DS3 Programme Workshop

Industry Forum

1st February 2016, Dublin

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Agenda

DS3 PROGRAMME		
Time	**Agenda Item**	**Speaker**
14:00-14:05	**Introduction**	Chair: Louis Fisher (5min)
14:05-14:35	**DS3 Programme Status Update** • 2016 focus areas • SNSP Studies / Trial	Presentation: David Cashman (20 mins)
	Questions and Answers	Chair: Louis Fisher (10 min)
14:35-15:55	**Rate of Change of Frequency** (General Update)	Presentation: David Cashman (20 min)
	Rate of Change of Frequency (RoCoF Alternatives Technical Presentation)	Presentation: Martin Eager (40 min)
	Questions & Answers	Chair: Louis Fisher (20 min)
15:55-16:00	**Closing Remarks**	Chair: Louis Fisher (5 min)

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DS3 Programme Status Update

David Cashman

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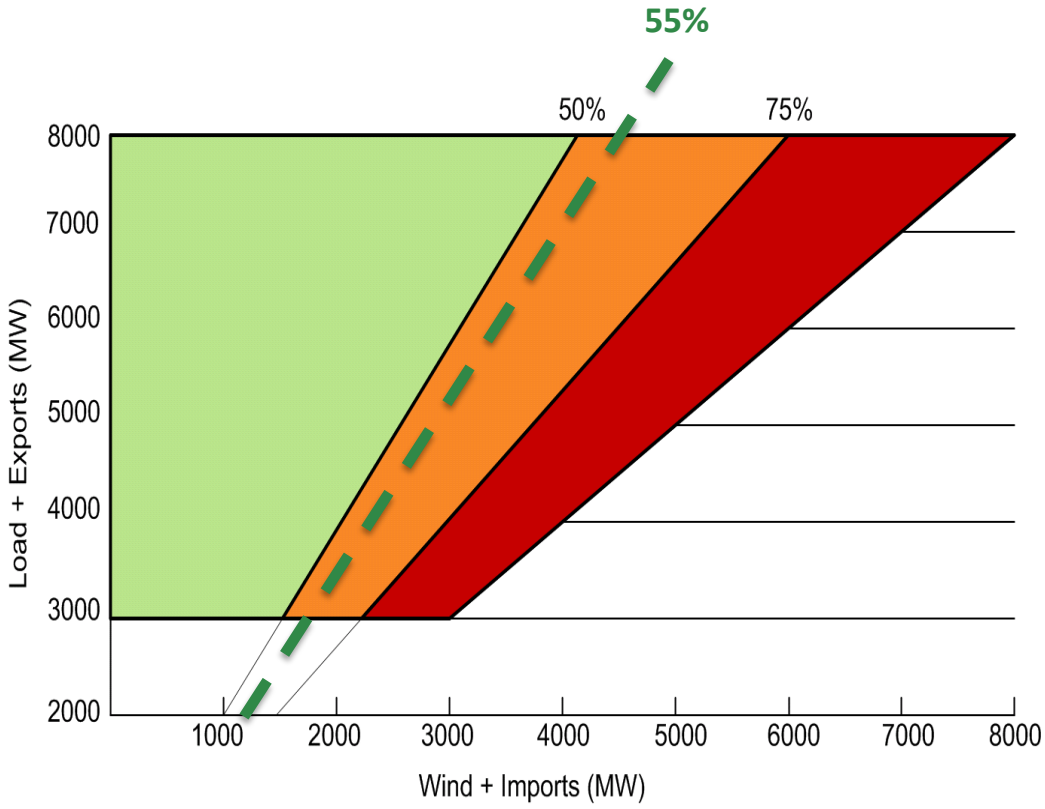
Increase of SNSP to 55% - System Trial

- Builds on the policies and tools brought through the OPR Committee
- Will inform future operational policy



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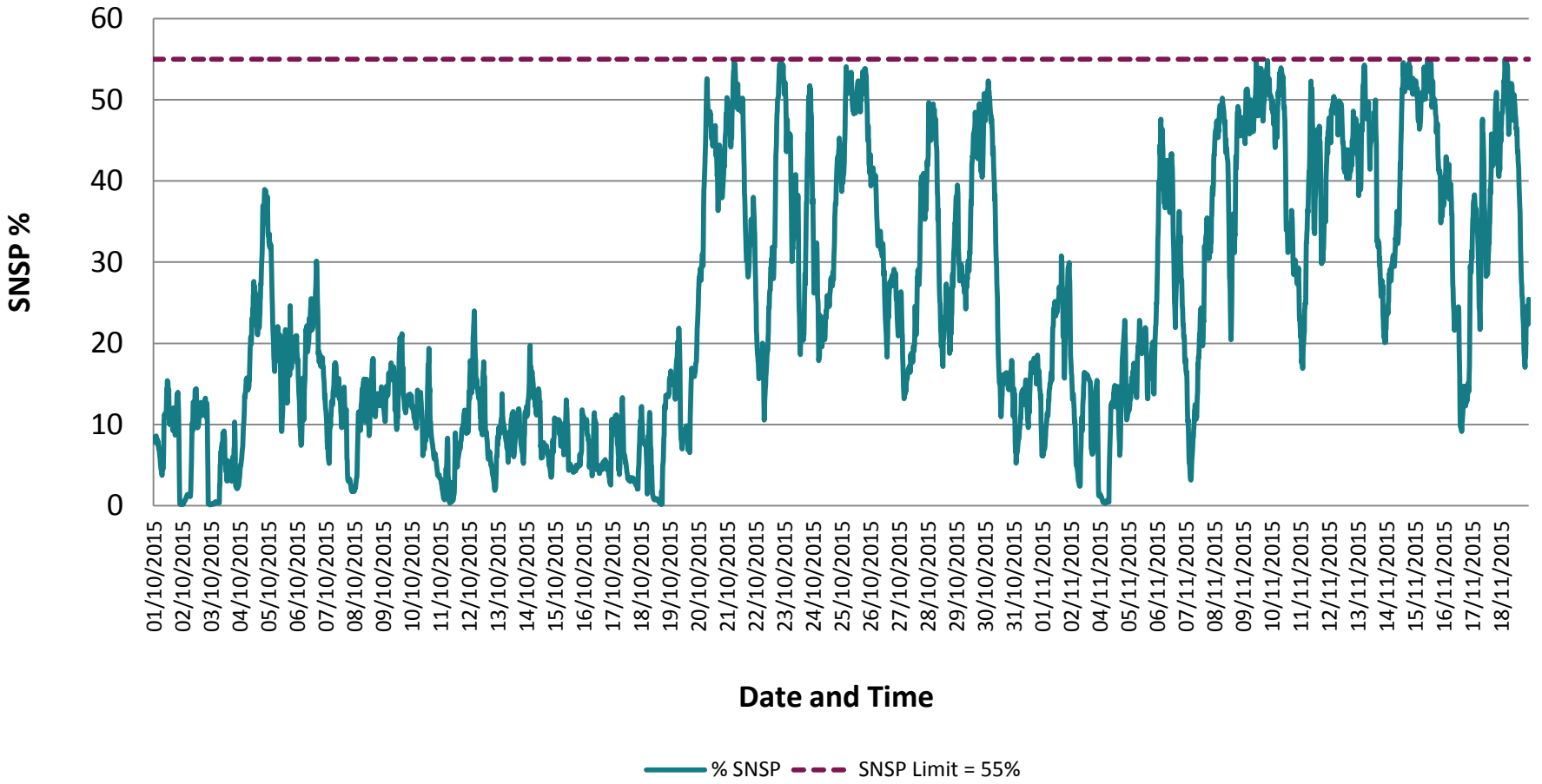
SNSP Trial – Real Time Experience



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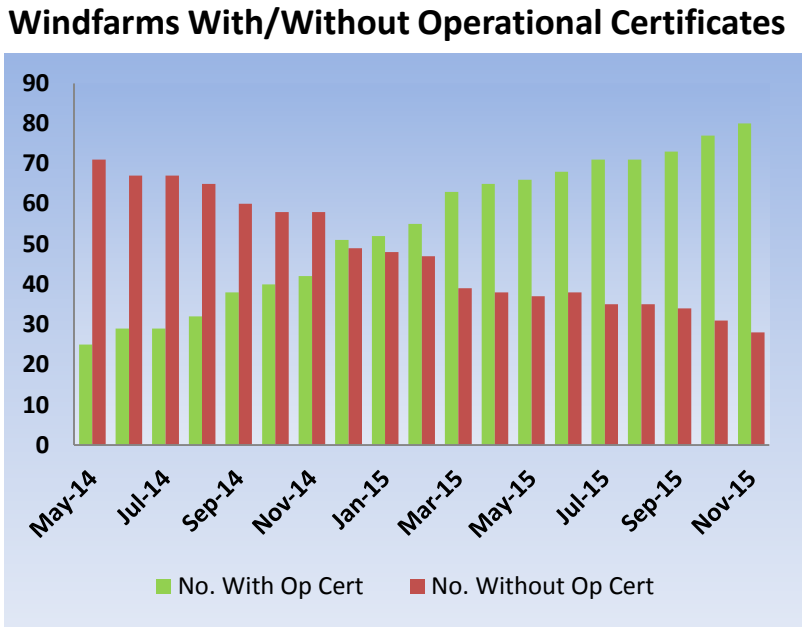
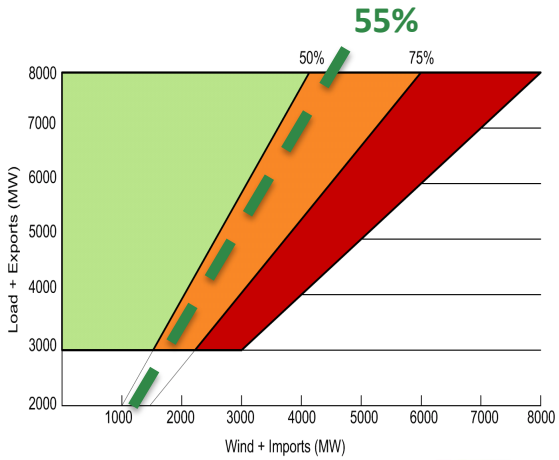
SNSP Trial - Enablers

- Ramping Tool
- Frequency Regulation
- RCUC – RoCoF/Inertia
- WSAT transfers
- High Frequency Analysis
- Etc.



