

# DS3 Advisory Council

**Dublin**

**24th January 2018**

EIRGRID SONI

# Agenda

| Topic | Time | Speaker |
|---|---|---|
| Introduction & Welcome | 10.00 | Jon O'Sullivan , EirGrid (5 mins) |
| Industry Perspective | 10.05 | Presentation: Paul Ahern, DCCAE 'RESS - Design Policy' (20 mins)<br>Presentation: Peter Harte, IWEA 'Significance of DS3 to the Wind Industry' (20 mins)<br>Discussion: All (20 mins) |
| DS3 Programme Status Update (including System Services) | 11:05 | Presentation: Ian Connaughton, EirGrid (15mins)<br>Discussion: All (10 mins) |
| Rate of Change of Frequency (RoCoF) | 11.30 | Update: Jon O'Sullivan , EirGrid (10 mins)<br>Update: NIE Networks, ESB Networks (15mins)<br>Discussion: All (5 mins) |
| OFGS Discussion | 12:00 | Presentation: Eoin Sweeney, EirGrid (15 mins)<br>Discussion: (5 mins) |
| Key Risks Summary | 12:20 | Presentation: Ian Connaughton, EirGrid (5mins)<br>Discussion: All (5 mins) |
| Lunch & Networking (12:30 – 13:30) | | |

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# Agenda

| Topic | Time | Speaker |
|---|---|---|
| **Nodal Controller Project** | 13:30 | Presentation: Barry O'Connell (EirGrid), NIE N, ESB N (15 mins)<br>Discussion: (15 mins) |
| **Beyond 2020 - EUSysFlex & Future Interconnection studies** | 14:00 | Presentation: Noel Cunniffe, EirGrid (15 mins)<br>Presentation: Noel Cunniffe, EirGrid (15 mins)<br>Discussion: (5 mins) |
| **Closing Remarks and Actions** | 14:35 | Jon O'Sullivan, EirGrid (10 mins) |
| **Session Closed / Networking (14:45)** | | |

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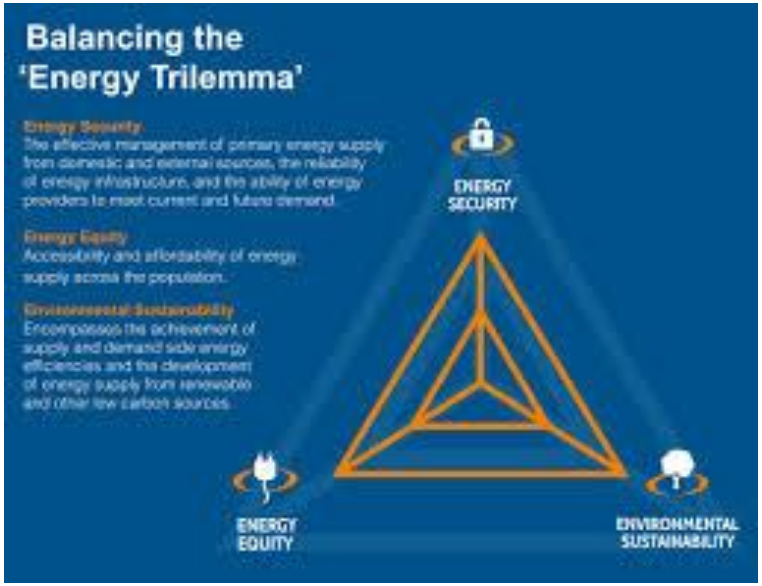
Roinn Cumarsáide, Gníomhaithe
ar son na hAeráide & Comhshaoil
Department of Communications,
Climate Action & Environment

# Renewable Electricity Support Scheme (RESS) Policy Design

DS3 Advisory Council Meeting
24th January
Eirgrid, The Oval

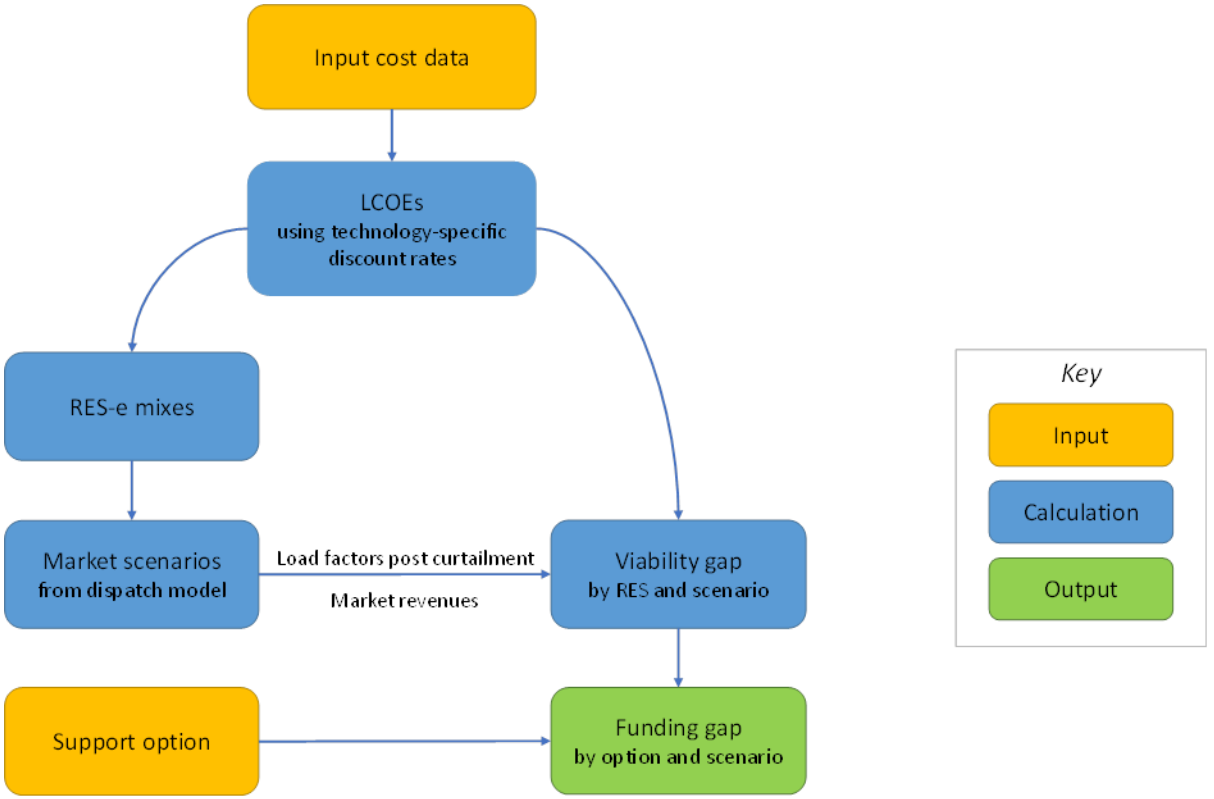
# Designing RESS – planning phase

- Commitment made in the Energy White Paper and 2016 Programme for Government to review costs associated with renewable electricity generation and to developer a new support scheme.
  - Two Studies; One Scheme
    - Economic Study
    - Community Study
- Community characteristic a key component
- Multiple policy objectives delivered via RESS
- EU Framework & State Aid Rules



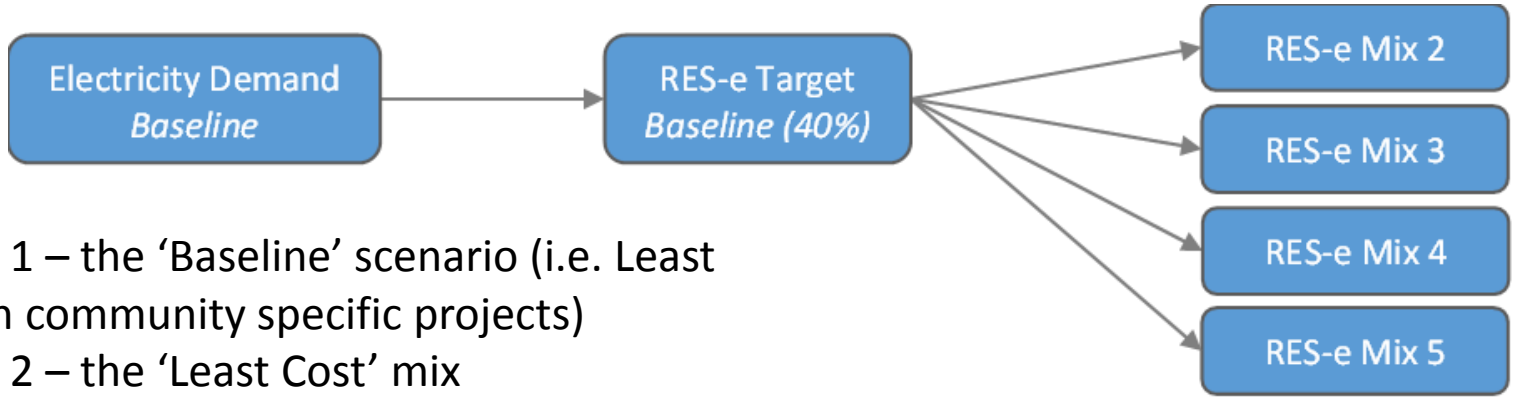
# Economic Analysis

- Levelised Cost of Energy (LCOE) 2020-2025-2030
- Viability Gap
- Funding Gap
- Support Mechanism
- Cost of Support
- PSO impact



# Different Scenarios

- Multiple scenario development




Scenario 1 – the 'Baseline' scenario (i.e. Least Cost with community specific projects)
Scenario 2 – the 'Least Cost' mix
Scenario 3 – the 'Solar PV plus' mix;
Scenario 4 – the 'Offshore wind plus' mix; and
Scenario 5 – the 'Bioenergy plus' mix.

- Additional scenarios were examined in order to understand the implications of technology specific allocations

# Sensitivities

- The analysis considered a range of scenarios reflecting different assumptions about the electricity market, policy decisions and costs.

- The sensitivities modelled against the 5 scenarios were:
  - Electricity demand
  - RES-E targets
  - Composition of the RES-E mix
  - Technology costs
  - Community options

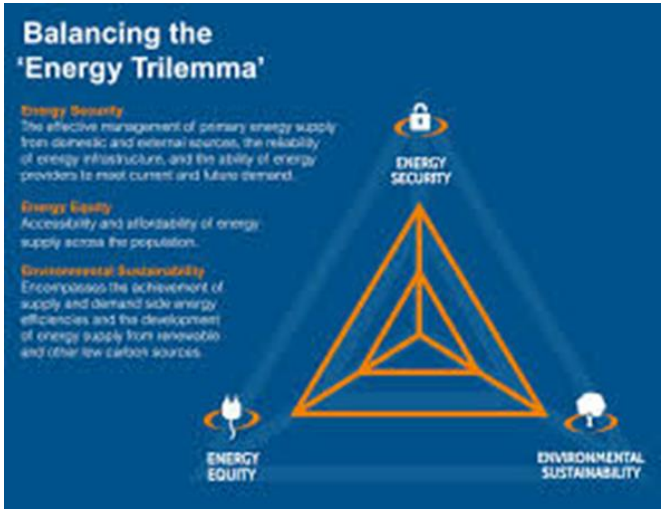
Different sensitivities will result in different answers to the same question

| | Electricity market modelling | | | Financial modelling | |
|---|---|---|---|---|---|
| **No.** | **RES-e mix** | **RES-e target** | **Electricity demand** | **Technology cost** | **Community options** |
| **1** | **Baseline mix** | **40% target** | **Median** | **Central** | **Community-led mechanism** |
| ***RES-e mix scenarios*** | | | | | |
| 2 | **Least-cost mix** | 40% target | Median | Central | None |
| 3 | **Solar Plus** | 40% target | Median | Central | As Baseline |
| 4 | **Offshore Wind Plus** | 40% target | Median | Central | As Baseline |
| 5 | **Bioenergy Plus** | 40% target | Median | Central | As Baseline |
| ***RES-e target sensitivities*** | | | | | |
| 7 | Baseline mix | **45% target** | Median | Central | As Baseline |
| 8 | Baseline mix | **50% target** | Median | Central | As Baseline |
| 9 | Baseline mix | **55% target** | Median | Central | As Baseline |
| ***Electricity demand sensitivities*** | | | | | |
| 10 | Baseline mix | 40% target | **Low demand** | Central | As Baseline |
| 11 | Baseline mix | 40% target | **High demand** | Central | As Baseline |
| ***Technology cost sensitivities*** | | | | | |
| 12 | Baseline mix | 40% target | Median | **Low technology cost** | As Baseline |
| 13 | Baseline mix | 40% target | Median | **High technology cost** | As Baseline |
| 14 | Baseline mix | 40% target | Median | **Low discount rate** | As Baseline |
| 15 | Baseline mix | 40% target | Median | **High discount rate** | As Baseline |
| ***Community options sensitivities*** | | | | | |
| 16 | Baseline mix | 40% target | Median | Central | As Baseline and **Development cost sensitivity** |
| 17 | Baseline mix | 40% target | Median | Central | As Baseline and **Community benefit payment** |

# RESS Criteria

| Assessment Criteria | Description |
|---|---|
| **1. Incentivise an efficient level of investment to meet the primary objective** | Does the design option incentivise the introduction of sufficient renewable generation to ensure the delivery of Ireland's 2030 RES-E ambitions? |
| **2. Minimising costs to the consumer** | Is the design option cost effective, does it minimise impact on the consumer and does it find the right balance between lowest overall cost, and broader policy objectives? |
| **3. Allocating Risks efficiently** | Does the design option allocate risks efficiently, such as between the consumer and the renewable electricity producer? |
| **4. Complexity / Clarity** | Would the complexity of the design option deter investors? |
| **5. EU State Aid Guidelines** | Is the design option compatible with EU State Aid Guidelines? |
| **6. Impact on the diversity of the renewable technology industry** | Does the design option lead to a sufficiently diverse technology mix? |
| **7. Community and Citizen ownership and Participation.** | Does the design option provide pathways for community and citizen participation and benefit in renewable electricity projects in their local area? |
| **8. Security of Supply** | Does the design option Improve Ireland's security of supply? |
| **9. Other policy ambitions** | Does the scheme provide potential for supporting broader policy objectives as per the Programme for Government? |





# Community Ownership Study

- Literature Review / International Experience
- Irish Stakeholder workshop

  Identifying barriers and solutions to community ownership and participation
  50 experts across 13 different sectors including Finance, Grid, Developers, Community Energy Groups, Government, Planners, Energy Agencies, Suppliers

  - Long list of policies and support measures (lit review/intl. exp)
  - Short List identified for detailed Multi Assessment Criteria (via stakeholders)
  - Detailed analysis and policy recommendations
  - Interaction with DCCAE economic study

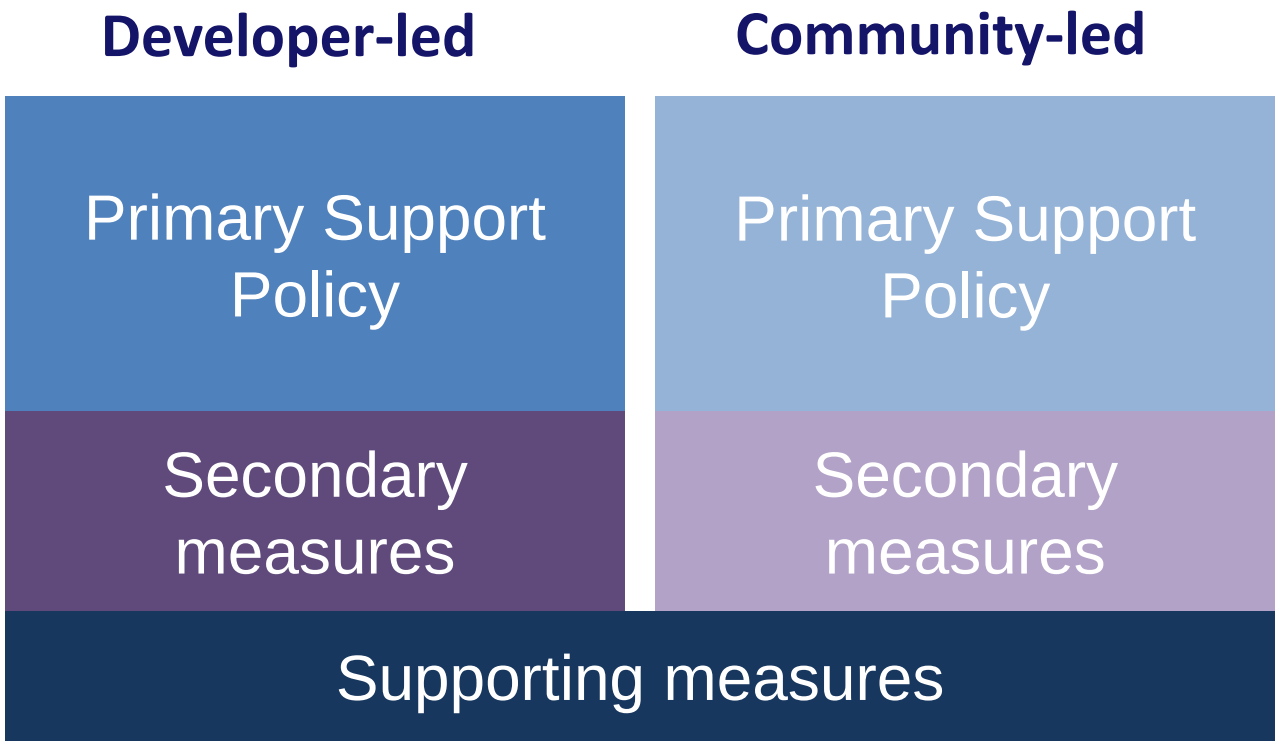
# Community Ownership Models

- 2 Categories of 'community-owned' projects being considered;
  - Developer-led : Developer initiates the project and community own a smaller share of the assets <50%.
  - Community-led : Community initiate the project and own >50% of the assets

1. Main mechanism through which community projects can secure revenue for their project

2. Other supporting measures to make community projects viable

3. Additional supporting measures which both types of project could avail of



# Community Ownership Models – Policy Assessment

| Developer-led community projects | |
|---|---|
| Ranking | Policy |
| Joint 1st | RESS generation revenue policy with mandated requirement for investment opportunities to be made available to communities. |
| Joint 1st | FIP for smaller developer-led community projects. |
| 3 | In a capacity auction, auction rules account for provision of developer-led community projects through a ring fencing of capacity. |
| 4 | FIT for smaller developer-led community projects. |
| Joint 5th | In a capacity auction mechanism, auction rules account for preferential weighting applied to developer-led community projects. |
| Joint 5th | In a capacity auction, auction rules account for provision of developer-led community projects by applying an uplift to the agreed strike price. |

| Community-led | |
|---|---|
| Ranking | Policy |
| 1 | FIP for community-led projects. |
| 2 | In a capacity auction, auction rules account for provision of community-led projects through a ring fencing of capacity. |
| 3 | FIT for community-led projects. |
| Joint 4th | In a capacity auction mechanism, auction rules account for provision of community-led with preferential weighting applied to community-led projects. |
| Joint 4th | In a capacity auction, auction rules account for provision of community-led projects by applying an uplift to the auction strike price. |



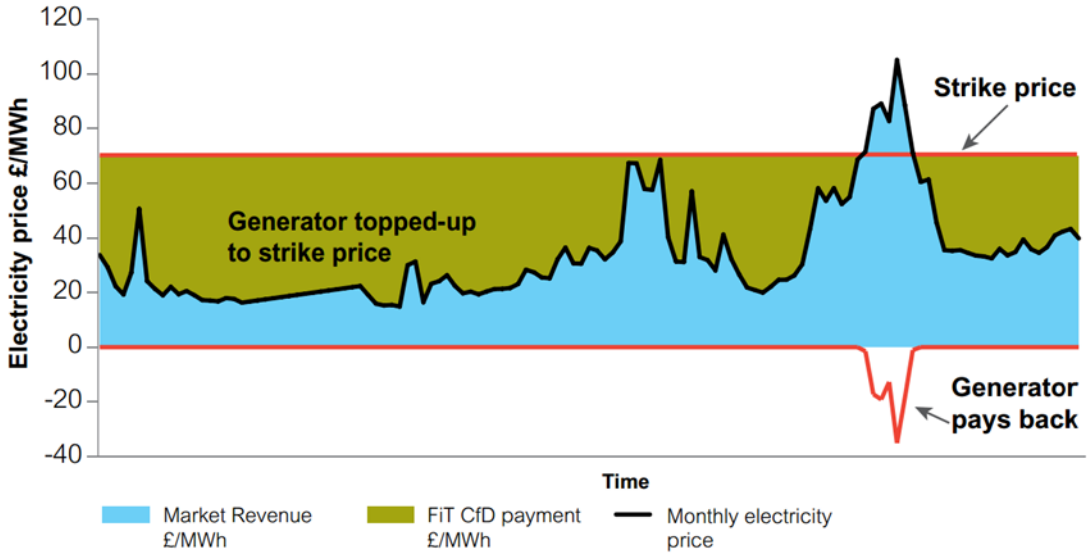
# Form of Primary Funding Mechanism

| Criteria group | Criterion | FIT | Floating FIP | Fixed FIP | RO | Grants |
|---|---|---|---|---|---|---|
| **Revenues and costs** | Uncertainty of revenue streams | Very low | Low | Moderate | Very high | Very low |
| | Cost of capital and risk premiums | Very low | Low | Moderate | Moderate | Low/Moderate |
| | Risk of windfall profits | Very high | Moderate | Moderate | Moderate | High |
| | Risk of deadweight costs | Very high | Moderate | High | Moderate/Low | Moderate |
| | Overall system costs | High | Moderate | Moderate/ High | Moderate/Low | Moderate |
| **Flexibility and robustness** | Risk of mis-specified parameters | Very high | Moderate | Moderate | Moderate | Moderate |
| | Risk of future need for re-design | Very high | Moderate | Moderate | Moderate | Moderate |
| **Regulatory** | Subsidy risk | Very low | Low/Moderate | Low | Very high | Moderate |
| | Policy uncertainty /credibility risk | High | Low | Moderate | Moderate | High |
| | Complexity | Very low | Low | Moderate | Moderate | Low |
| | Risk of unintended consequences | Very high | Moderate | High | High | Moderate |
| **Technical** | Learning curve / technology cost risk | High | High | Moderate | Low | High |
| **Political feasibility** | Negative distributional impacts | High | Moderate | Moderate | Moderate | Moderate |

# Emerging RESS Characteristics

- EU Constraints
- Competitive Auctions
- Funding Mechanism
- Tech Neutral/Specific
- RESS Ambition
- Community Category
- Principal Category

Floating Feed in Premium –



# Control Mechanisms

- RESS : largely shaped by EU State Aid Rules
- Irish Government (through the process of policy development and public consultation) can control the costs of the scheme.
    - Cost; through € budget or MW cap, admin strike cap etc.
    - Auction Frequency / Auction Size
    - Technology Mix / Diversity
    - RES-E ambition
    - Community Participation
    - Support for Micro Generation

# Emerging Principles

- Allocating all support through auctions, with potential exceptions for small-scale generation, or emerging technologies.
- Technology-neutral auctions within each category
- Each auction should be uniform-price, with the level of support set by the highest value bidder still needed to meet the required amount of RES-E.
- Selection of winners based on price only.
- Potential competition should be monitored and assessed prior to auction clearing. If an auction is unlikely to produce competitive outcomes, then auction clearing can be postponed.
- Ensure potential competition by selecting appropriate volumes to be procured in each auction. For example 5 biennial auctions or 10 annual auctions. Learnings between auctions would increase the chance of competitive outcomes and auctioning smaller volumes would control the cost of support.

