Connection of embedded Generation in Ireland

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ESB Ireland

Presentation outline

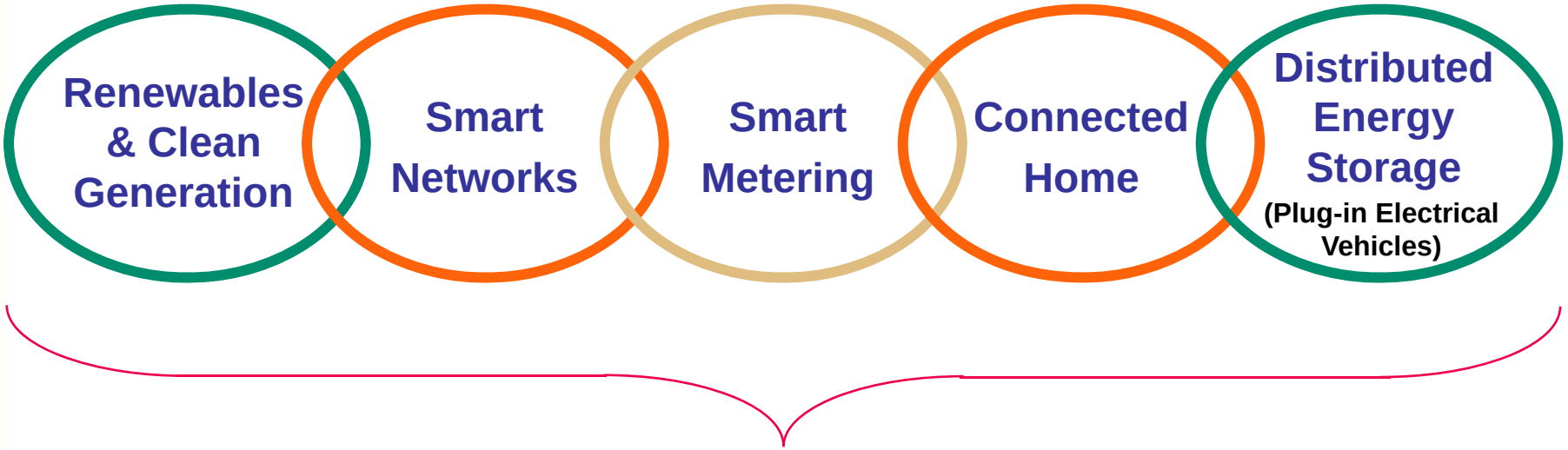
- ESB's Sustainability strategy
- ESB's Strategic Framework to 2020
- Wind Penetration in Ireland
- Group Processing Approach
- Implementation to date
- Other wind specific innovations
- Conclusion

ESB Strategic Framework to 2020

Targets

- to halve carbon emissions within 12 years
- to be carbon net-zero by 2035
- that by 2020, one third of all electricity delivered by ESB will be from renewables
- €6.5 Billion to be spent in facilitating Renewables including Smart Metering and Smart Networks
- This to include 1,400MW of wind

Sustainability Strategy



Internal Sustainability

A sustainable energy system connecting with energy aware interactive customers

SmartNetwork Components

- Distributed intelligence
- Distributed energy
- Distributed communications and controls

Smart Networks

What do we have already ?

- SCADA /OMS
- MV Automation
- Fault indicators
- Cluster design for wind connections
- MV90
- Networks loss reductions programme (20kV, Refurb, Compact Trafo's)
- Enablers

  - Fibre Network & Radio System

  - SAP Platform

Many of the components in place

Future Smart Networks

"Build on existing components to produce an active network"

- Intelligent automation
- Automatic device monitoring
- Self-healing network
- Cope with operation of 6000MW of wind
- Smart metering and its communications network - (The Gateway)
- Distributed generation management (micro CHP, micro wind, photovoltaics
- Distributed storage
- Load & losses management (down to LV & individual customer)
- New network design & Control systems

Efficient / Active Network = Smart Network

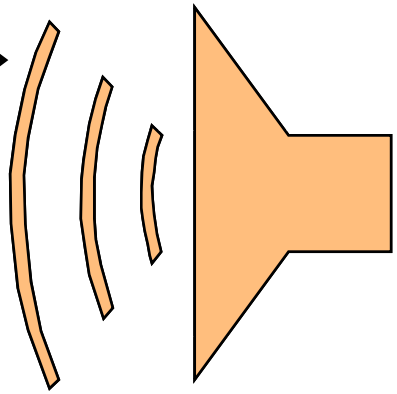
Background: Situation in Ireland

Background

- Up to 2003, applications for connections for wind, were dealt with sequentially
- This was on a first come – first served basis

Increase in Wind Applications

Date	Dec 3rd, 2003
Connected	166
Contracted	534
Offered	75
In Queue	422
Total MW	**1197**



- At that time, the TSO [Now Eirgrid], called for a moratorium on the processing of any new wind applications until certain technical issues were resolved
- From this emerged new “wind” Grid and Distribution codes
- However this took a year to complete