Observations and Next Steps

- SNSP above 50% for 10% of the time
- No observed differences in system behavior at 50%<SNSP<55%
- Analysis of events are ongoing and expected to end Q1 2016
- Further development in operational metrics



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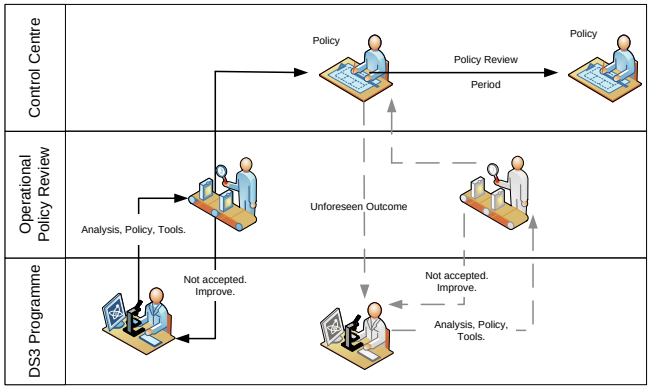
Operational Policies & Related Studies

- Voltage dip induced frequency dip (on-going)
- Voltage trajectory studies (on-going)
- Interim HVDC export limits analysis (on-going)
- Cauteen Nodal Voltage Control Pilot Project (on-going)
- Northern Ireland “smart” voltage control (almost complete)
- Quantitative frequency oscillation analysis (almost complete)
- Report on windfarm frequency response tests (almost complete)



Operational Policy Review Committee

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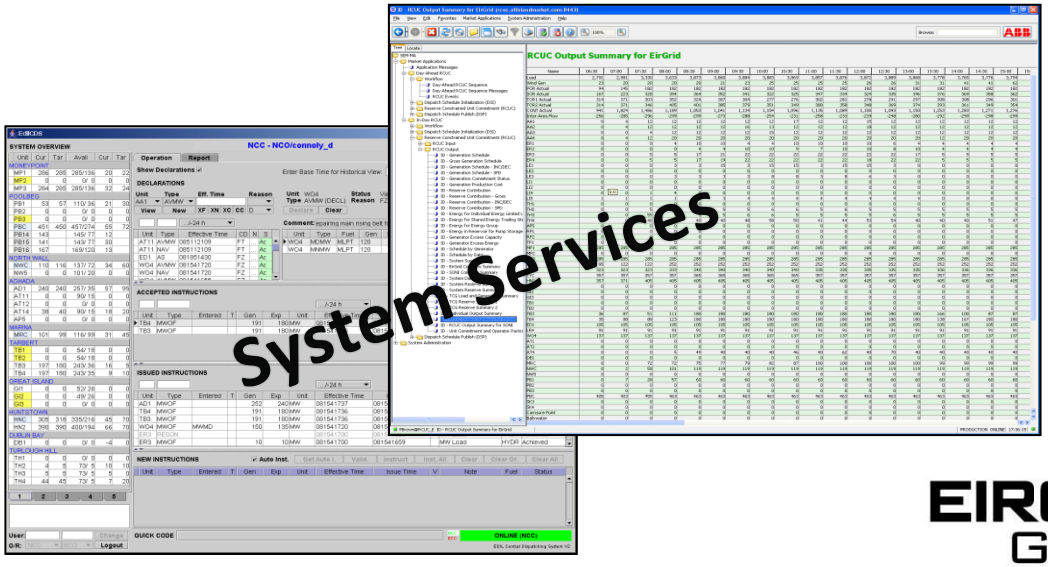
Control Centre Tools

Dublin

Belfast



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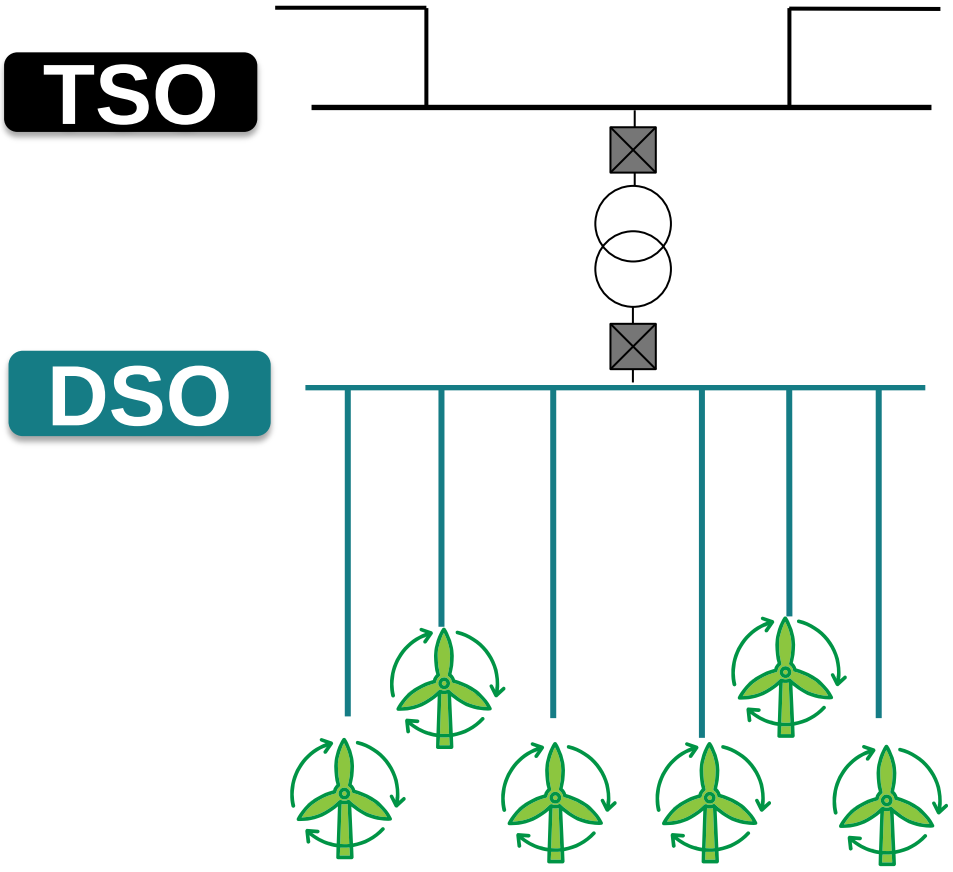
Smart Voltage Control



- Realise potential of DSO generation to avoid transmission network reinforcements
- IE: Progress continues on Cauteen Nodal Voltage Control Pilot Project
- NI: Study investigating Smart power factor for embedded WFs

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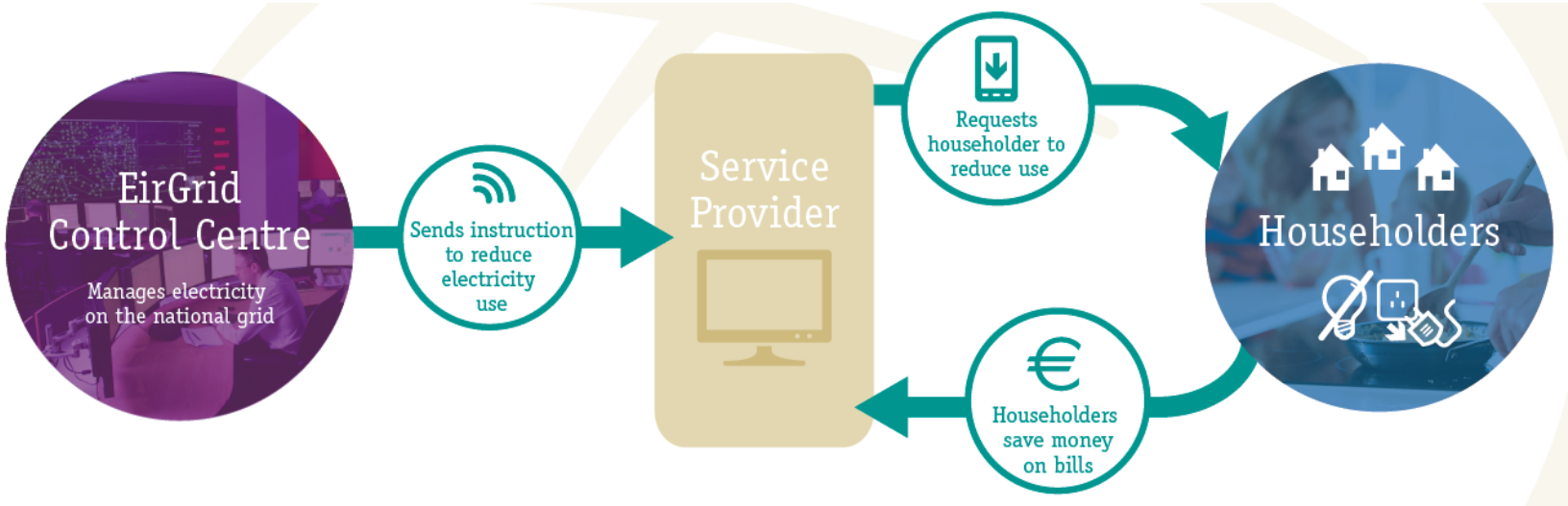
DSM – Residential DSM Scheme

