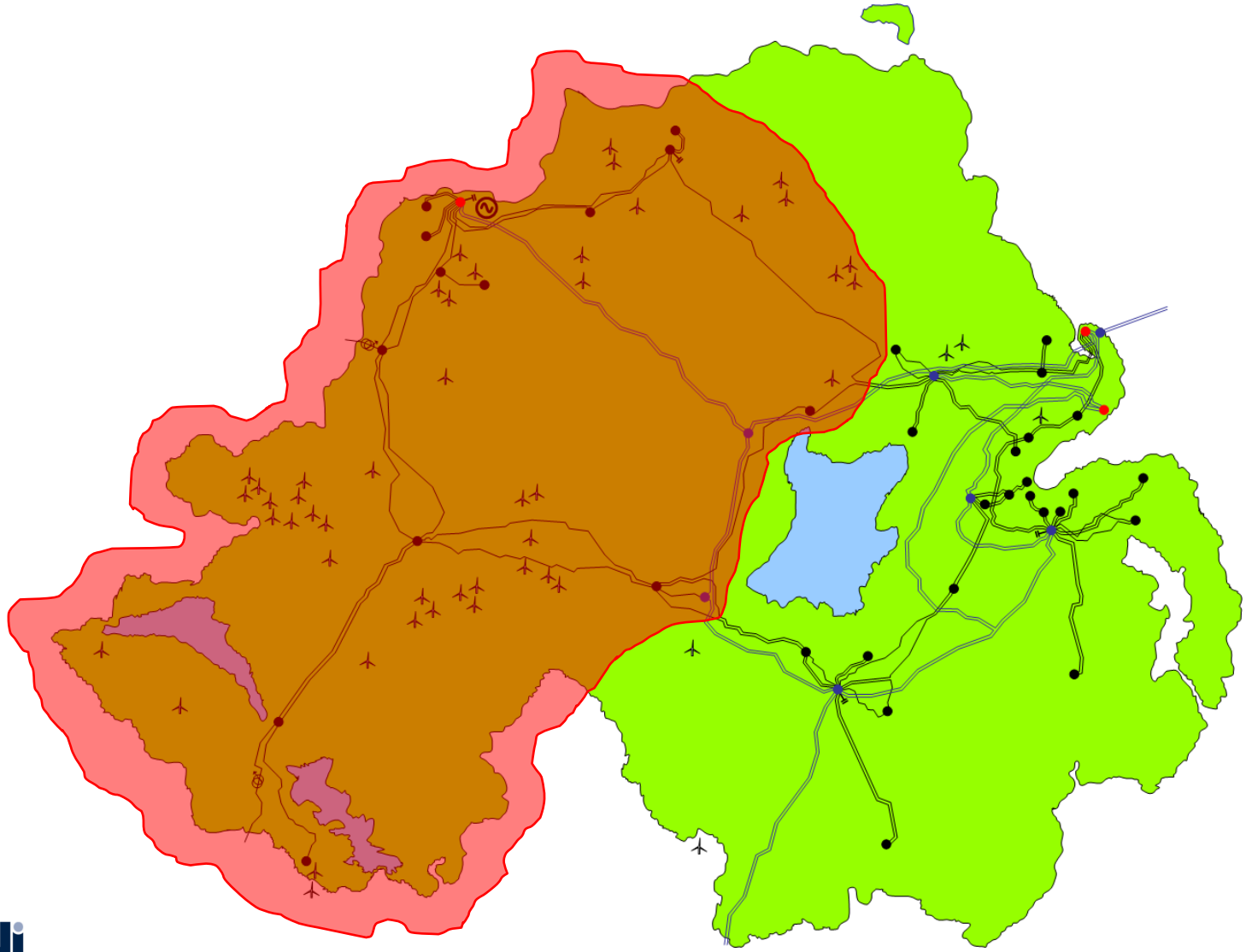


GENERATION BY 2016

- **RENEWABLE:**
  - **PRESENTLY 397.8 MW CONNECTED**
  - **OF WHICH 119 MW CONNECTED VIA SPECIAL PROTECTION SCHEME**
  - **FURTHER 512 MW WITH PLANNING APPROVAL**
