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DS3

Delivering a Secure Sustainable
Electricity System

Ensuring a secure, reliable and efficient Power System in a Changing Environment

Delivering a Secure Sustainable Power System

17th August 2011

EIRGRID

SONI
System Operator for Northern Ireland

Outline Agenda

Chair: Dick Lewis, Manager, Grid Operations Planning

10.00 a.m.	Registration (Tea and Coffee)
10.30 a.m.	Introduction and welcome *Fintan Slye, Director Operations*
10.40 a.m.	Overview of previous studies – Context *Jon O'Sullivan, Manager, Sustainable Power Systems*
11.00 a.m.	Report on "Ensuring a Secure, Reliable and Efficient Power System" *Shane Rourke, Sustainable Power Systems*
11.40 a.m.	Programme & Advisory Council *Yvonne Coughlan, Sustainable Power Systems*
12.00 a.m.	Questions from Audience
12.20 a.m.	Closing comments followed by Lunch

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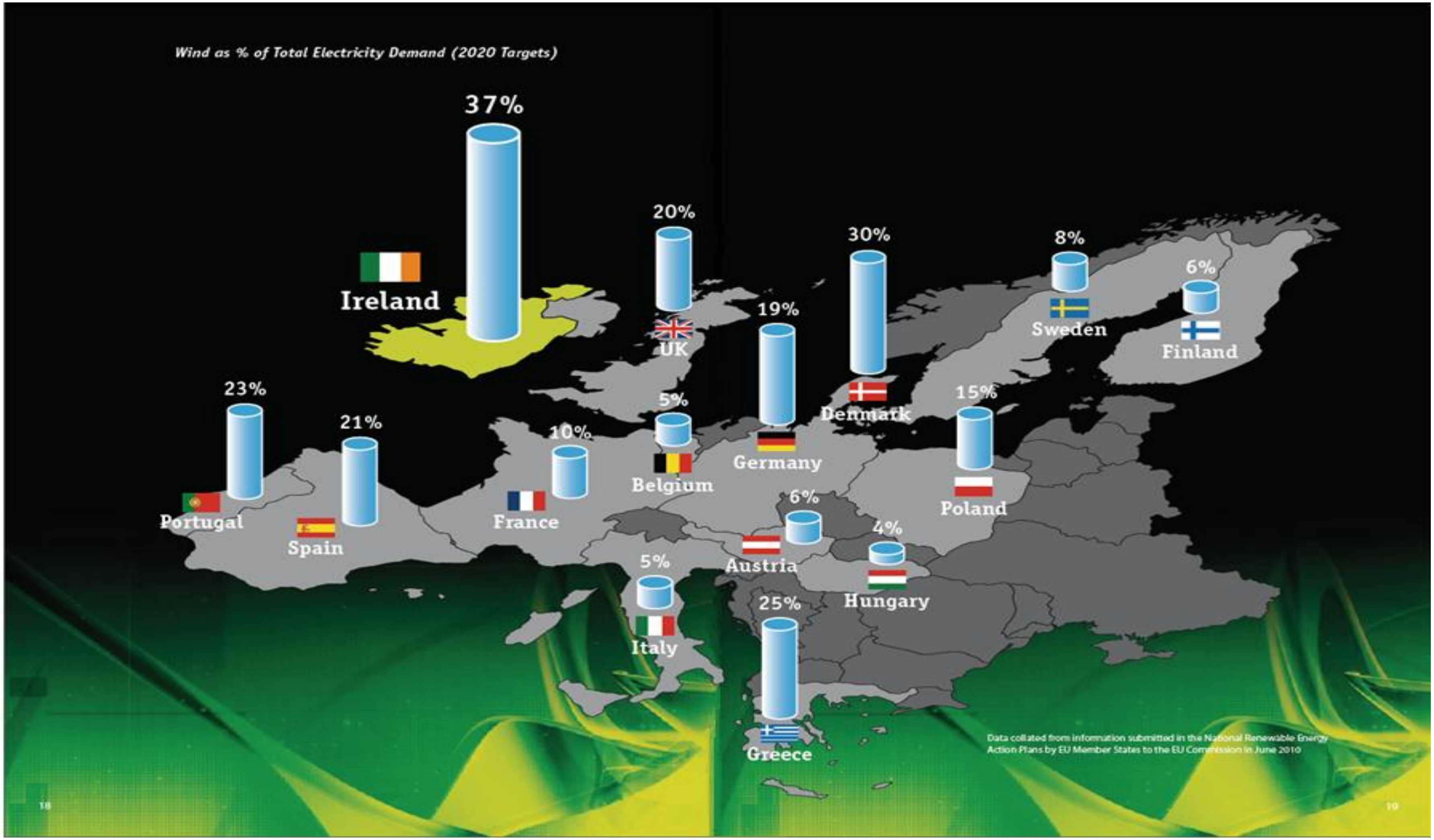
European NREAP 2020 Wind Figures



Delivering a Secure Sustainable Electricity System

Delivering a Secure Sustainable System

All Island Grid Studies
- Infrastructure Requirements and Resource Assessment

Facilitation of Renewables Studies
- Power System Operational Needs

Sustainable Power Systems Report
- Ensuring the needs of the future power system

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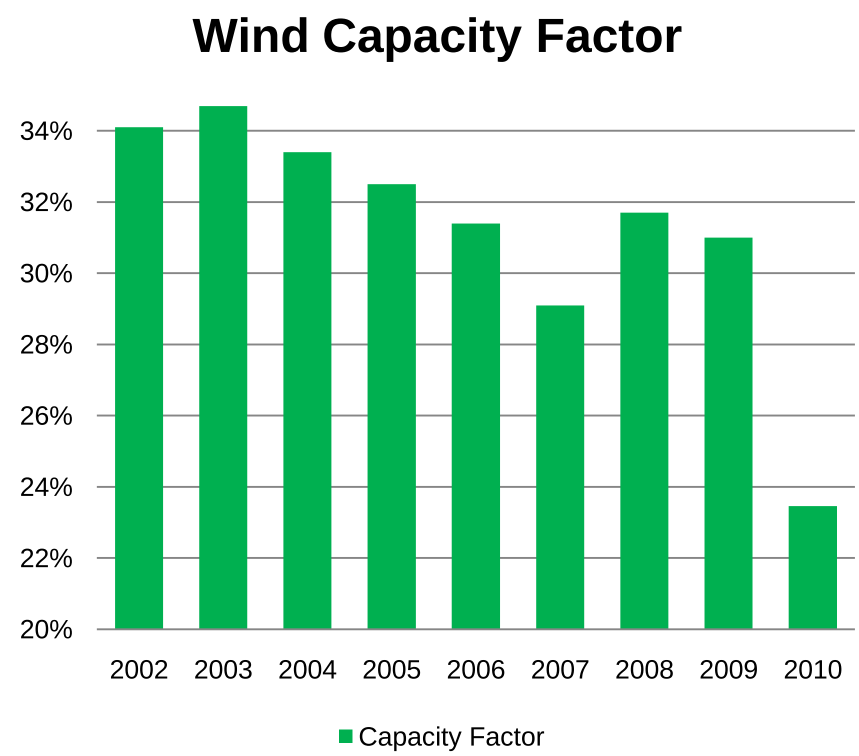
Ireland and Northern Ireland Wind Statisitcs

	Ireland	Northern Ireland
Installed	1425 MW	314 MW
Maximum Output	1259 MW	314 MW
Highest Instantaneous %	52.3 %	50 %
Highest Daily Energy	37%	29%
Annual Output % 2010	10%	7.2%