Have a residential consumer based demand response project in operation in 2016



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2016 Focus Areas

RoCoF	• Generator Studies • TSO-DSO project • Alternatives Report close out
System Services	• Interim Arrangements: Q4 2016 • Enduring Arrangements: Q4 2017
Operational Policy	• Voltage dip induced frequency dips • Grid Code • High Wind Speed Shut-Down • Operational Metrics: Fast Frequency Response
Control Centre Tools	• EMS Integration Project • System Services Tools • Off-line WSAT

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RoCoF Project Overview

David Cashman

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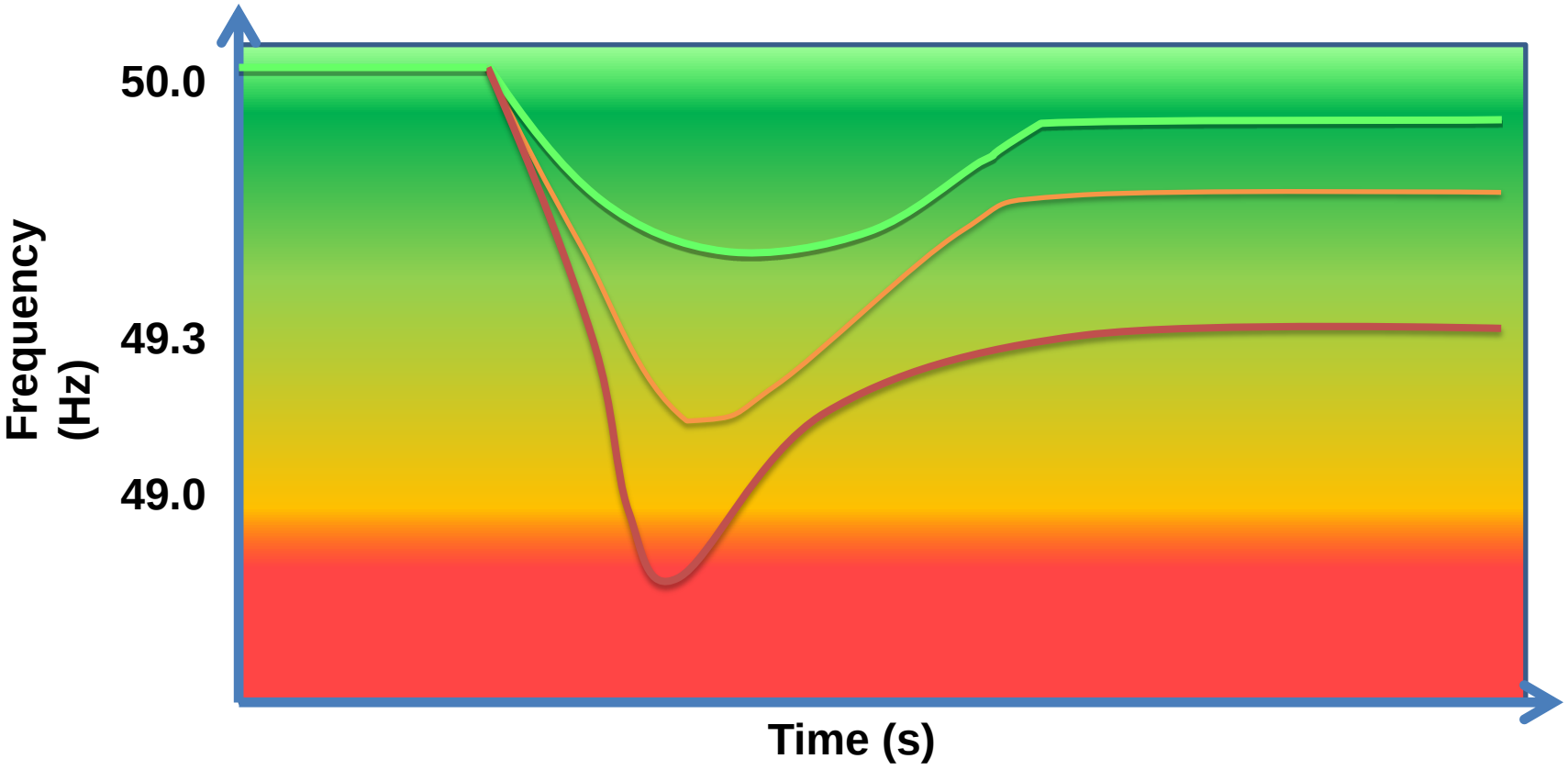
RoCoF Concept



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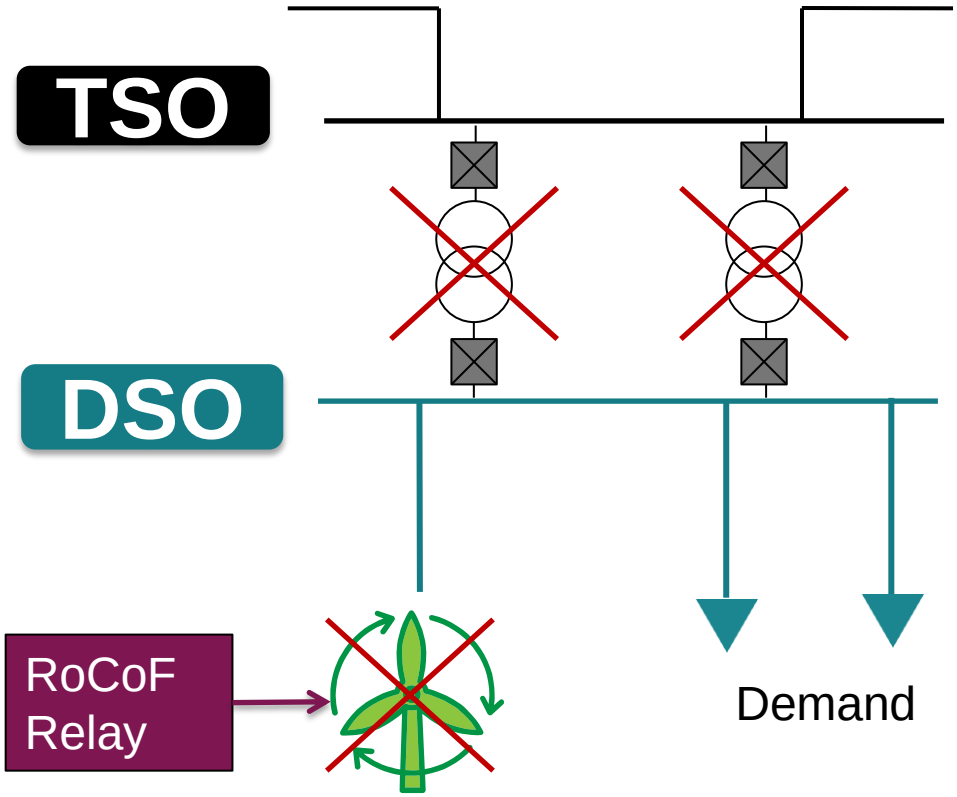
RoCoF TSO-DSO Project



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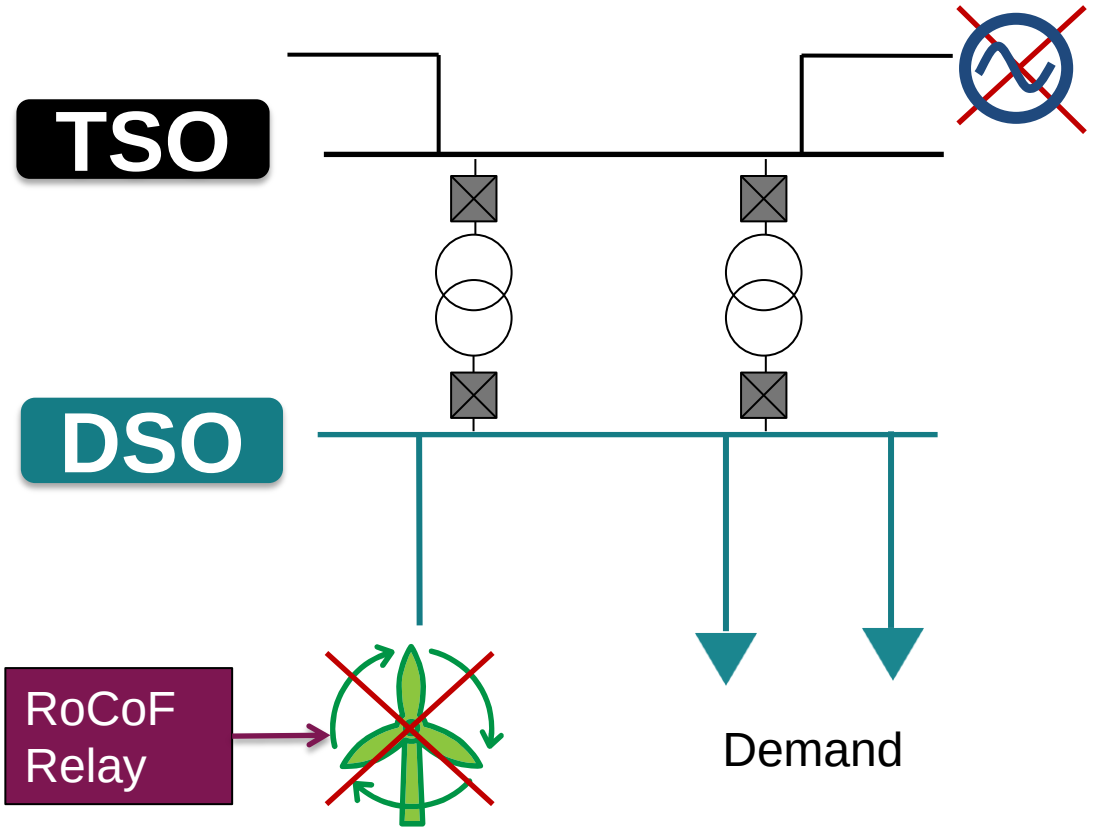
RoCoF TSO-DSO Project