Moratorium

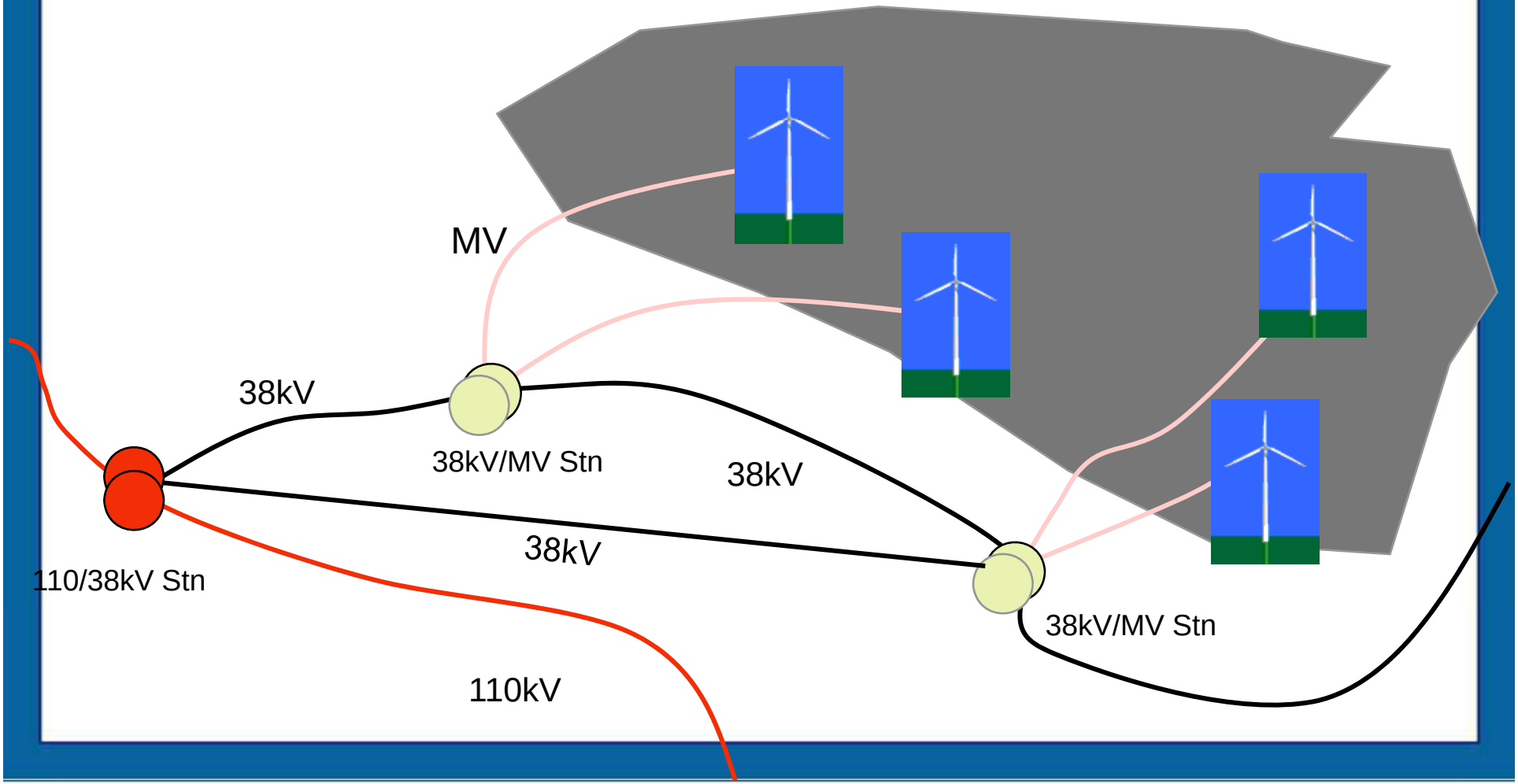
Date	Dec 3rd, 2003	Dec 3rd, 2004	May 3rd, 2006
Connected	166	280	580
Contracted	534	605	641
Offered	75	98	63
In Queue	422	2295	3072
Total MW	**1197**	**3278**	**4355**

GPA

- It was clear that from that point forward, the sequential processing of wind applications was no longer vialble
- Ever since, applications have been dealt with under the “Group Processing Approach”