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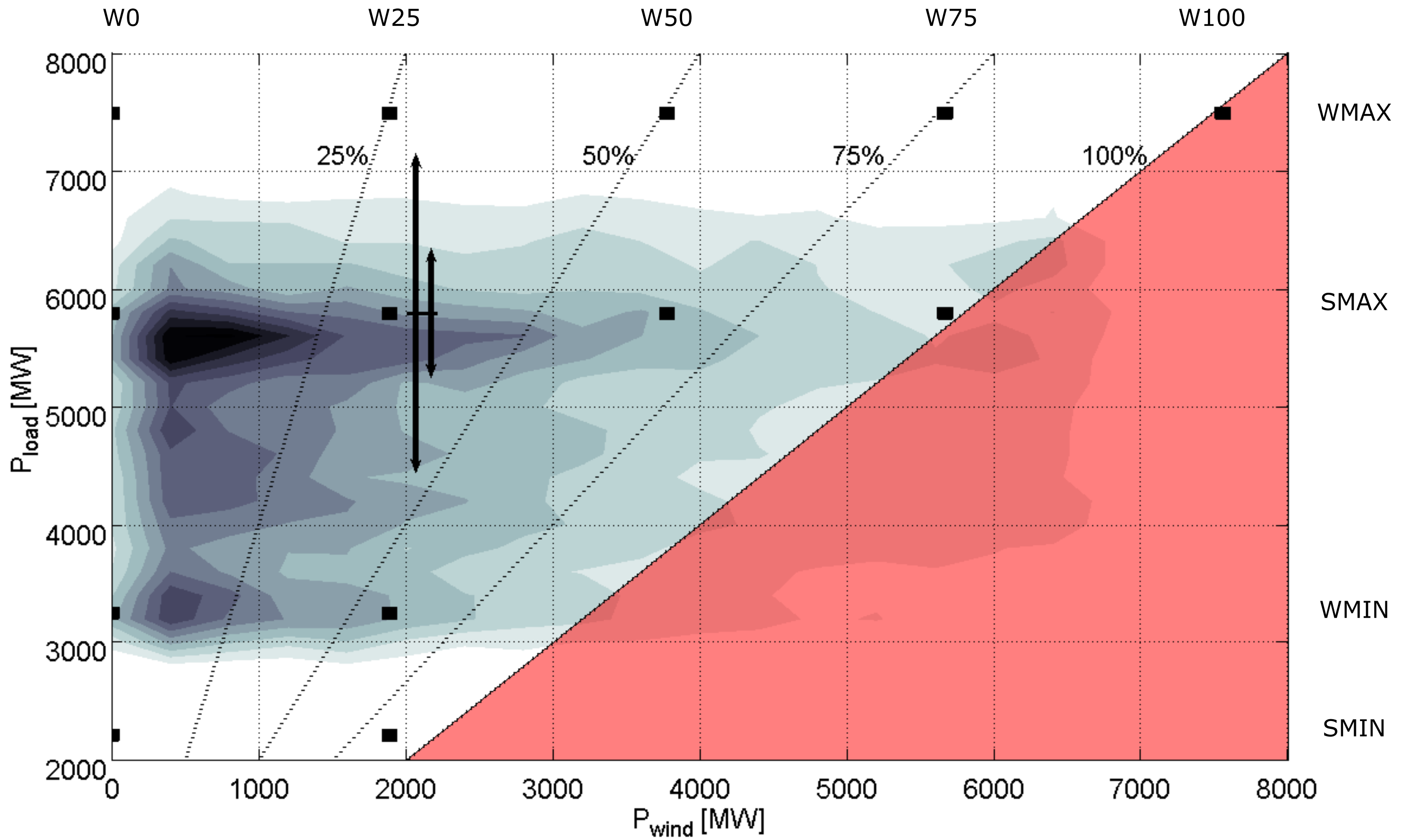
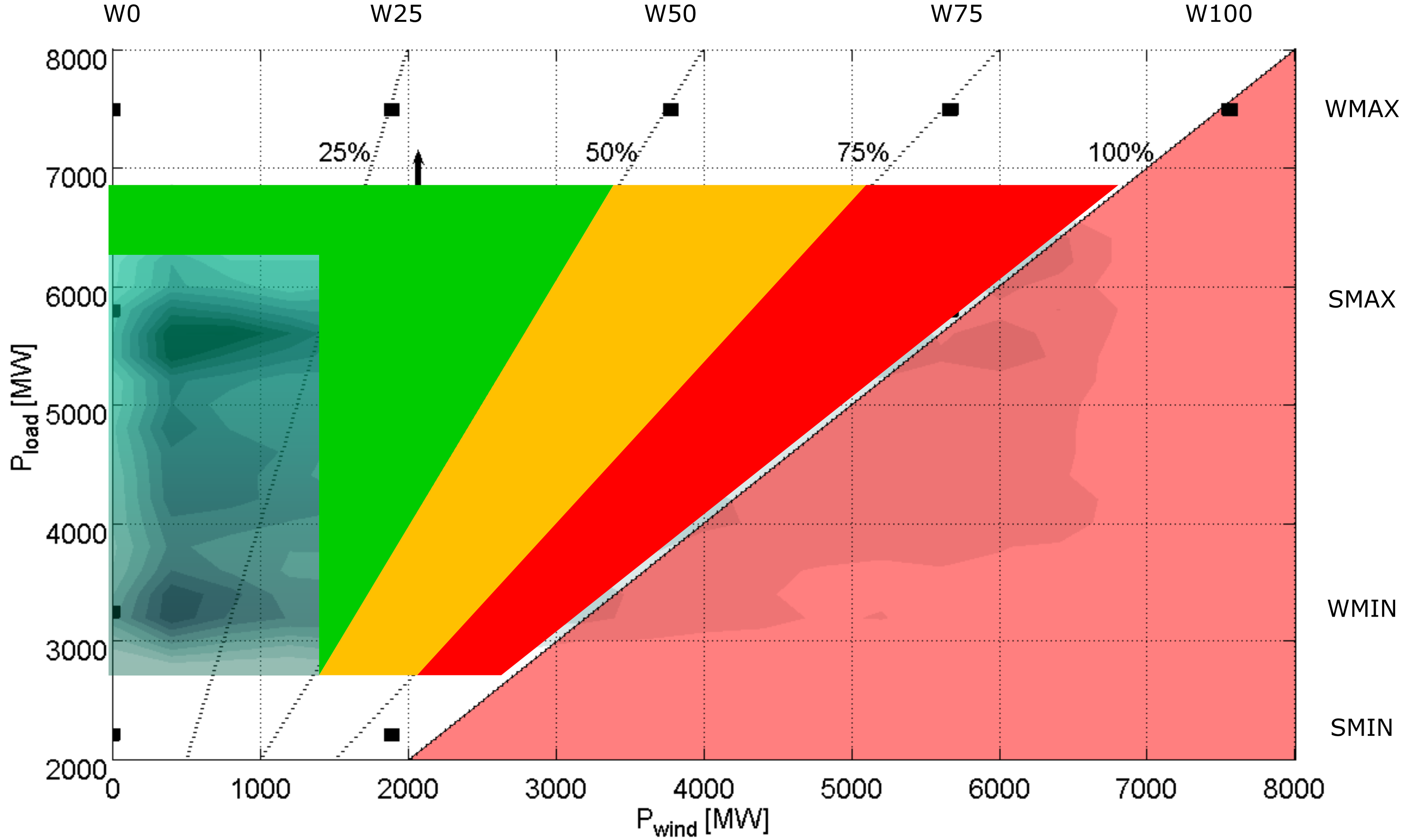
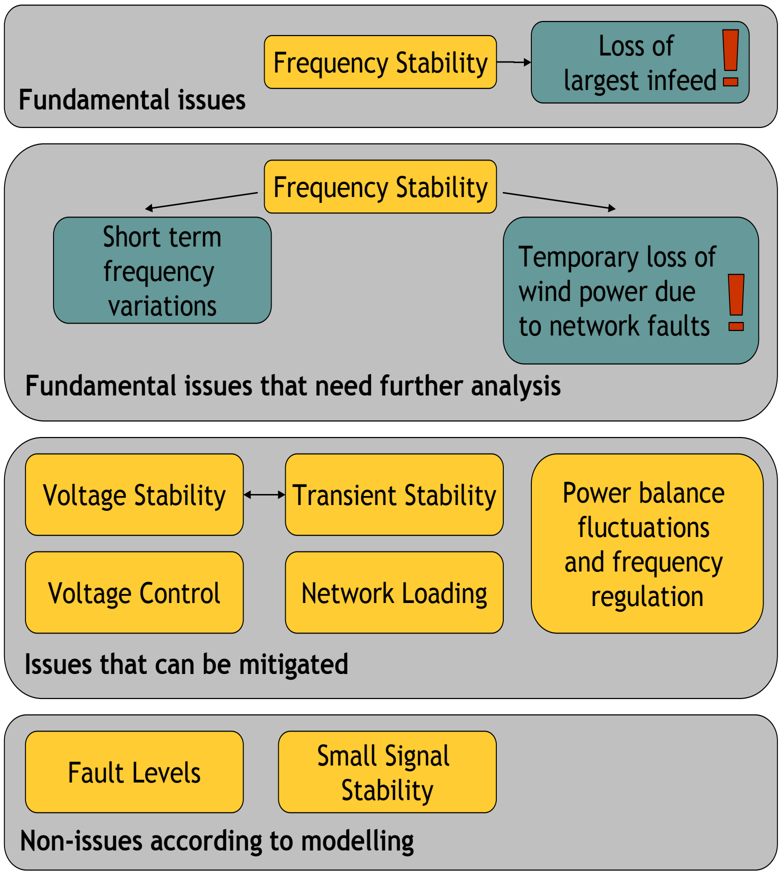
Operational Boundaries