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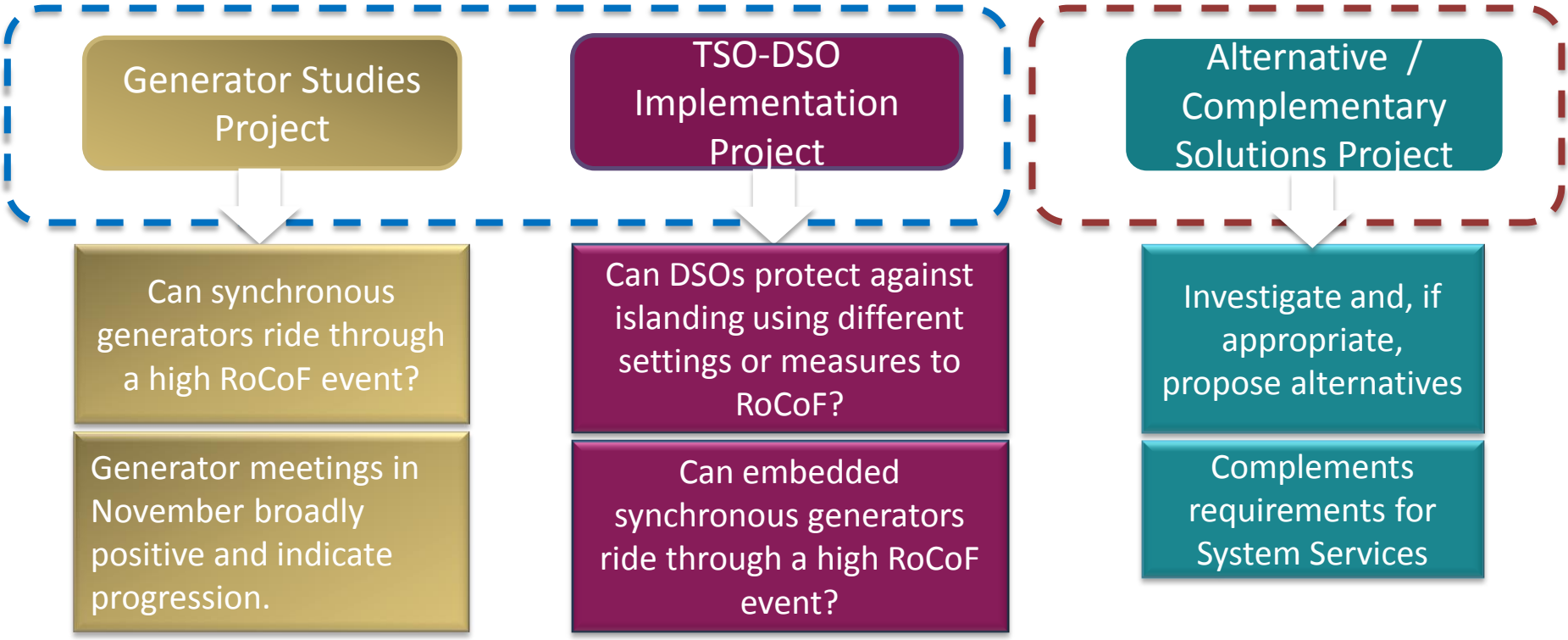
RoCoF Implementation Project



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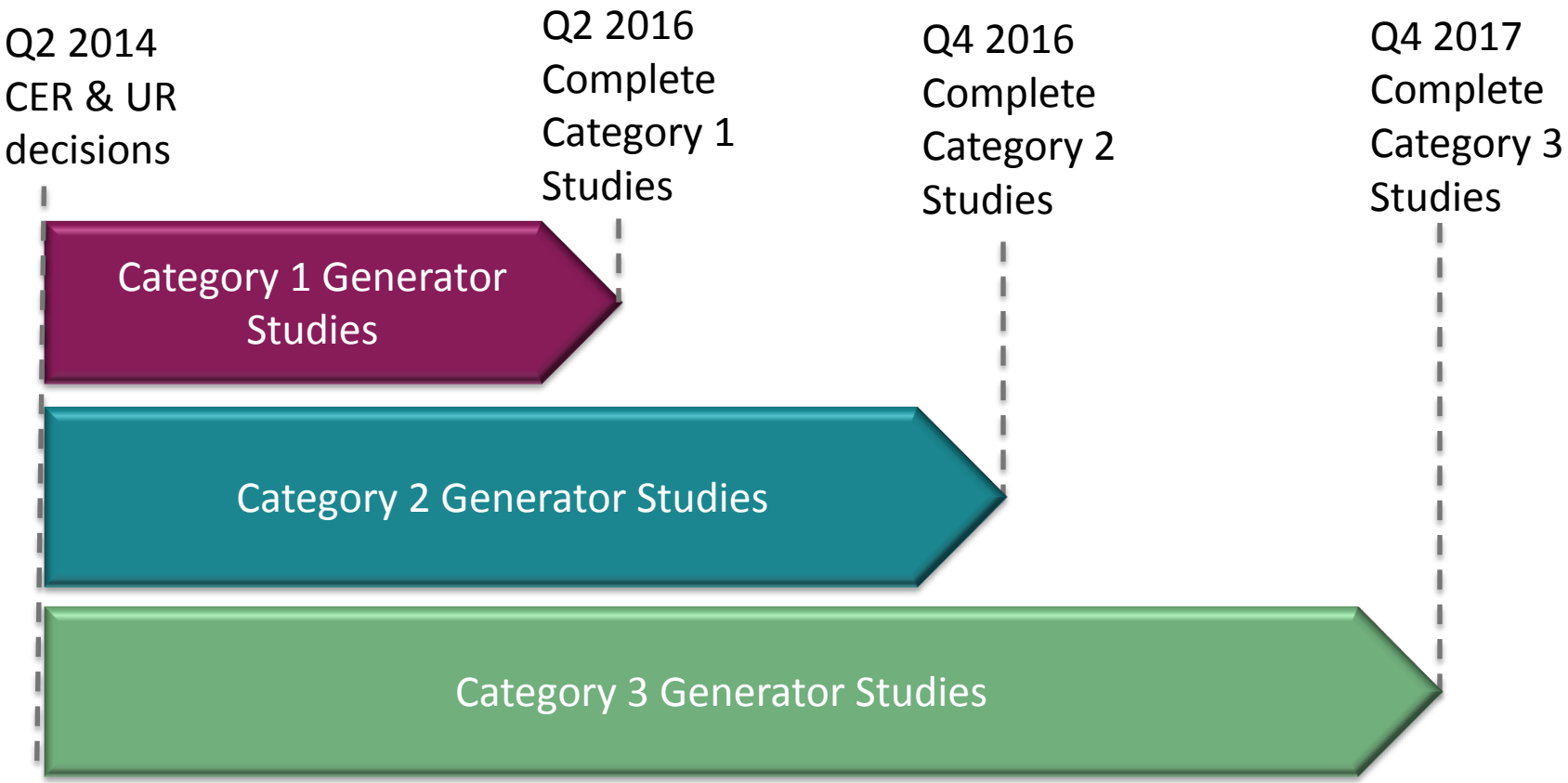
Generator Studies Timelines



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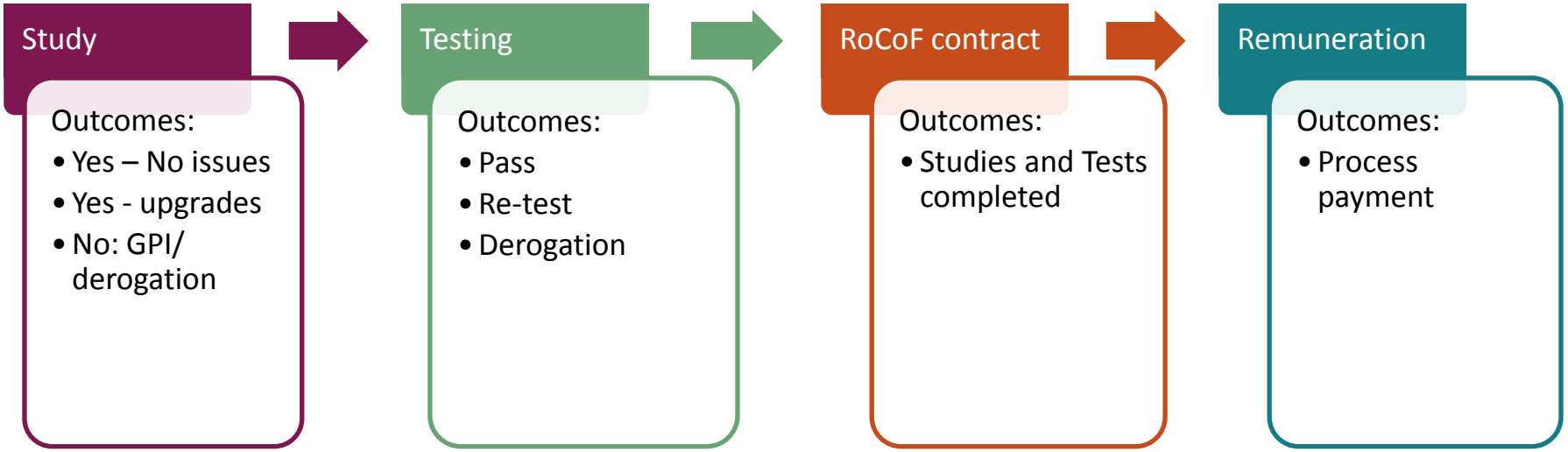
RoCoF Remuneration Method