Group Processing Approach

Example of Sequential Approach



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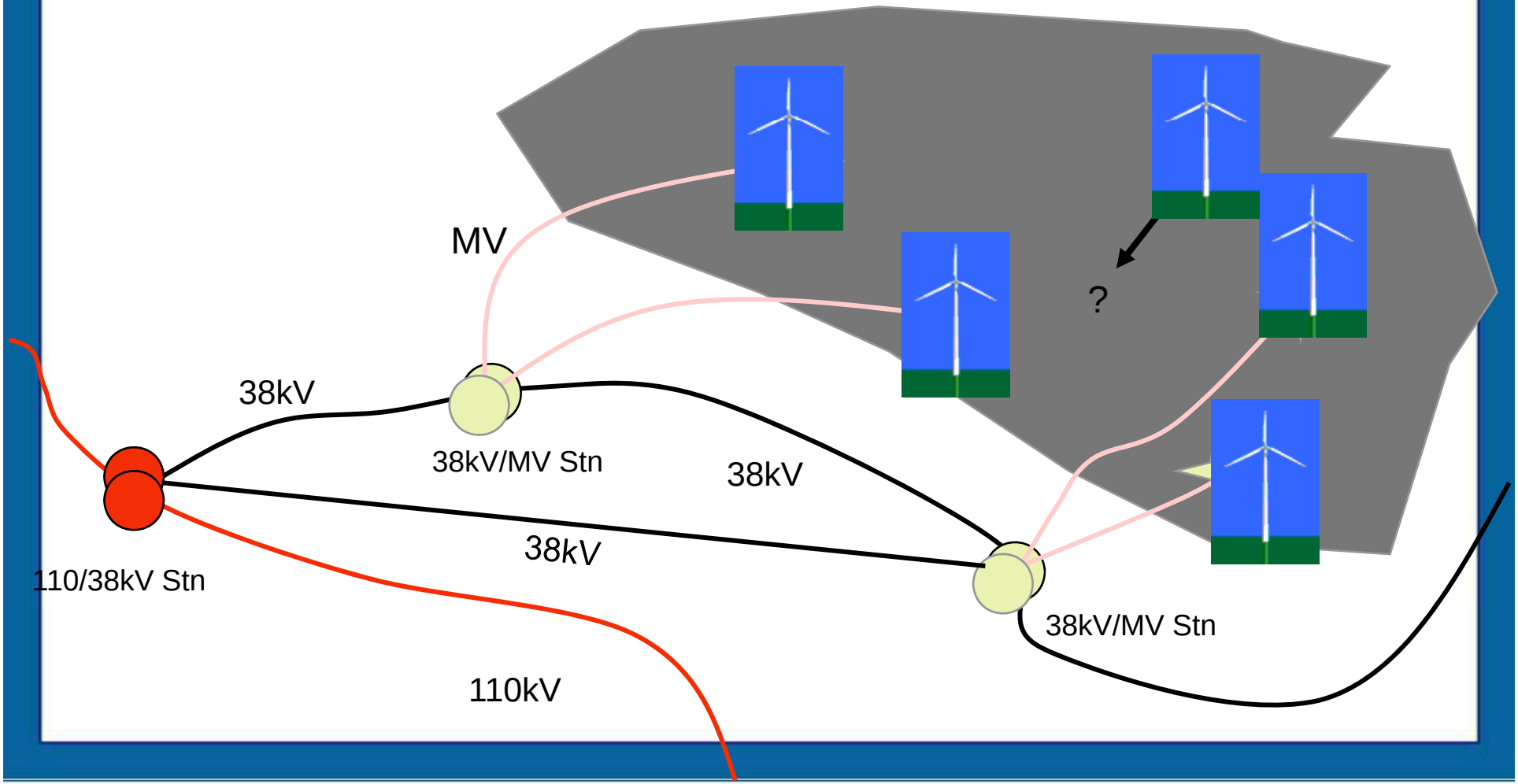
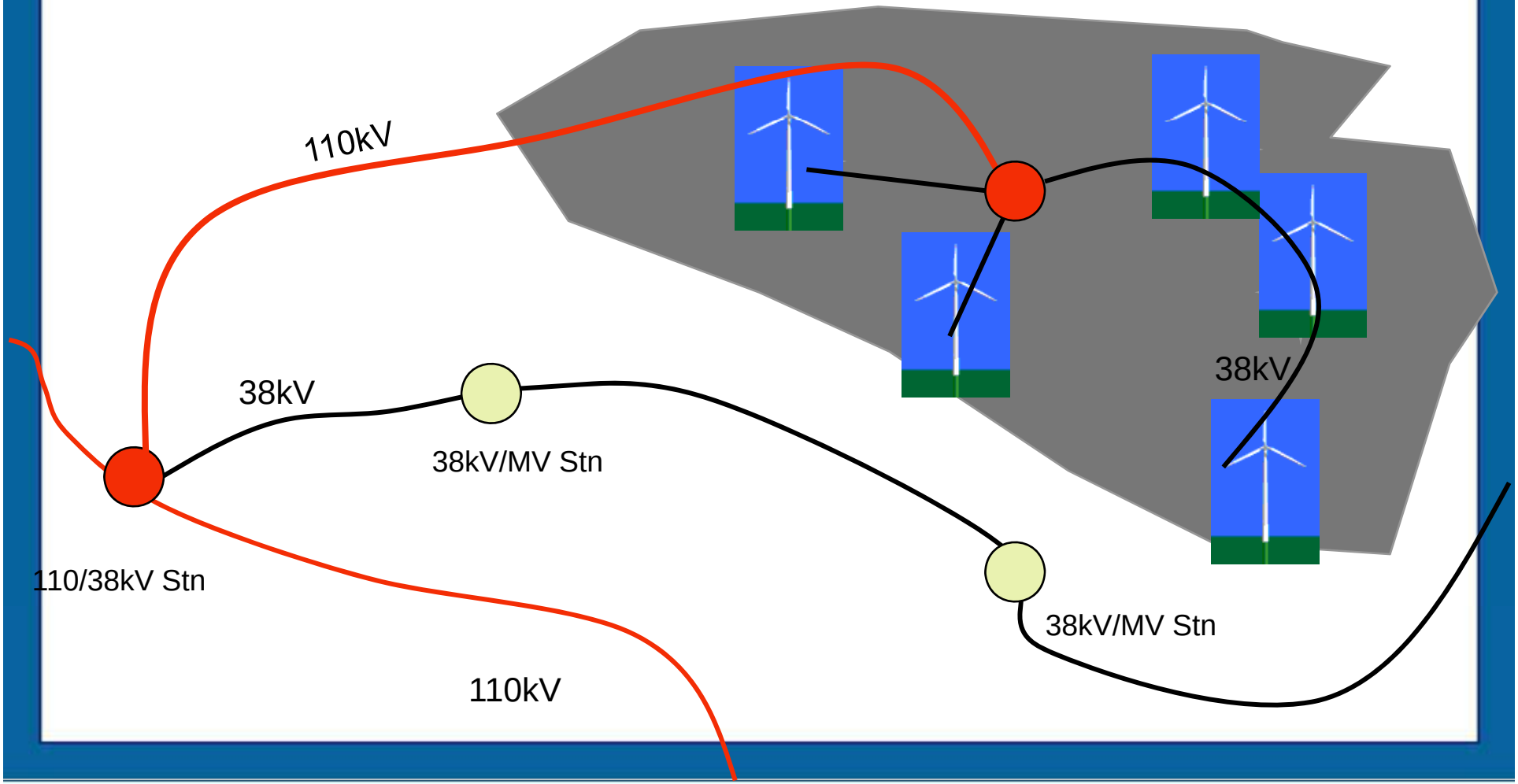
Example of Sequential Approach



Example of GPA



Gates

- Since advent of GPA, applications have been processed in blocks called “Gates”
- Within Groups, costs for shared assets are distributed on a per/MW basis
- Periodically, following consultation with the wind industry, criterion for inclusion in a Gate are agreed
- Structure of Gates to date have been quite varied