# Emerging Principles

- Price or budget caps could be added as cost control measures.

- Capping the total amount of support received by each RES-E project that clears in a RES-E auction by the level of support (€/MWh) determined in the auction and The cleared volume of the project (MWh).

- RES-E producers should not receive a premium when the wholesale price is negative to avoid perverse incentives to generate.

- RES-E projects allowed to participate in support auctions should be subject to Pre-qualification rules to ensure that, if selected, the projects are likely to be realised. Penalties should be established for RES-E projects selected in the auctions for Non-compliance and delays.

- Community policy measures to increase community ownership of and participation in renewable electricity projects:
  Mandatory equity offer; Ring fenced category; Facilitating Grid Access; Trusted Intermediary / Advisors; Financial Supports; CBP

# Micro Generation

- Opportunities for Micro Generation have been explored as part of the RESS development and experiences of other member states have been examined.
  - The economic evidence indicates that meeting Ireland's renewable electricity targets and renewable diversity ambitions are more cost-effectively achieved at large and medium scale.
- In addition
  - Relative higher costs associated with micro-generation
  - Required Network Charges & Tariff Reforms needed
  - Further work required to identify a fair and just means for compensating self-generating consumers
  - Ensuring supports for micro-generators are aligned with the recast Renewable Energy Directive.
  - Distributional impact on the PSO

- Micro generation Workshop 17th October

# Next Steps

- Complete the review of public submissions
  - Specific community questions
- Final design and Government approval
- EU State Aid application process
- Structures for renewable energy auctions
- Structures to accommodate community policy measures
- Opening of scheme and running renewable energy auctions



IWEA
Irish Wind Energy Association




# DS3 Advisory Council

24th January 2018

# Key Concerns for Wind Related to DS3

Irish Wind Energy Association

- With >500MW connected last year, we are now in the “hockey stick” part of the deployment curve, as predicted.
- Curtailment is the “canary in the mine” of Irish electricity policy, an early warning that we’ve missed something.
- Energy Systems Committee has been created to model, forecast and track overall costs, and curtailment in particular as we move to 2030.
- But we need a firm foundation of 40% RES-E with minimal curtailment in 2020 before we start talking about 70%+ in 2030. Key to this:
    1. Successful and timely roll-out of DS3 System Services to get to 75% SNSP
    2. Optimizing min gen of conventional fleet during curtailment events
    3. Proactive management of interconnectors to minimise curtailment

# Successful and timely roll-out of DS3 System Services #1

- Achieving 75% SNSP limit is a fundamental objective of DS3
- The aim of DS3 System Services is to put in place the correct structure, level and type of service in order to ensure that the system can operate securely at this level of SNSP
- Original go-live for System Services was October 2015
- Delays in roll-out of System Services has already contributed to 2-year delay in reaching 75% SNSP (from 2017 to 2019)
- Impact of this delay has been mitigated by REFIT 2 extension and delayed build-out of wind
- At current rates of installation (500MW per year) curtailment will ramp up rapidly, creating investment uncertainty, if SNSP can't be lifted soon.

# Successful and timely roll-out of DS3 System Services #2

- Volume Uncapped Procurement now open- important milestone but will not work where significant capital investment required
- EirGrid acknowledge importance of new providers in order to meet System Service requirements post-2020
- New Providers need 2 things to deliver:
  - Volume Capped Procurement process (scheduled to kick off April 2018)
  - Access to grid for their devices (DS3 Grid Regime now unlikely to deliver offers until end 2018 earliest)
- There is a mismatch between volume capped procurement timeline and DS3 grid access timeline
- IWEA has an interest in seeing that only real projects will be awarded DS3 contracts

# Successful and timely roll-out of DS3 System Services

Irish Wind Energy Association

**IWEA Recommendations**

- Work on principle that some certainty over grid if pre-condition to volume capped procurement
  - 'Deemed Complete' would seem reasonable
- Also must ensure projects are for DS3 to get priority e.g. not CRM/Balancing
- It may be necessary to delay Volume Capped Procurement by 2-3 months to enable DS3 grid processing to 'deemed complete' point
  - Current deadline is May with projects awarded in September 2018, so delay must be >2-3 months since grid offers won't be made until end of 2018
  - For competitive auctions, you need more projects/MWs competing than actually required
- This delay is not ideal but better than:
  - (a) having an undersubscribed auction due to a lack of projects with grid (since grid is a pre-condition) or
  - (b) proceeding with procurement where winning projects are not ready to build causing further delays

# Optimizing Min Gen of Conventional Fleet

Irish Wind Energy Association

**Quantifying the problem**

- As things stand high merit order conventional units regularly run significantly above standard min_gen requirements as per grid code
- Many of these units may have capability to reduce min gen further than currently stated
- At high SNSP wind is being curtailed to leave room for these units

**Key Questions**

- Does this meet the EU directive on minimising curtailment of renewables?
- SIR payment may incentivise improvements, but can plant make a capital investment against only 12 months SIR payment certainty? Should there be a 6 year SIR contract?
- Should there be a programme to simply enforce the grid code?
- What does the cost benefit case for temporary derogations around min_gen look like now, given the amount of wind curtailment its causing?
- See Mullangrid table or graph on next slide

# Power Plants Can Do More During Hours of Curtailment: Historically Not Going to Min Gen During Curtailment

Table Shows the Operation of Must Run Power Plants During Curtailment indicates that some of the plants (highlighted in yellow) are consistently operating at levels well above their minimum generation levels over the last 6 years

| | Must Run Plant | MEC (MW) | Min Gen Level (MW) | Avg Generation Level During Curtailment Events (MW) | | | |
|---|---|---|---|---|---|---|---|
| | | | | Q1 to Q3 2017 | 2016 | 2015 | 2012-14 |
| Republic of Ireland | Dublin Bay | 415 | 203 | 259 | 257 | 248 | 271 |
| | Huntstown 2* | 412 | 121 | 159 | 158 | 176 | 181 |
| | Huntstown 1* | 344 | 120 | 138 | 191 | 195 | 181 |
| | Poolbeg A | 230 | 120 | 123 | 129 | 236 | 242 |
| | Poolbeg B | 230 | 120 | 108 | 121 | | |
| | Tynagh** | 384 | 220 | 195 | 224 | 199 | 198 |
| | Moneypoint 1 | 285 | 99 | 118 | 121 | 117 | 121 |
| | Moneypoint 2 | 285 | 99 | 120 | 121 | 118 | 120 |
| | Moneypoint 3 | 285 | 99 | 122 | 127 | 120 | 115 |
| | Aghada 1 | 258 | 112 | 0 | 0 | 0 | 0 |
| | Aghada 2 (Longpoint) | 431 | 216 | 213 | 207 | 218 | 206 |
| | Tarbert 3 | 241 | 35 | 0 | 0 | 35 | 0 |
| | Tarbert 4 | 243 | 35 | 0 | 0 | 0 | 0 |
| | Whitegate (Glanagow) | 442 | 180 | 205 | 225 | 187 | 188 |
| | Great Island*** | 464 | 203 | 205 | 255 | 257 | 0 |
| | Edenderry | 118 | 41 | 67 | 74 | 75 | 85 |
| | Lough Ree | 91 | 71 | 75 | 76 | 79 | 75 |
| | West Offaly**** | 137 | 77 | 92 | 96 | 101 | 101 |
| | Sealrock 1 | 80 | 40 | 73 | 76 | 74 | 76 |
| | Sealrock 2 | 81 | 40 | 75 | 78 | 75 | 76 |
| | **Average** | | **113** | **138** | **149** | **148** | **149** |
| | **Average Total ROI Min Gen During Curtailment Events (MW)** | | | **1361** | **1403** | **1280** | **1329** |
| Northern Ireland | Ballylumford B4 | 170 | 54 | 0 | 56 | 0 | 0 |
| | Ballylumford B5 | 170 | 54 | 32 | 57 | 0 | 0 |
| | Ballylumford B6 | 170 | 54 | 0 | 0 | 54 | 54 |
| | Ballylumford B10 | 101 | 63 | 62 | 62 | 64 | 65 |
| | Ballylumford B31 | 247 | 113 | 123 | 106 | 121 | 110 |
| | Ballylumford B32 | 247 | 113 | 126 | 127 | 0 | 83 |
| | Kilroot K1 | 238 | 93 | 108 | 107 | 117 | 122 |
| | Kilroot K2 | 238 | 93 | 105 | 108 | 119 | 118 |
| | Coolkeeragh | 412 | 260 | 290 | 283 | 271 | 264 |
| | **Average** | | **100** | **121** | **113** | **124** | **117** |
| | **Average Total NI Min Gen During Curtailment Events (MW)** | | | **479** | **488** | **470** | **411** |

* = Min gen of Huntstown plants were previously 170MW but reduced in 2017.

** = Min gen of Tynagh plant was previously 194MW but increased in 2017

*** = Min gen of Great Island plant was previously 232MW but reduced in 2017.

**** = Min gen of West Offaly plant was previously 48MW but increased in 2015

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# Proactive management of interconnectors to minimise curtailment

- SO-SO counter-trading was initiated to mitigate curtailment of wind and has delivered reasonable results but still see instances where I'C flows work against wind
- No clarity on how this will be managed in I-SEM
- Last trade closes 17:30 but EirGrid currently not set up for night-time counter-trading

**Key Questions**

- What is the cost benefit case around moving to 24hr counter-trading arrangements?
- How does counter-trading requirement change under I-SEM?
- What can be done to minimise the negative impact of intra-day trading platform limitations day one?
- What metrics can be published to show efficacy of countertrading?
- Should these be broken out in curtailment reports?

# Update on Interconnector Activity During Curtailment Events

| | | 2014 | Q1 & Q2 2015 | Q3 & Q4 2015 | 2015 | Q1 & Q2 2016 | Q3 & Q4 2016 | 2016 | Q1 & Q2 2017 | Q3 2017 | Q1 to Q3 2017 | 2014 to Q3 2017 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Curtailment Events | Curtailment Events(nr.) | 137 | 57 | 62 | 119 | 53 | 34 | 87 | 49 | 21 | 70 | 413 |
| | EWIC Avg Net (MW) | 190 | 74 | -76 | -1 | -114 | -14 | -64 | -160 | -411 | -244 | -15 |
| | EWIC Avg Net (%) | 36% | 14% | -14% | 0% | -22% | -3% | -12% | -30% | -78% | -46% | -3% |
| | Moyle Avg Net (MW) | 99 | 5 | -96 | -46 | -116 | -139 | -127 | -210 | -236 | -219 | -63 |
| | Moyle Avg Net (%) | 40% | 2% | -38% | -18% | -39% | -46% | -42% | -70% | -79% | -73% | -21% |
| All Periods | EWIC Absolute Avg (Day) (MW) | 376 | 267 | 160 | 213 | 31 | -3 | 14 | -15 | -66 | -32 | 154 |
| | EWIC Absolute Avg (Night) (MW) | 78 | 51 | -100 | -24 | -19 | -10 | -15 | -119 | -296 | -178 | -25 |
| | Moyle Absolute Avg (Day) (MW) | 154 | 111 | 11 | 61 | 34 | -56 | -11 | 26 | -39 | 4 | 55 |
| | Moyle Absolute Avg (Night) (MW) | 50 | -53 | -132 | -92 | -56 | -61 | -59 | -86 | -159 | -111 | -49 |

Notes:

Positive figures represents imports, negative figures represent exports

EWIC Out of Service: 21st to 22nd Feb 2014, 2nd to 3rd May 2014, 26th to 28th Aug 2014, 9th to 14th Sep 2014, 30th Sep 2014 to 1st Nov 2014, 7th Jan 2015, 10th to 13th Mar 2015, 20th to 21st Jun 2015, 22nd Jun 2015, 8th to 11th Sep 2015, 28th to 29th Sep 2015, 6th Sep 2016 to 23rd Dec 2016, 17th Mar 2017 to 23rd Mar 2017, 18th Apr 2017 to 31st May 2017

Moyle Out of Service: 31st Mar 2014 to 7th Apr 2014, 5th July 2014 to 29th Aug 2014, 3rd to 4th Nov 2014, 12th to 13th Dec 2015, 13th to 15th Apr 2016, 26th to 28th Apr 2016, 6th Jun to 16th Sep 2016

Inter-connector Activity 2014-2017

- Review of interconnector activity during curtailment events over the last 4 years indicates that imports have steadily reduced over time through increased exports due to market activity and SO countertrading, with both interconnectors now operating on a net exporting basis during curtailment events.
- Summary of interconnectors over past 4 years:
  - EWIC on average exporting 15MW during curtailment events which is 3% of its 530MW export capacity. During all periods EWIC on average importing 154MW per day and exporting 25MW per night. However EWIC is predominantly exporting over the last 2 years.
  - Moyle on average exporting 63MW during curtailment events which was 21% of its 300MW export capacity at the time. During all periods Moyle on average importing 55MW per day and exporting 49MW per night. Again, Moyle is predominantly exporting over the last 2 years. Noted that the firm export capacity of Moyle reduced from 300MW to 80MW in Nov 2017 due to the connection of a number of large wind farms in Scotland. However it is noted that exports on Moyle have exceeded the 80MW firm capacity on occasions since Nov 2017.



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# Volume Risk on Temporal Scalar

- Every factor that affects curtailment also affects SNSP volumes.
- DSM, storage and conventional plant have to predict how many hours SNSP will be above 50%, 60% and 70%, whether they are in volume uncapped or capped procurement.
- Mullangrid replicated EirGrid analysis of hourly frequency distribution of SNSP (assuming base case 31% capacity factor, full utilisation of interconnectors and 5 units must run, SNSP limit 75%).
  - Total revenues including all scalars for FFR/POR/SOR/TOR EirGrid base case is c. **€16/MWh**.
  - Low wind (24% capacity factor) reduces that to **€11/MWh**; high wind (33% c.f.) increases to **€22/MWh**.
  - Low utilisation of interconnectors (30% export limit) would increase revenues to **€19/MWh.**
  - If must run units remained high at 8, then revenues would decrease to **€11/MWh**
  - If **both** low wind and 8 units, then revenues would be **€8/MWh**.
- Cost of risk
  - This is going to attract a very large risk premium from investors
  - We can apply statistical techniques to wind risk, but not to how well the TSO trades interconnectors or rolls out min _units.
  - There are no ways to reconfigure your plant or service to mitigate these risks that we can see.
  - Is risk being placed on the party that can most cost effectively mitigate it?

# Optimised Dispatch and Transmission Constraints

Irish Wind Energy Association

**Key Questions**

- How quickly can EirGrid move the minimum number of units lower (from 8 to as low as 4)?
- If the N-S interconnector is further delayed, is there a contingency plan for lowering min_units?
- Can inertia/RoCoF constraints be applied more flexibly, and what was assumed in the Base Case?
- When will either EirGrid or industry be able to paint a dispatch picture of 2030?
  - We have high level quantities from Low Carbon Living Scenario
  - But we need accompanying likely transmission constraints volumes of DS3 likely to be required, changes to largest infeed, likely SNSP level, likely minimum inertia level, operational philosophy, interconnector countertrading philosophy
  - This vision can help industry estimate costs, predict curtailment, and predict SNSP volume scalars.

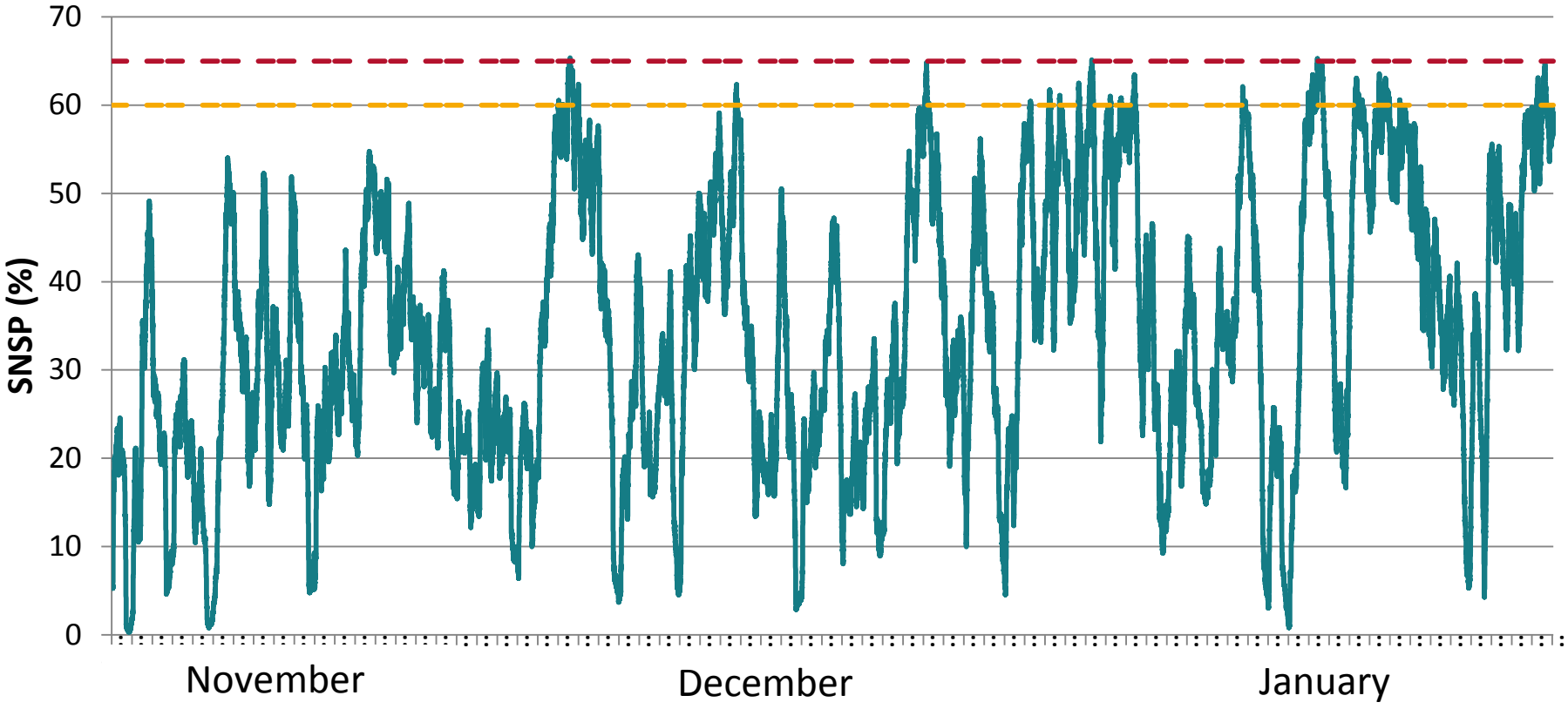



# DS3 Programme Status Update – January 2018

**Ian Connaughton**

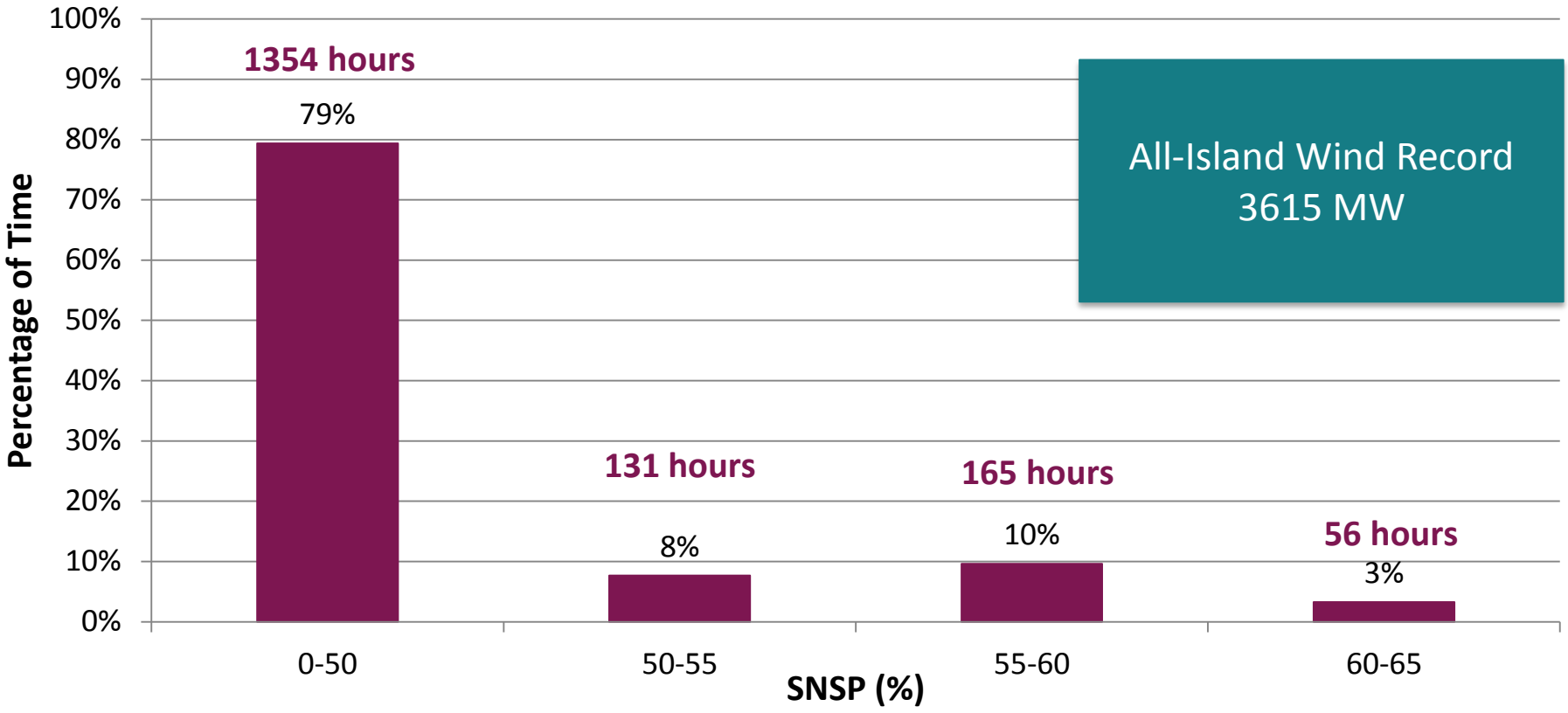
EIRGRID SONI

# 65% SNSP Trial




EIRGRID SONI

# 65% SNSP Trial

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# DS3 System Services

| Achievements | |
|---|---|
| **DS3 System Services Regulated Arrangements (11 Services) Contracts Consultation** | 26 September – 24 October 2017 |
| **DS3 System Services Industry Workshop** | 12 October 2017 |
| **DS3 System Services Tariffs for Regulated Arrangements Recommendations Paper published** | 23 October 2017 |
| **DS3 System Services Scalar Design Recommendations Paper Published** | 23 October 2017 |
| **DS3 System Services Qualification Trials Process Outcomes and Learning 2017 paper published** | 06 November 2017 |
| **DS3 System Services Regulated Arrangements (11 Services) documents published** | 12 December 2017 |
| **DS3 System Services Regulated Arrangements (11 Services) tender process** | 12 December 2017 |
| **DS3 System Services Bidders Conference held** | 19 December 2017 |