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RoCoF Remuneration - Next Steps

- 6-week consultation on Remuneration paper currently in progress
- Industry comments up to February 8th
- SEMC review March/April
- TSO workshop early March
- Remuneration Mechanism to apply from June 1st 2016
- Payments back-dated to March 2016 for early submissions

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TSO-DSO Project: Ireland

DSO Wind

- Requests for protection settings changes issued
- Roll-out of changes on wind farms is continuing
- DSO have provided database of settings to TSO

Embedded non-wind generation

- D-code modification tabled and agreed in principle
- Meetings with representatives to assess impact on existing fleet
- DSO have provided indicative volumes of generation to TSO
- TSO to perform impact assessment studies based on these volumes

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TSO-DSO Project: Northern Ireland

Large-scale generation

- Studies to be completed by Q2 with NIE review by Q3 2016
- Commence Roll-out of LoM protection settings Q3 2016
- All large-scale generators have new settings Q3 2017

Small-scale generation

- D-code modification consulted on and currently under review
- Studies to commence Q2 2016
- Commence Roll-out of LoM protection settings Q4 2016
- All small-scale generators have new settings Q3 2017

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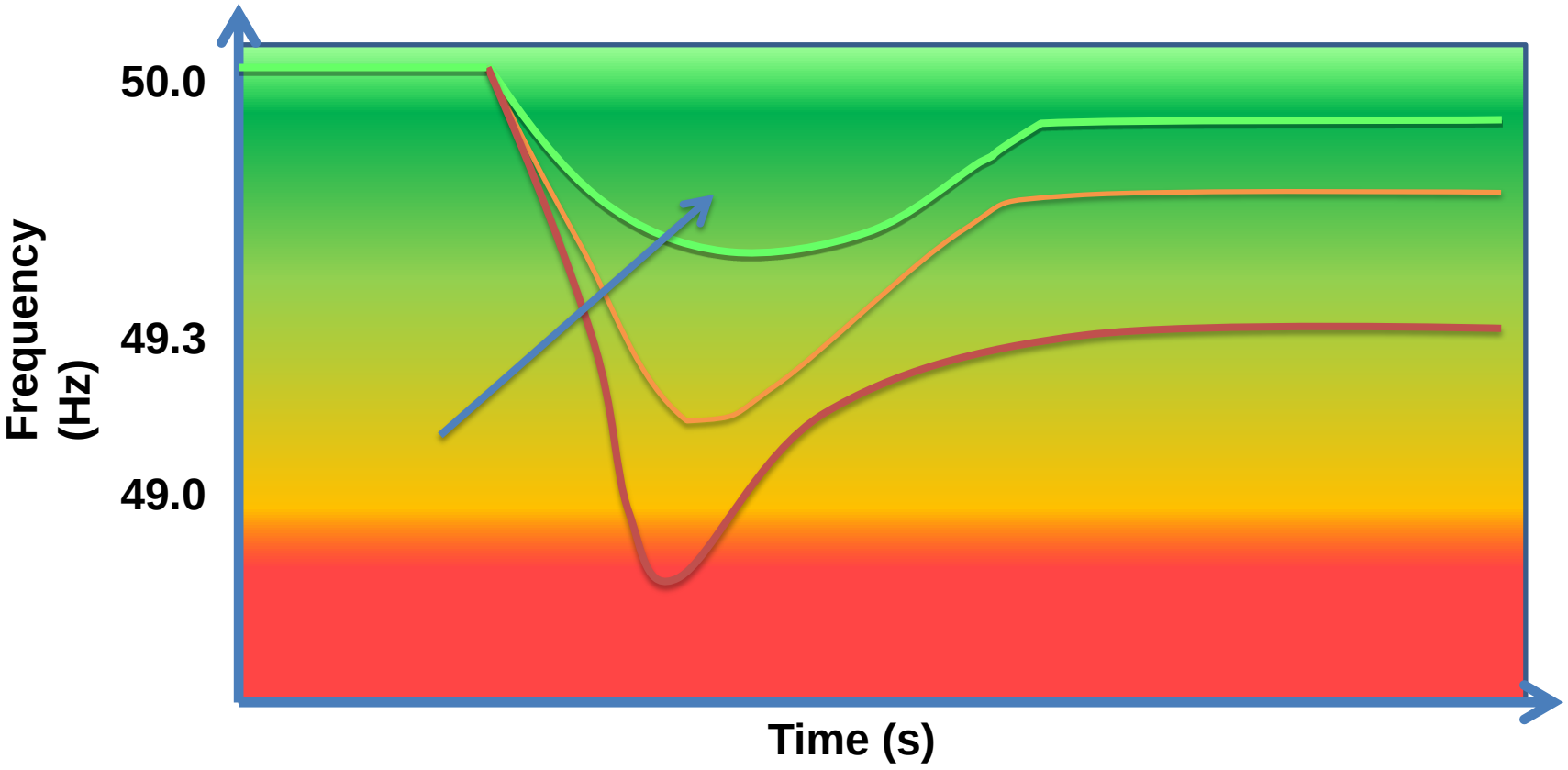
RoCoF Alternatives Objective



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Phase 1 Review

Highlights

- Both Synchronous and synthetic inertia can provide solutions to RoCoF
- Weighted Scoring Matrix did not favour any specific solution
- Event Detection essential for synthetic devices
- A combination of devices may be required to resolve RoCoF

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Phase 2 Overview

Synchronous Inertia

- 20,000 MW.s required to maintain RoCoF

Synthetic Inertia

- Begin to respond within 100 ms
- Ramp to full output in 200 ms
- Control for recovery
- +/- 360 MW

Combination

- Sensitive to synthetic device performance

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Study Conclusions

- Alternative Solutions are available for the RoCoF issue
- Further analysis required to implement alternatives project
- RoCoF Alternatives Solutions is ‘back-up’ to primary RoCoF Project and not a procurement exercise
- Generator Studies and TSO-DSO projects progressing
- TSOs welcome feedback on report from industry

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Timelines

Dec. 2015	• RoCoF Alternatives Phase 2 Report
1st Feb 2016	• DS3 Industry Forum
19th February 2016	• Submission of industry comments
End March 2016	• Publication of Final Report

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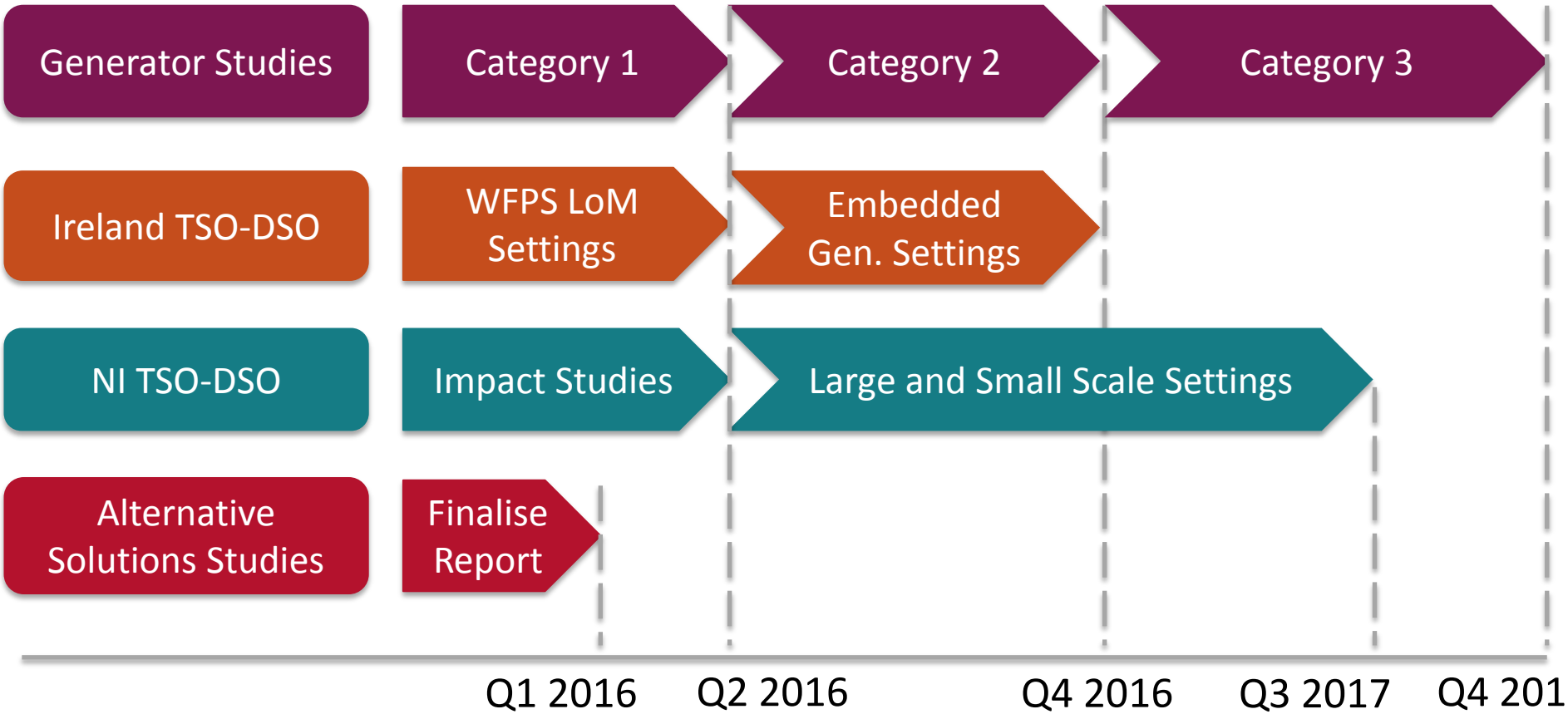
RoCoF Project Summary