  - **TOTAL OF 910MW OF RENEWABLE GENERATION CONNECTED BY 2016**

- **CONVENTIONAL:**
  - **NO PRESENT APPLICATIONS**

GENERATION BY 2016



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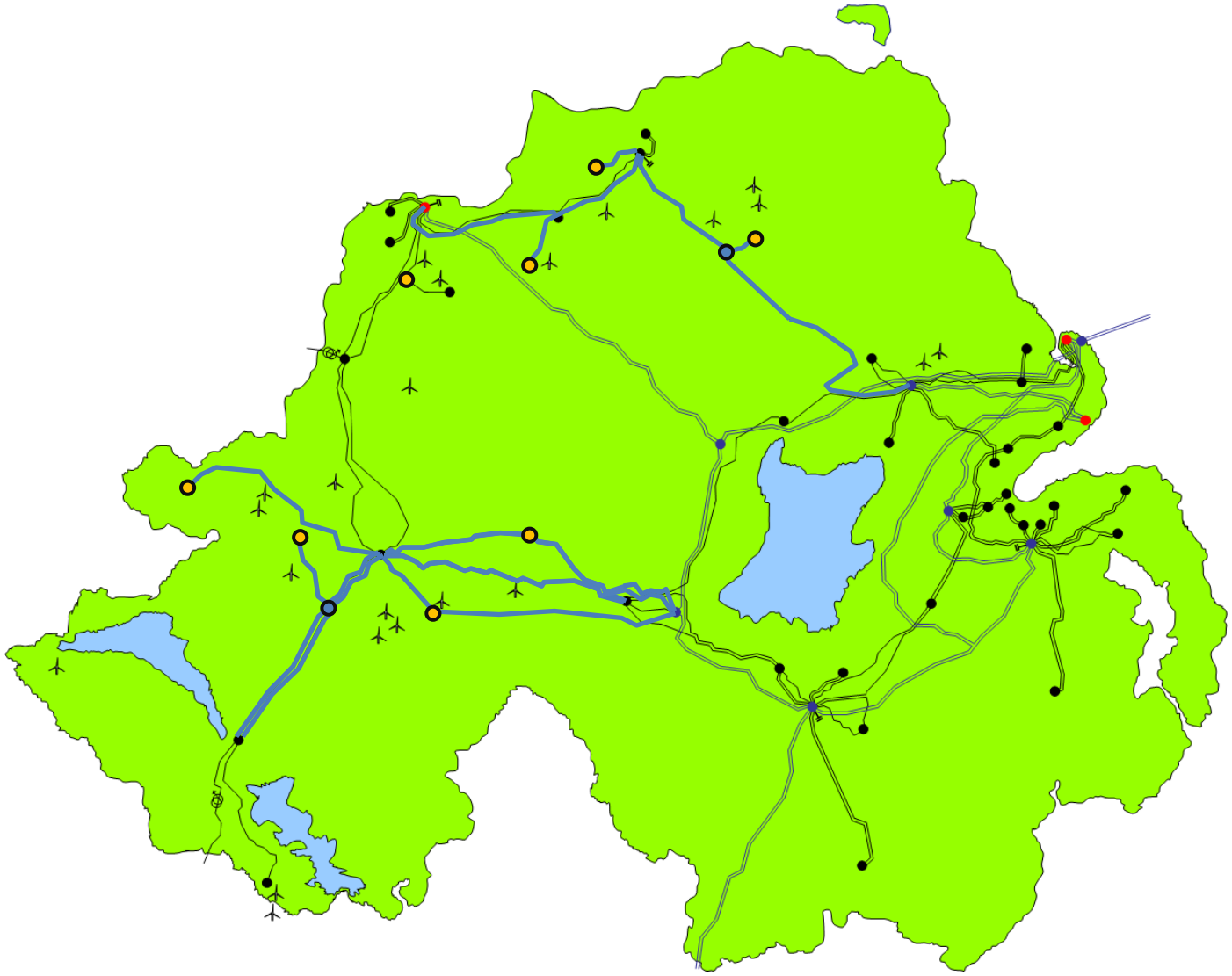
NI TRANSMISSION NETWORK DEVELOPMENT