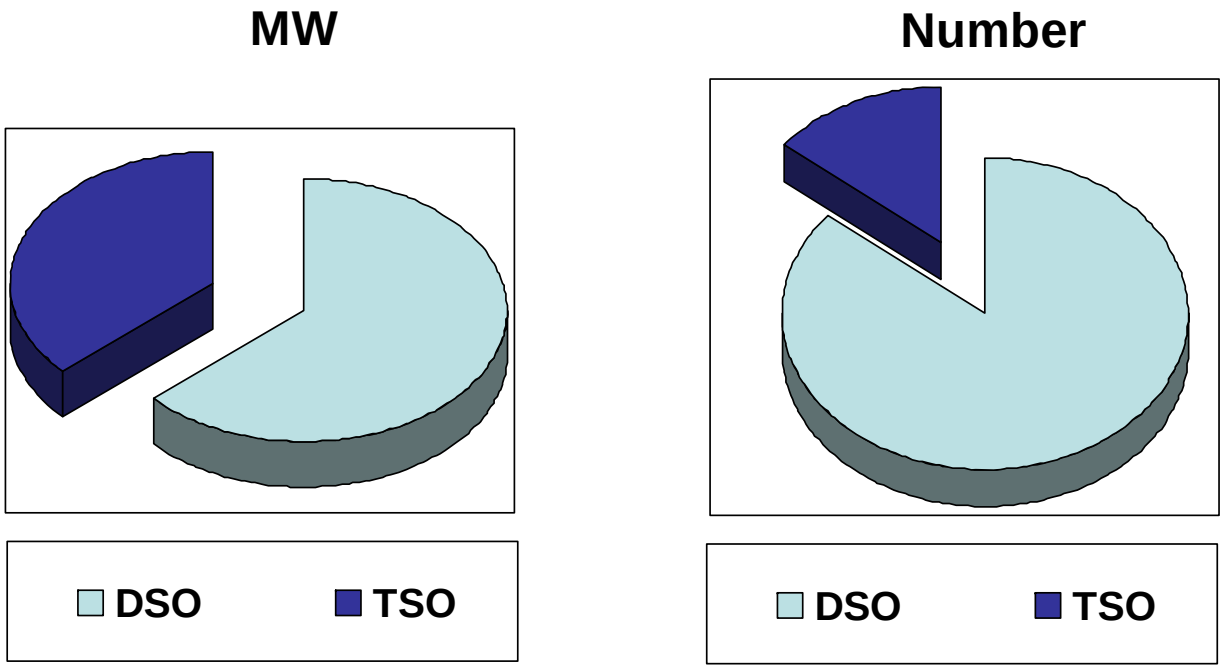
Gate 1 vs Gate 2

- Gate 1: 370MW: purely date order
- Gate 2:
  - Date order plus element of System optimisation
  - First 500MW in Queue “driver”
  - Applications that share a LCTA shallow connection with “driver”
  - Extensions to existing installations
  - Outliers with interactions <10MW at 110kV node
  - Resulting size circa 1385MW

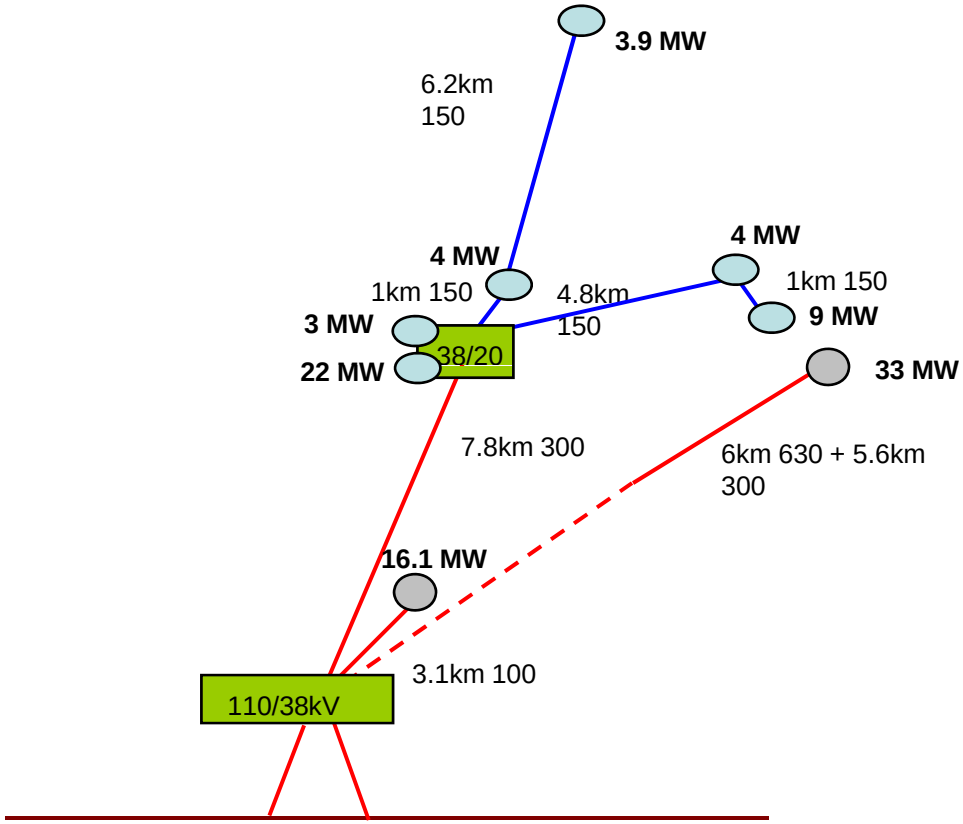
Gate 2 construction statistics

New 110kV stns	9
New 38kV stns	3
ESBN built 38kV Customer compounds	17
kms 110kV OH	48
Kms 38kV OH	80
kms 38kV UG	22
Kms MV OH	181
Kms MV UG	59
New 63MVA 110/38kV	4
New 31.5MVA 110/38kV	4
New 31.5MVA 110kV/MV	5
New 20MVA 110kV/MV	4
New 15MVA 38kV/MV	2
New 10MVA 38kV/MV	12
New 5MVA 38kV/MV	2
New 5MVA IFT	3
New 38kV booster	1
New 38kV LBFM switch	2