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RoCoF Alternative & Complementary Solutions Phase 2 Study

Martin Eager

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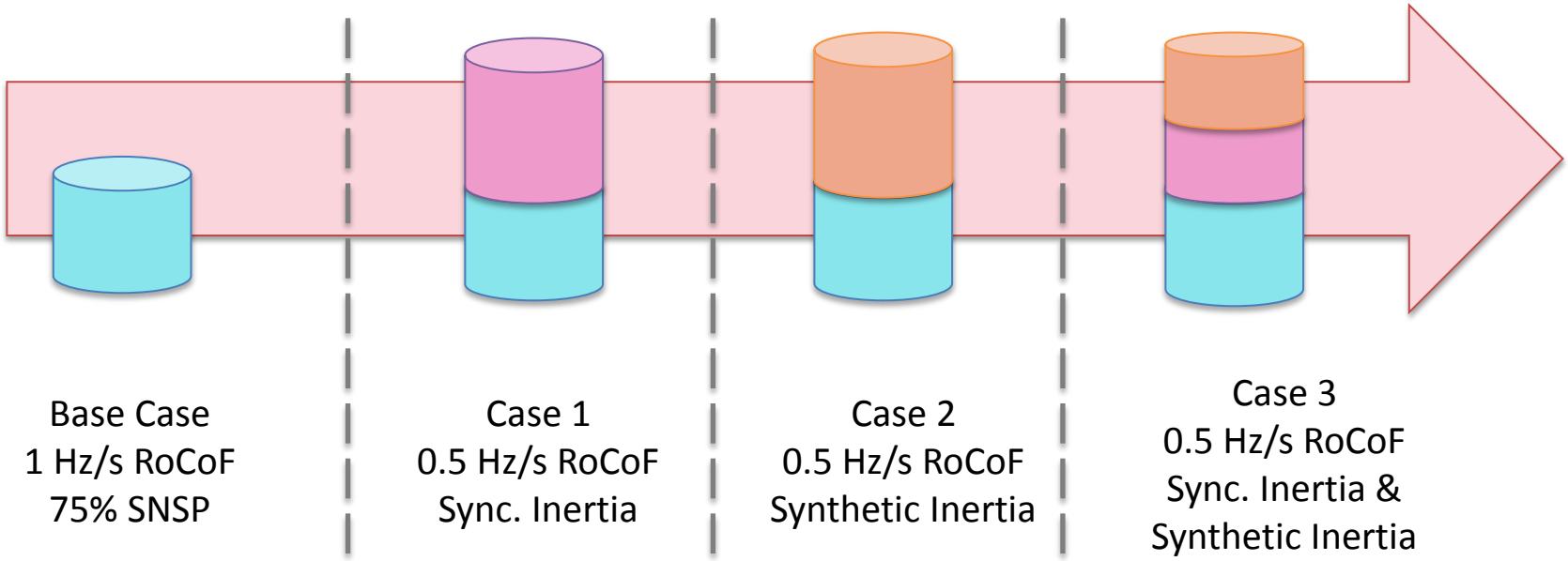
RoCoF Phase 2 Outline

- Determine the extra volume of synchronous and/or synthetic inertia to maintain RoCoF within 0.5Hz/s and allow 75% SNSP
- 3 Cases investigated:



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Base Case Generation

Property	Value
SNSP	75 %
RoCoF	1.0 Hz/s
Moyle Interconnector	Import 450 MW / Export 80 MW
East-West Interconnector	Import 500 MW / Export 500 MW
Installed Large Scale Wind Capacity	4732 MW
Number of Must Run Units	Existing constraint disabled
Second North-South Line	In service
Frequency Reserve	Existing constraints disabled

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Acceptance criteria

- A scenario is deemed acceptable if:
  - RoCoF is within ±0.5 Hz/s (measured over 500 ms) in 99% of the solved cases following an N-1 event.

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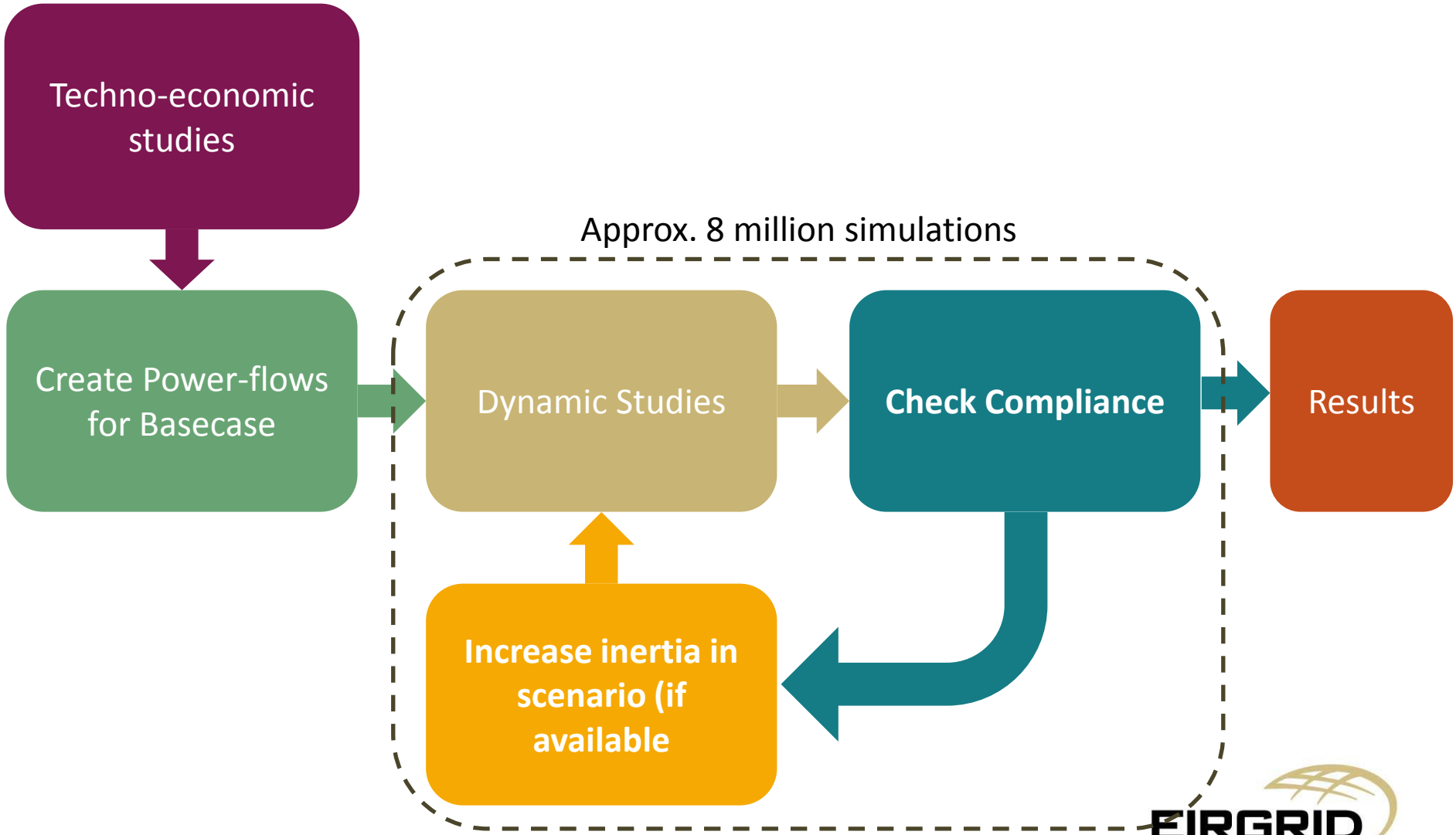
Study Process Flow



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Techno Economic Studies

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Techno Economic Studies – Constraints

Techno-economic scenario	Constraints			
	SNSP (%)	RoCoF (Hz/s)	P Min (%)	POR / SOR (% of LSI)
A	75	0.5	Existing limit	-
B			35	-
C			Existing limit	75
D			35	75
E		1	Existing limit	-
F			35	-
G			Existing limit	75
H			35	75