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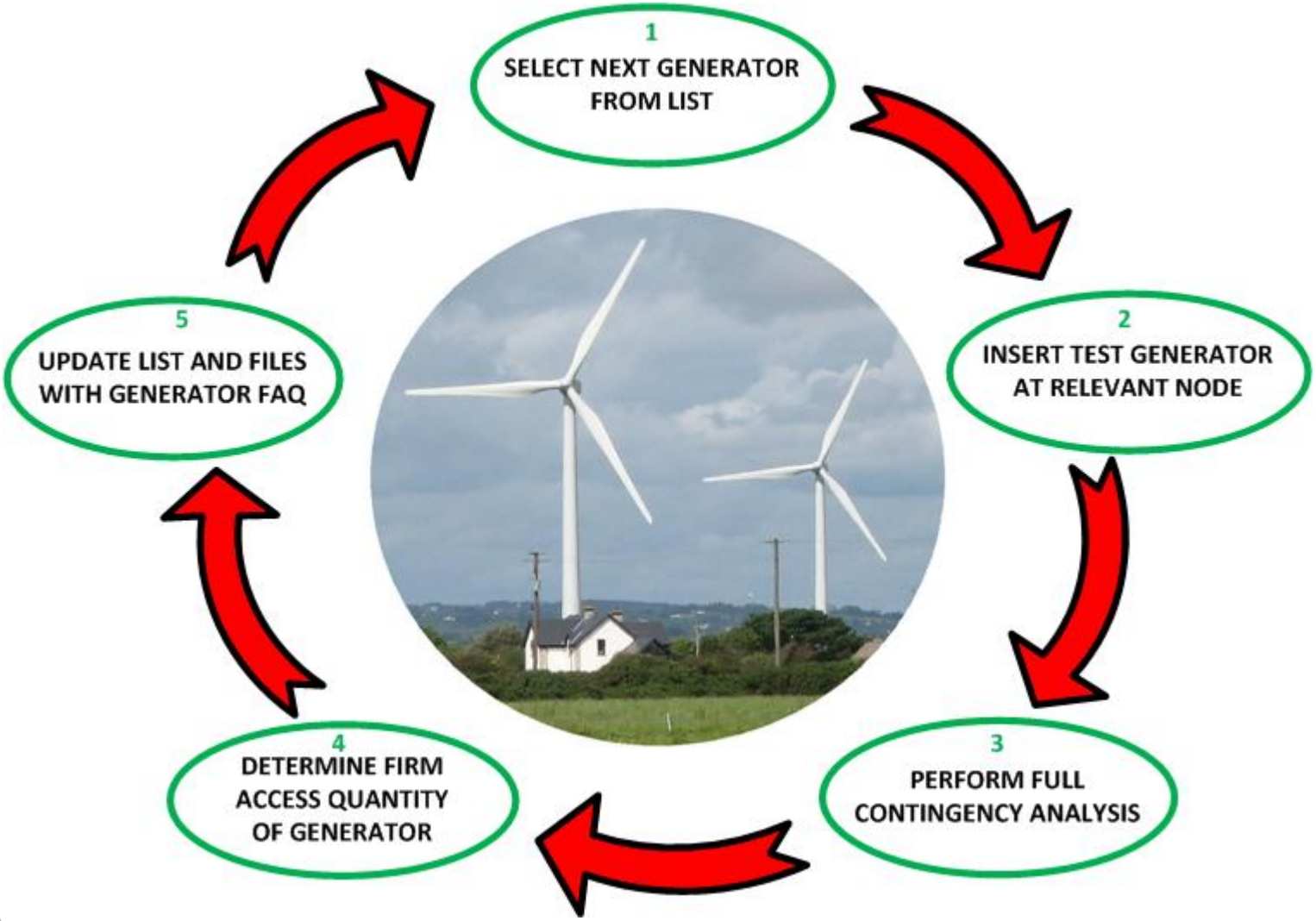
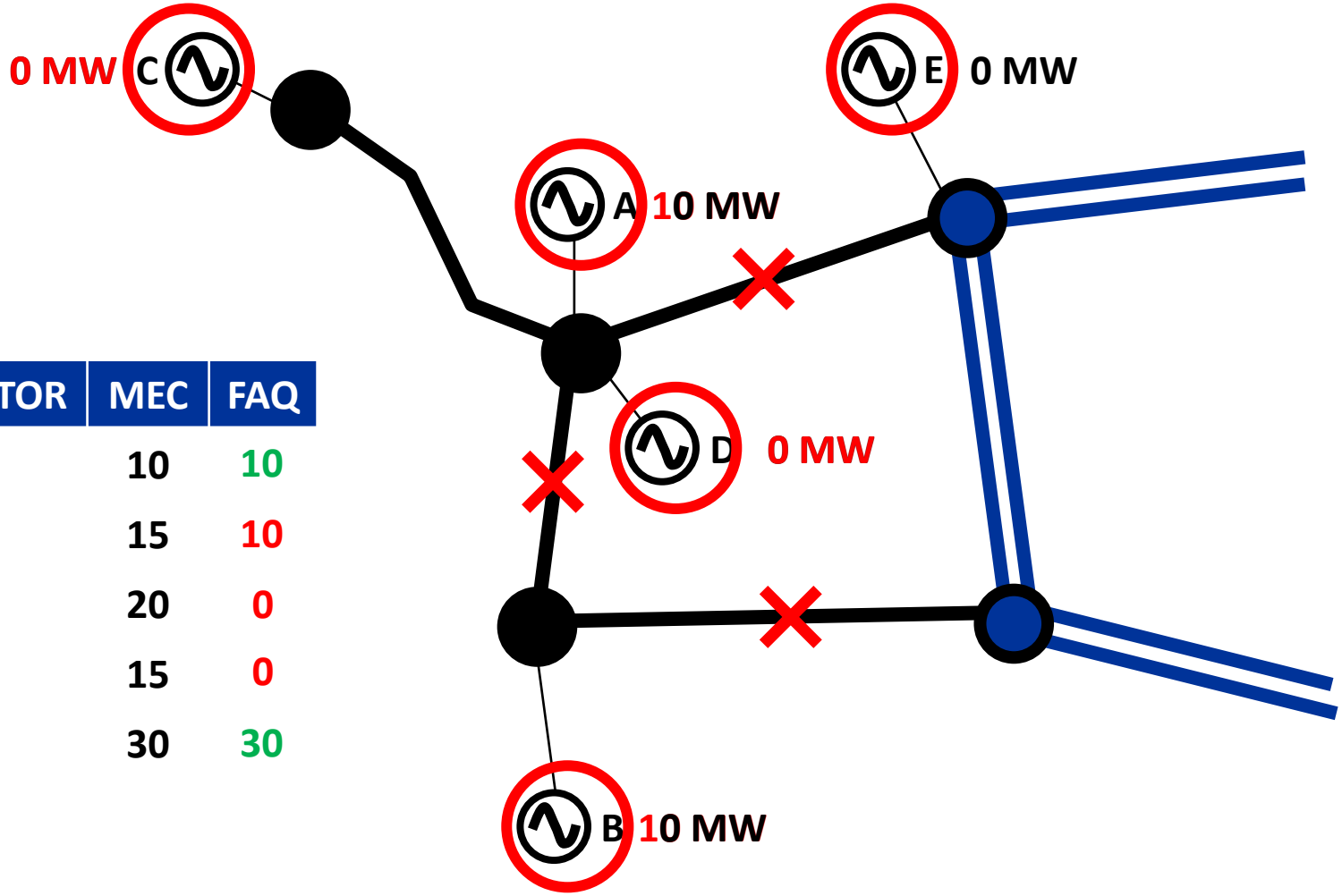
SIMPLIFIED PROCESS