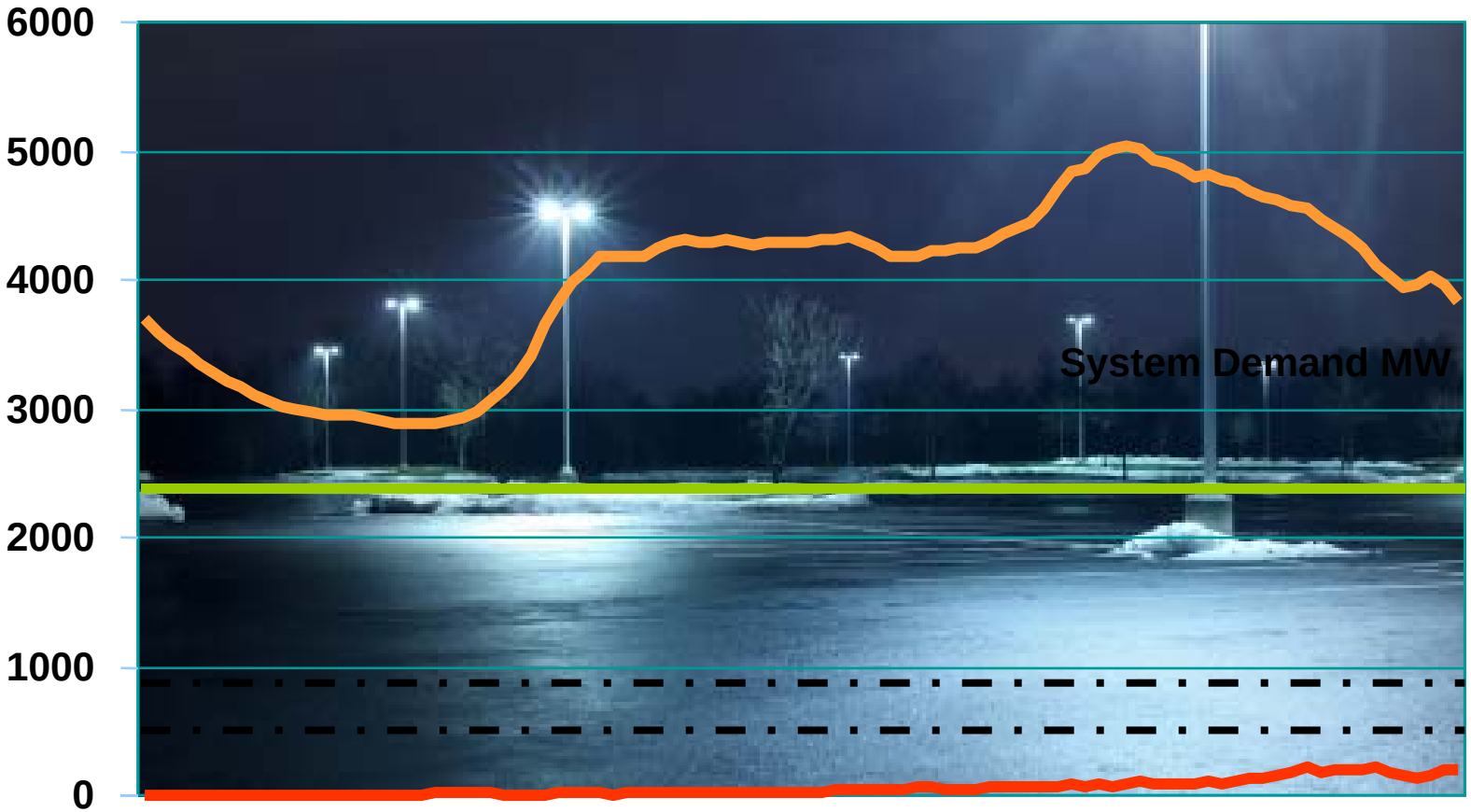
Network Connections



Example of Group



Wind Capacity –v- System Demand



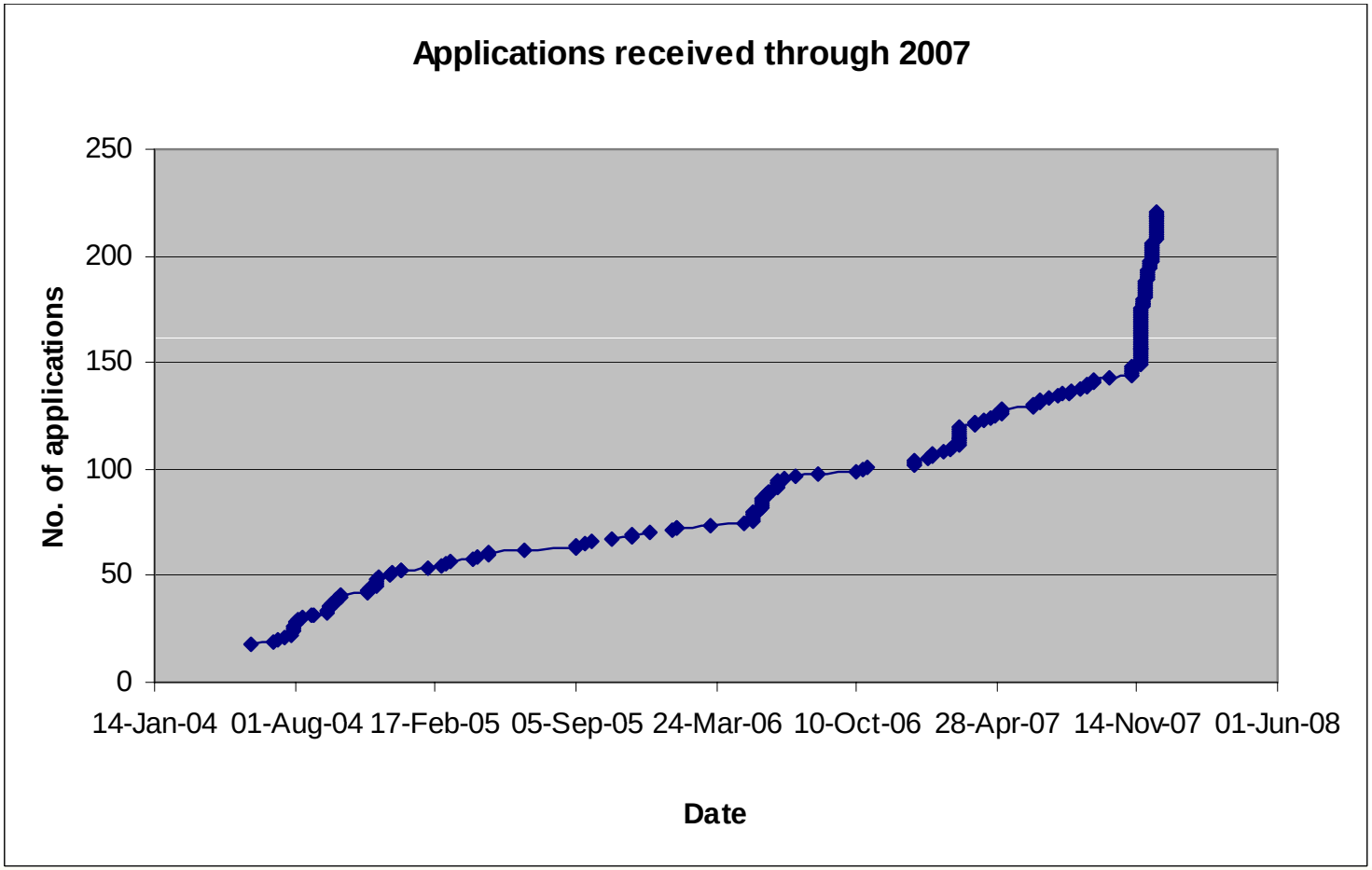
Gate 3

- Gate 3 is about to start
- Currently expected to be c 4000MW
- Will based upon Eirgrid's Grid Development Strategy out to 2025
- Transmission Firm Access dates for 110kV nodes will be published