0.5 Hz/s constraint ⇨

System inertia > 20,000MW.s for most the year

Pmin at 35% ⇨

No material impact on the no. of large units dispatched

Reserve constraint ⇨

Equivalent to adding another large unit

Technical simulations will be based on Case E

Base Case Studies

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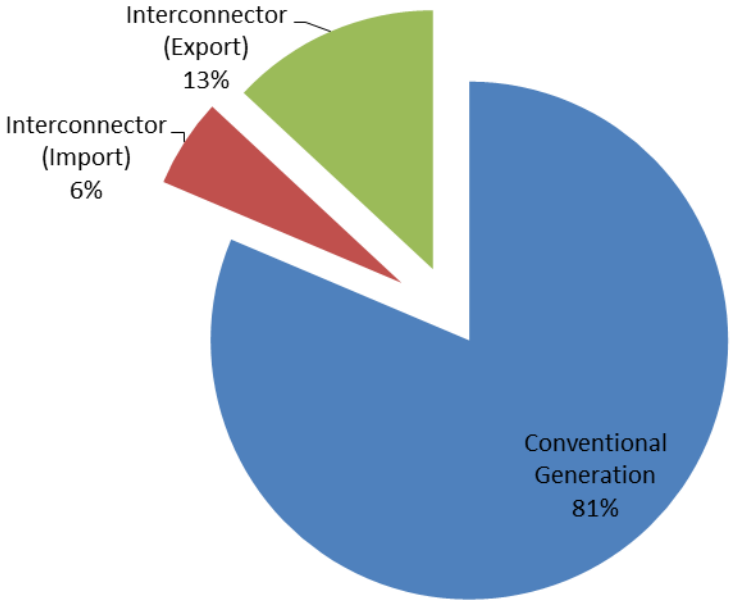
Base Case Studies

Approximately 60% of the hours of the year require supplementary inertia within 200ms – 500ms.



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Synchronous Inertia Studies

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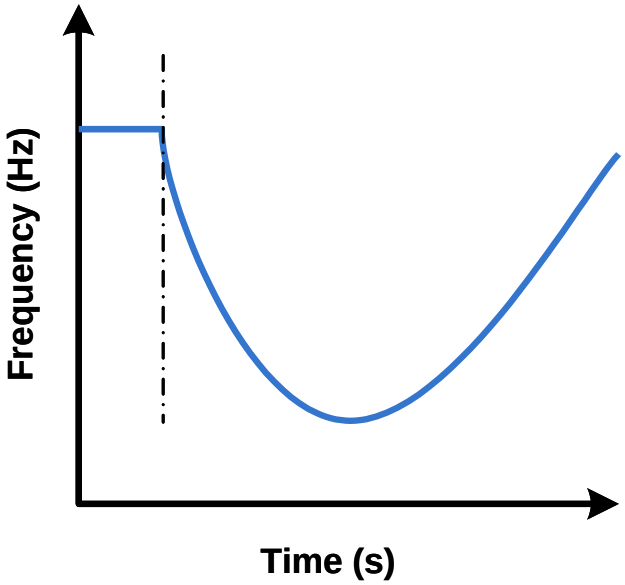
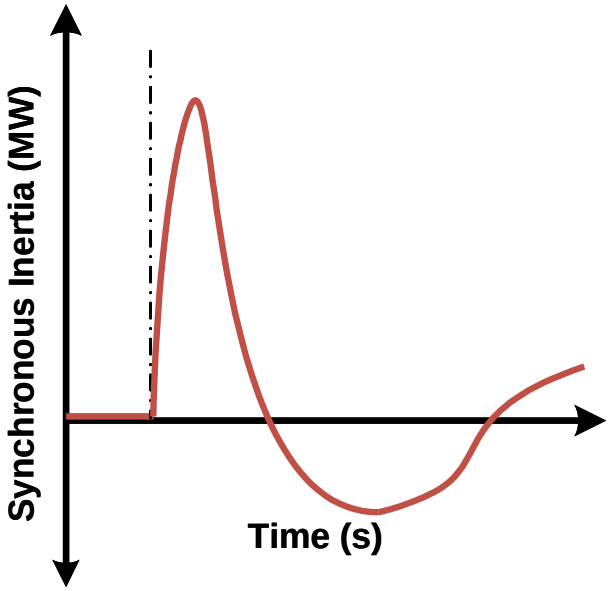
Synchronous Inertia Model





20,000MW.s of system inertia required to maintain RoCoF.

Approx. 12,000 MWs of supplementary synchronous inertia is required by the Base Case to met the acceptance criteria.

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Synthetic Inertia Studies

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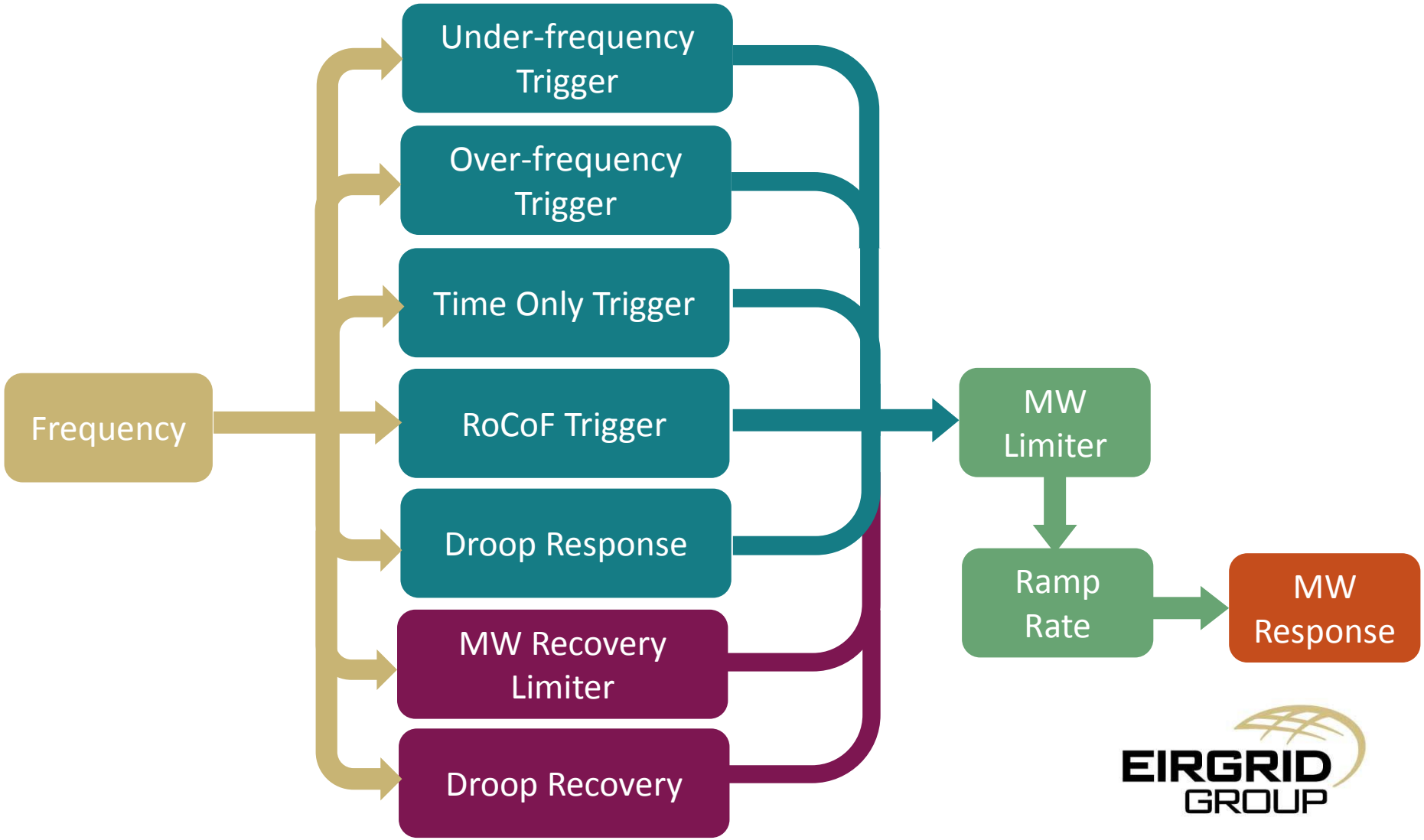
Synthetic Inertia Model