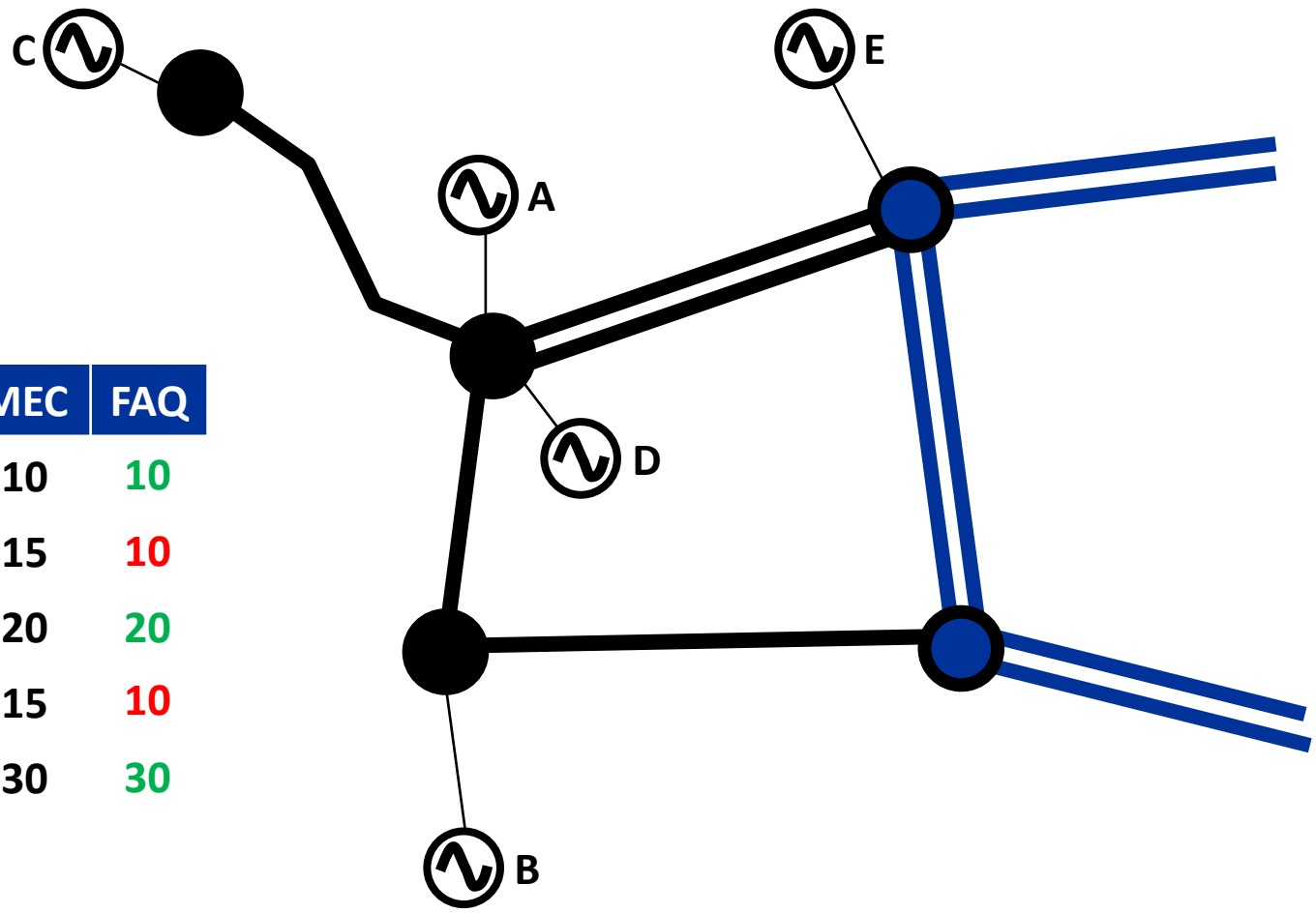
PROCESS – YEAR 1



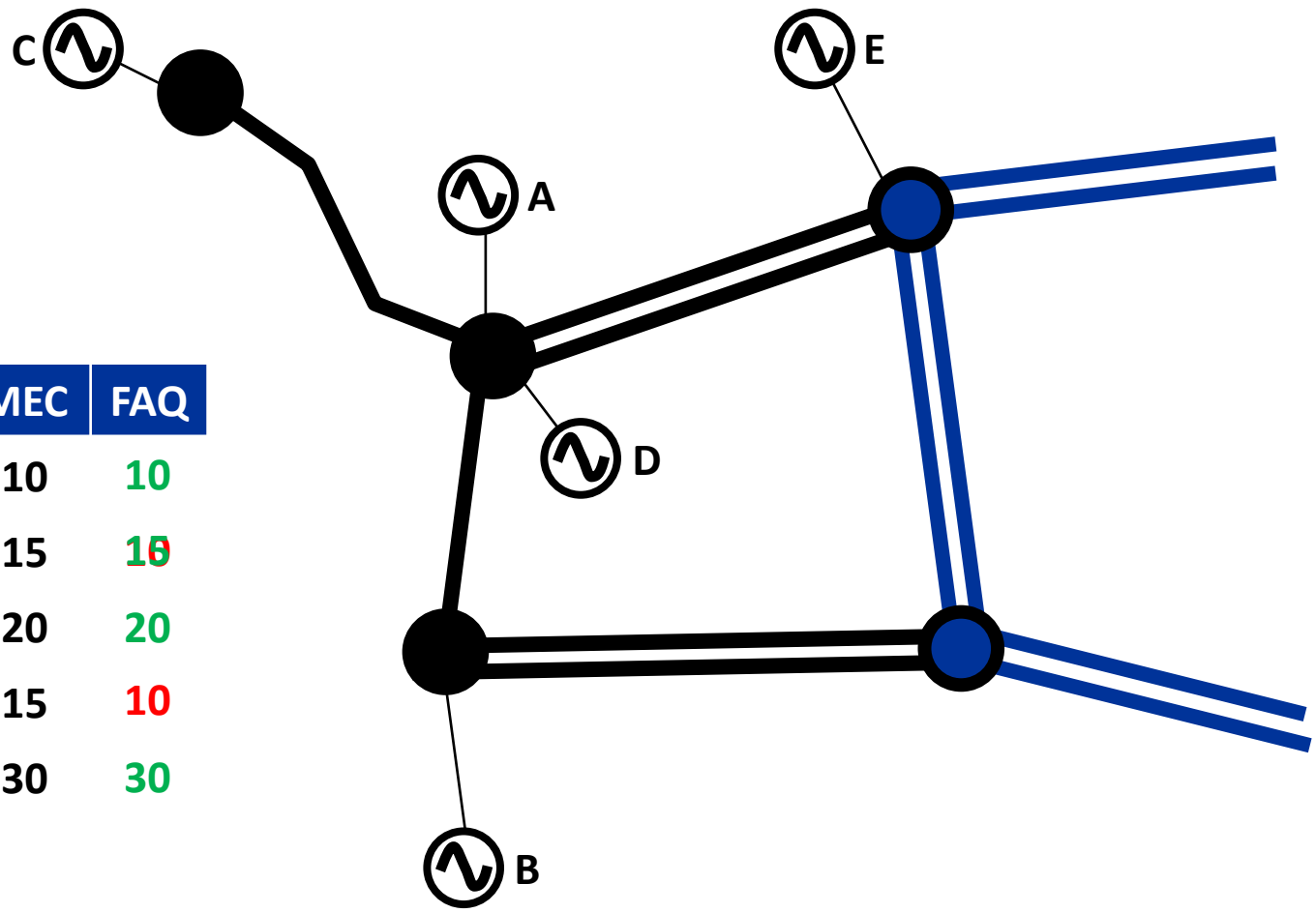
GENERATOR	MEC	FAQ
A	10	10
B	15	10
C	20	0
D	15	0
E	30	30