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# Key Enablers for DS3

| | 2017-2018 | 2018-2019 | 2019-2020 |
|---|---|---|---|
| ***Operational Change*** | ***SNSP 65%*** | ***SNSP 70%*** | ***SNSP 75%*** |
| RoCoF transition to 1Hz/s | | Y | Y |
| Implement OFGS enduring | | | Y |
| Minimum Sets/ Inertia Floors | | Y | Y |
| ***Control Centre Tools*** | ***SNSP 65%*** | ***SNSP 70%*** | ***SNSP 75%*** |
| Robust WSAT | Y | Y | Y |
| Ramping | | Y | Y |
| Look Ahead WSAT | | Y | Y |
| SNSP & Inertia Metrics display | | | Y |
| Voltage Trajectory Tool | | Y | Y |
| ***System Services*** | | | |
| New Service Providers connecting & displacing Conventional Service Providers | | | |

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# Key Operational Milestones

| | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|
| SNSP | 60% -> 65% | 65% -> 70% | 70% -> 75% | 75% |
| RoCoF | 0.5 Hz/s | 0.5 -> 1 Hz/s | 1 Hz/s | 1 Hz/s |
| Inertia | 23,000 MW.s | 20,000 MW.s | 17,500 MW.s | 17,500 MW.s |
| Min Sets | 8 | 8 | 7 | 7 |
| Exports | 300 -> 500 MW (interim) | 500 MW (interim) | 500 MW (interim -> enduring) | 500 MW (enduring) |
| System Services | Current providers, 11 Services | | | 14 Services |

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# DS3 RoCoF Project

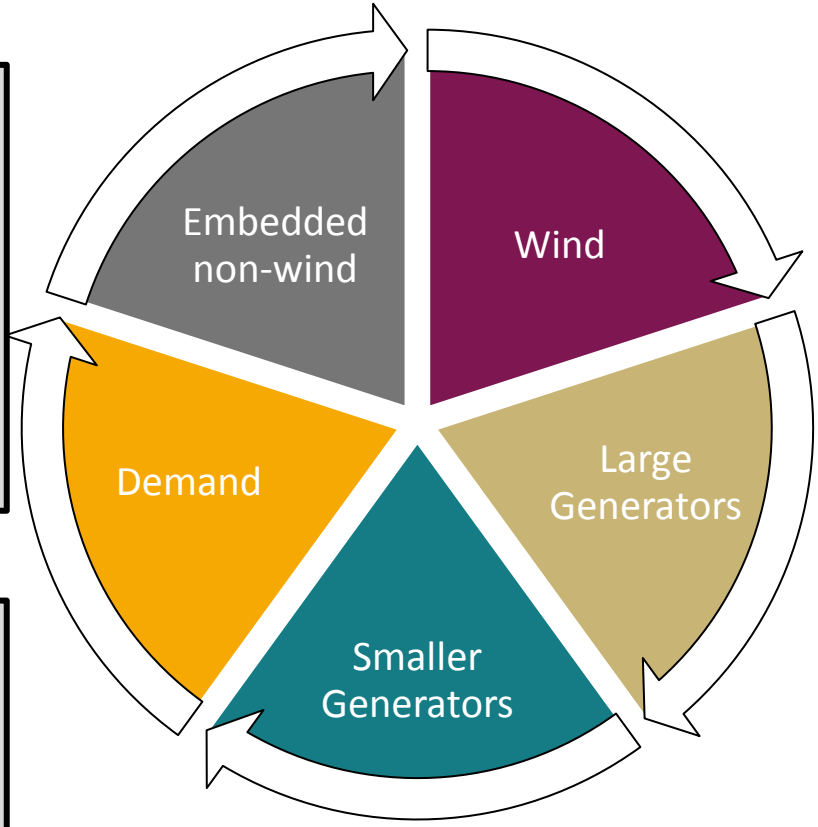
Jon O'Sullivan

EIRGRID SONI

# RoCoF Status – Jan 2018

**IE:** Confirmed that target of 110MW to be changed by YE/ 80% completed by Nov 18 ahead of schedule

**NI:** Consultation conducted during January on applying new settings retrospectively including proposals for roll-out logistics and timeline




**IE:** >98% of settings changed; project finished (remaining sites those with derogations)

**NI:** Progress ongoing with roll-out of settings for Large Scale Generation (LSG) – completion expected end of January

**IE:** ESB N have no concerns

**NI:** NIE & SONI have agreed overall prudent approach to risk to demand

**IE:** Engagement ongoing for large units which are behind schedule – number of ongoing issues undergoing resolution

**NI:** Some large units successfully moved to testing phase – continuing engagement needed

**IE:** Studies underway; testing scheduled into 2018, as per plan

**NI:** n/a – NIE considering all SSG (<5MW) together

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# DS3 – NIE NETWORKS UPDATE

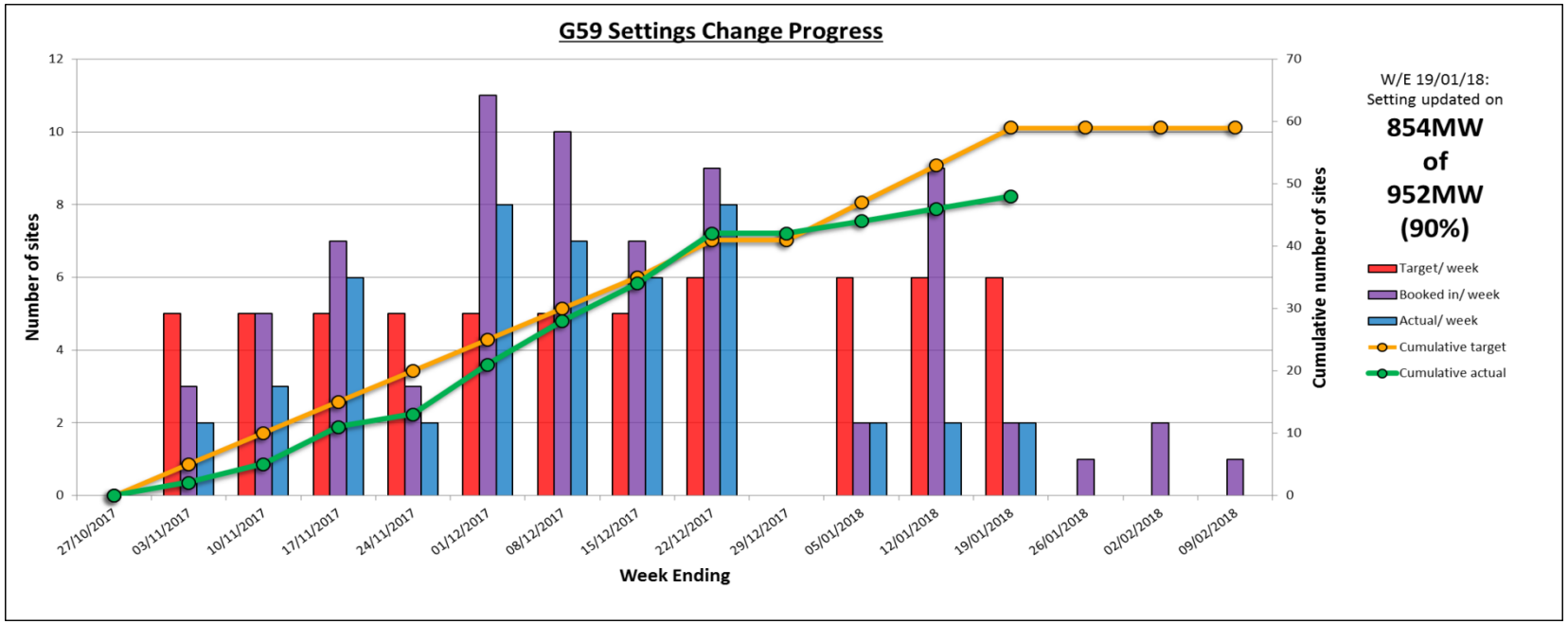
**DS3 ADVISORY COUNCIL – 24/01/18**

# Agenda

- Update on LSG Interface Protection Amendments
- SSG Consultation Update

# LSG settings implementation

- UR approval for new settings on 17/10/17.
- As of 19/01/18 the new settings have been implemented at 48 of 59 LSG sites.
- 854MW of 952MW (90%) changed




- Of the 11 outstanding sites:
  - 4 sites (29MW) are booked in for Jan / early Feb
  - We are working with owners to arrange bookings for the other 7 sites (69MW).
    - This is mostly due to relay issues.

# SSG Consultation

- **The Consultation commenced on 11/12/17 and closed on 22/01/18**
- **Proposed that LoM (RoCoF) amended to 1.0Hz /second (with a 500ms time delay)**
- **3 Responses received**
- **Reviewing responses this week**
- **Next Steps**
  - Agree methodology /mechanism to get SSG interface settings amended
  - Confirmation of quantum of SSG (MW)* that needs to have interface settings amended
  - Timescales for implementation to be agreed with UR and SEM Committee
  - Recommendations paper submitted to the UR
- **Historically, we have a very low level of interaction/response from SSG owners**
  - SSG SCADA Installation (300+ generic ‘reminder’ letters issued & 7 responses)

*Currently c1000 SSG sites, excluding micro generation
c420MW, including micro generation

# QUESTIONS?

# DSO RoCoF Update
# DS3 Advisory Council
# 24/01/18

**Tony Hearne**

**Manager, Future Networks**

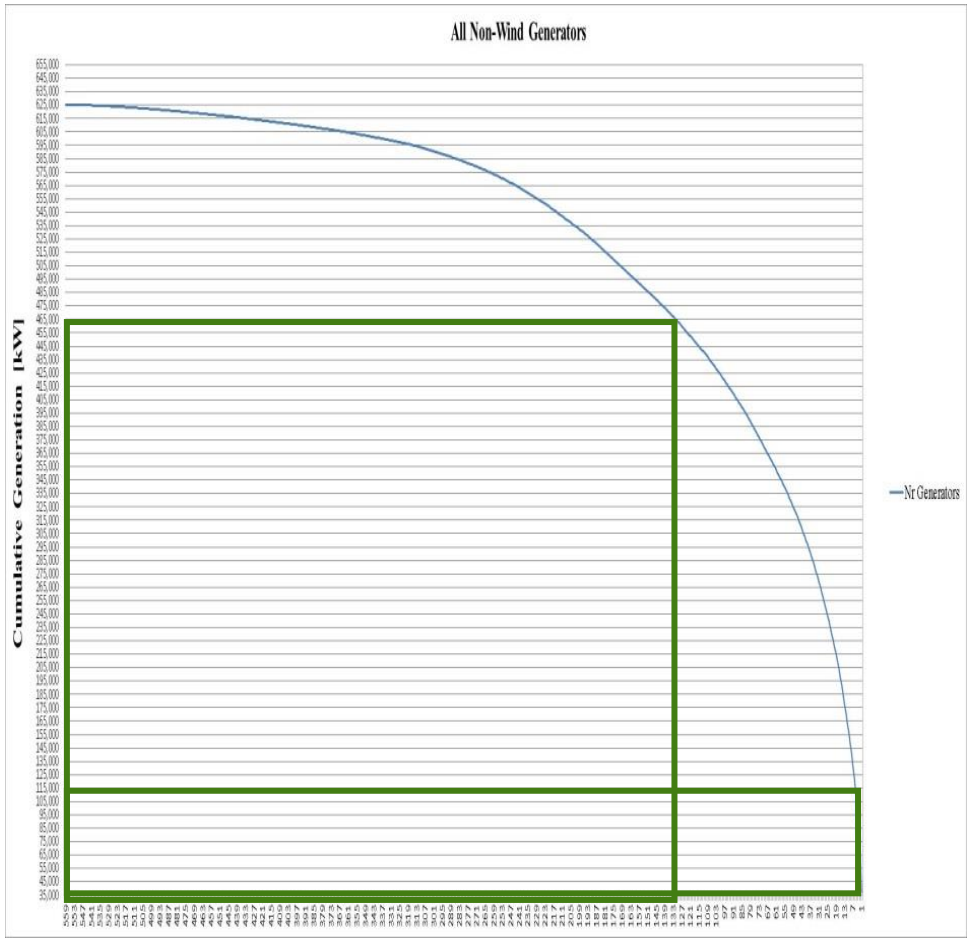
# DSO RoCoF Project Wind Breakdown



| Wind Figures Breakdown | % |
|---|---|
| Confirmed Returns | 95.3% |
| WFs to Confirm Completion | 1.2 % |
| Likely to request a Derogation | 3.5% |

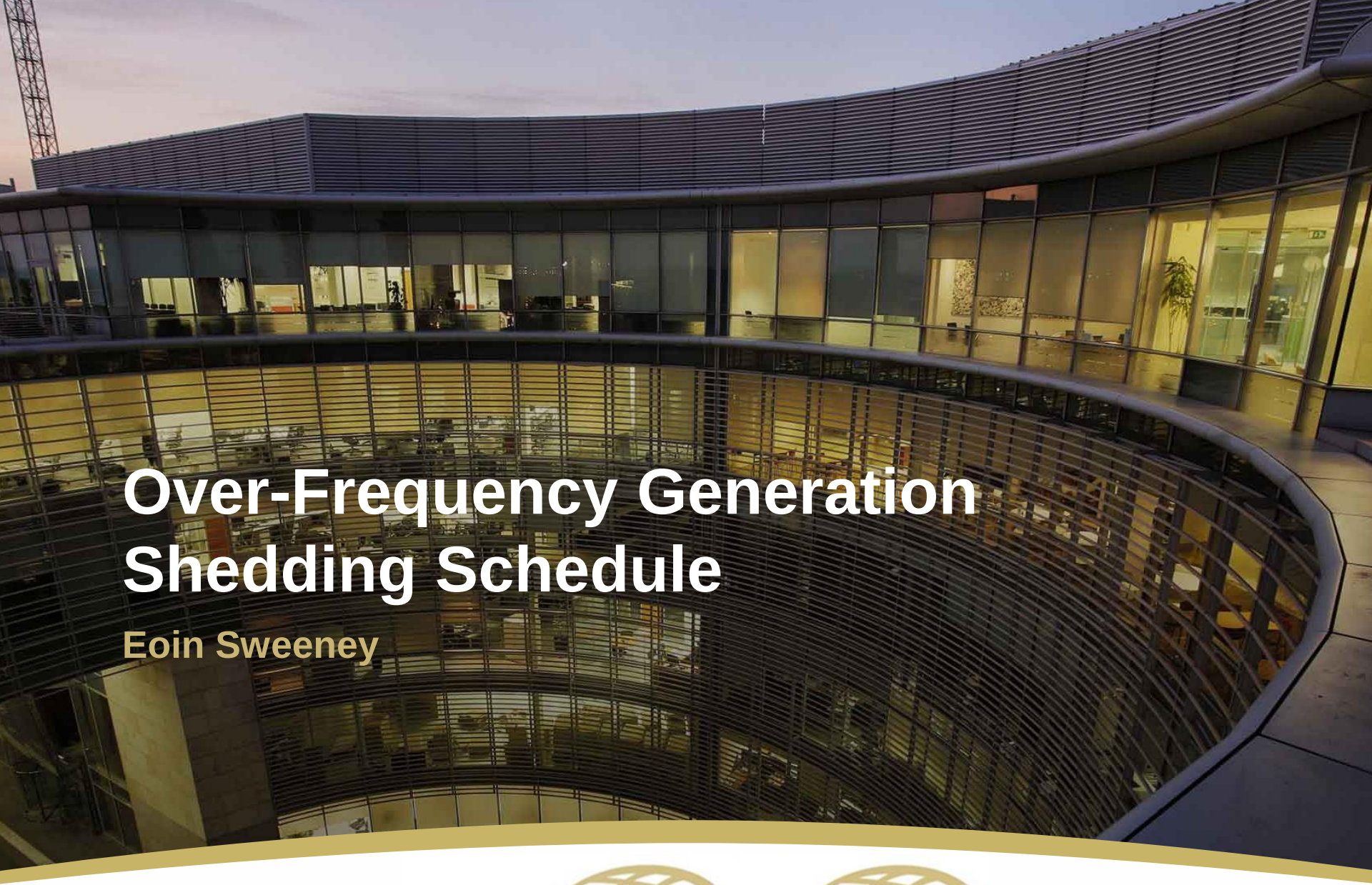
**All wind [Except any derogated] to be changed by mid-February.**

# Non Wind




- 185MW completed[1]
- Customer Engagement 385MW
- OEM Engagement 300MW
- On track for 75-80% of the total MW installed completed[1] by November 2018

# Questions?



# Over-Frequency Generation Shedding Schedule

Eoin Sweeney

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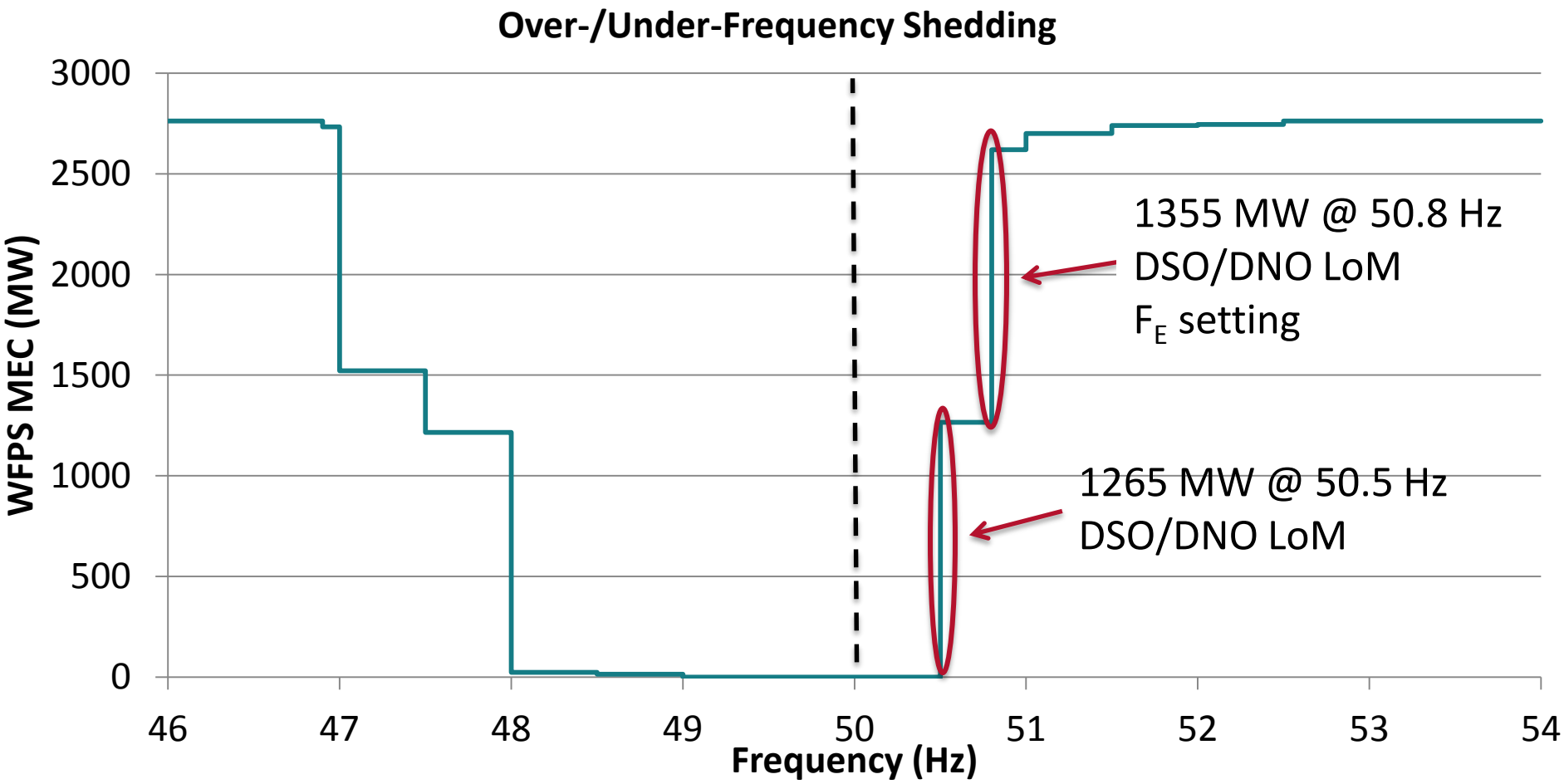
# The issue…

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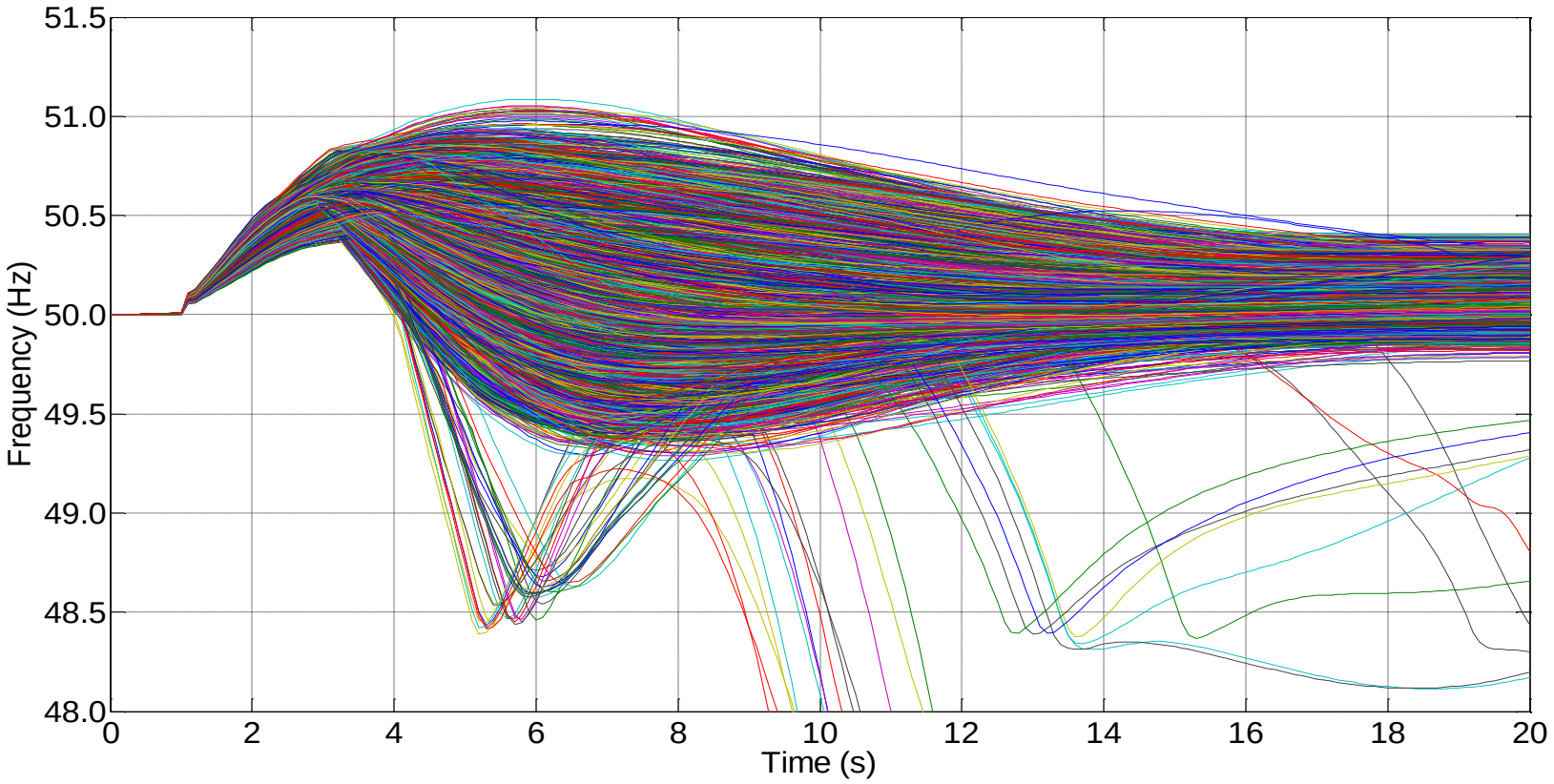
# …which if not solved