Operational Boundaries



Key findings



- RoCoF capability and protection
- Conventional Generator Reserve performance
- Windfarms controllability and reactive power capability
- New operating procedures including embedded windfarms

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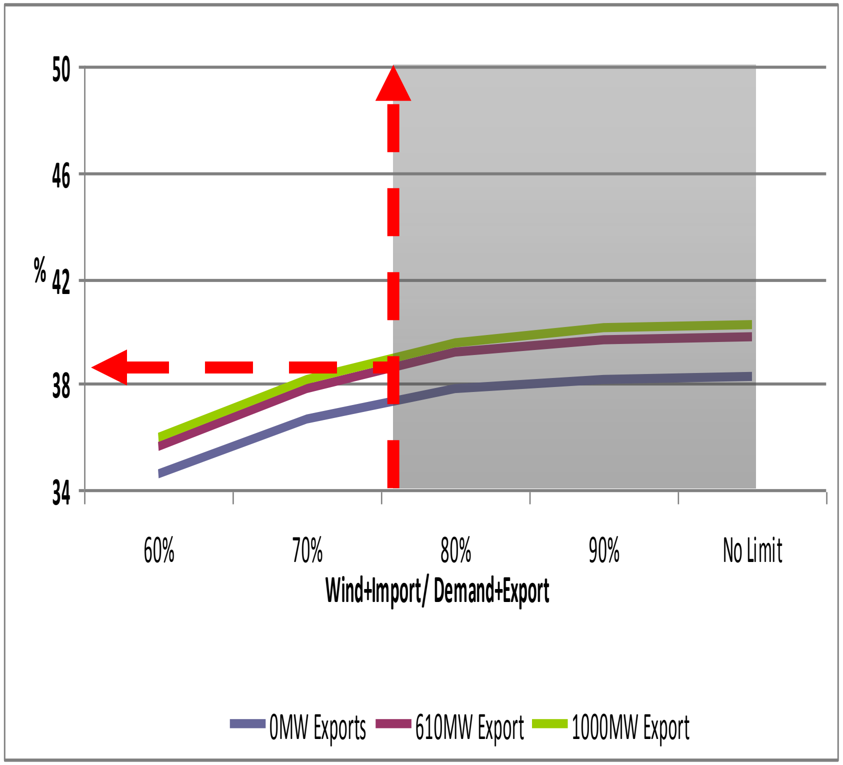
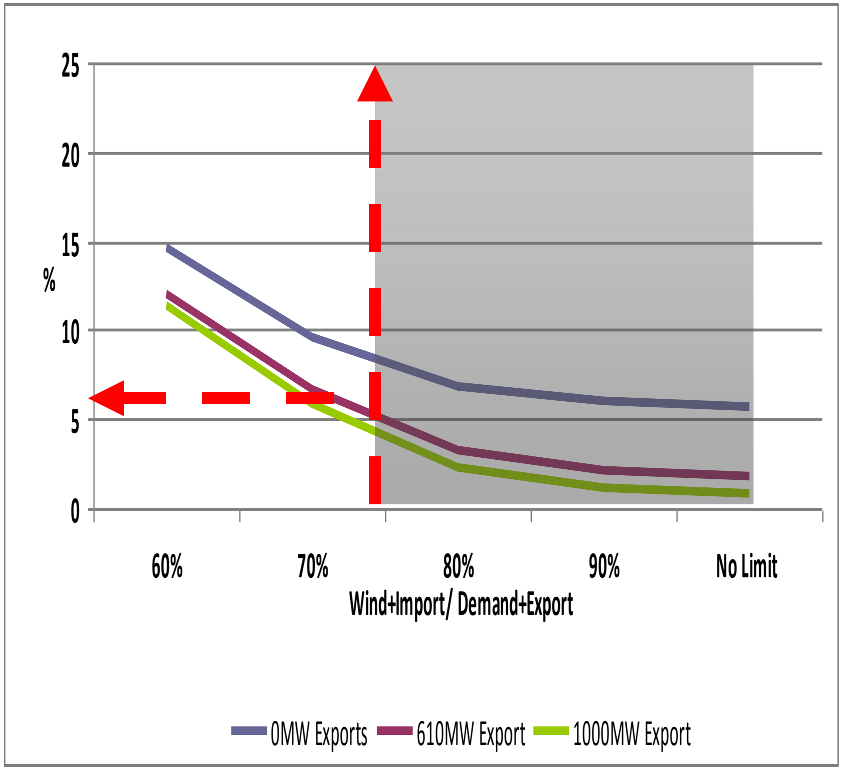
Impact on Renewable Targets and Individual Wind Curtailment - 6000 MW Installed

% Annual Energy from Wind



% Individual Wind Curtailment



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Follow Up Analysis – System Services

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Methodology

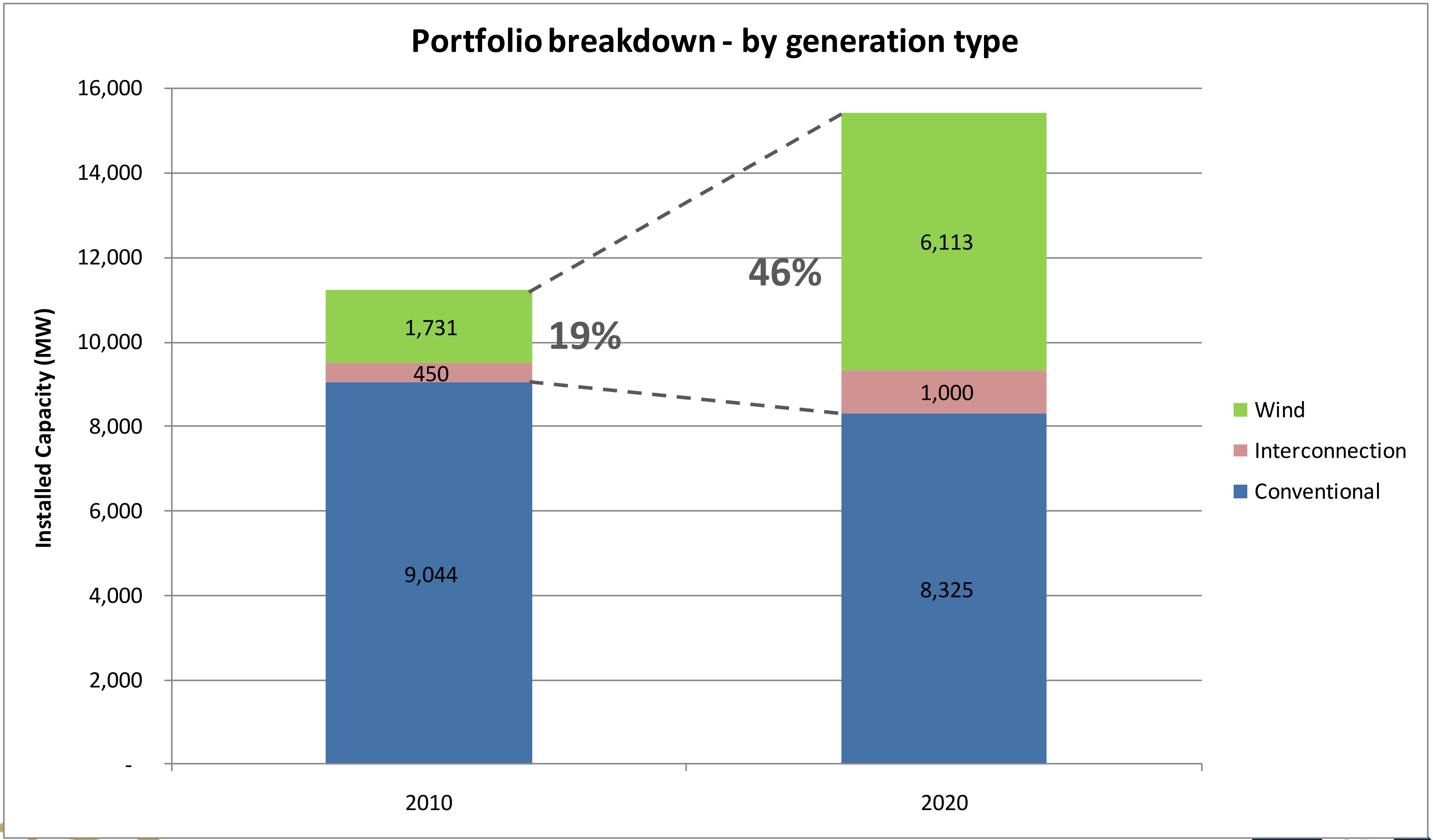
- Analysis builds on the results of the FoR
  - Using out-turn data and observed behaviour
- Three type of analysis carried out
  - Portfolio capability (theoretical maximum)
  - Actual availability (dispatch dependent)
  - Performance analysis
- Two timeframes considered:
  - Current: 2010
  - Future: 2020