PROCESS – YEAR 2

GENERATOR	MEC	FAQ
A	10	10
B	15	10
C	20	20
D	15	10
E	30	30



PROCESS – YEAR 3



GENERATOR	MEC	FAQ
A	10	10
B	15	15
C	20	20
D	15	10
E	30	30

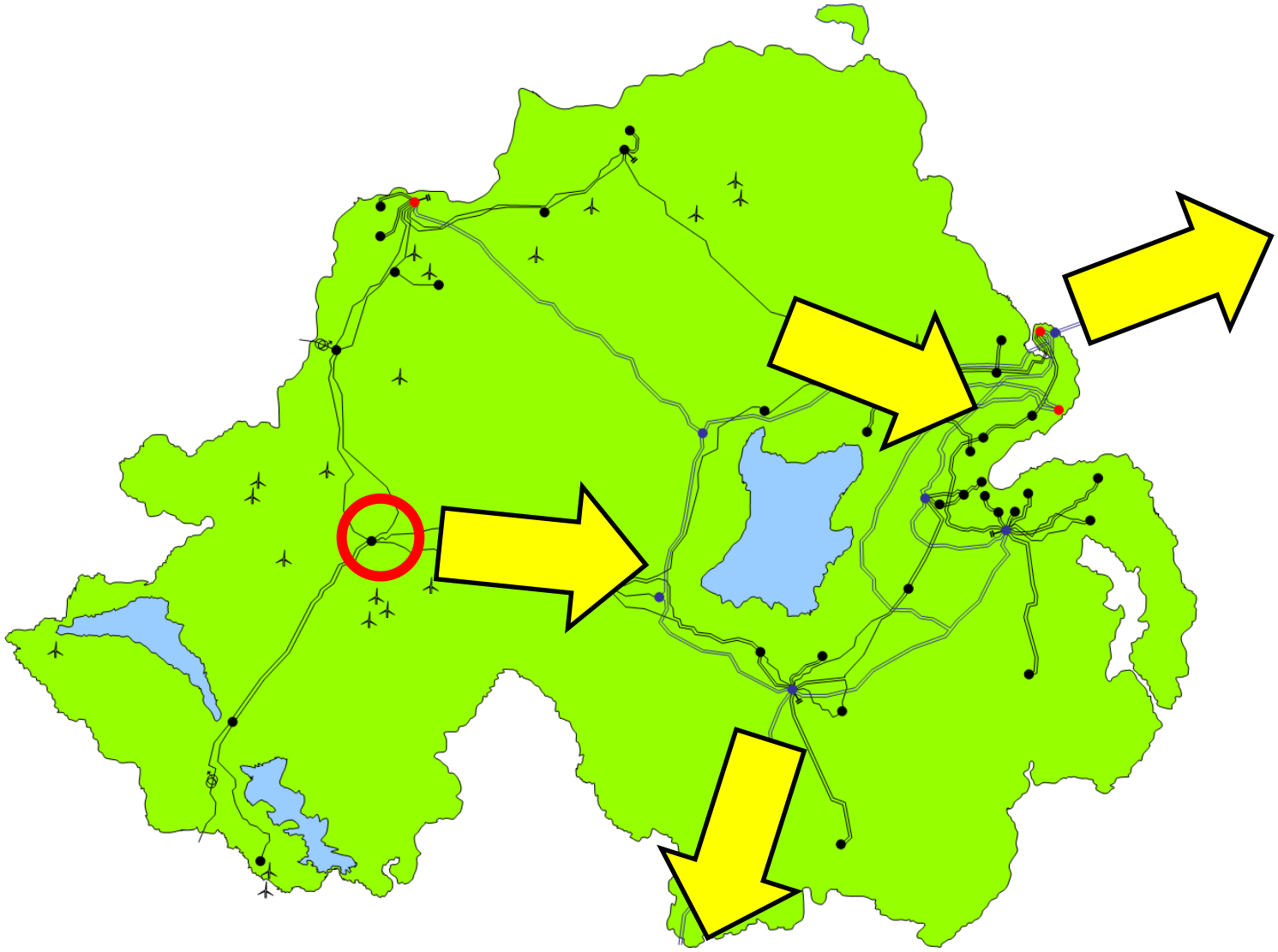
NORTHERN IRELAND APPROACH

- **EACH GENERATOR TESTED AT FOUR DEMAND SCENARIOS:**
  - **WINTER MAXIMUM**
  - **AUTUMN MAXIMUM**
  - **SUMMER MAXIMUM**
  - **SUMMER MINIMUM**

- **CONTINGENCY ANALYSIS PERFORMED FOR EACH SEASON:**
  - **N-1 AND N-DC FOR WINTER**
  - **N-1 FOR AUTUMN AND SUMMER**
  - **COOLKEERAGH-MAGHERAFELT DOUBLE CIRCUIT LOSS INCLUDED FOR ALL SEASONS**

- **NEW GENERATION ACCOMMODATED BY THREE METHODS:**

NORTHERN IRELAND APPROACH



NORTHERN IRELAND APPROACH

- **EACH GENERATOR TESTED AT FOUR DEMAND SCENARIOS:**
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- **CONTINGENCY ANALYSIS PERFORMED FOR EACH SEASON:**
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  - **N-1 AND N-M-T FOR AUTUMN AND SUMMER**
  - **COOLKEERAGH-MAGHERAFELT DOUBLE CIRCUIT LOSS INCLUDED FOR ALL SEASONS**

- **NEW GENERATION ACCOMMODATED BY THREE METHODS:**
  - **BY DISPLACING EXISTING NI GENERATION**
  - **SENDING THE POWER TO RoI**
  - **SENDING THE POWER TO GB**

- **IN TOTAL, 12 SETS OF CONTINGENCY STUDIES PERFORMED FOR EACH GENERATOR**

DISPATCH ASSUMPTIONS IN NI

- EXISTING RENEWABLE GENERATION DISPATCHED AT 100% OUTPUT
- MOYLE TRANSFER BASED ON AVERAGE HISTORICAL FLOWS
- CONVENTIONAL GENERATION DISPATCHED ON A MERIT ORDER BASIS:
  - MINIMUM OF THREE MACHINES ON IN NORTHERN IRELAND
  - CONVENTIONAL PLANT DISPATCHED ON AN ALL-ISLAND BASIS
- NORTH-SOUTH TRANSFERS MAINTAINED WITHIN EXISTING LIMITS
  - 330 MW EXPORT
  - 260 MW IMPORT

OUTPUT

GENERATOR	110kV NODE	MEC	2011		2012		2013	
			FAQ	NOTES	FAQ	NOTES	FAQ	NOTES
A	COLERAINE	20	10	Overloads on Coleraine-Kells 110kV circuit restricts FAQ	20	Transfer of windfarm to new cluster allows full FAQ	20	Full FAQ allocated
B	BALLYVALLAGH	30	30	Full FAQ allocated	30	Full FAQ allocated	30	Full FAQ allocated
C	OMAGH	25	0	No FAQ as there is no capacity on the existing 110/33kV TXs	5	Omagh TXs changed, FAQ limited by Omagh-Dungannon 110kV circuits	25	Completion of third Omagh-Dungannon 110kV circuit allows full FAQ
D	COLERAINE	20	0	No FAQ due to overloads on Coleraine-Kells 110kV circuit	10	Transfer of windfarm A to new cluster allows allocation of some FAQ	20	Completion of uprating on Coleraine-Kells 110kV circuit allows full FAQ
E	OMAGH	15	0	No FAQ as there is no capacity on the existing 110/33kV TXs	0	Overload on Omagh-Dungannon 110kV circuits	15	Completion of third Omagh-Dungannon 110kV circuit allows full FAQ

SUMMARY

- 512MW OF RENEWABLE GENERATION TO BE CONNECTED BY 2016
- SORTED INTO A QUEUE BASED ON PLANNING APPROVAL DATE
- EACH GENERATOR IN TURN SUBJECT TO COMPREHENSIVE N-1 AND N-DC ANALYSIS
- NETWORK REINFORCEMENTS BASED ON NIE's TIP