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# Two Stage Solution

| | |
|---|---|
| ***Interim Scheme*** | • Modified HF Triggers on I/C's<br>• WF High Frequency Response<br>• Revised settings on WF Grid Interface Protection<br>• CCGT Special Protection Scheme |
| ***Enduring Scheme*** | • Modified HF Triggers on I/C's<br>• WF High Frequency Response<br>• OFGS Protection Settings |

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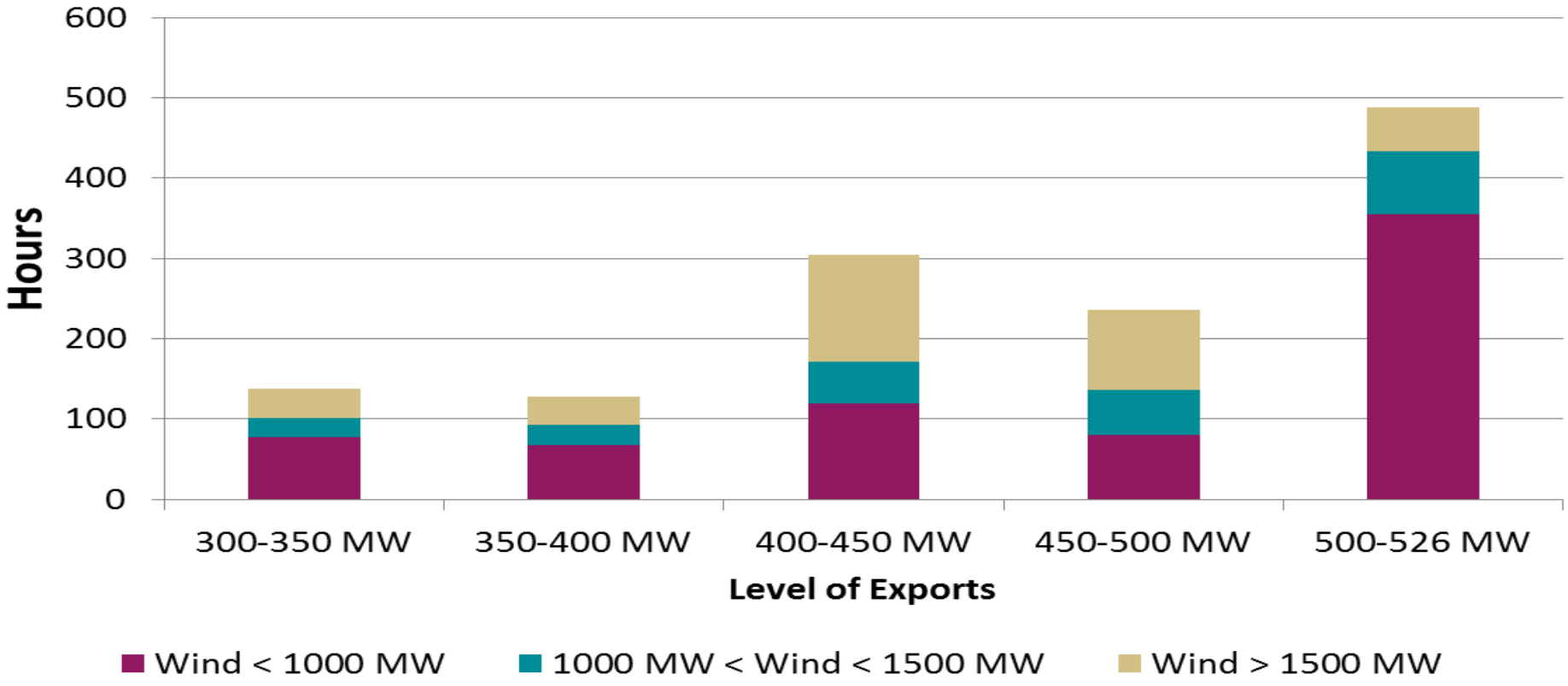
# EWIC 500 Trial Summary

20/06/2017 – 06/11/2017

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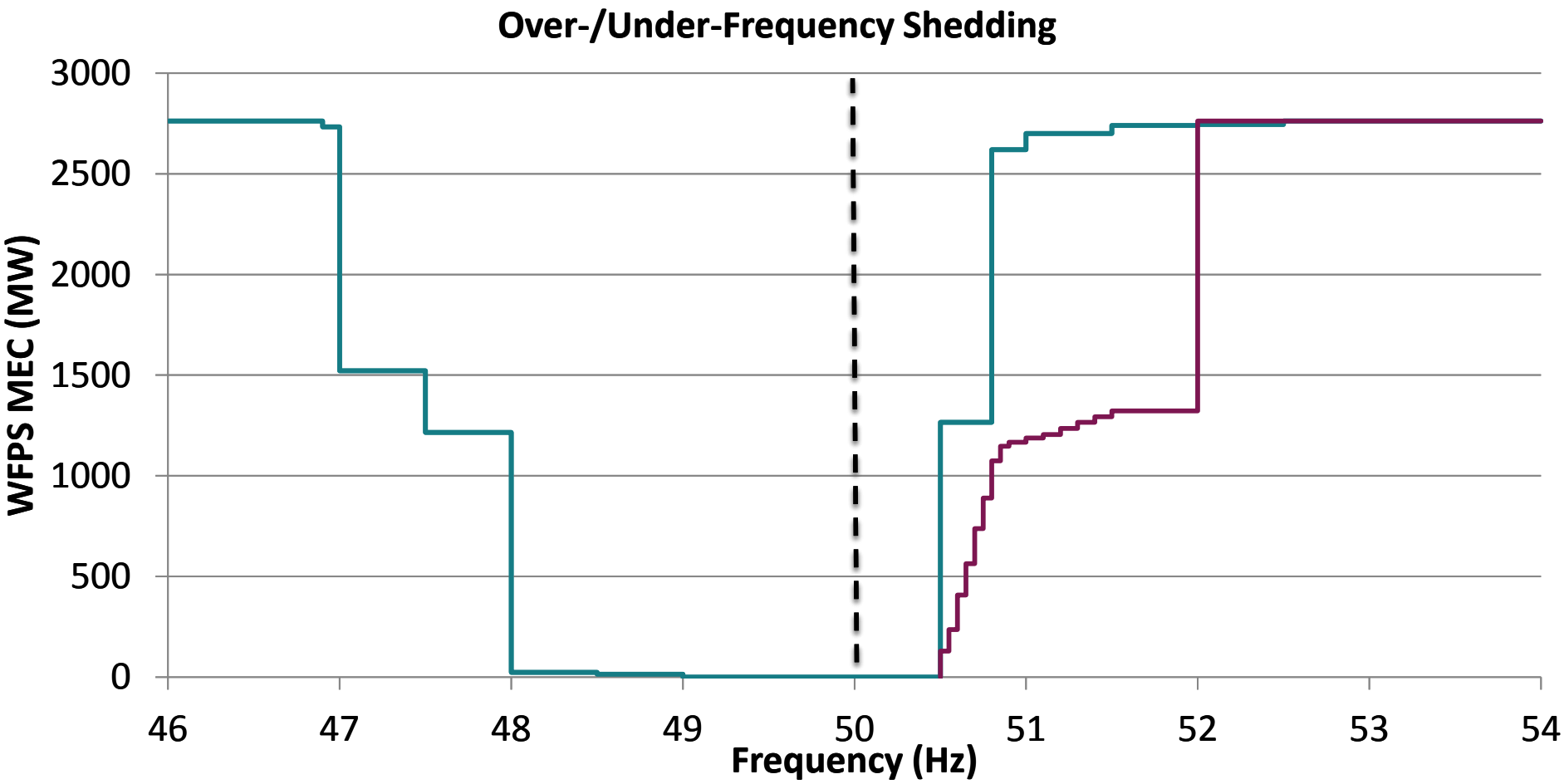
# OFGS Schedule

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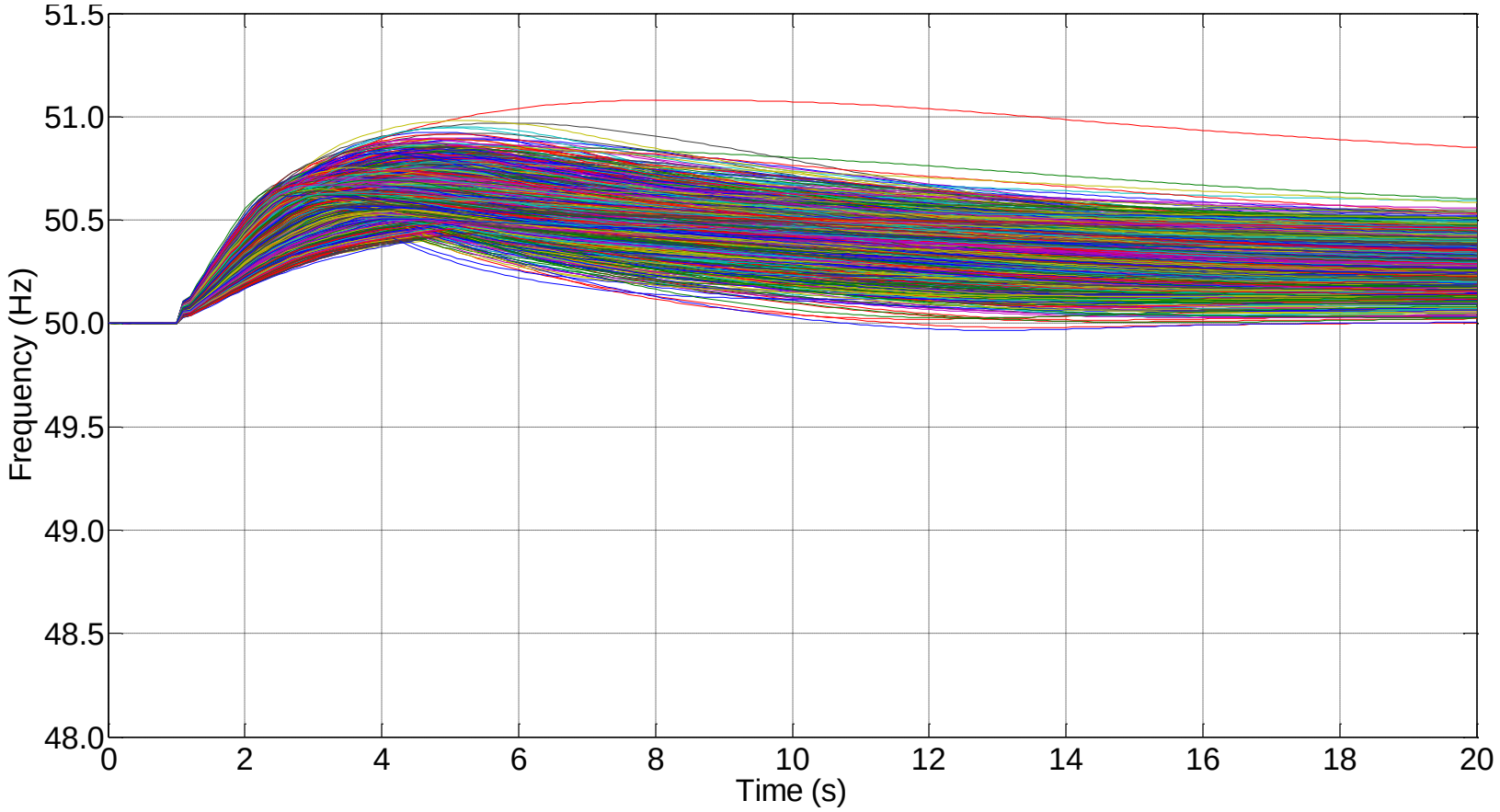
# Frequency Traces - EWIC Export



# Enduring OFGSS Settings

| Frequency Set-point | All-Island (MW) | IE (MW) | NI (MW) |
|---|---|---|---|
| 50.5 | 129 | 109 | 21 |
| 50.55 | 106 | 106 | |
| 50.6 | 172 | 154 | 19 |
| 50.65 | 156 | 156 | |
| 50.7 | 174 | 156 | 18 |
| 50.75 | 152 | 152 | |
| 50.8 | 186 | 160 | 26 |
| 50.85 | 72 | 72 | |
| 50.9 | 21 | | 21 |
| 51 | 21 | | 21 |
| 51.1 | 18 | | 18 |
| 51.2 | 30 | | 30 |
| 51.3 | 31 | | 31 |
| 51.4 | 27 | | 27 |
| 51.5 | 30 | | 30 |
| **Total** | **1322** | **1063** | **260** |

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# Next Steps

- Project has been set up in EirGrid/SONI
  - ESBN moving LoM settings
  - NIE rolling out OFGS settings
  - Over Frequency Response Curve & Grid Interface Protection

- Summary report will be published shortly

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# Key DS3 Risks

Ian Connaughton

24th January 2018

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# Key Risks to DS3: RoCoF transition to 1Hz/s

- **Risk:** *Cannot operate to the 1Hz/s standard, due to either generator non-compliance or DSO failing to implement required changes*

- **Mitigating steps**
  - ✓ Resolution of large generators' issues with plant owners/OEMs
  - ✓ Completion of analysis by NIEN and decision on SSG for NI
  - ✓ Completion of implementation of settings for LSG by NIEN for NI
  - ✓ Completion of RoCoF settings on embedded wind/ non wind by ESB N
  - ✓ Delay to phased transition to operating at 1Hz/s over 500ms

# Key Risks to DS3 - Control Centre Changes

- **Risk:** *pace & scale of change required in the Control Centre associated with ISEM will impact the capability to deploy DS3-specifc tools*

- **Mitigating steps**
  - ✓ Co-ordination with I-SEM on operational changes required and timeline associated with such changes
  - ✓ Develop transition plan including training and engagement with Control Centre operators.
  - ✓ Management of “ISEM freeze” in Control Centres

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# Key Risks to DS3: Increasing SNSP alone

- **Risk:** *increasing SNSP without delivery of other operational measures such as minimum number of sets and inertia floor results in increased curtailment and undermines DS3*

- **Mitigating steps**
  - ✓ Agreement on RoCoF transition plan
  - ✓ Breakdown requirements to increase SNSP steps & other operational parameters
  - ✓ Internal plan and stakeholder buy-in, including early engagement with Control Centre

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# DS3 Advisory Council Membership

- Looking for expressions of interest from:
  - Academia
  - Solar industry
  - Storage industry
  - Wind manufacturers
- Interested parties please email DS3@eirgrid.com

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# Lunch

12:30 – 13:30

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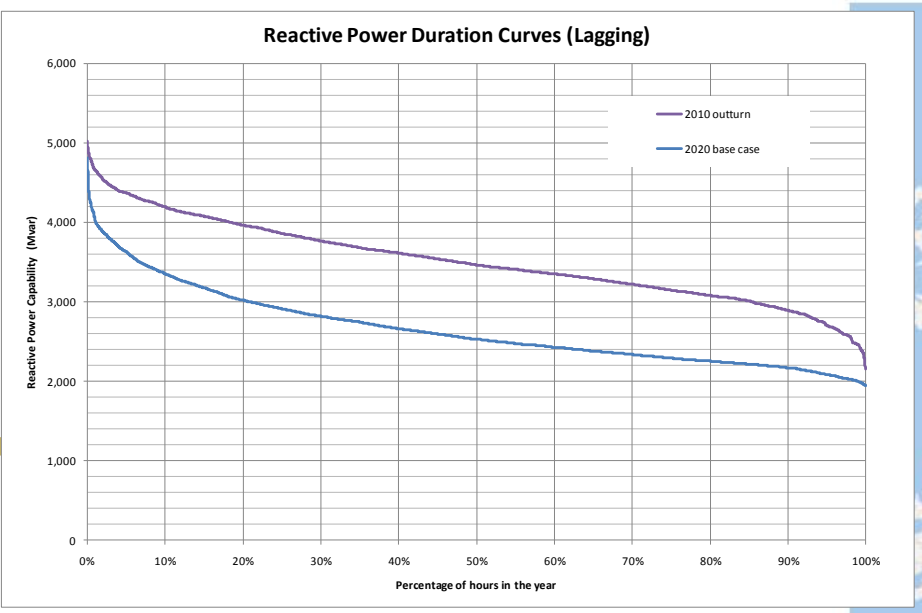
# Nodal Controller Project

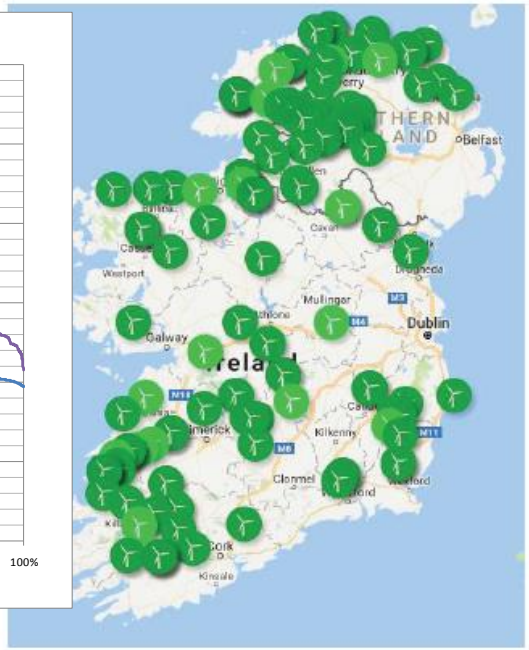
Barry O'Connell

EIRGRID SONI

# DS3 - Need for SSRP

1) FOR - Reduction in Online Reactive Power
2) Increased loading & distance (low voltage)
3) Distribution connected generation setup absorbing reactive power (low voltage)
4) Displacement of conventional generation (Voltage Control)
5) Underground cable (high voltage)
6) Harmonic filters (high voltage)

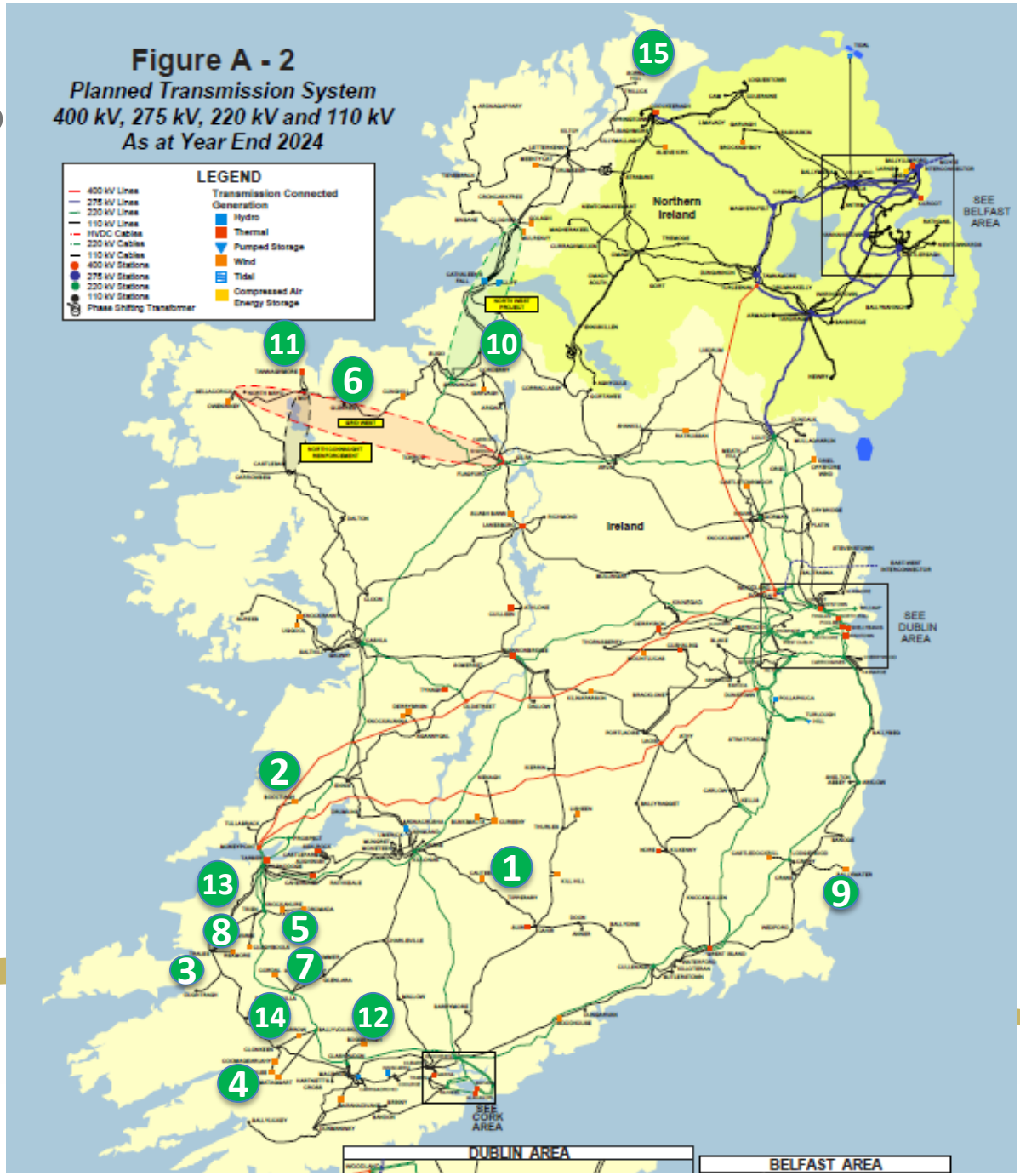





# Ireland –Type B

| | Cluster | MVAr + / - |
|---|---|---|
| 1 | Cauteen | 58 |
| 2 | Booltiagh | 32 |
| 3 | Reamore | 24 |
| 4 | Coomataggart | 26 |
| 5 | Athea | 14 |
| 6 | Glenree | 11 |
| 7 | Cordal | 18 |
| 8 | Cloghboola | 15 |
| 9 | Crory | 15 |
| 10 | Corderry | 12 |
| 11 | Tawnaghmore | 10 |
| 12 | Boggeragh | 9 |
| 13 | Kilpaddoge | 6 |
| 14 | Garrow | 3 |
| 15 | Sorne Hill | 3 |



# Northern Ireland - Cluster

| | Cluster | MVAr + / - |
|---|---|---|
| 1 | Magherakeel | 45 |
| 2 | Gort | 30 |
| 3 | Tremoge | 30 |
| 4 | Rasharkin | 30 |
| 5 | Drumquin | 30 |
| 6 | Garvagh | 30 |
| 7 | Kells | 30 |
| 8 | Killymallaght | 10 |



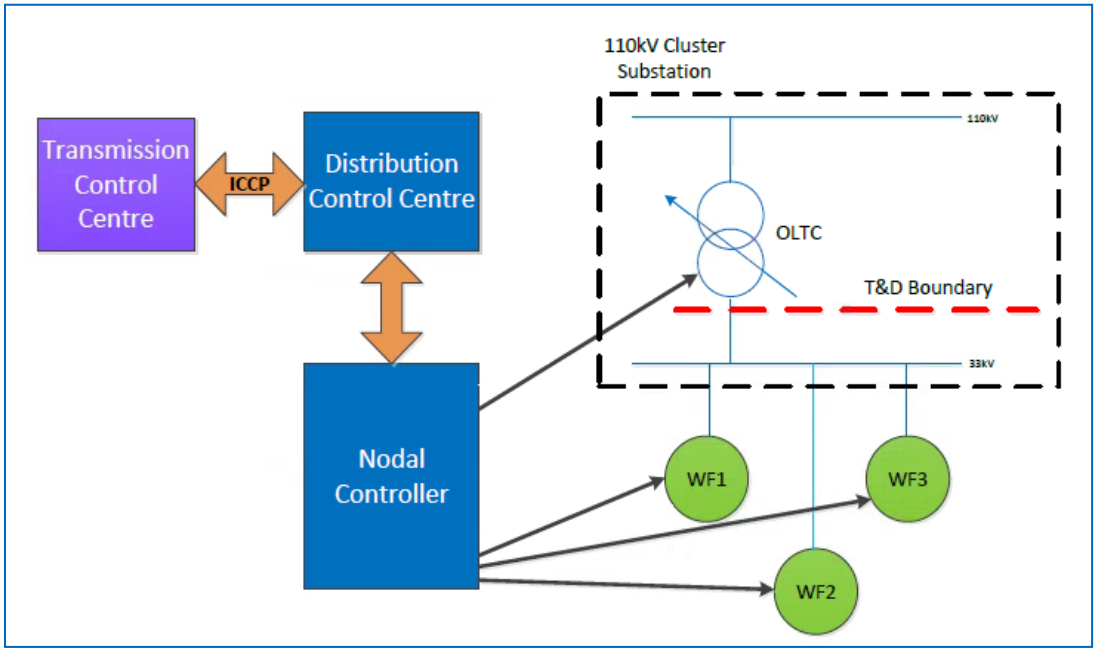
# NIE NETWORKS' NODAL CONTROLLER PROJECT

**DS3 Advisory Council – 24/01/18**

# What is the Northern Ireland Nodal Controller

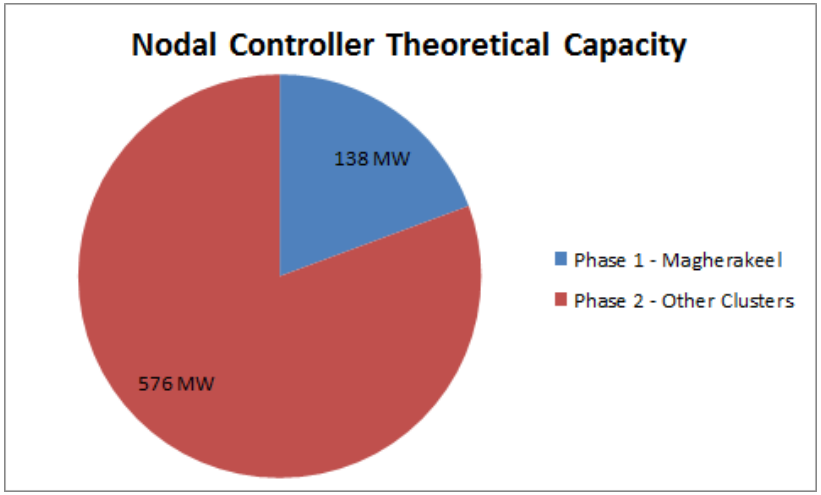
- Controller which regulates the reactive power of downstream generators to deliver a constant:
  - Power Factor
  - Reactive Power; or
  - Voltage

  set point at an upstream node.
- Required to:
  - Ensure stable operation (no hunting from occurring).
  - Protect the distribution and transmission system from voltage and thermal violations.
  - Enable consistent Principles of Access to be applied.
  - Ensure efficient use of the system i.e. reduced OLTC operations.