Portfolio evolution

- 2010 portfolio – 2011 GCS
- 2020 portfolio – credible evolution of current portfolio
  - Complementary to renewables targets
  - Sufficient investment to ensure capacity adequacy

Technology	Net capacity change (MW)
Wind	**+ 4400**
Interconnection	**+ 500**
CCGT	**+ 700**
OCGT	**+ 800**
Conventional thermal	**- 2000**

Portfolio evolution



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Areas of analysis

Frequency Response

- Synchronous Inertia
- Operating Reserve

Voltage Control

- Reactive Power Capability
- Dynamic Reactive Power

Ramping Services

- Generator Ramping
- Wind Variability & Forecasting

Areas of analysis

Frequency Response	• Synchronous Inertia • Operating Reserve
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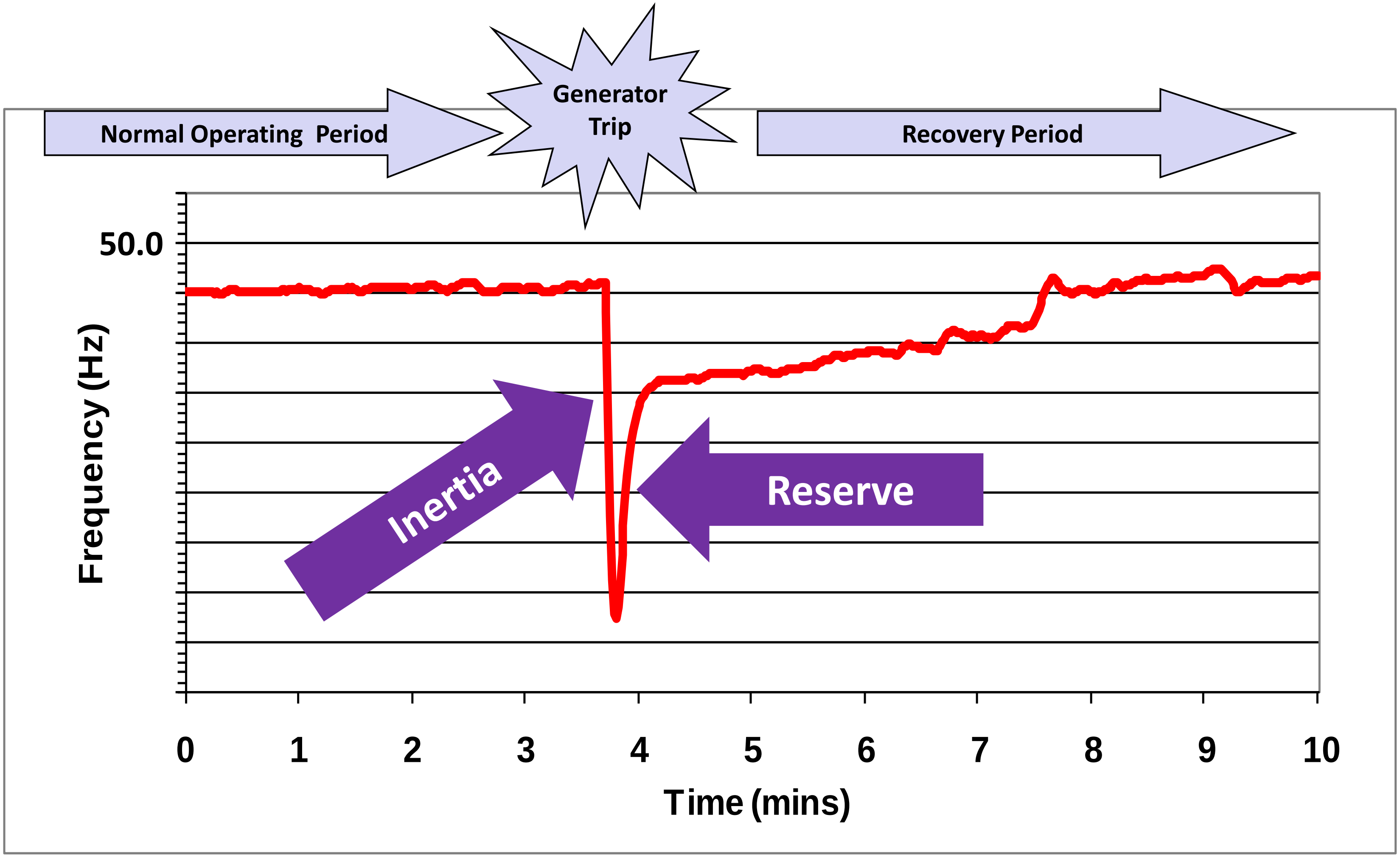
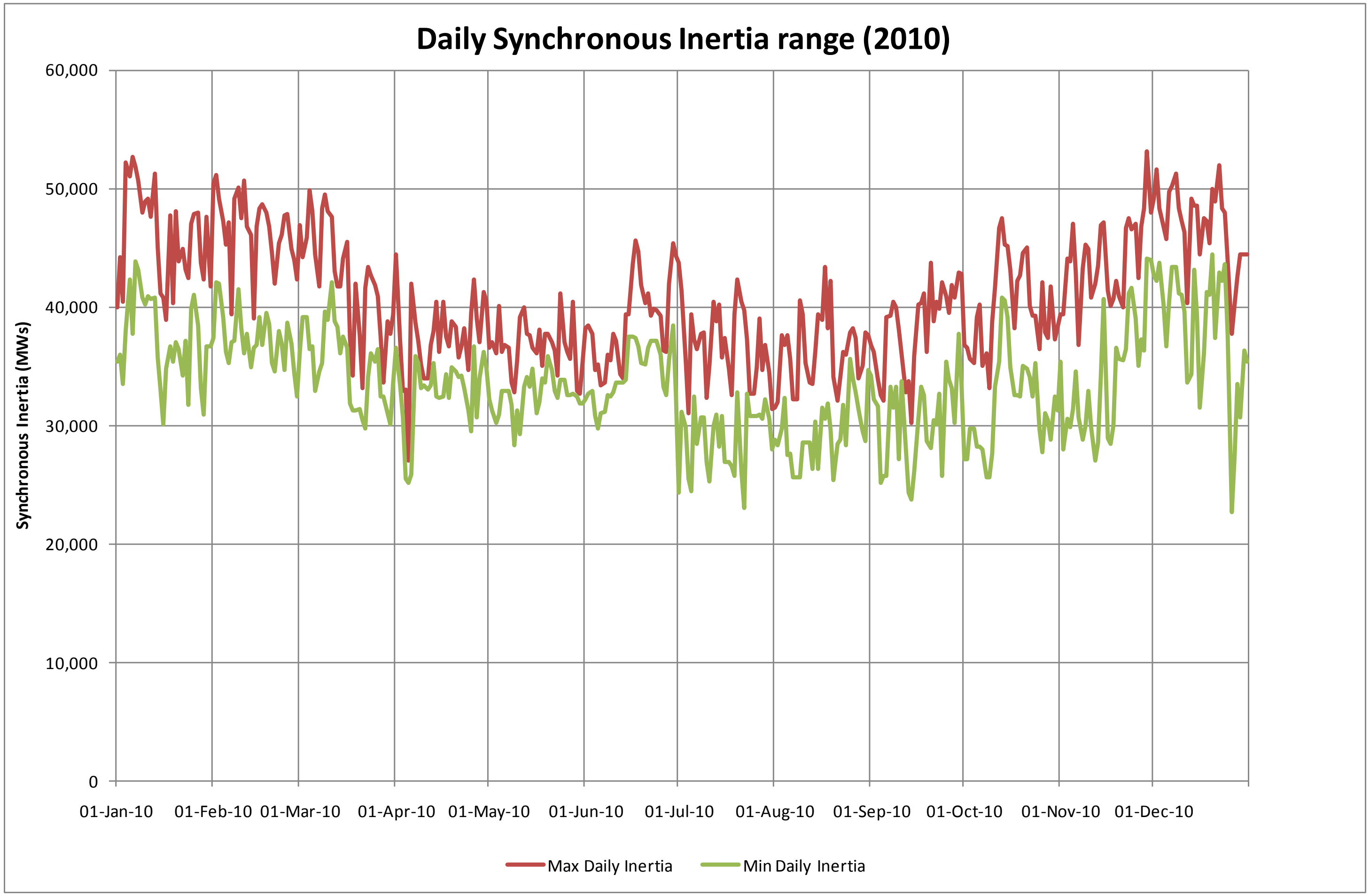
Example of Incident