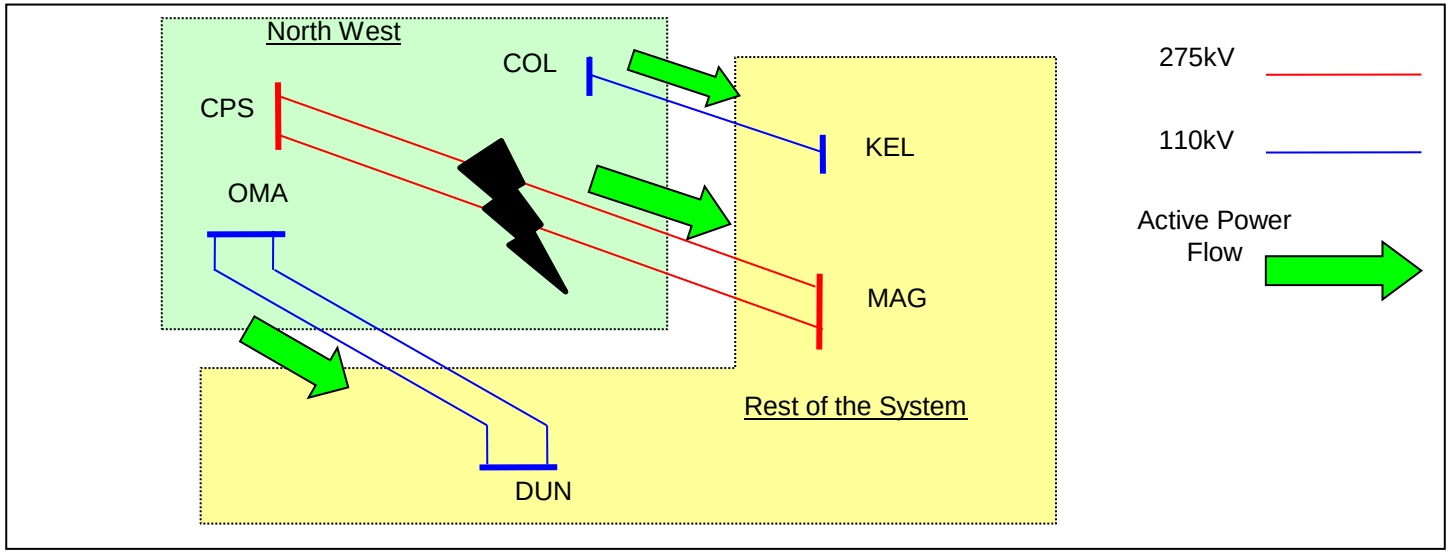
System Operator for Northern Ireland

Generator Output Reductions

Methodology

Methodology – Part One

- The worst case contingency for the NI transmission system is the loss of CPS – MAG 275kV Double Circuit. This methodology assumes that SONI will pre fault constrain to prevent overloads should this outage occur at any time. (the remaining network is modelled solid)

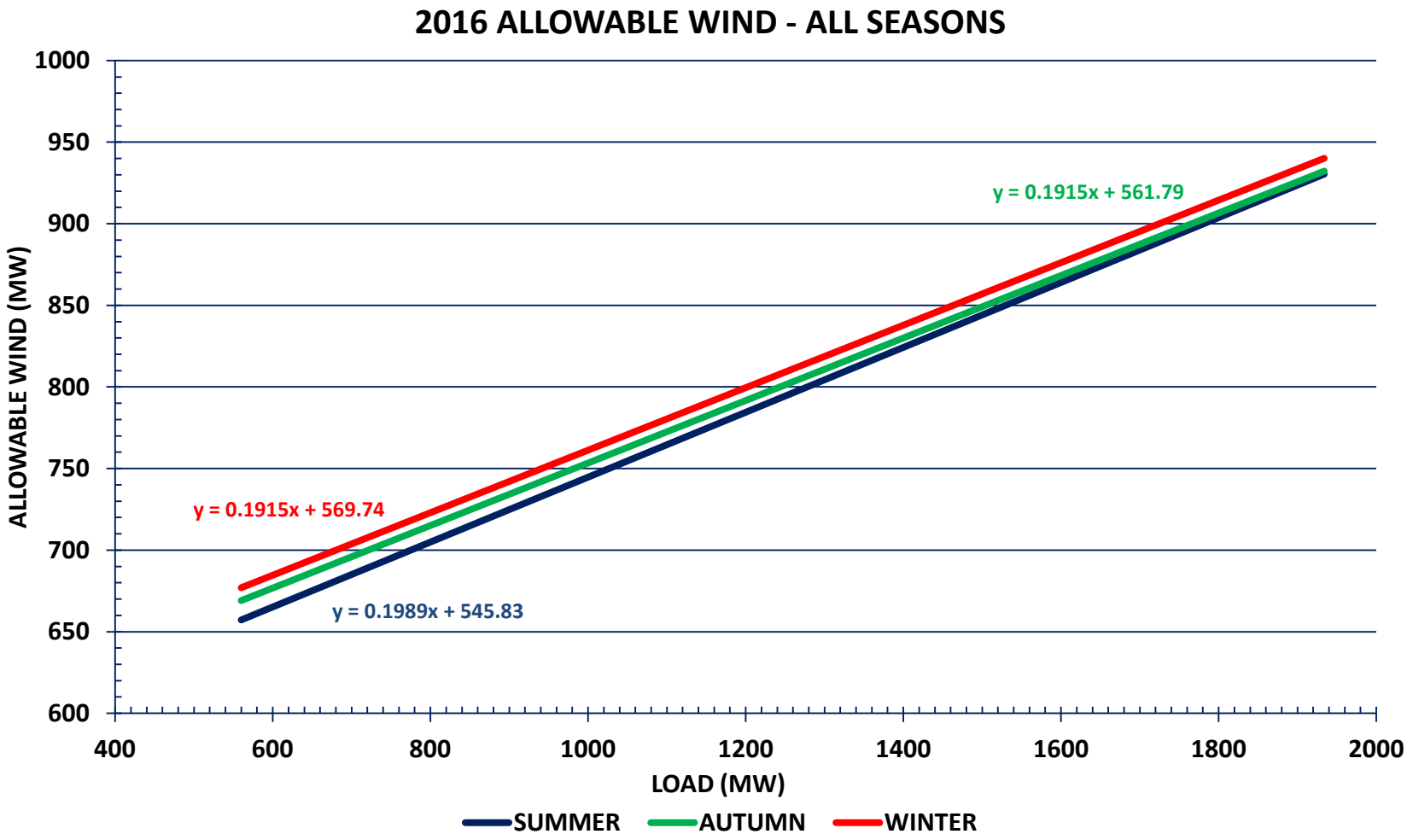


Methodology – Part One

- Load flow studies are carried out in Summer, Autumn/Spring and Winter (to take account of seasonal ratings). These studies identify how much generation can be connected to the Northern Ireland system before a network overload occurs i.e. by connecting proposed generators incrementally. The studies are carried out over a range of system load conditions for each season.