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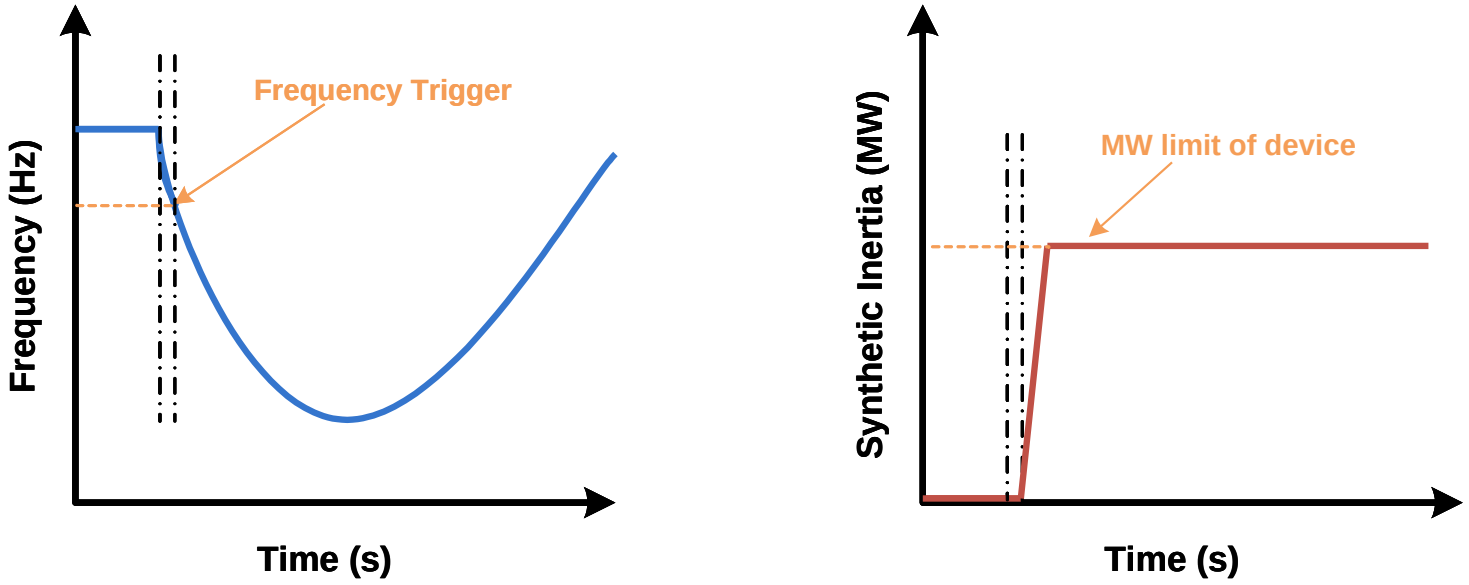
Synthetic Inertia Model

Frequency triggered – Step response

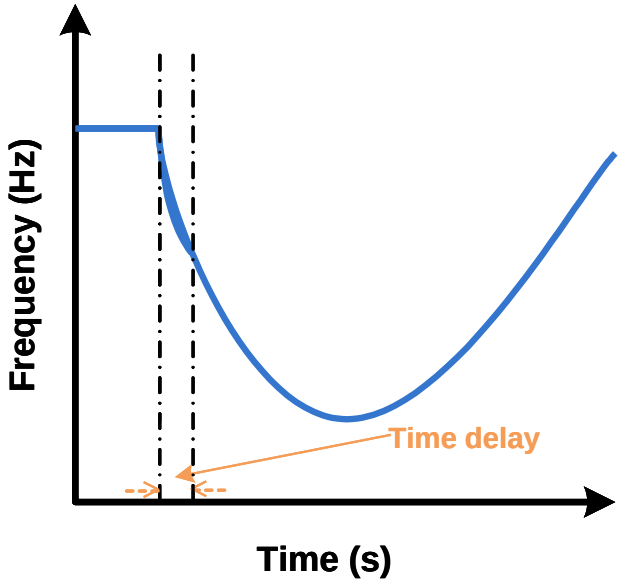


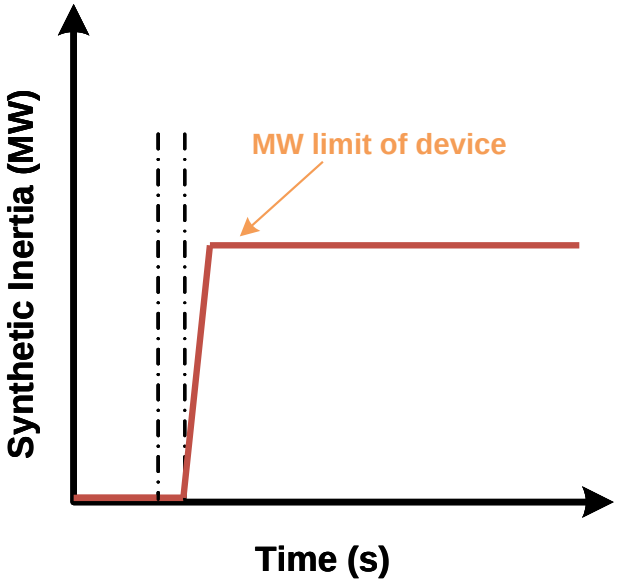
A trigger of 49.8Hz does not met the acceptance criteria.

A trigger of 49.9Hz with a step injection of 360MW may meet the criteria but would lead to over-providing active power following small frequency excursions.

Synthetic Inertia Model

Time triggered – Step response





To met the acceptance criteria synthetic devices should respond within 100 ms of the event and ramp to full output in 200 ms of the initial device response.

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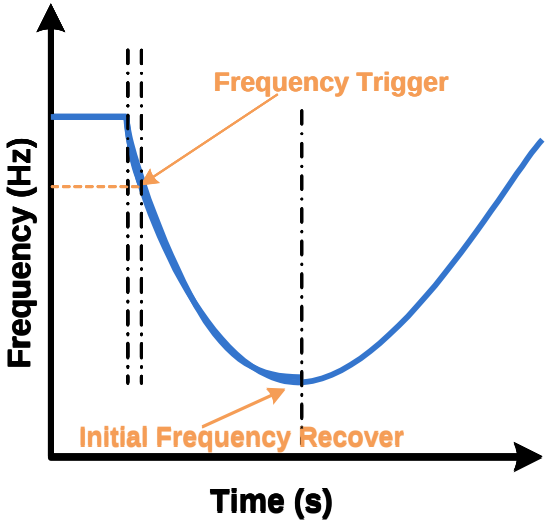
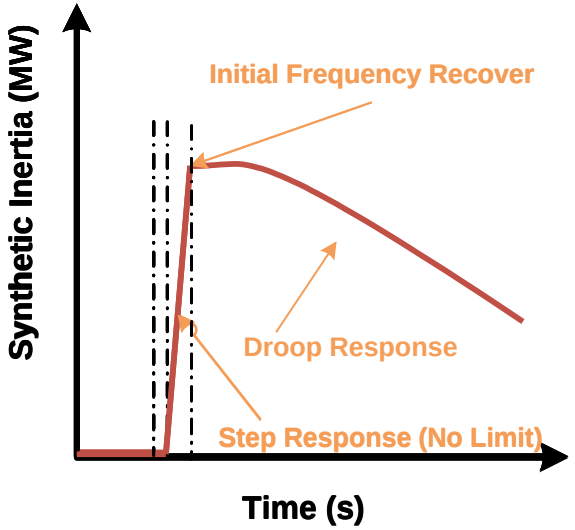
Synthetic Inertia Model

Step triggered at 49.8Hz followed by droop controlled recovery





A fast initial response maintains initial RoCoF within 0.5Hz/s, while a droop controlled recovery resolves unintended frequency recovery issues.

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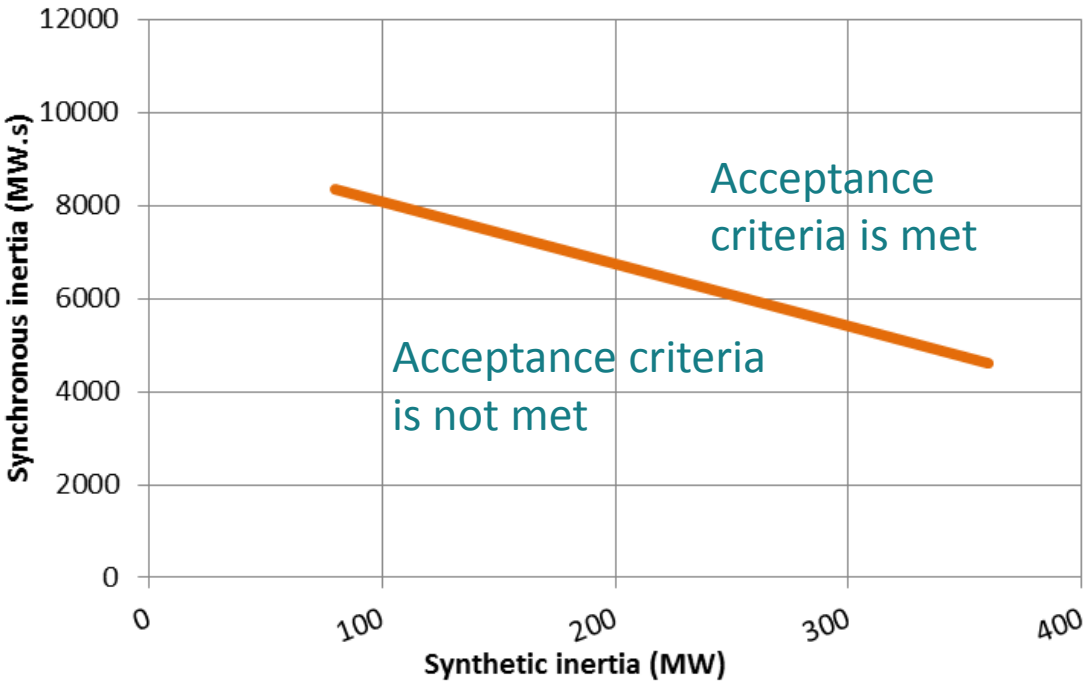
Combined sync. & synthetic inertia

Synthetic inertia injects a step response at 49.8Hz



The combination results are found to deliver a solution where the different devices responses can complement each other.

Results are highly depend on the synthetic inertia characteristics.

Key Findings

Synchronous Inertia

- 20,000 MW.s required to maintain RoCoF
- 12,000 MW.s was added to Base Case

Synthetic Inertia

- Begin to respond within 100 ms
- Ramp to full output in 200 ms
- Control for recovery
- +/- 360 MW

Combination

- Sensitive to synthetic device performance

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Closing Remarks and Actions

Louis Fisher

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