Frequency Response: Inertia (daily range)



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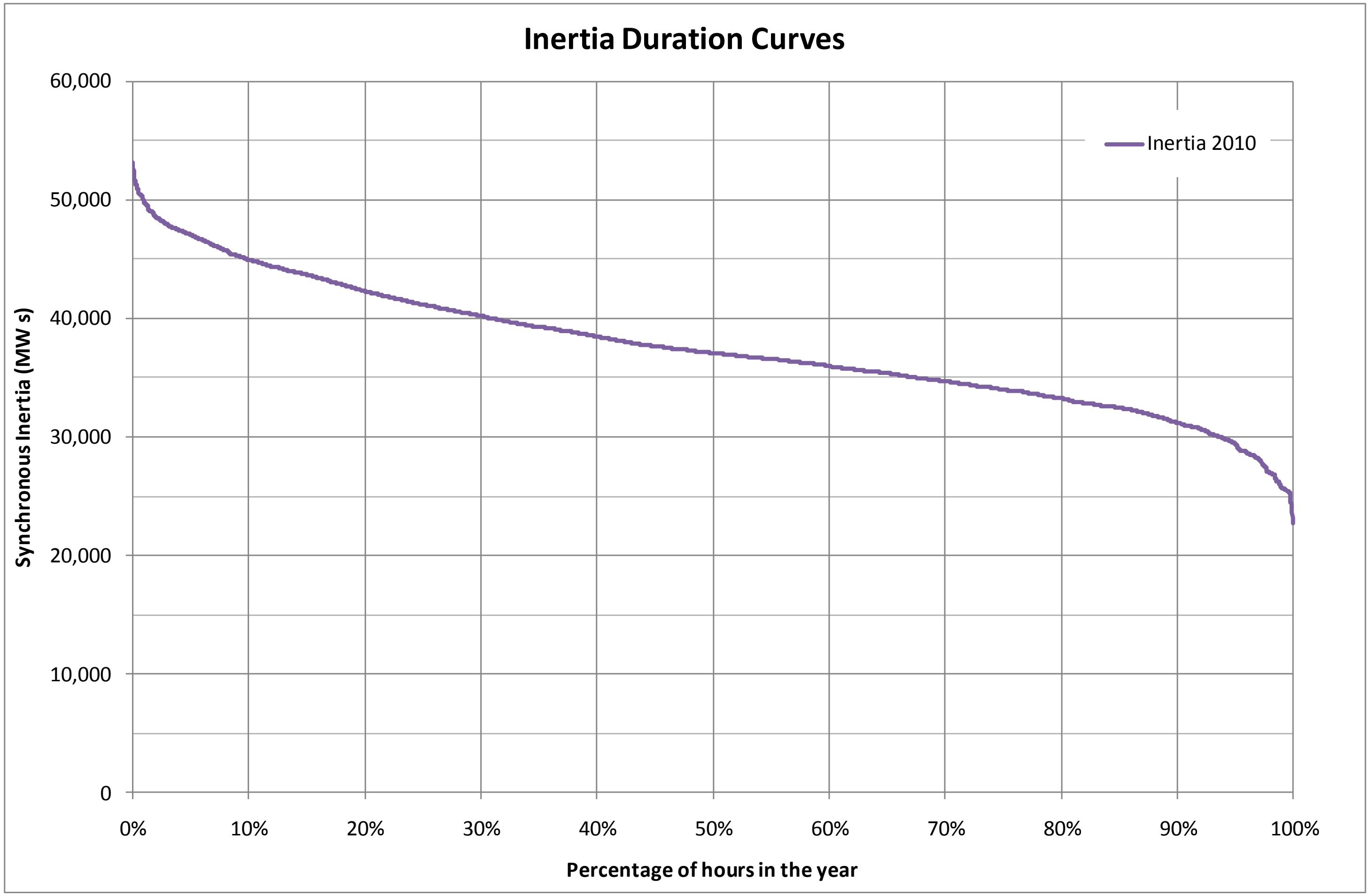
Frequency Response: Inertia



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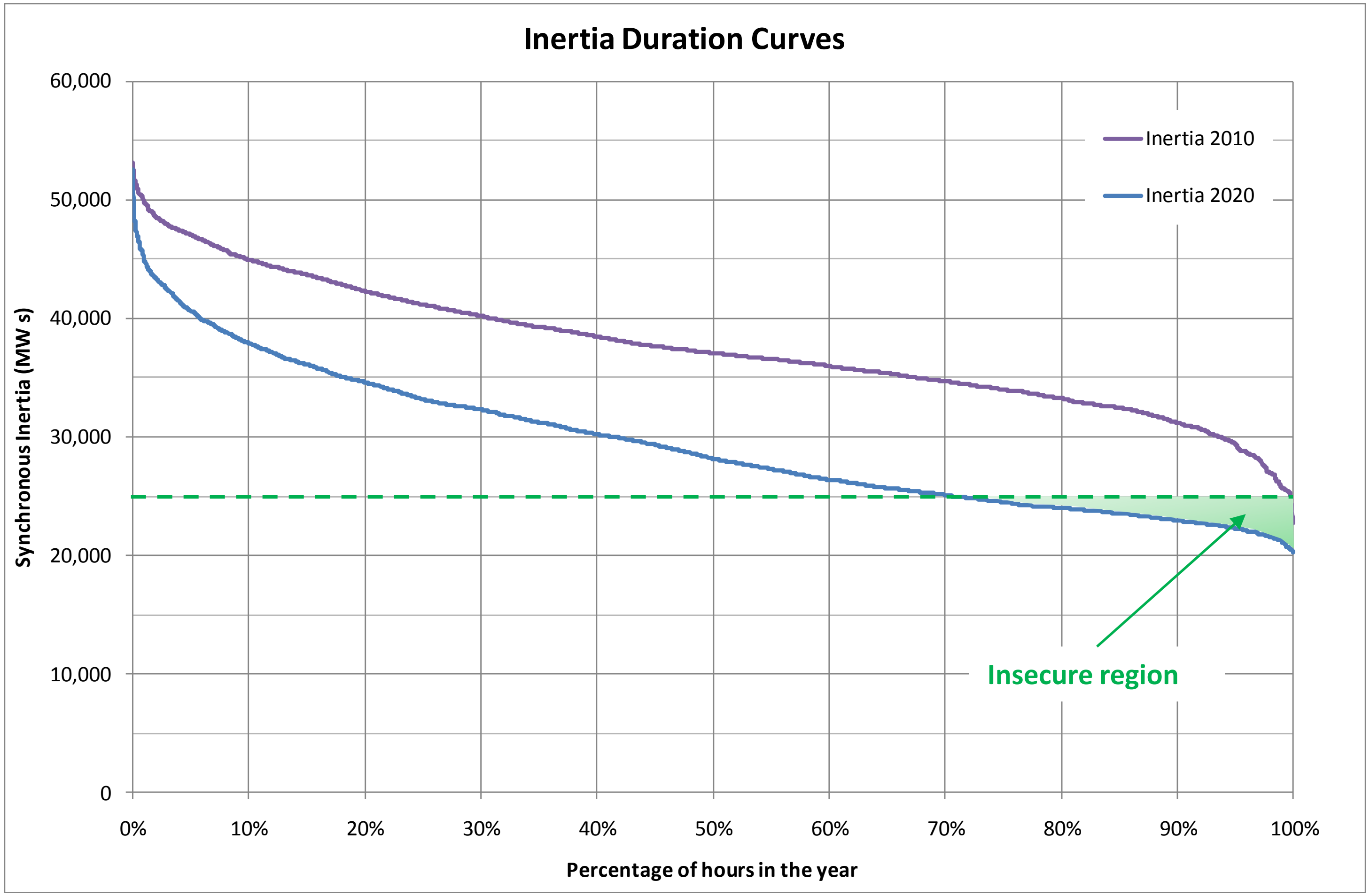
Frequency Response: Inertia