- The results are plotted and correlated to determine an equation that allows us to input into the Half hour constraints model.

Load flow studies from 2016 analysis



Methodology – Part Two

4. We determine how much **Network capacity** there is on the remaining transmission network to export power from the West to the East. (363MW of the 398MW installed in NI lies to the western side of the 3 remaining transmission lines).

5. A half-hour **Network Capacity** figure is calculated and used in the constraint model along with–

   - Half hour forecasted demand data
   - Forecasted wind profile (2008 base year)

   When the forecasted Wind profile is higher than the Allowable wind in any half hour, then a constraint occurs.

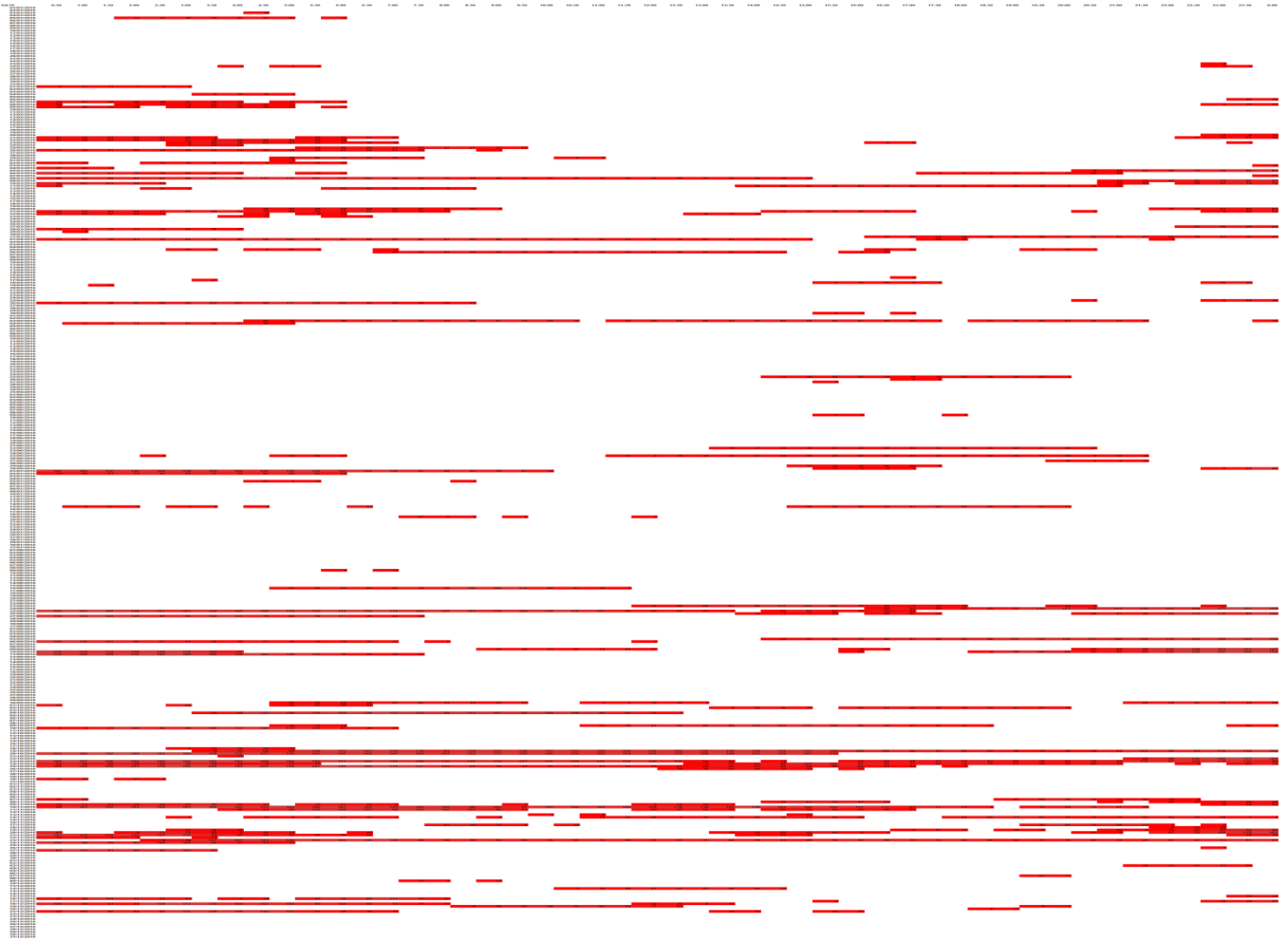
   Outcomes from Constraint model

   - Constrained half hour wind profile
   - Quantity and Occurrence of constraints (half hour)

6. The half hours are counted and the percentage of time that wind needs to be constrained will be presented

Methodology – 2016 Constraints

- MAX = 205MW
- AVERAGE = 5MW



Constraints

- Constraints are applied on a pro rata basis across all nodes that contribute to the constraint. Pro Rata is based on MEC.
- No distinction has been made between controllable and non controllable wind. The figures are presented at a nodal level.
- The 2008 wind profile has been used as a base year.
- For 2012, wind farms are included as they are assumed to be commissioned i.e. Starting at 397.7MW and finishing at 494.6MW.
- For 2016, all wind farms with planning permission will be included from the beginning of the year. (910MW)
- SPS connected wind is included as ‘allowable wind’ i.e. The TSO does not need to pre-fault constrain this wind

Curtailment

- Curtailment studies will be carried out to ensure that at least 3 conventional generators will remain connected. This summates to ~420MW.
- An historic Moyle Profile is used to forecast future years. This analysis uses the same profile that was used in this year's Dispatch Balancing Costs Model.
- The same 2008 wind profile is used.