- Distribution shallow works will be designed to fill out this capacity

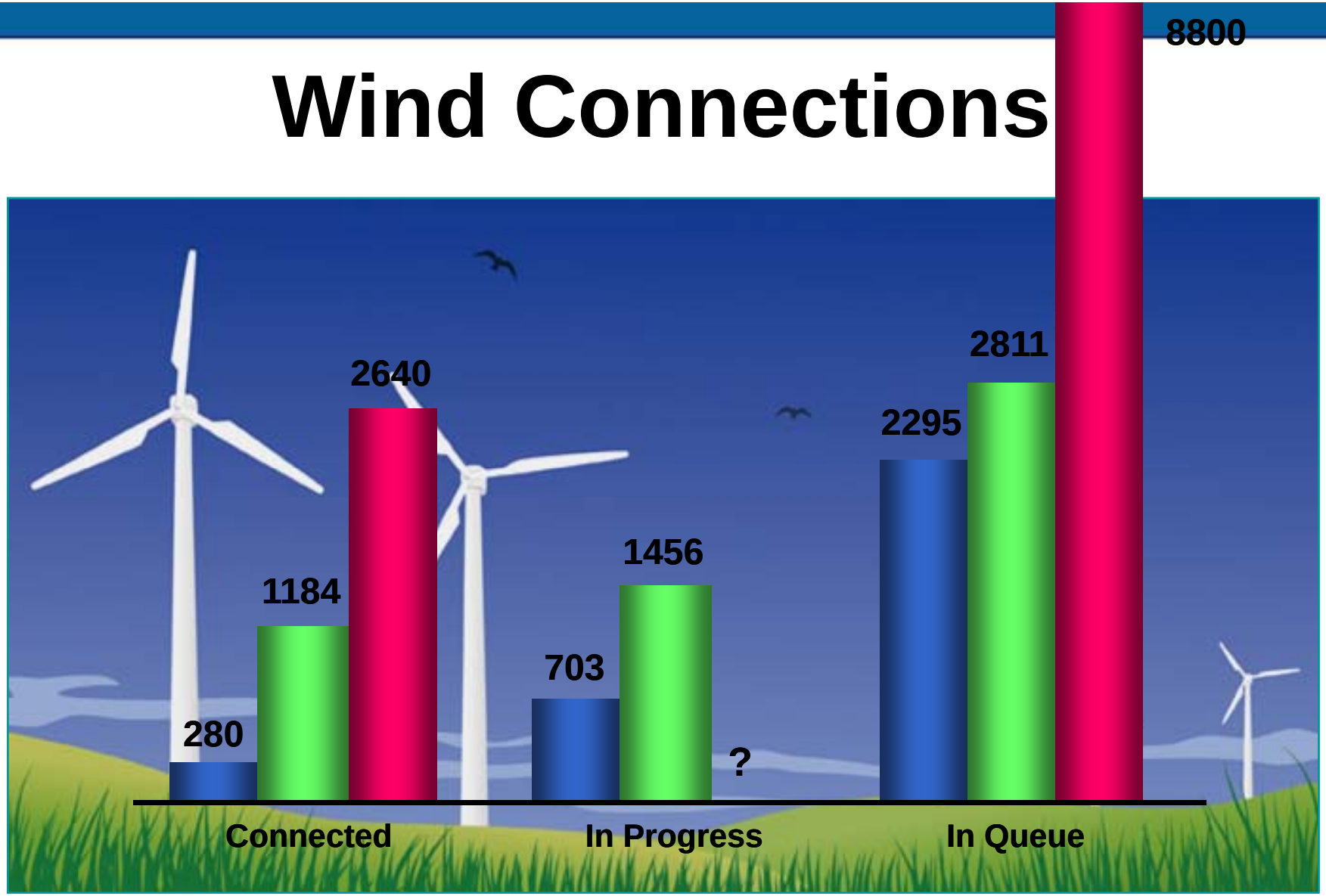
Generation Applications in 2007

	No. of Applicants			MW		
	DSO	TSO	Total	DSO	TSO	Total
Ist January 2007	83	21	104	1156	921	2077
16th November 2007	130	25	155	1901	1213	3114
14th December 2007	203	51	254	3259	3143	6402