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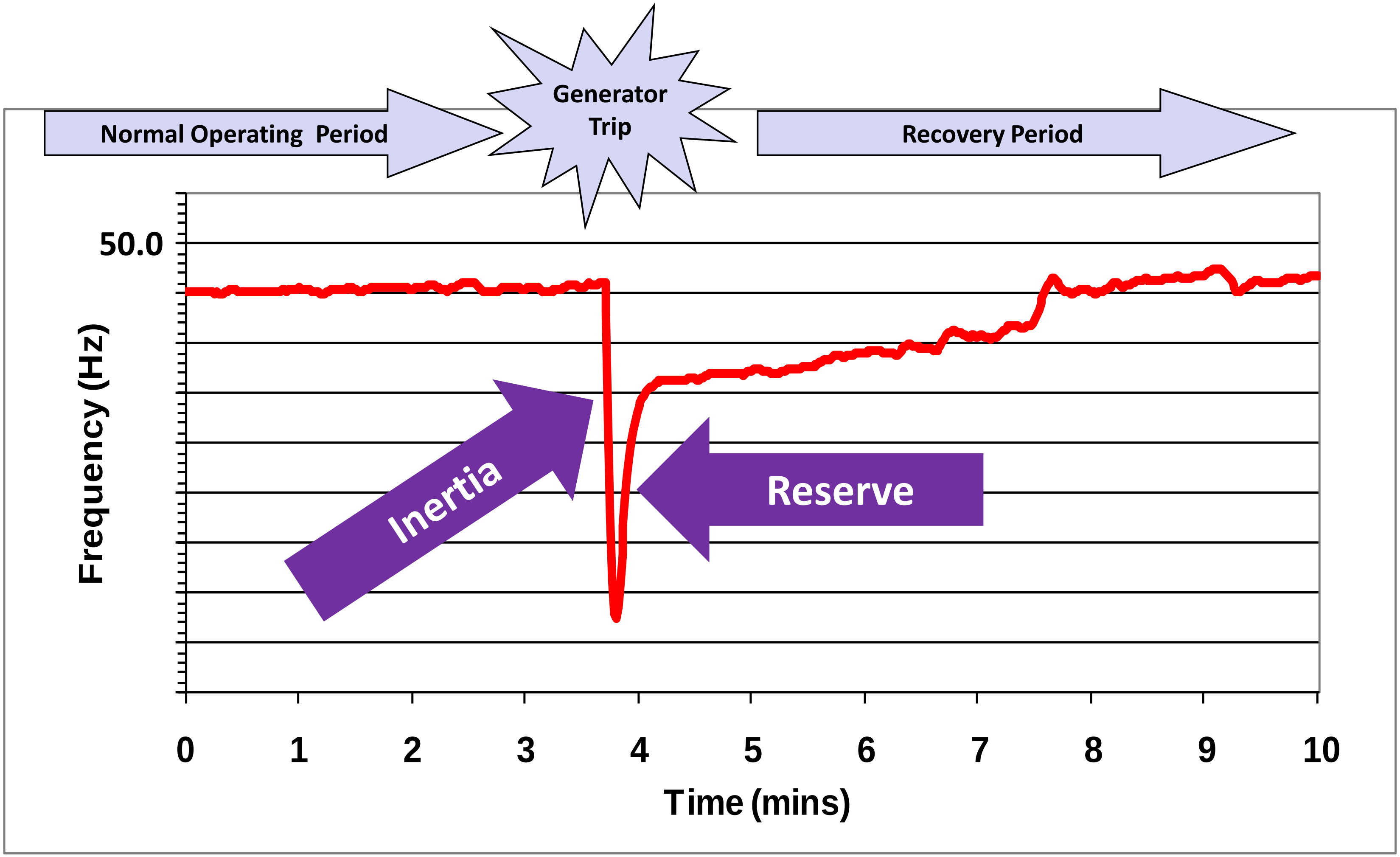
Example of Incident



Inertia

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Frequency Response: Operating Reserve

- Automatic generator response to frequency deviation
  - Timescales: Primary, Secondary, Tertiary …
  - Primary the most onerous
- Grid Code requirement (Primary): at least 5% Reg Cap
- Portfolio has 8% capability overall
  - Some generators with >> 5%
  - Other generators with < 5%