# NIE Networks Nodal Controller Strategy

- Phase 1: Nodal Controller Trial at Magherakeel cluster substation.
- Phase 2: If Phase 1 is successful, roll out of Nodal Controllers at other cluster substations. Subject to a positive CBA outcome for each site.
- Phase 3:Decision on mechanism to deal with non-cluster connected LSG.




| Phase | Stage | Timeline |
|---|---|---|
| 1 | Integration into SCADA system | Q1 2018 |
| | Algorithm Development | Q2 2018 |
| | Trial Live | Q2/Q3 2018 |
| | Decision on Nodal Controller success | Q2 2019 |
| 2 | Begin roll out of Nodal Controllers at remaining cluster substations. | Q3 2019 |
| 3 | Decision on mechanism to deal with non-cluster connected LSG. | Q3 2019 |

# Nodal Controller Project Update
# DS3 Advisory Council
# 24/01/18

**Tony Hearne**

**Manager, Future Networks**

# Layers of this cake – Type B WF >5MW




Layer 3: SSRP Procurement

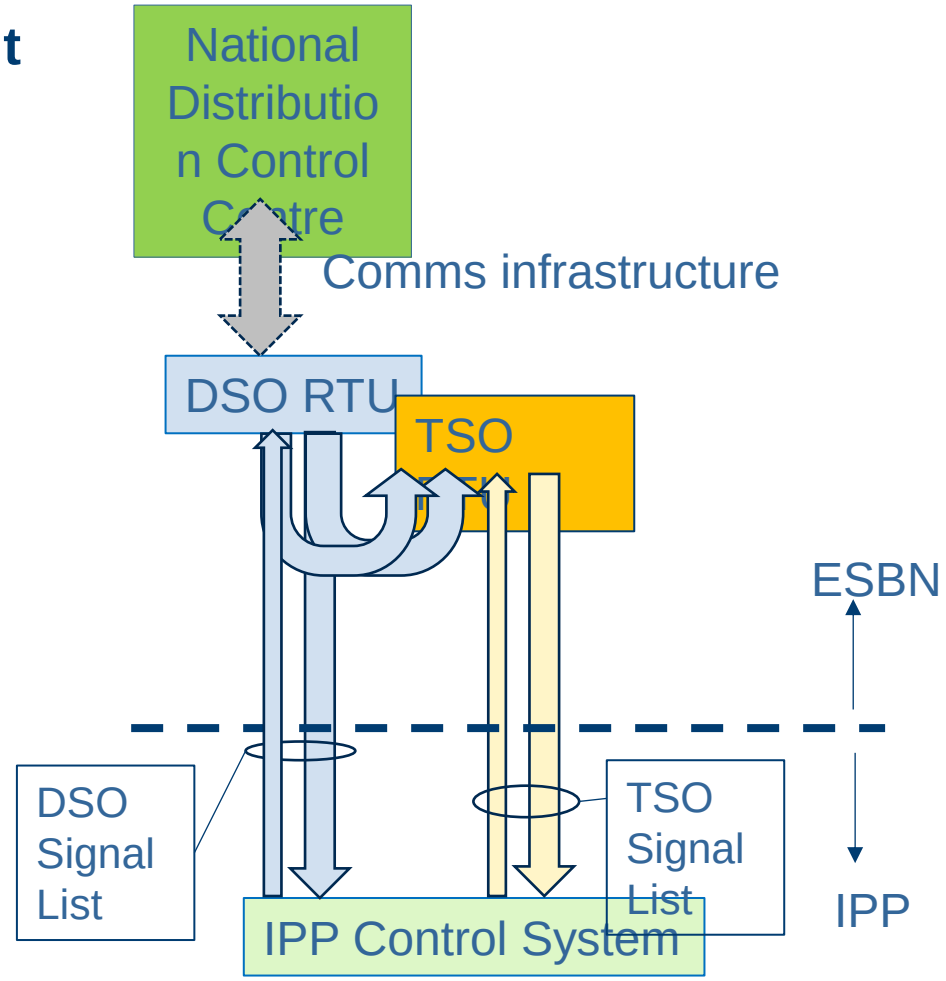
Layer 2: Nodal Controller

Layer 1: Distribution Code compliance / Testing

# Layer 1:  Distribution Code compliance

# Layer 1: Distribution Code compliance

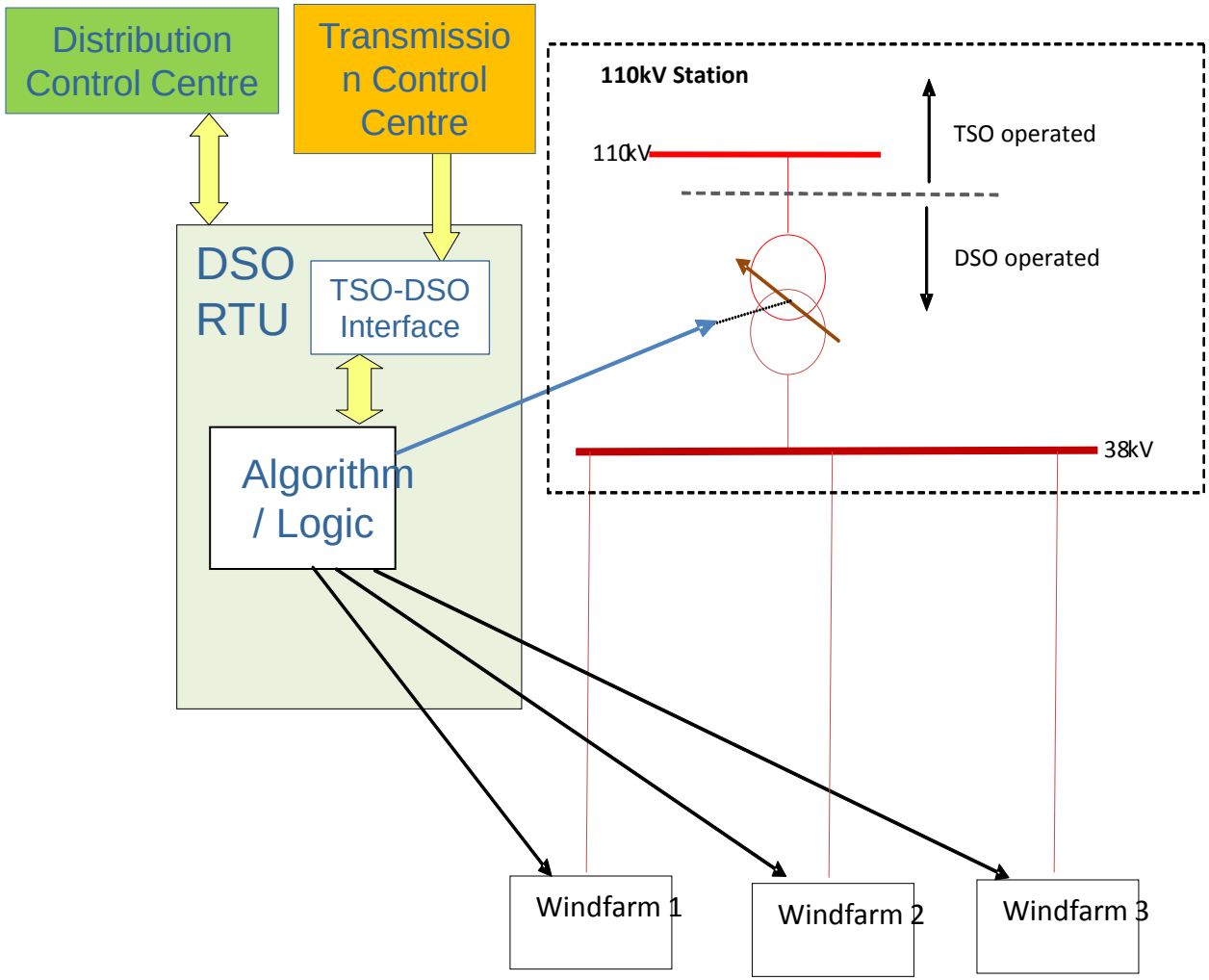
- **Not optional unless permanent derogation obtained**
- **Many brownfields on temporary derogations to enable IPP works to be completed in 2017**
- **ESBN / ESBTS need to put programme of work in place for telecoms infrastructure from WF site to DCC**
- **This will be either fibre or polling radio**
- **Existing temporary derogations are being extended to 2018**



# Layer 2:  Nodal Controller

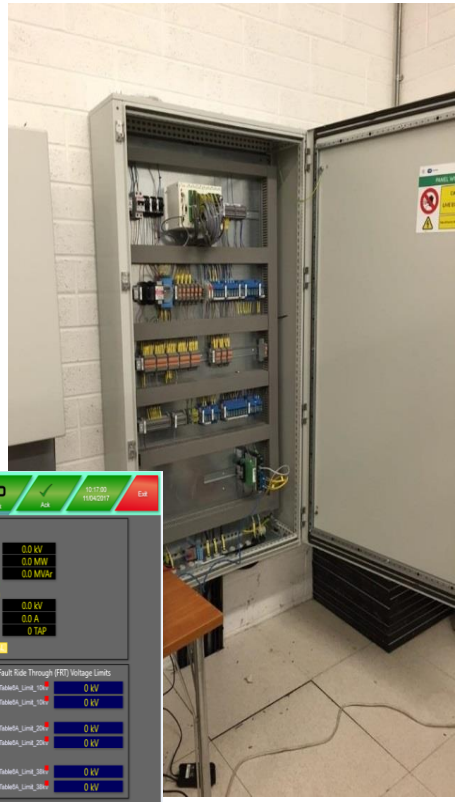
# What is a Nodal Controller?

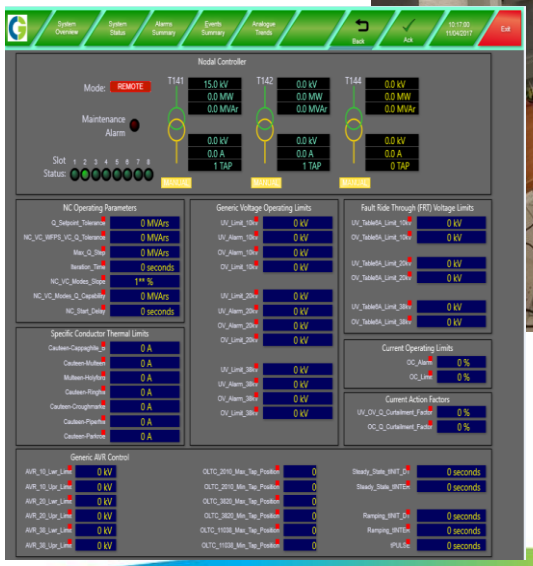
- **A means of utilising the mandated reactive power capabilities of the larger windfarms and delivering a Transmission support functionality at the TSO-DSO interface**
- **Whilst ensuring that all Distribution voltages and current limitations are maintained and protected**
- **Vast majority of the intelligence is located in the DSO RTU at the 110kV station**
- **When in Auto Mode, Nodal Controller needs to take exclusive control of the OLTC**



# Nodal Controller Timings

- Trial underway at Cauteen
- Progress to date slower than expected – interaction with other ongoing works at Cauteen
- Commissioning/testing are ongoing with first windfarm. Second to be added as early as testing can be completed. [End March]
- Will be a period of evaluation TSO and DSO [April-May]
- Joint report to CRU [End May]
- Other windfarms in cluster expected to be brought into the scheme through the year [Q3]
- Thereafter wider roll out is intended

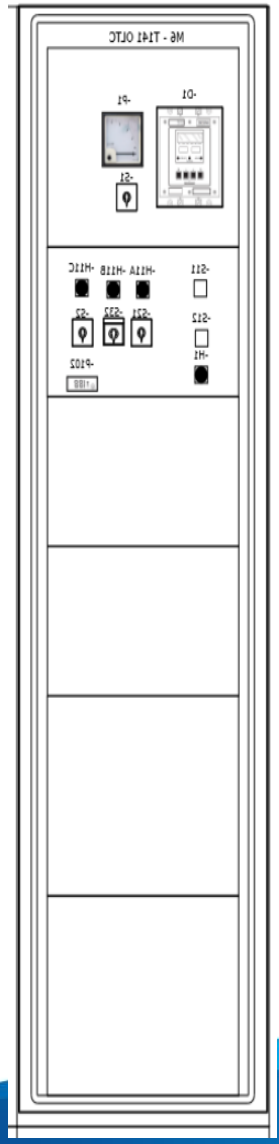




# Greenfield pipeline Type B >5MW projects

- Intention that if NC-ready RTU in place, algorithm is then loaded onto it to enable NC operation
- Where possible, and by agreement with the project owners, these projects are being intercepted to make them “Nodal Controller Ready”
- Three main impact areas:

- Signal lists
- DSO RTU
  - Different order code from vendor Crompton Greaves
  - No material change in cost
- OLTC panel
  - Different OLTC panel design available
  - Very little material difference

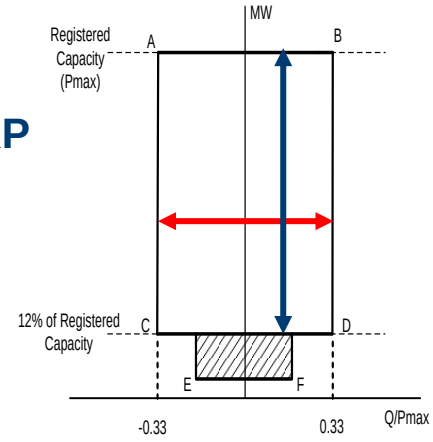




# Layer 3:  Steady State Reactive Power Product

# SSRP

- The presence of a Nodal Controller is a pre-requisite for participation by Distribution connected wind in SSRP
- EirGrid procurement process will be applied
- Ultimately EirGrid decide on whether and where to award SSRP contracts
- Technical definition of SSRP product signed off on by CER
- Payment based on P-Q capability – minimum D Code requirements must be met
- Horizontal and vertical scalars - effectively the largest rectangle that can fit in the observed P-Q capability
- This will be informed by the Reactive Power controllability tests [up to wind level on the day] and inferred for remainder
- Nodal Controller will manage distribution constraints in real time



# Eating the cake…….

# Next Steps

- **ESBN / EirGrid to hold a joint workshop with the existing Type B windfarms**
- **Outcomes from this:**

**From ESBN perspective:**

- **Communication to windfarmers of what is involved in making Layers1 and 2 happen for;**
- Brownfield sites
- Greenfield sites
- **A clear view of who and at what pace the Type B windfarms are putting the necessary kit in for Layer 1**
- **A clear view on the likely interest in Layer 2 / SSRP**
- **A clear work programme**

**From Windfarm perspective**

- **A view of pain [monetary, disruption etc.] and potential reward**

# A Piece of Cake……







# Future Interconnection Study

Noel Cunniffe

24th January 2018

EIRGRID SONI

# Introduction and Background

- Additional interconnection is likely over the next decade to Great Britain and/or France

- Numerous benefits to increased interconnection:
  a) Increased security of supply – high capacity link
  b) Support to renewable development
  c) Increased market competition

- Potential system impacts due to:
  a) Increased SNSP levels
  b) Increased Largest Single Infeed/Outfeed from 500 MW to potentially 750 MW

- Future Interconnection Study assessed these potential issues

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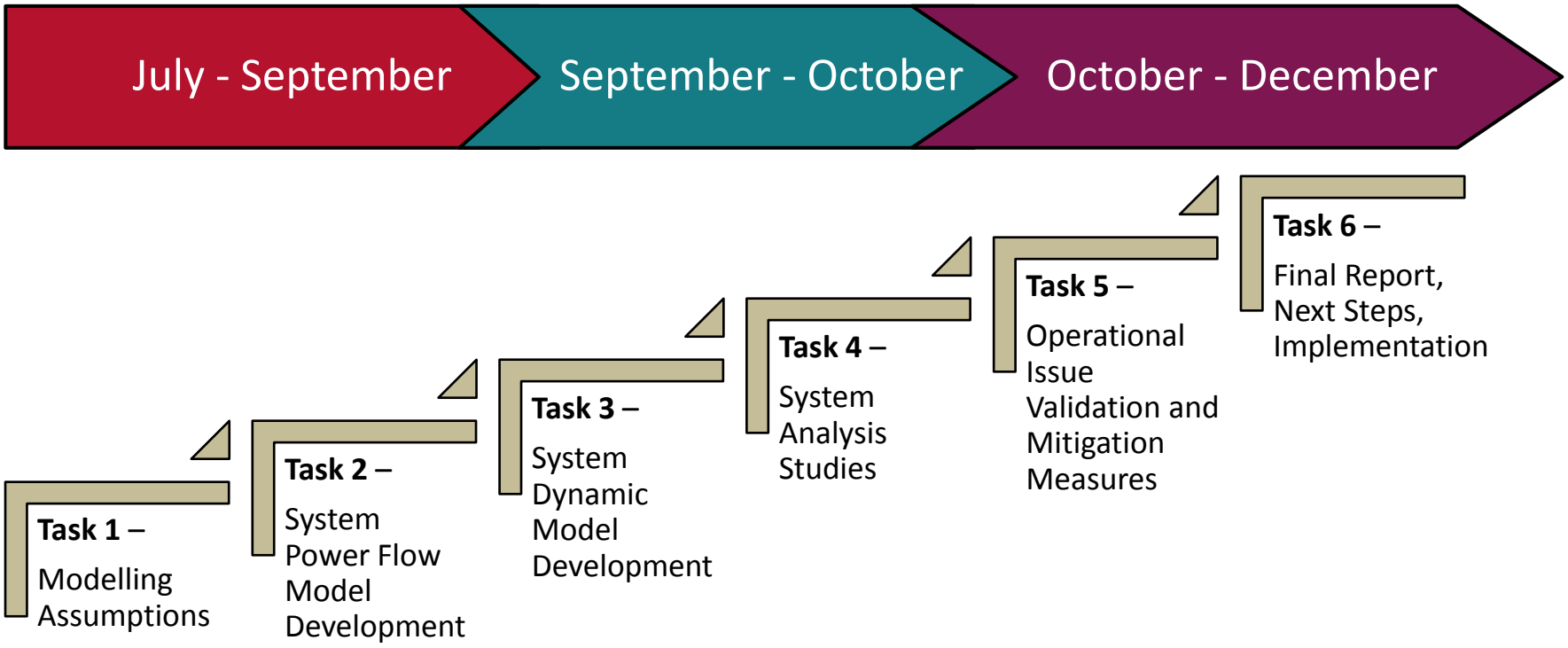
# Future Interconnection Study Timeline