Increase in Applications



Wind Connections



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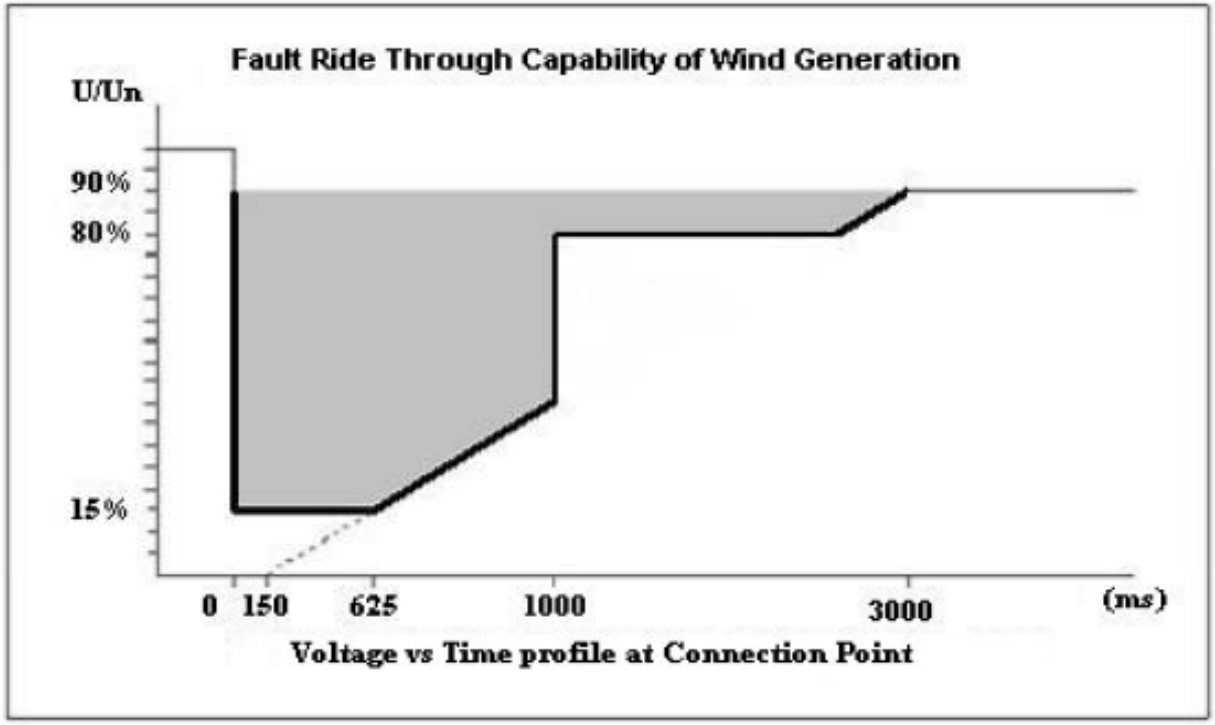
Other technical aspects

Other innovations

- Fault Ride Through
- Frequency response
- Curtailment/Constraint
- Voltage Regulation – Power Factor Range