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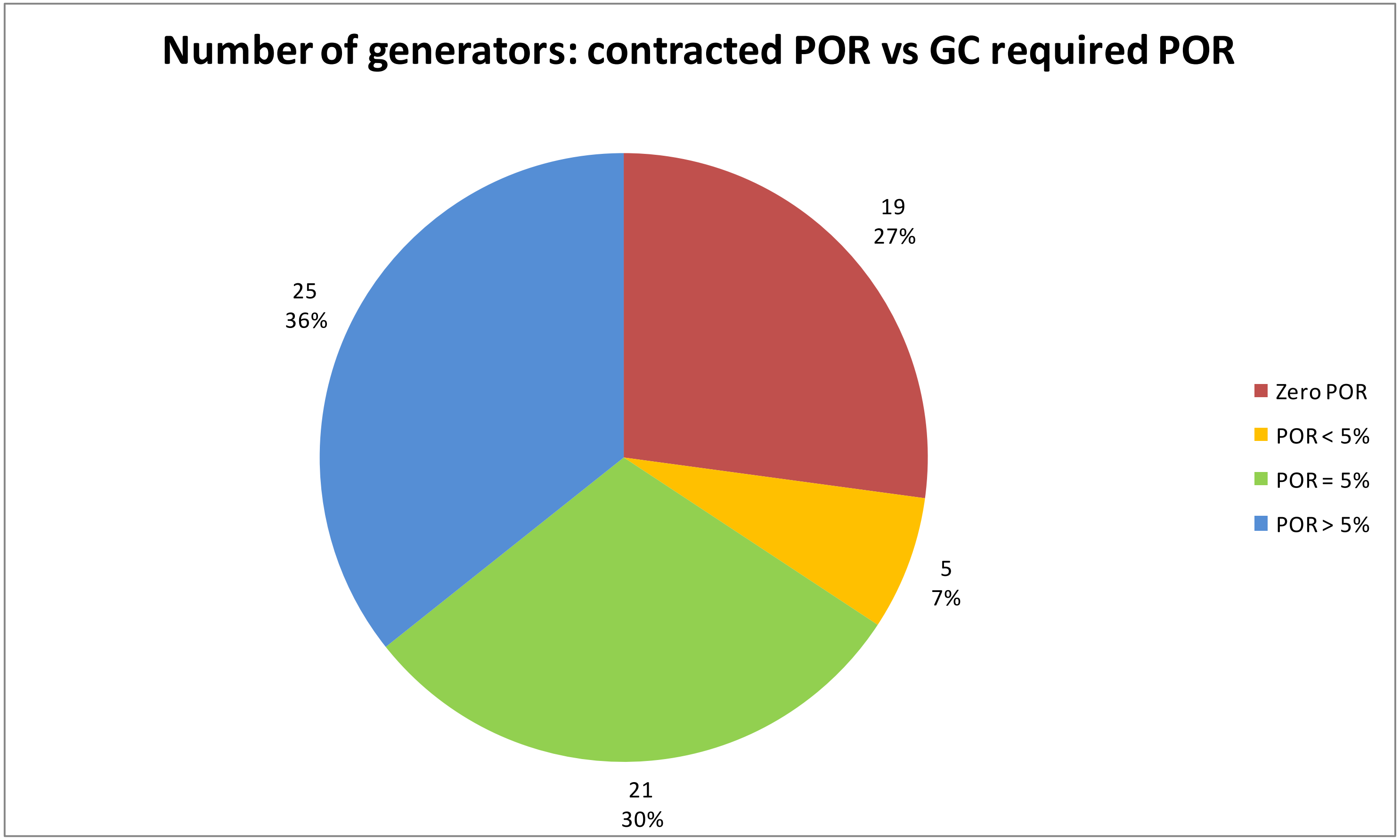
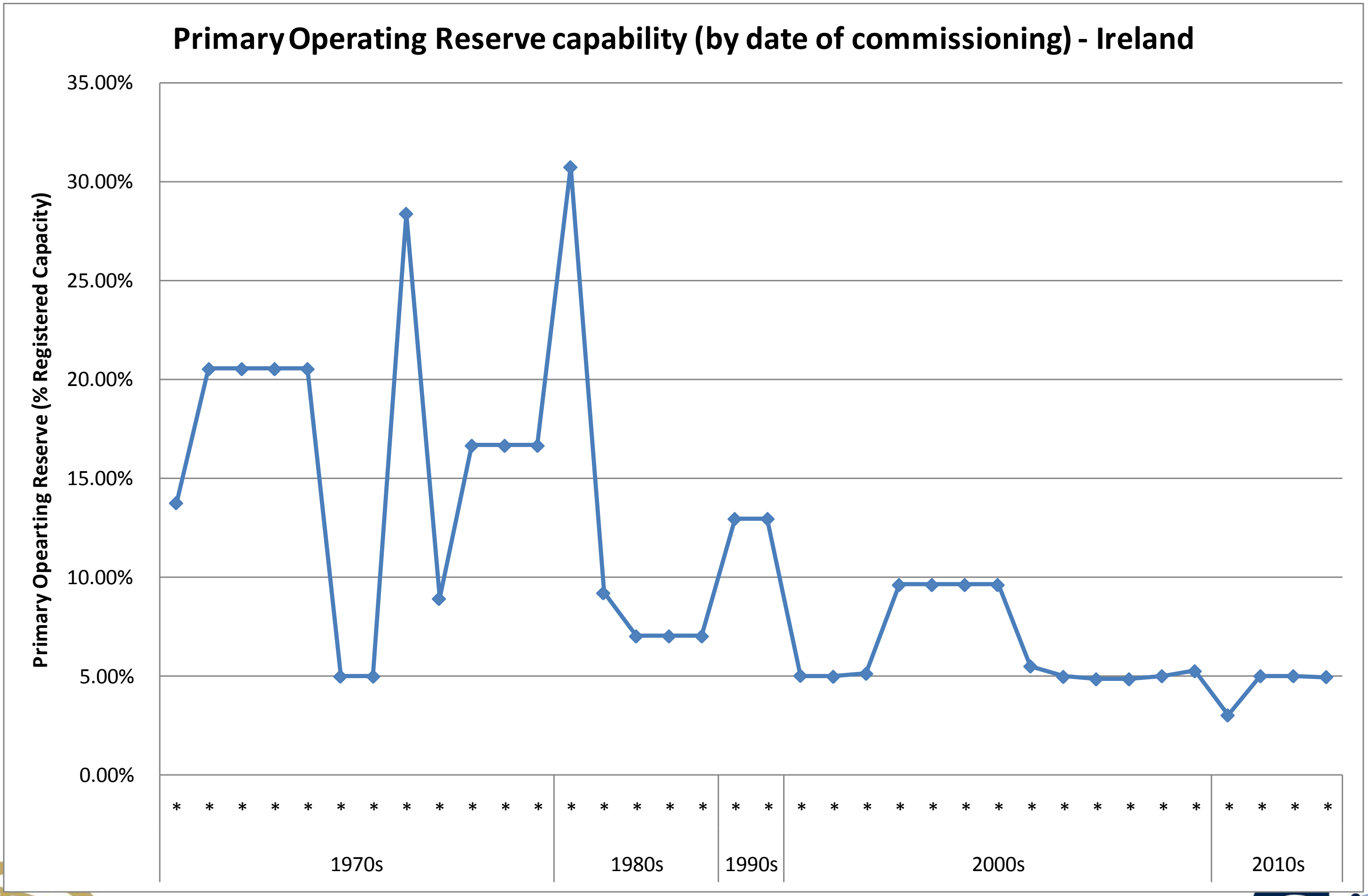
Operating Reserve – Capability



Operating Reserve – Capability (Ireland only)



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Operating Reserve – Performance

- Performance improvements observed since the introduction of HAS
- Preliminary analysis of 2010 low frequency disturbances
  - Generators in Ireland classified based on Primary Operating Reserve performance vs declared capability

Achieved 80% response	No of generators
Good: > 80% events	**7**
Average: > 40%, < 80% events	**10**
Poor: < 40% events	**11**
Unknown / limited data	***23***