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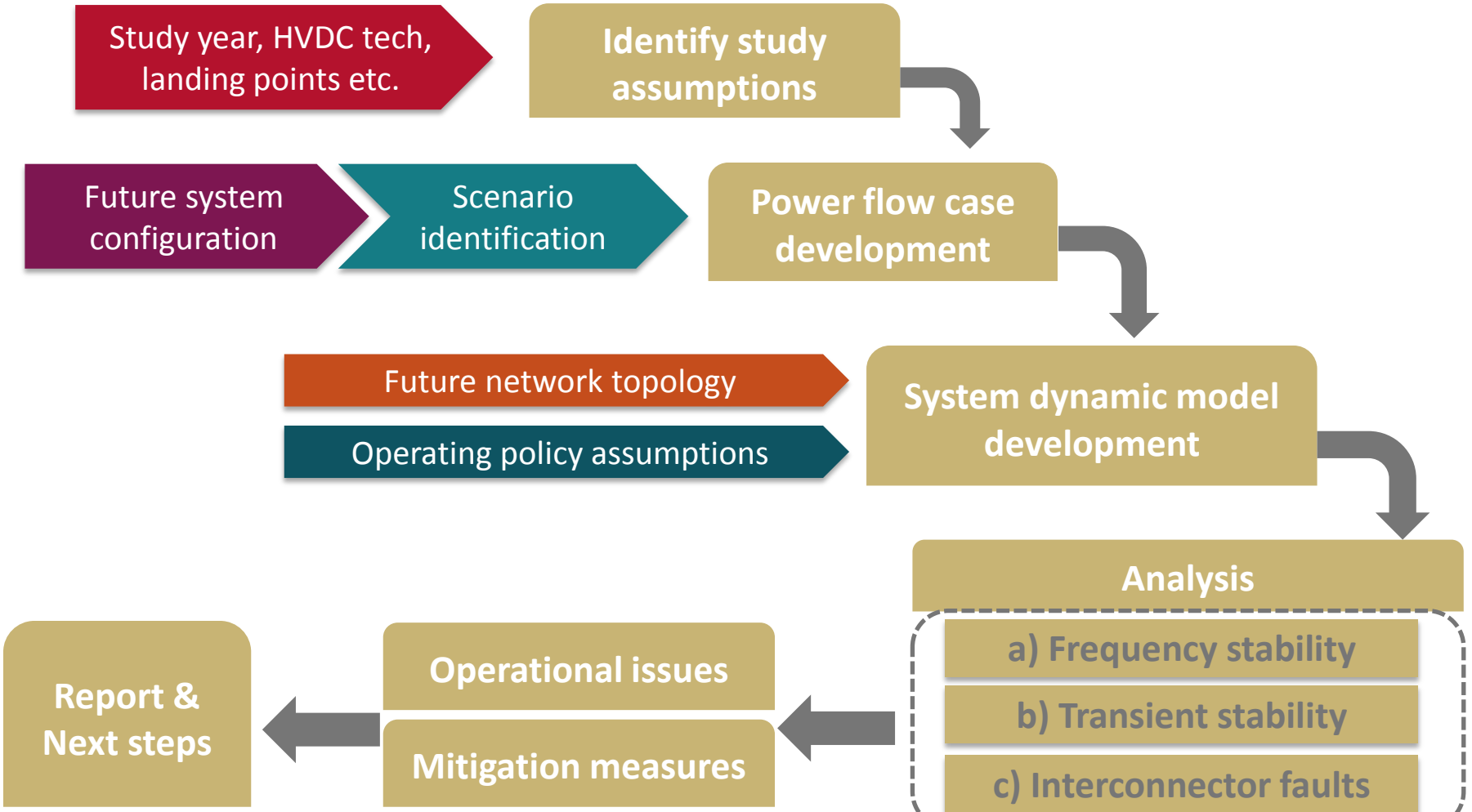
# Future Interconnection Study Process

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# Frequency Stability Analysis

- Developed 2025 steady state, dynamic, and transient models of the All-Island system to assess frequency, voltage and angular stability (Single Frequency Model and WSAT model)

- WSAT model is most sophisticated transient model we have developed – STATCOMS, batteries, and new generation technologies all modelled

- PLEXOS dispatches created for worse-case scenarios:
  - 750 MW import trip – low frequency event
  - 750 MW export trip – high frequency event

- Frequency stability analysis highlighted **issues with 750 MW import cases – high RoCoF & low frequency nadir**

- Frequency stability analysis also highlighted a **high frequency zenith** with **750 MW export cases**

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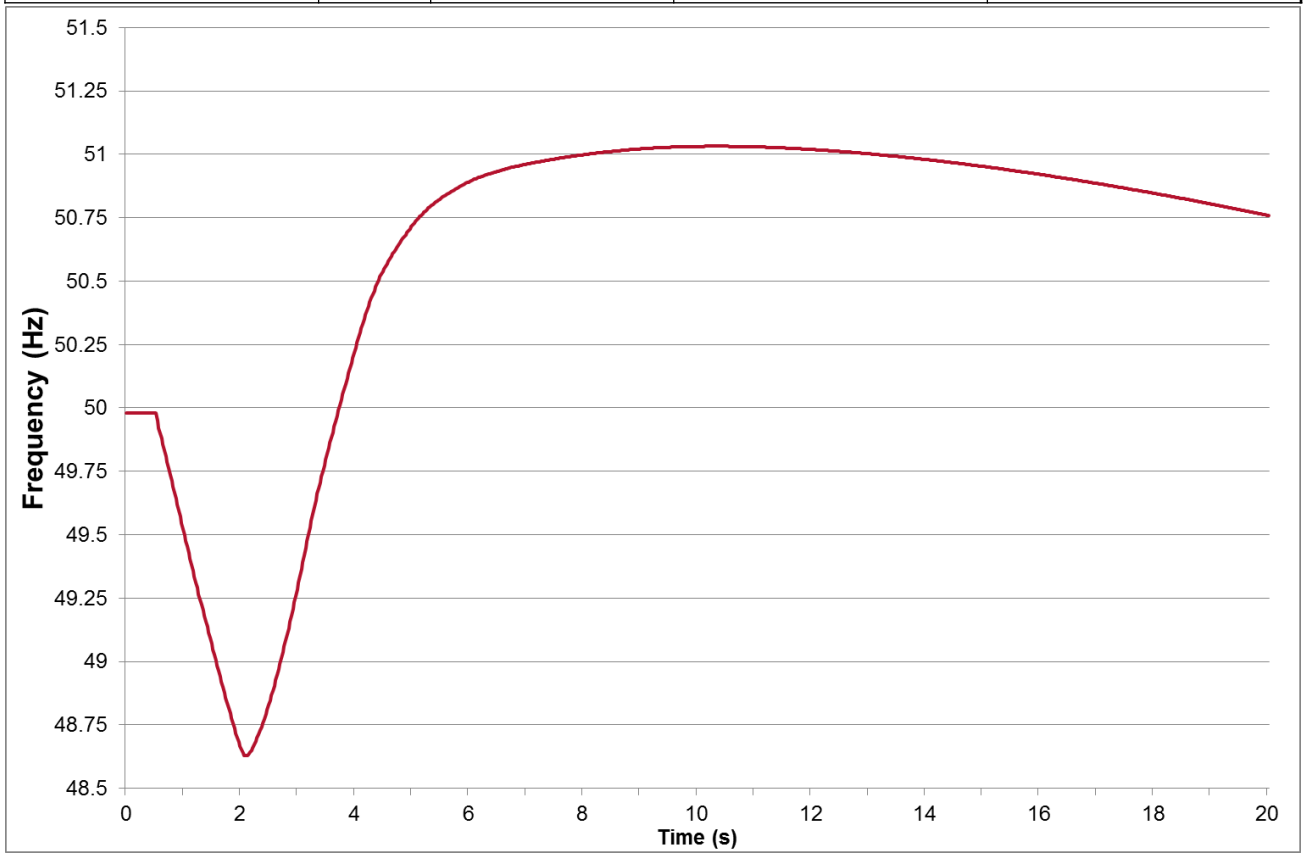
# Frequency Analysis – Base Case

| Case Details | | | | |
|---|---|---|---|---|
| System Demand (MW) | SNSP (%) | Inertia (MWs) | Maximum RoCoF (Hz/s) | Wind Generation (MW) |
| 4,046 | 74.5 | 15,050 | 1.246 | 1,644 |




Comments:

- Initial summer case has no dynamic inertia constraint for RoCoF containment
- Very high RoCoF – theoretical maximum of 1.246 Hz/s
- Load inertia limits RoCoF to less than maximum but still above system limit
- Trip results in uncontracted customer load shedding at 48.7 Hz

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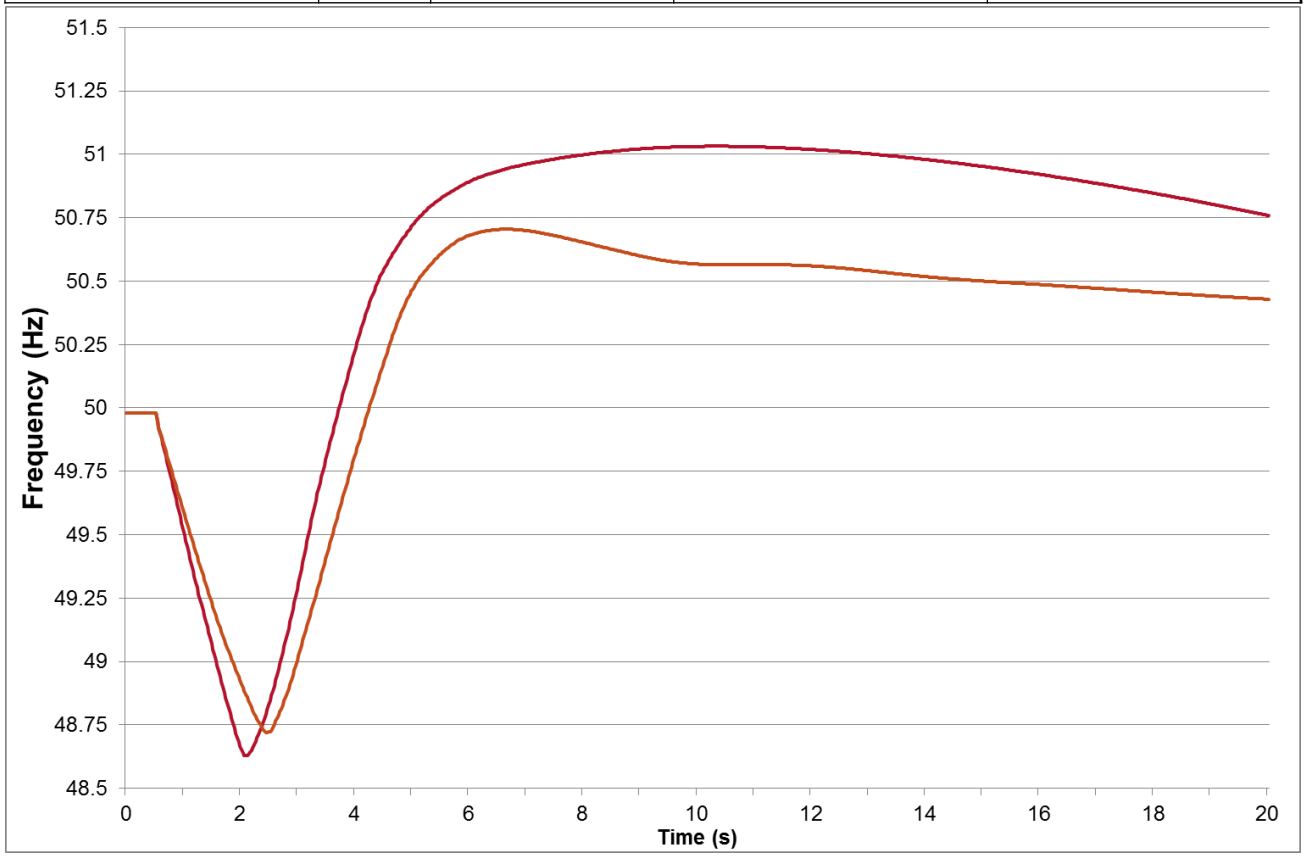
# Frequency Analysis – BC + Inertia Constraint

| Case Details | | | | |
|---|---|---|---|---|
| System Demand (MW) | SNSP (%) | Inertia (MWs) | Maximum RoCoF (Hz/s) | Wind Generation (MW) |
| 4,046 | 69.2 | 19,692 | 0.952 | 1,452 |




Comments:

- Dynamic RoCoF Constraint dispatches on more inertia to limit RoCoF to less than 1 Hz/s
- Wind generation is curtailed slightly to make headroom for additional generation
- RoCoF is less than 1 Hz/s but Fast Frequency Response (FFR) does not respond fast enough to stop nadir hitting load shedding
- Additional solution is required as a result

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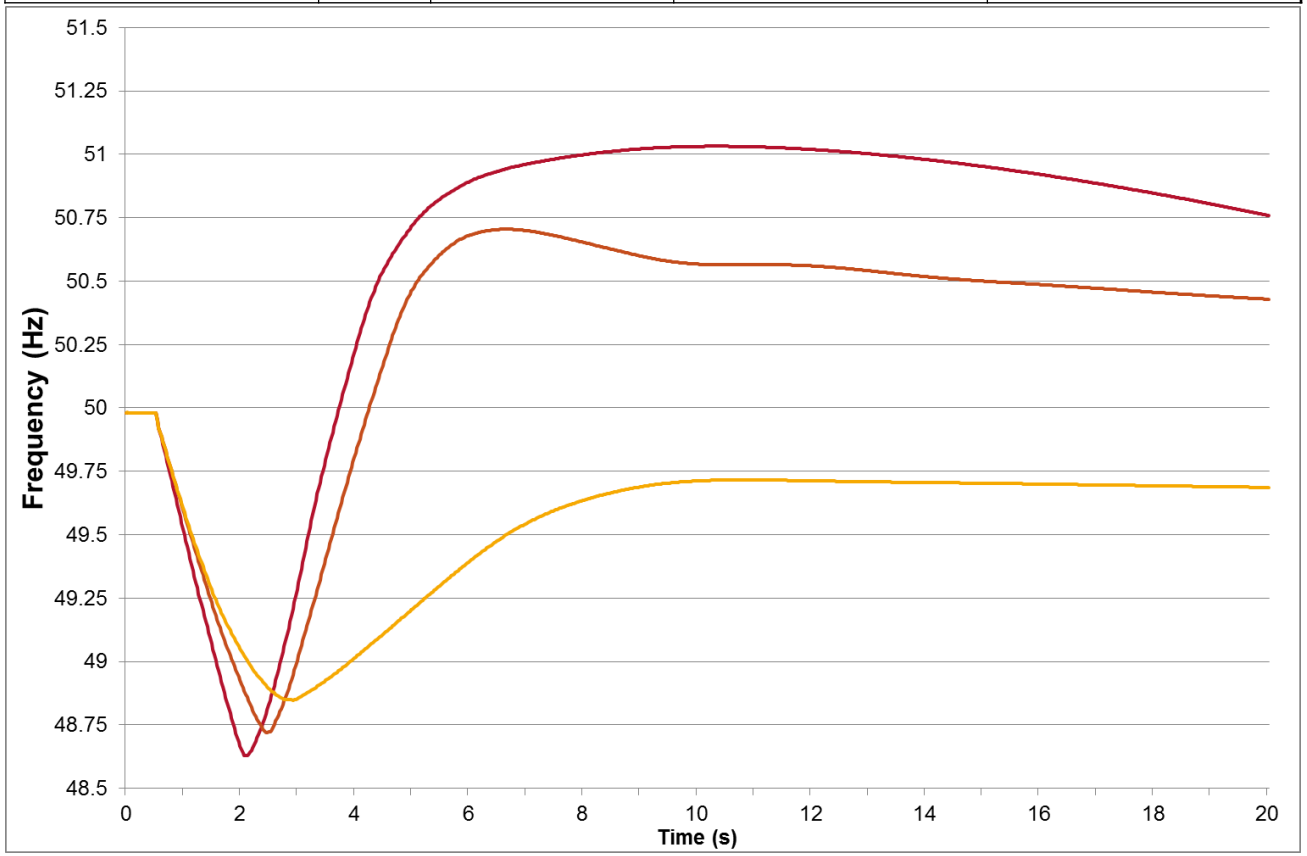
# Frequency Analysis – BC + IC + Wind Response

| Case Details | | | | |
|---|---|---|---|---|
| System Demand (MW) | SNSP (%) | Inertia (MWs) | Maximum RoCoF (Hz/s) | Wind Generation (MW) |
| 4,046 | 69.2 | 19,692 | 0.952 | 1,452 |




Comments:

- The introduction of a fast response from wind generation eliminates customer load shedding
- Wind is modelled to give a maximum additional response of 10% output at a rate of approximately 2% droop
- Load shedding does not occur but frequency nadir is still below 49 Hz

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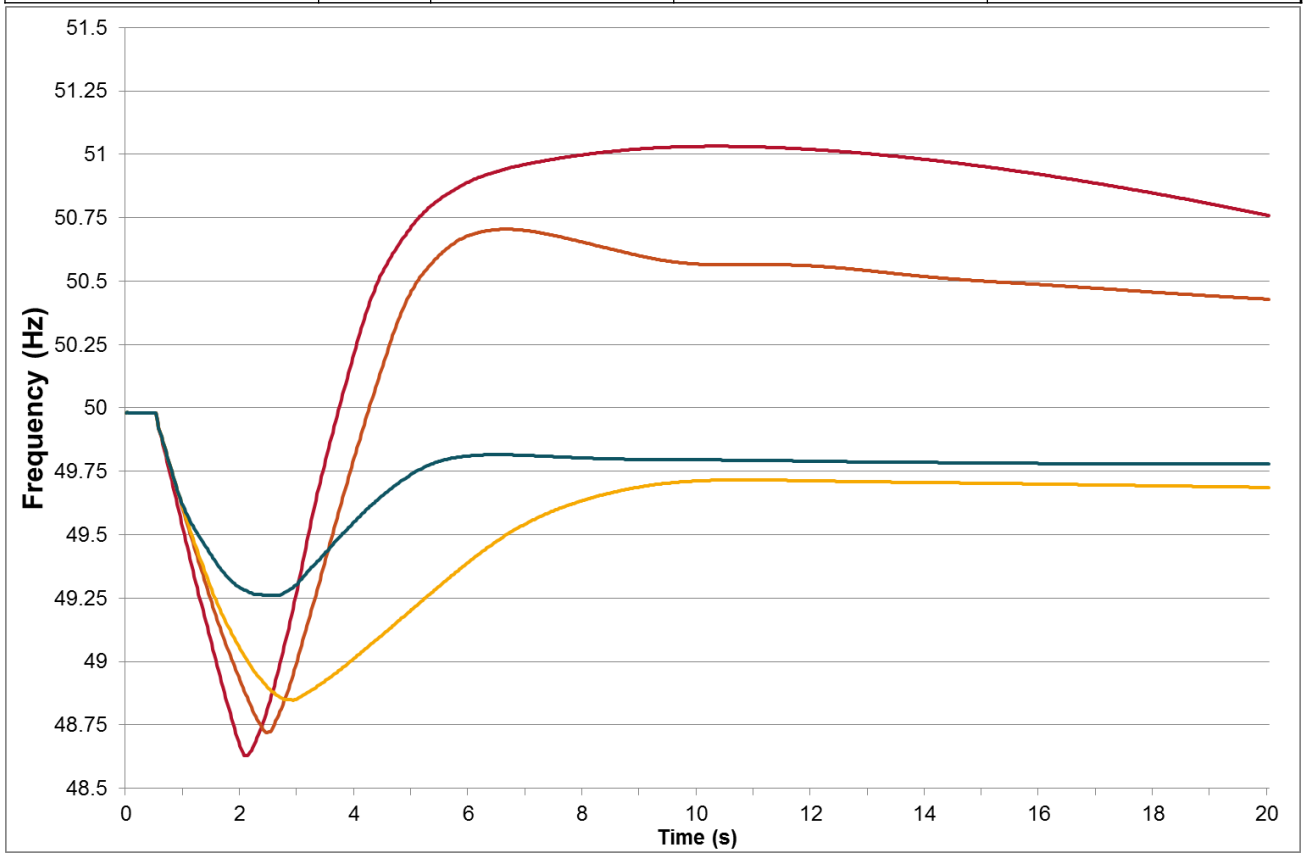
# Frequency Analysis – BC + IC + WR + DSR

| Case Details | | | | |
|---|---|---|---|---|
| System Demand (MW) | SNSP (%) | Inertia (MWs) | Maximum RoCoF (Hz/s) | Wind Generation (MW) |
| 4,046 | 69.2 | 19,692 | 0.952 | 1,452 |




Comments:

- Introducing fast acting response from demand improves the frequency nadir dramatically
- In this case, demand response of approximately 200 MW increases the frequency nadir above 49.25 Hz
- Demand response is a proxy for more static FFR – batteries or other technologies could provide similar responses in terms of response speed

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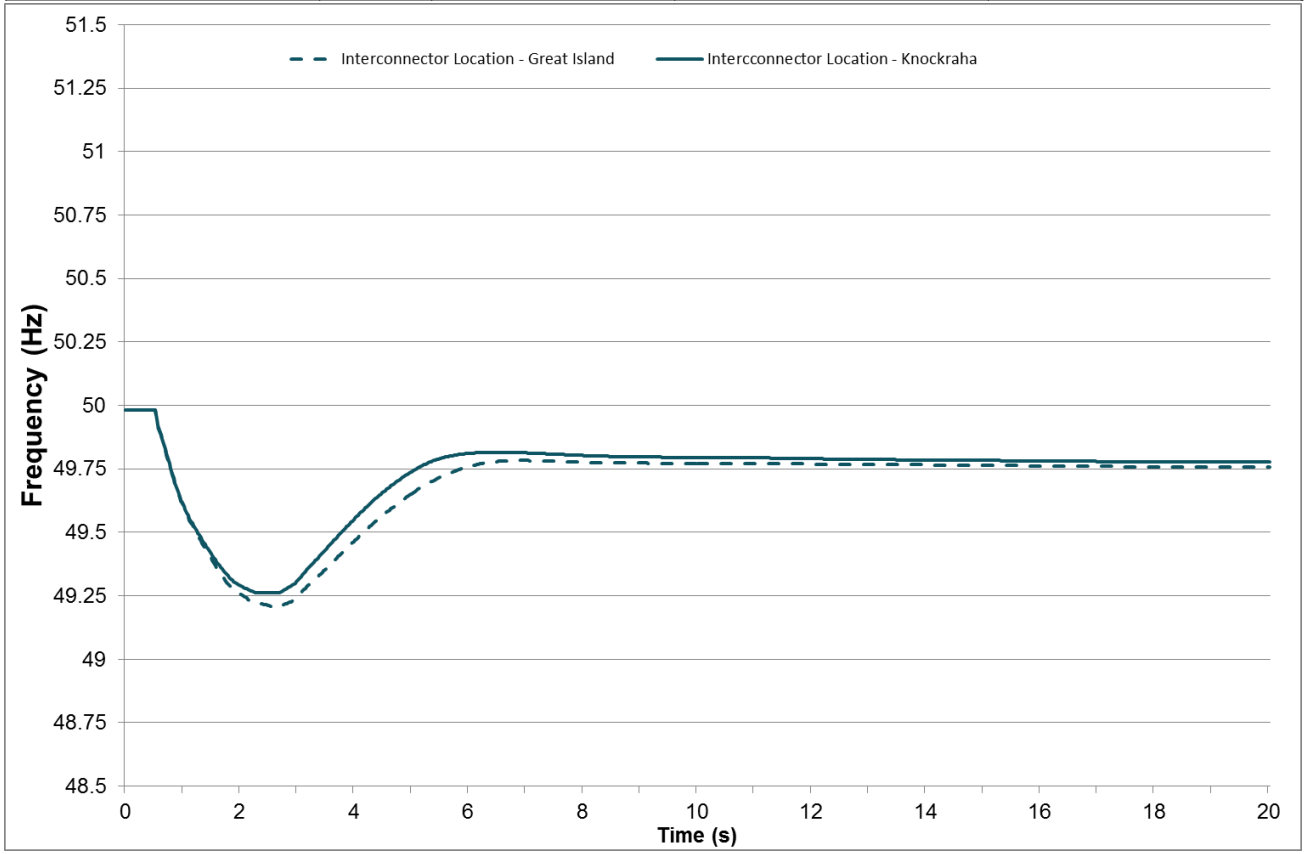
# Interconnector Location Sensitivity

| Case Details | | | | |
|---|---|---|---|---|
| System Demand (MW) | SNSP (%) | Inertia (MWs) | Maximum RoCoF (Hz/s) | Wind Generation (MW) |
| 4,046 | 69.2 | 19,692 | 0.952 | 1,452 |




Comments:

- Moving the interconnector to Great Island has a minimal impact on frequency nadir
- Nadir decreases by less than 0.05 Hz as a result of the measurement point at Irishtown 220 kV substation
- Irishtown is electrically closer to Great Island, and thus sees a marginal decrease in nadir
- Solution proposed remains valid regardless of interconnector location