Curtailment

- The analysis assumes that the TSO will take measures to prevent curtailment. These measures equate to 200MW.

  e.g. Demand = 1000MW
  Conventional Gen + Moyle = 670MW
  Remaining Demand for Wind = 330MW

  Wind Forecast (2016) = 700MW
  Potential curtailment = 370MW
  TSO curtailment prevention = 200MW
  Actual Curtailment figure = 170MW

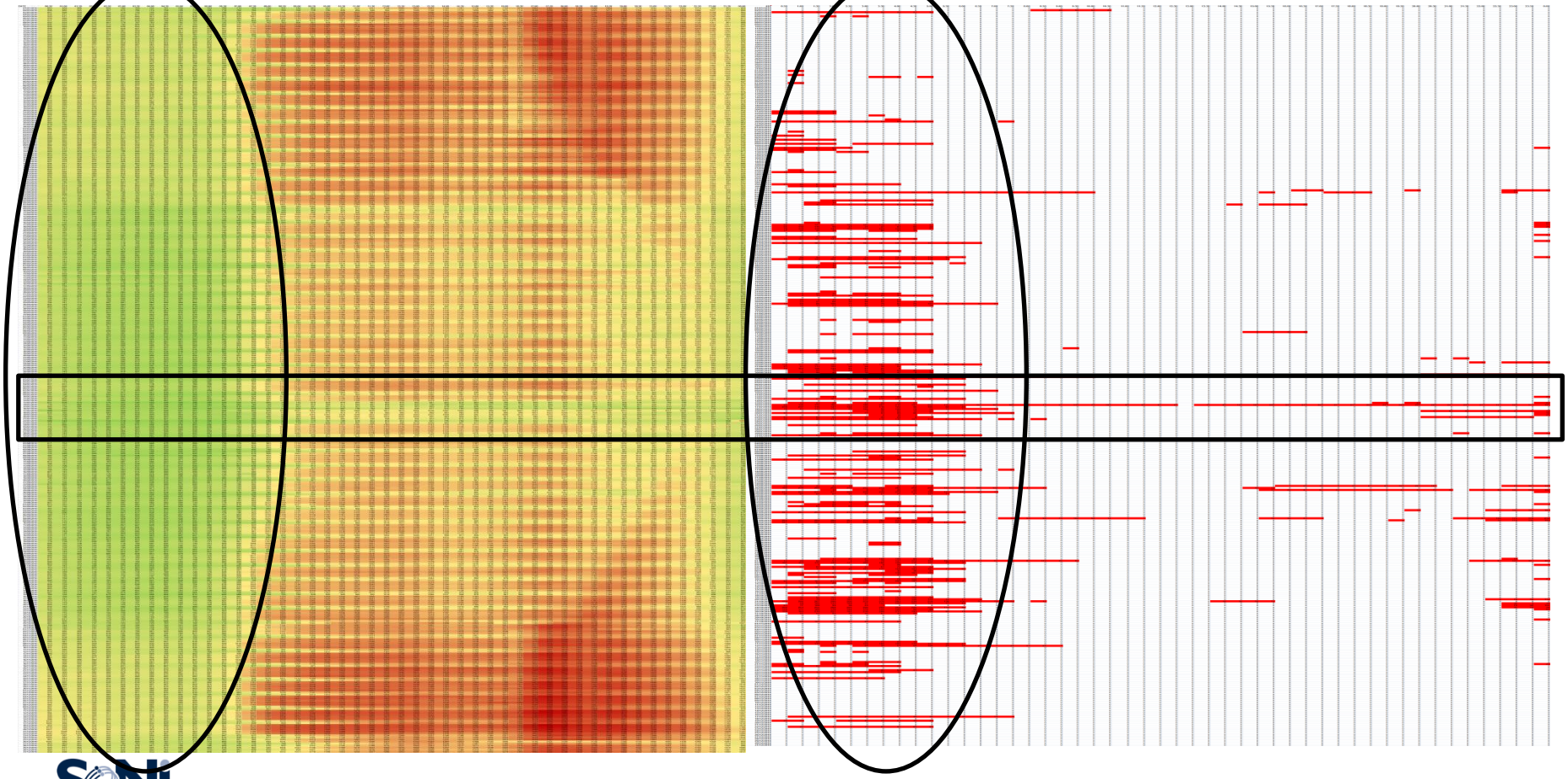
- Where there is constraints and curtailment required at the same time, constraints will take precedence. Additional wind generation will be reduced if curtailment is greater than the constraint.

- Curtailment figures, constraint figures and combined generator reductions will be reported.

2012 Demand Vs Curtailment

- MAX = 1731MW
- AVERAGE = 1044MW
- MIN = 496MW

- MAX = 298MW
- AVERAGE = 6MW
- CAPACITY = 910MW



Reporting

- Each transmission modification is accounted for in the original Load flow studies for the relevant years
- Proposed Wind connections and demand forecasting are used for future years.
- This will allow developers to see what impact network upgrades will have on constraints.
- Curtailment figures, constraint figures and combined generator reductions will be reported.
- Brief commentary will be provided on each node.

Results

Omagh Generation Node					
Results	**2012**	**2013**	**2014**	**2015**	**2016**
Potential Energy (Mwh)	376251	-	-	-	201146
Constrained Energy (Mwh)	457	-	-	-	3649
Curtailed Energy (Mwh)	14541	-	-	-	27222
Constrained & curtailed Energy (Mwh)	14558	-	-	-	27482
Curtailment (%)	3.86%	-	-	-	13.53%
Constrained (%)	0.12%	-	-	-	1.81%
Constraint & Curtailment (%)	3.87%	-	-	-	13.66%

Results

Mid Antrim Generation Node					
Results	**2012**	**2013**	**2014**	**2015**	**2016**
Potential Energy (Mwh)	-	-	-	-	157146
Constrained Energy (Mwh)	-	-	-	-	2851
Curtailed Energy (Mwh)	-	-	-	-	21267
Constrained & curtailed Energy (Mwh)	-	-	-	-	21470
Curtailment (%)	-	-	-	-	13.53%
Constrained (%)	-	-	-	-	1.81%
Constraint & Curtailment (%)	-	-	-	-	13.66%

Disclaimer

Disclaimer

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