Fault Ride Through



Conflict with Distribution Interface Protection
– Under-voltage setting relaxed

Frequency response

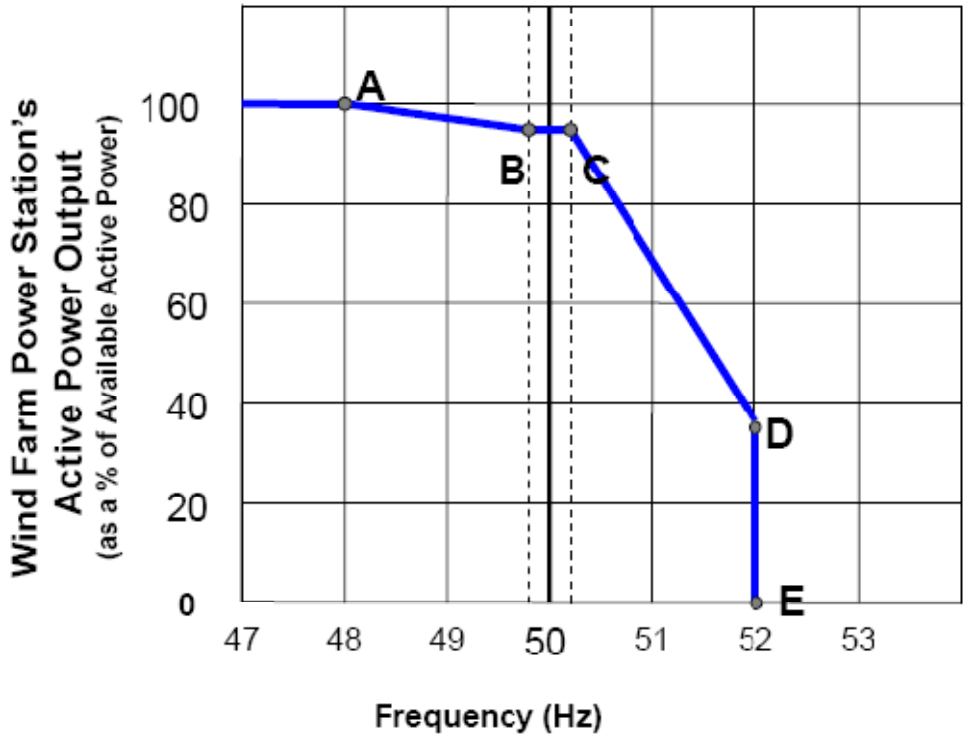


Figure 11 - Power-Frequency Control Curve

Curtailment/Constraint

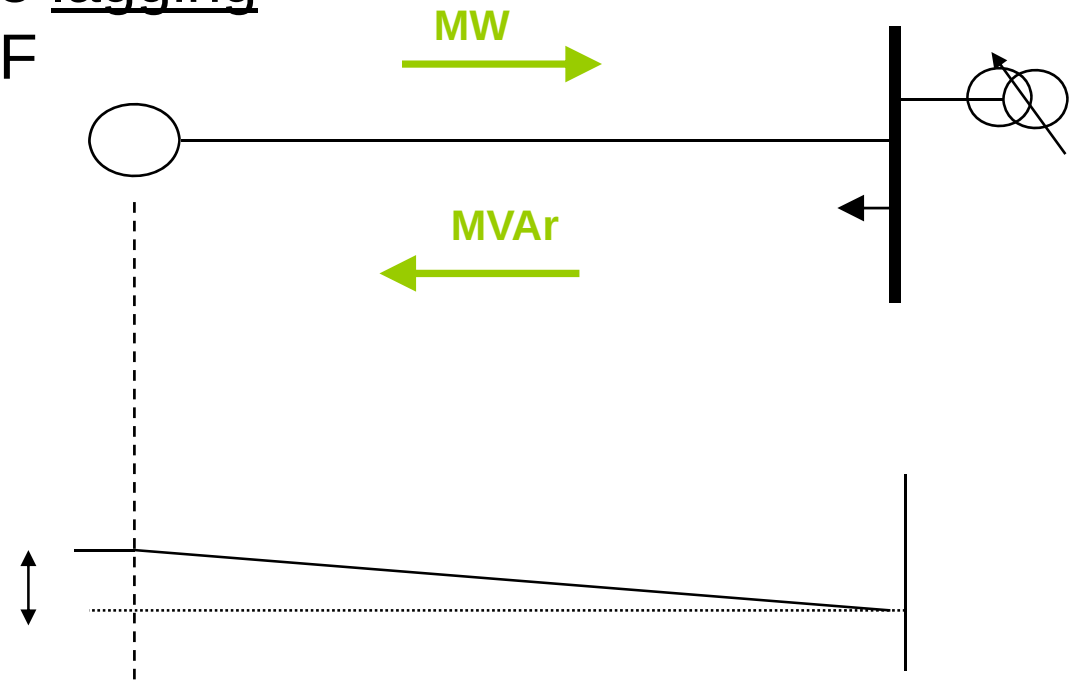
- Windfarms have option to connect in advance of required Transmission Deep Re-enforcements
- Where this arises, they are liable to Constraints and at some point, Curtailment
- Windfarms >5MW are required to have SCADA installed to facillitate this functionality

Voltage Regulation – Power Factor Range

- TSO require Windfarms >5MW to be capable of providing VARs if required for Transmission System voltage support
- Therefore required to be capable of operating at a Power Factor Range of 0.95 lagging to Leading
- Conflict with Distribution shallow planning standards

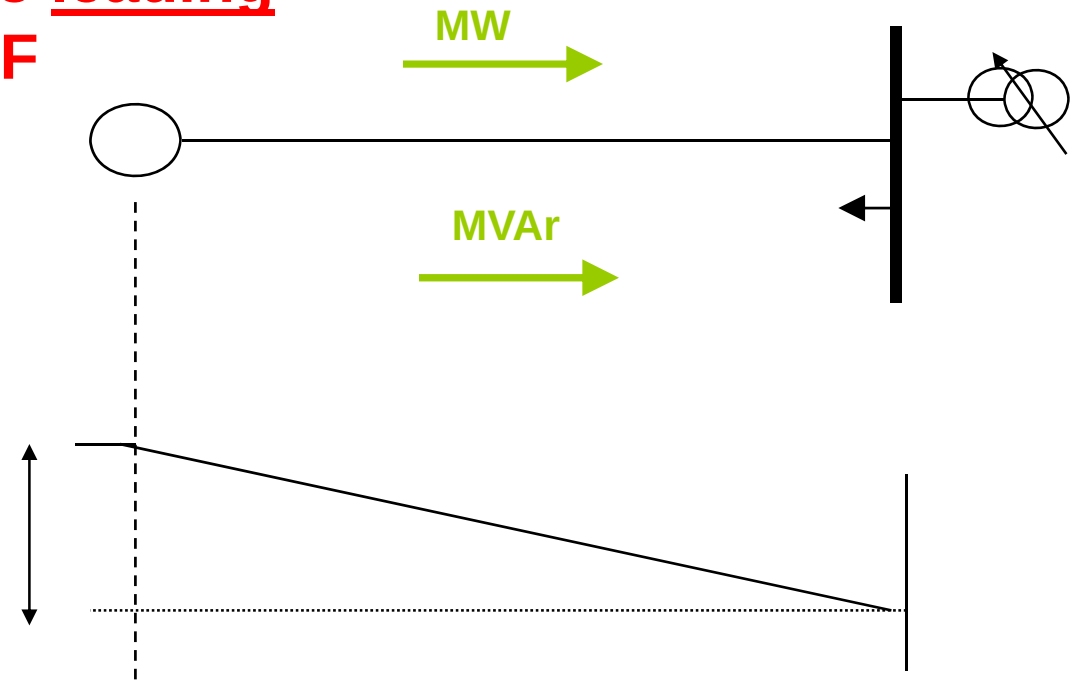
Comparison of leading vs lagging Power Factors

DG with 0.95 lagging PF



Comparison of leading vs lagging Power Factors

DG with 0.95 leading PF



150’s AAC 38kV line

- New 38k kV line design
- All wood-pole structures
- Steel masts at angles and ends eliminated
- Less visually intrusive
- Better chance of securing Planning Permission

Conclusions

- Wind Penetration in Ireland in proportion to System load will become uniquely high
- This present many challenges
- Whilst as much as possible is connected to existing network, the sheer volume dictates the need for large new clusters
- Group Processing helps to plan these clusters efficiently
- VAr control issues to be worked out TSO-DSO

Thank you for your attention

Questions?