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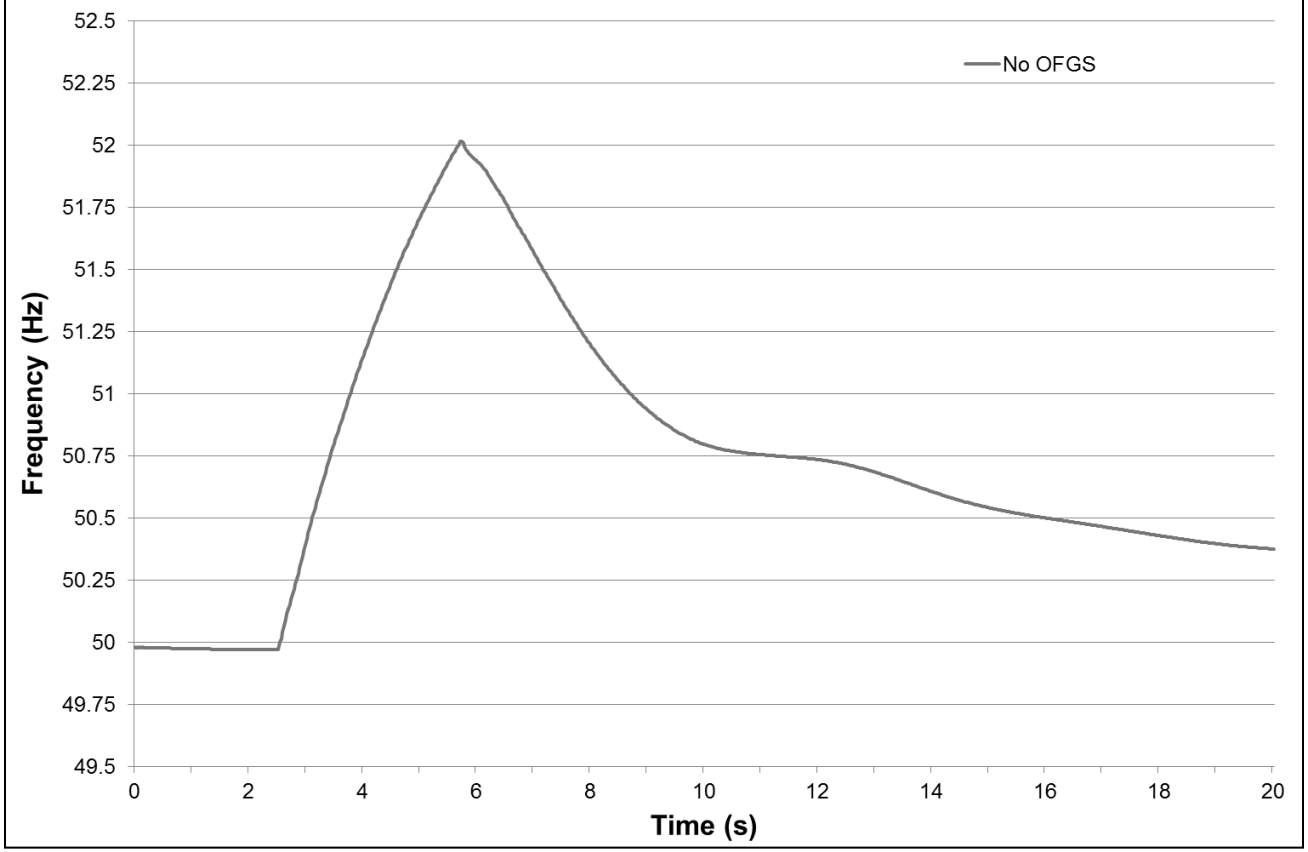
# Frequency Stability – Export Base Case

| Case Details | | | | |
|---|---|---|---|---|
| System Demand & Exports (MW) | SNSP (%) | Inertia (MWs) | Maximum RoCoF (Hz/s) | Wind Generation (MW) |
| 4,580 | 70.9 | 22,108 | 0.848 | 3,226 |




Comments:

- Initial dispatch case has little downward regulation from conventional generation – i.e. at (or close to) their minimum generation
- With no Over Frequency Generation Shedding Scheme (OFGS) – frequency increases to 52 Hz and conventional generation protection settings trip

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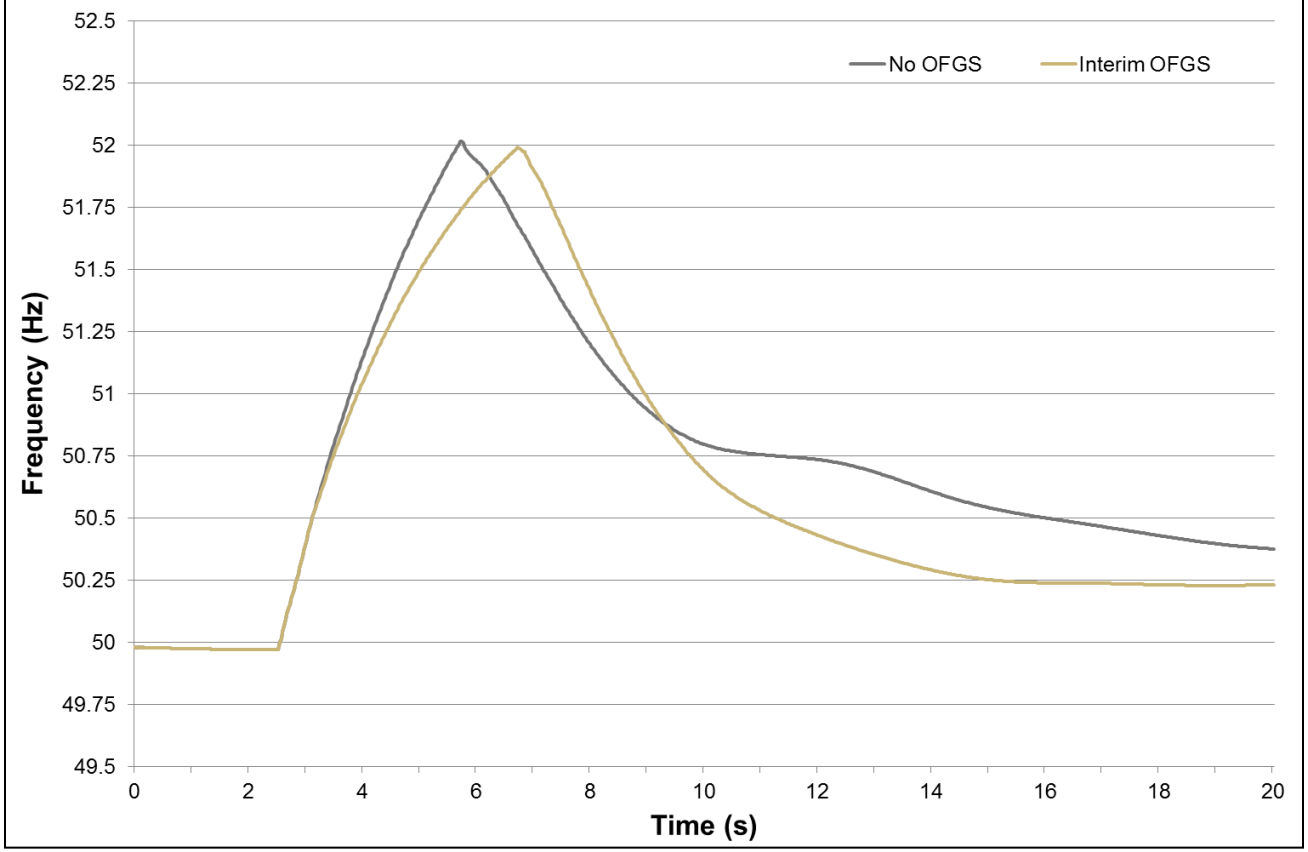
# Frequency Stability – Export Interim OFGS

| Case Details | | | | |
|---|---|---|---|---|
| System Demand & Exports (MW) | SNSP (%) | Inertia (MWs) | Maximum RoCoF (Hz/s) | Wind Generation (MW) |
| 4,580 | 70.9 | 22,108 | 0.848 | 3,226 |




Comments:

- Including the currently in place interim OFGS decreases the rate at which frequency increases
- Due to wind dispatch at the time, only 130 MW of wind is tripped off using existing scheme
- Frequency hits 52 Hz and conventional generation trip schemes operate
- Further solution required

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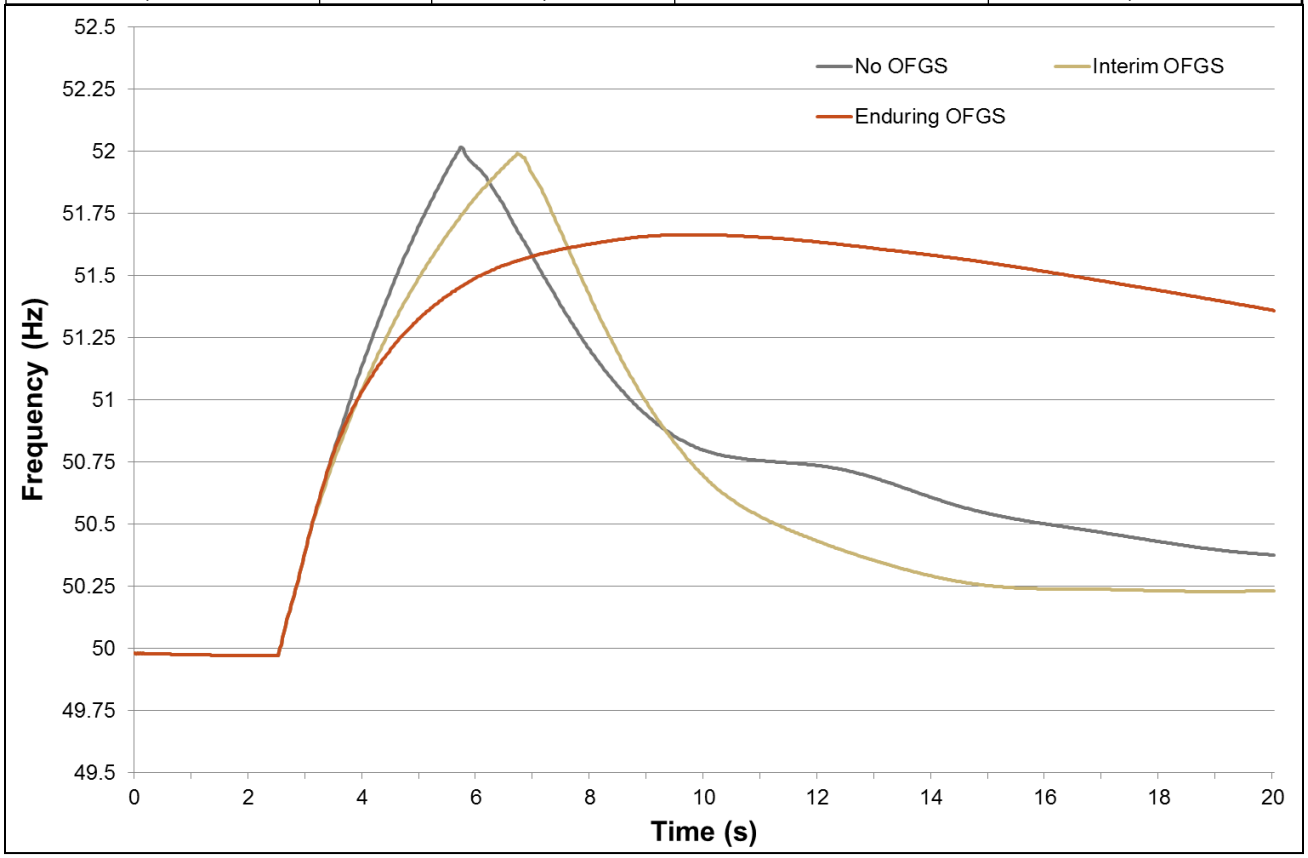
# Frequency Stability – Export Enduring OFGS

| Case Details | | | | |
|---|---|---|---|---|
| System Demand & Exports (MW) | SNSP (%) | Inertia (MWs) | Maximum RoCoF (Hz/s) | Wind Generation (MW) |
| 4,580 | 70.9 | 22,108 | 0.848 | 3,226 |




Comments:

- Including the enduring OFGS helps to limit frequency zenith below 52 Hz – the scheme is in the process of being implemented
- Due to wind dispatch at the time, only a proportion of wind generation trips (320 MW)
- Frequency exceeds 51.5 Hz and frequency outside of stable region after 20s
- Further enhancement recommend

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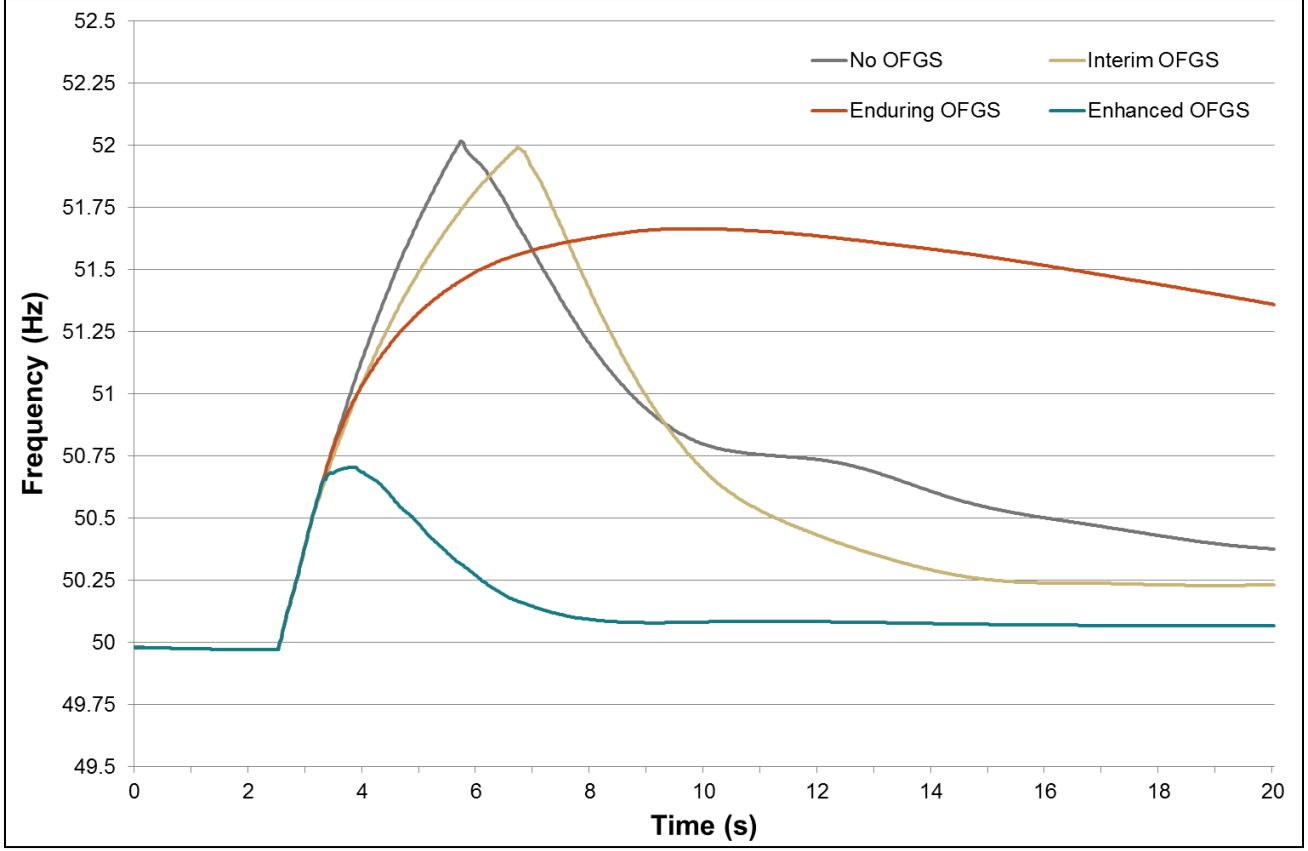
# Frequency Stability – Export Enhanced OFGS

| Case Details | | | | |
|---|---|---|---|---|
| System Demand & Exports (MW) | SNSP (%) | Inertia (MWs) | Maximum RoCoF (Hz/s) | Wind Generation (MW) |
| 4,580 | 70.9 | 22,108 | 0.848 | 3,226 |




Comments:

- Final sensitivity enhances the quantity of wind generation in the OFGS to return system frequency close to nominal
- In this case an additional 500 MW of wind is added to the scheme
- The exact design of the enhanced OFGS should be carefully considered and will be dependent on the generation portfolio on the system at the time

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# Transient Stability Analysis Summary

- **Transient stability analysis** was carried out on a number of scenarios with the 750 MW interconnector importing and exporting
- The focus of this assessment was on the **transient stability of all generators** following the application of **over 800 individual faults**
- In the cases examined there were **no angular instability issues** directly related to the 750 MW interconnector
- It is **recommended** that the transient stability of the transmission system be **assessed again** prior to the connection of such a new interconnector with the actual generation portfolio in place at the time

# Future Interconnection Study Summary

- Frequency and transient stability studies were carried out to assess the operational impact of a 750 MW interconnector operating on the system
- Frequency stability analysis highlighted **issues with 750 MW import cases – high RoCoF & low frequency nadir**
- Frequency stability analysis also highlighted a **high frequency zenith** with **750 MW export cases**
- **No direct issues** relating to the 750 MW interconnector seen in **angular stability analysis**
- Mitigation measures examined **address known issues** and **demonstrate implementable solutions** within the timeframe associated with the development of a new interconnector
- **No foreseen stability issues with enabling 750 MW import or export**

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# Mitigation Measure Summary

- **RoCoF issue** - A new RoCoF constraint should be introduced to the dispatch algorithm in the Control Centre. This will schedule enough system inertia to limit RoCoF to 1 Hz/s.

- **Frequency nadir issue** - An increased level of Fast Frequency Response with a short response time will be required – this could come from a number of technologies or service providers such as wind droop response or demand side response.

- **Frequency zenith issue** - The Over Frequency Generation Scheme (OFGS) should be enhanced to include further wind generation within the scheme. This will allow the system frequency to return to a stable region following the trip of the interconnector export.

- Meetings with PCI status interconnector developers & neighbouring TSOs to initiate the **development of an implementation roadmap** for solutions

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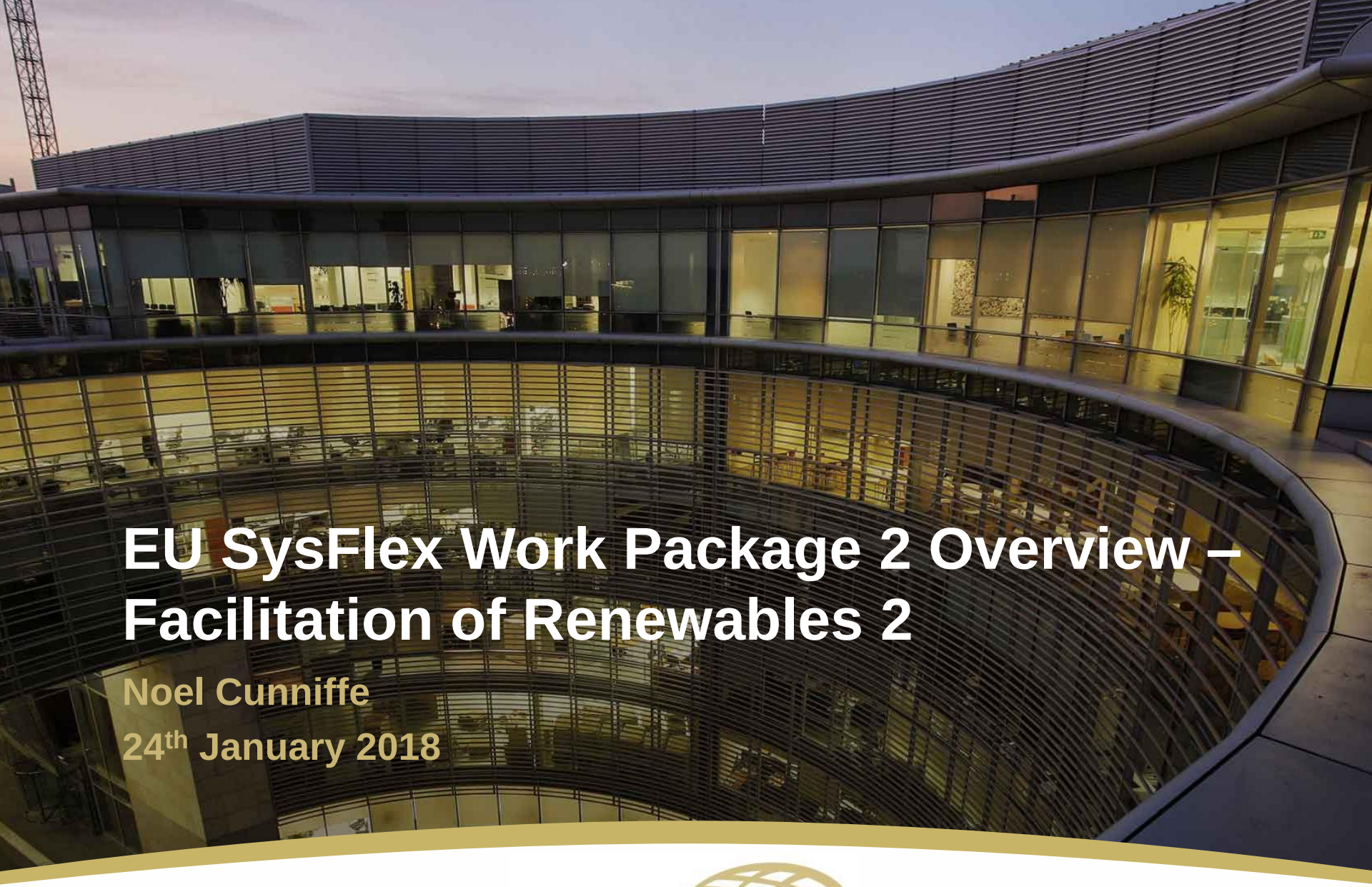


# EU SysFlex Work Package 2 Overview – Facilitation of Renewables 2

Noel Cunniffe

24th January 2018

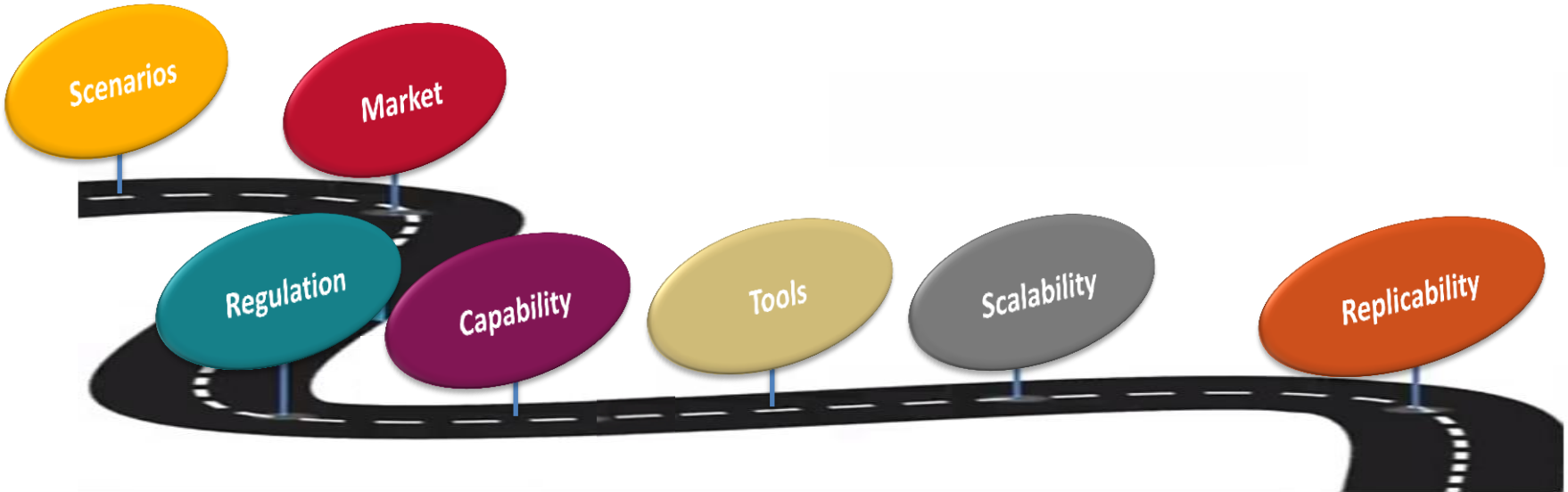
EUSysFlex

EIRGRID GROUP

Co-funded by the European Union

# Introducing… EUSysFlex

- Characterise **technical shortfalls** of EU power system for **50% RES 2030 scenarios**
- Recommendations of **market** and **regulatory changes** required to address this
- Increase **capability of system services** to facilitate high RES
- Provide **tools** to support Transmission System Operators across Europe in **integration of system services**
- **Scalability** and **Replicability** across Europe



# Consortium & Advisory Group

**Full list of Consortium Members**




**The Advisory Group**

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# EirGrid and SONI Leadership

**WP1 – Project Co-ordination and Management Activities**
EIRGRID – Leader

**WP2 – Development of new approaches for system operation with high RES-E**
EIRGRID – Leader

**WP3 – Analysis of market design and regulatory options for innovative system services**
EIRGRID – Participant

**WP4– Simulation of the integration of new system services into System Operator control centres.**
SONI – Leader
EIRGRID – Participant

**WP5 – Data management for facilitation of new flexible solutions**
EIRGRID – Participant

**WP6 – Demonstration of flexibility services from resources connected to the distribution network**
WP Leader – Innogy

**WP7 – Demonstration of flexible capability, pumped storage & wind.**
WP Leader - EDP

**WP8 – Demonstration of aggregation approaches for multi-services project from a portfolio of distributed resources**
WP Leader – EDF

**WP9 – Demonstration of cross-border and cross-section data management and exchanges**
WP Leader – Elering

**WP10 – Pan-European Scalability and Replicability Analysis and Flexibility Roadmap**
EIRGRID - Participant

**WP11 – Exploitation, Communication & Dissemination and Co-ordination with other H2020 projects**
EIRGRID & SONI – Participant

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# Kick Off Meeting 6th – 9th November

- Successful event < 100 consortium members attended
- Management Board meeting
- General Assembly
- Technical Sessions
- Kick off was attended by EU Commission Project Officer





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# Work Package 2 Overview

**WP2 – Development of new approaches for system operation with high RES-E**
EIRGRID – Leader

- Identify the **technical shortfalls** of the pan-European system with **high RES-E** and **high levels of electrification**

- Assess **technical characteristics** such as synchronous inertia, synchronising torque, fault ride-through capability, electromagnetism, reserves provision, reactive power, short circuit levels, black start, and network congestion

- Perform **cost-benefit analysis** for investment and operation optimisation to find where **gaps arise** – i.e. **value service provision** to operate at high RES-E

- Validate the ability of **improved market designs** and **technical flexibilities** from **demonstration projects** to reduce or remove the technical shortfalls and improve the **resilience and stability** of the system through innovative services

# WP2 Tasks & Deliverables

**WP2 – Development of new approaches for system operation with high RES-E**
EIRGRID – Leader

FASTTRACK → WP3

**2.1 - Augmented literature review and state-of-the-art review across Europe**
Review of literature, grid codes, European projects, existing models and studies for scenarios for EU, NI-IRE, Baltic states, UK

→ WP 3
Imperial College London
Nov 17 – Apr 18

→ WP 3,6,7,8,9

LONGTRACK → WP3

**2.2 - Definitions of the EU-SysFlex scenarios and hypotheses**
Scenarios HiRes and LoRes with electrification of heat and transport, with at least 50% RES-E

MS1
M4

EIRGRID
Nov 17 – Oct 18

→ WP 4

**2.3 - Setting up detailed models to simulate technical shortfalls on EU system**
New models to simulate production cost, steady-state, transient/dynamic and small signal studies in EU system, European subnetwork and NI-IRE power system as well as interaction TSO/DSO

MS2
M6

EDF
Nov 17 – Oct 18

**2.4 - Determining technical shortfalls from detailed simulations on EU system**
Technical issues arising from frequency, voltage and general disturbances on the EU system, European subnetwork and NI-IRE and proposed solutions

EIRGRID
Jul 18 – Oct 19

**2.5 - Financial & economical analysis of scenarios**
Financial gaps to identify where market incentives appear to be insufficient

EIRGRID
Oct 18 – Oct 19

← WP 3,6,7,8,9

**2.6 - Demonstration and market modelling validation**
Integration of demonstrators and market modelling into European wide simulations

EIRGRID
Oct 19 – Apr 21

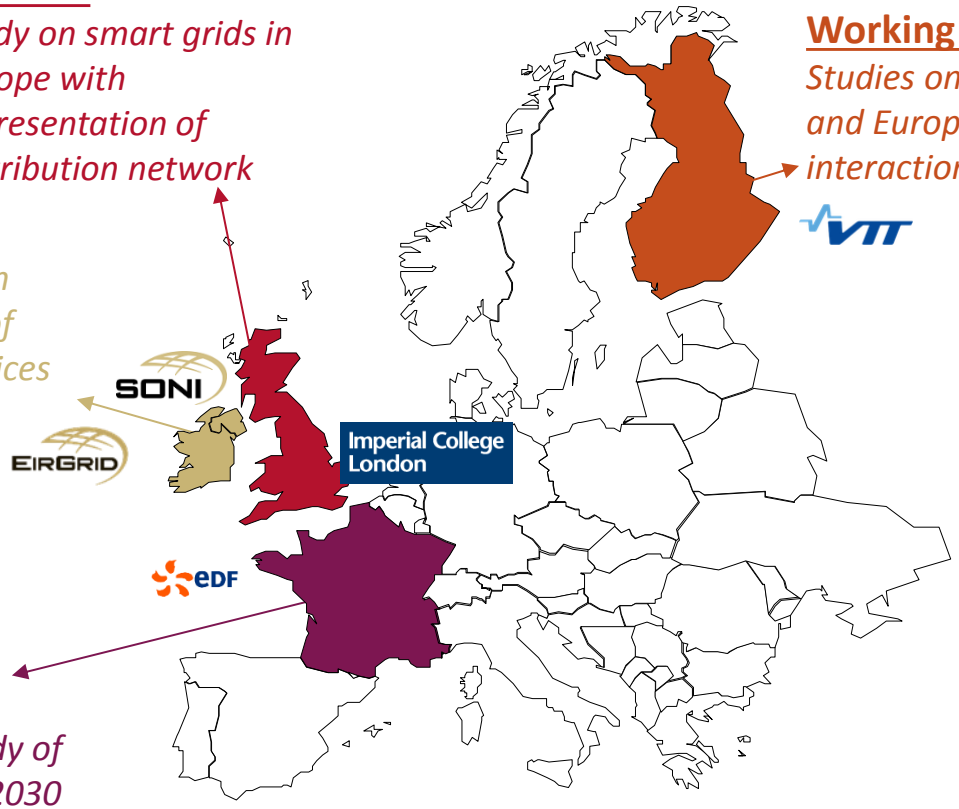
→ WP 10

# Task 2.1 - Literature Review

**Grid4EU**
*Study on smart grids in Europe with representation of distribution network*

**Nordic TSO Working Group**
*Studies on Nordel and Europe interactions*

**DS3**
*Study on NI-IE with high penetration of RES-E → new services*




**60% EnR**
*Europe-wide frequency study of 60% RES-E in 2030*

## Other Studies

HIGHWAY 2050
PROMOTioN PROGRESS ON MESHED HVDC OFFSHORE TRANSMISSION NETWORKS
MIGRATE
Market RES
ercot
REserviceS ECONOMIC GRID SUPPORT FROM VARIABLE RENEWABLES
AEMO AUSTRALIAN ENERGY MARKET OPERATOR
entsoe Reliable Sustainable Connected

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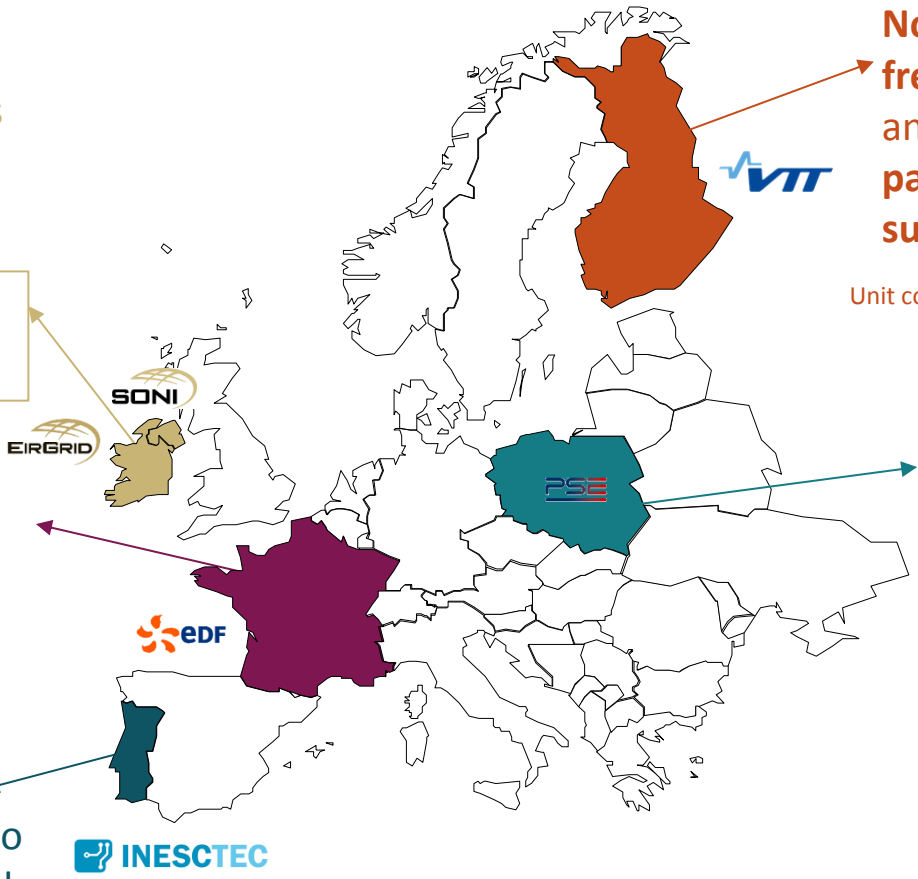
# Task 2.2 – 2.5 – System Studies (FoR2)

**NI-IE real-time** detailed representation of power system with instantaneous RES-E penetration reaching up to **100%**

| | |
|---|---|
| Synchronous inertia | Reactive Power |
| Reserve Provision | Short Circuit Levels |
| Synchronising Torque | Black-Start |
| Fault Ride-Through | |




**Nordic System frequency stability** analysis inputting to **pan-European** and **sub-network** models

- Unit commitment
- Synchronous inertia
- Reserve

**European sub-network** dynamic representation with detailed **network**

- Dynamic stability
- Voltage stability

**Pan-European frequency** and **dynamic** model (Continental + Paladyn)

- Unit commitment
- Synchronous inertia
- Reserve

Bulk modelling of **Distribution System demand side resources** into Transmission System models

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# Models and Modelling Results Example

**INPUTS TO PLEXOS**

Generator operating characteristics

Interconnection

Demand

High RES scenarios

**PLEXOS**

Simulation tool for energy market analysis

Cost minimisation

Supply and demand balance

Inertial constraints

**INPUTS TO SINGLE FREQUENCY MODEL**

Generator dynamic characteristics

**INTERIM OUTPUTS**

Generator commitments

Generator dispatches

Prices

IC flows

**INPUTS TO DSA Tools**

Generator dynamic characteristics

Network model

**SINGLE FREQUENCY MODEL**

Frequency assessment



**DSA Tools**

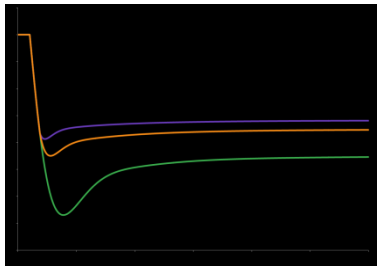
Simulation tools for assessment of power system stability

Transient stability assessment

Voltage stability assessment

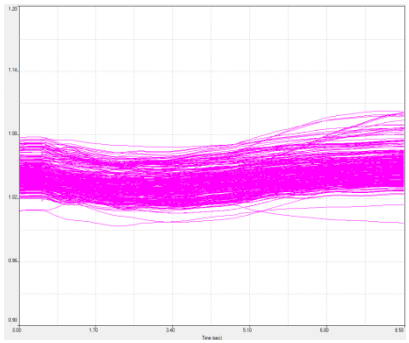
Frequency stability assessment

**OUTPUTS**



Frequency deviations and excursions

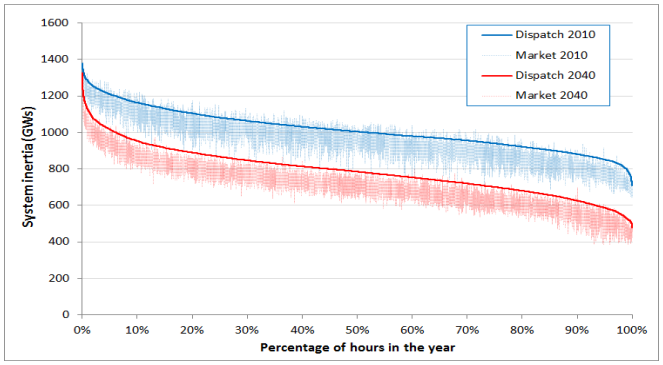
**OUTPUTS**



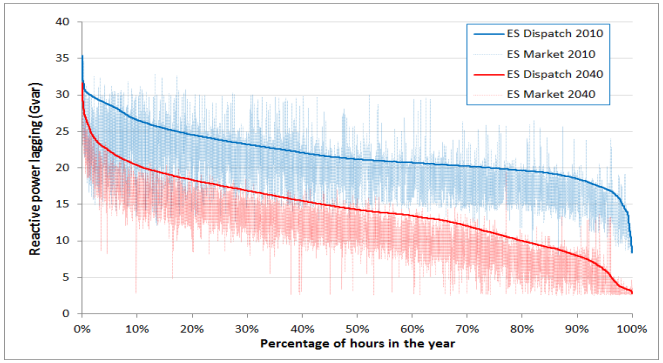
Dynamic behavior for various scenarios (frequency, voltage, rotor angles etc.)

# Models and Modelling Results Example

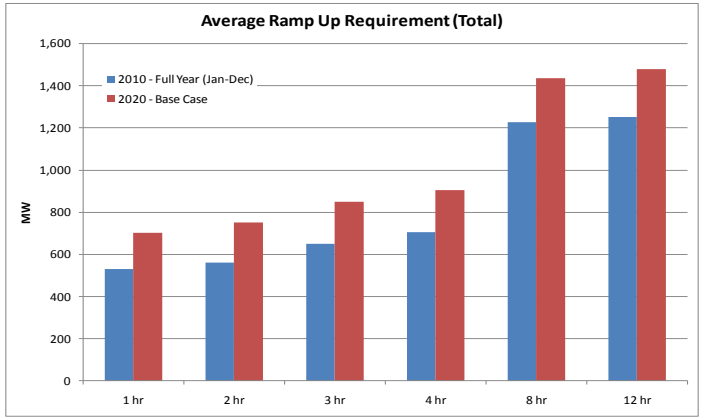
## Decreased System Inertia & Synchronising Torque




## Decreased Reactive Power Capability




## Increased System Ramping Requirements




**Note: These are purely illustrative examples and do not reflect results**

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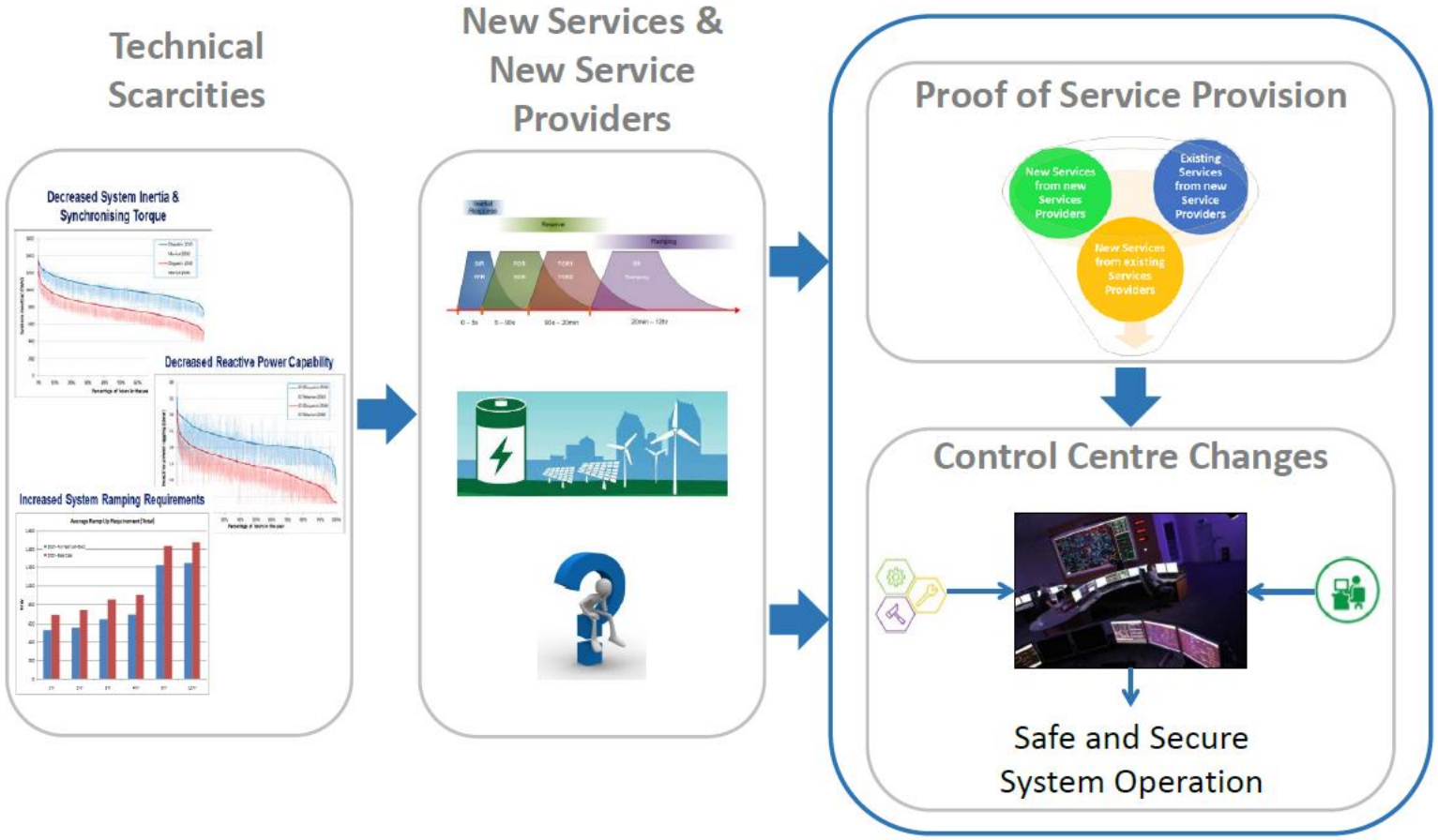
# Work Package 4 Overview

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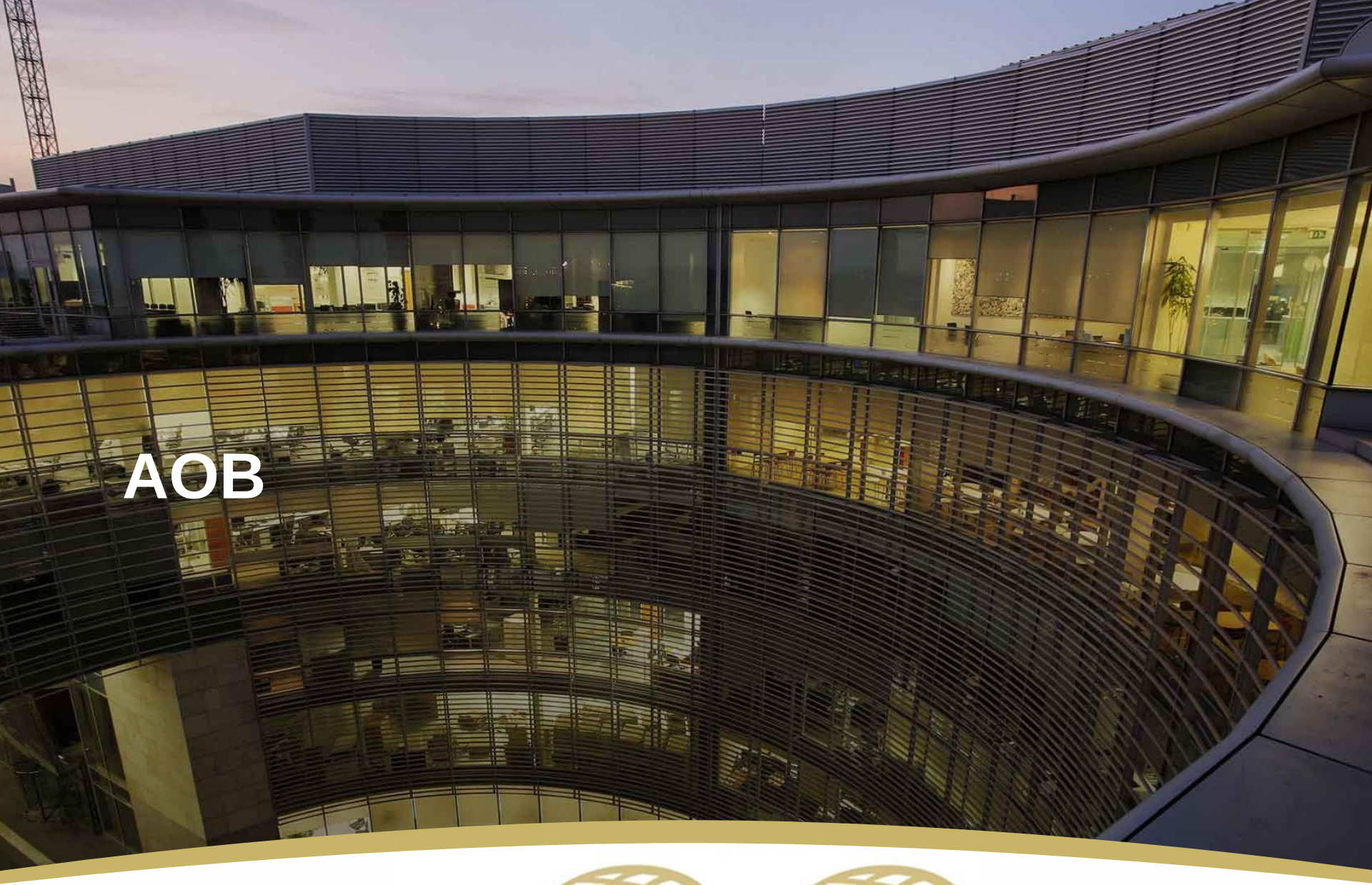


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