Note:
Ireland only

Areas of analysis

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Key Findings

Reduced Synchronous Inertia

Reserve capabilities less than Grid Code

Poor Generator Reserve Performance

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Areas of analysis

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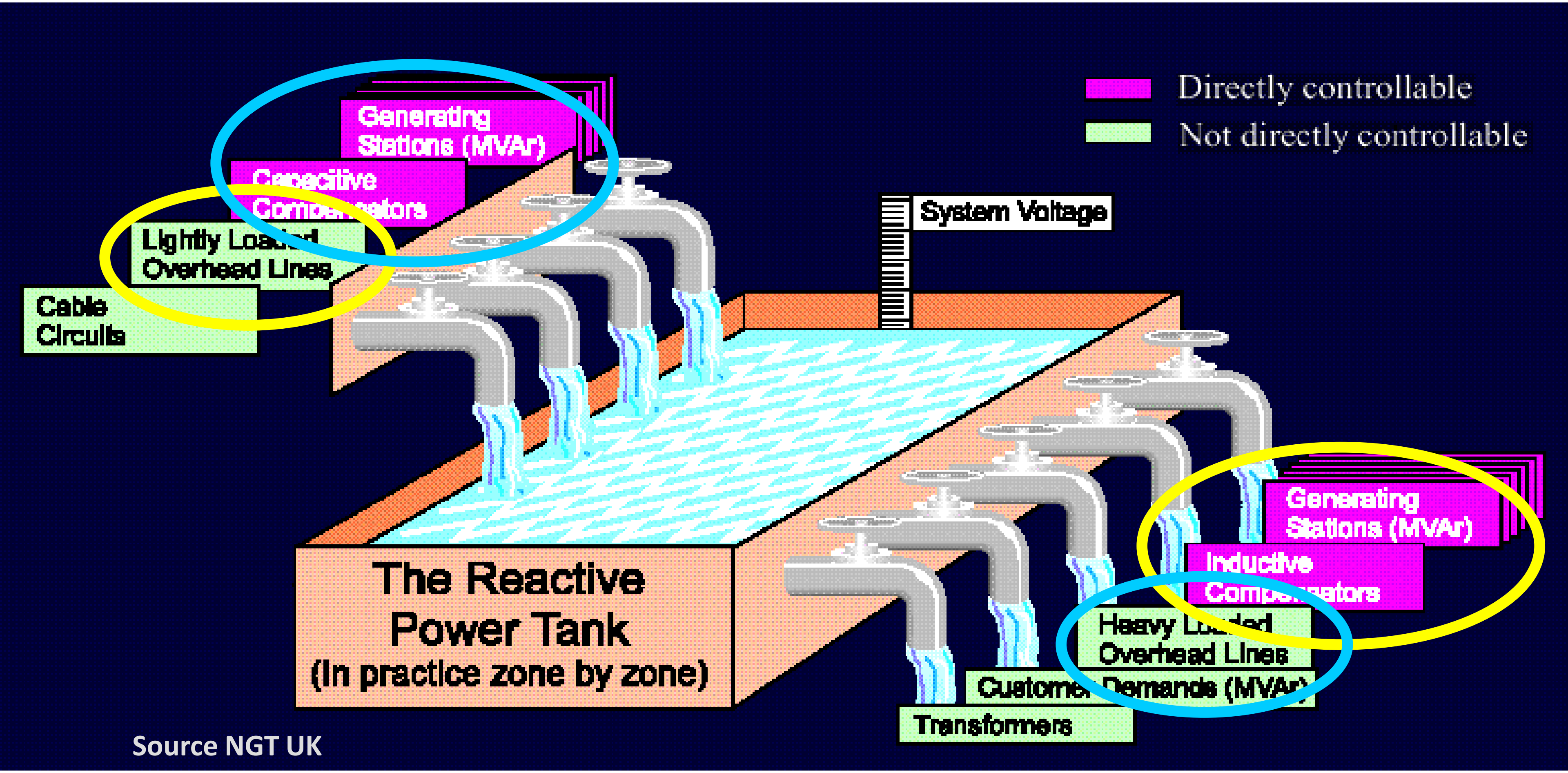
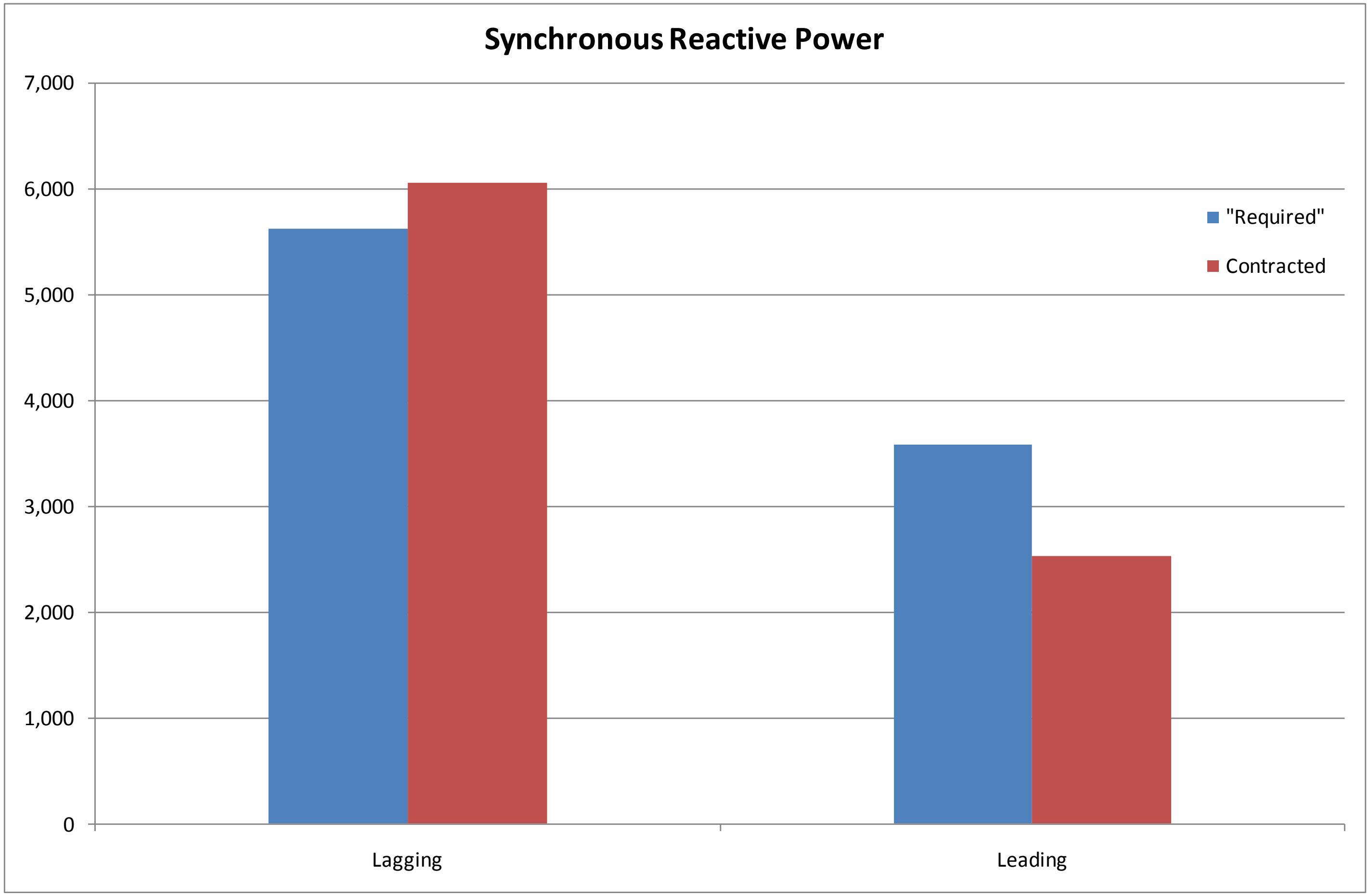
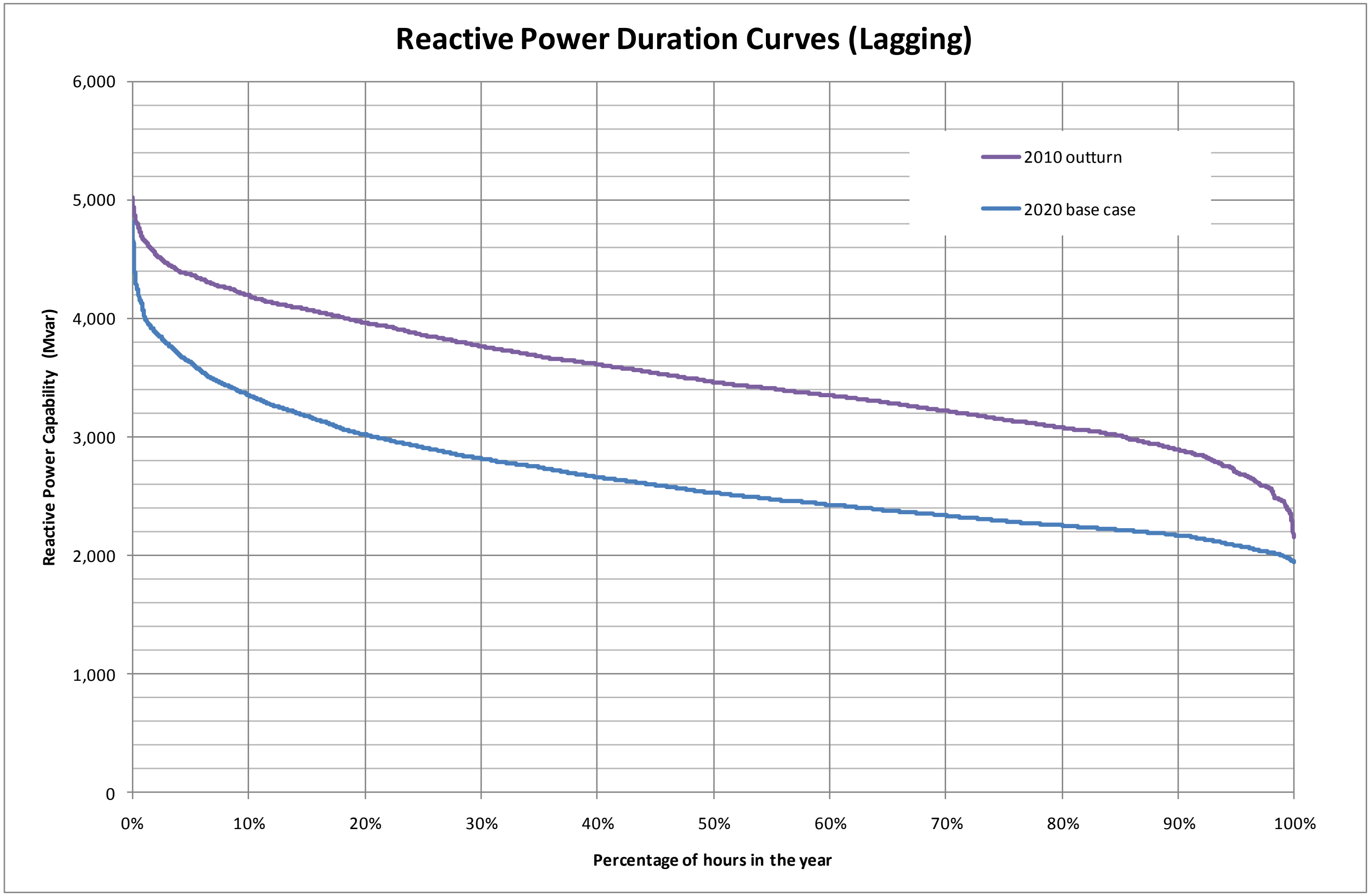
Voltage Control – Reactive Power



Reactive Power – Portfolio Capability



Reactive Power Availability – Synchronised



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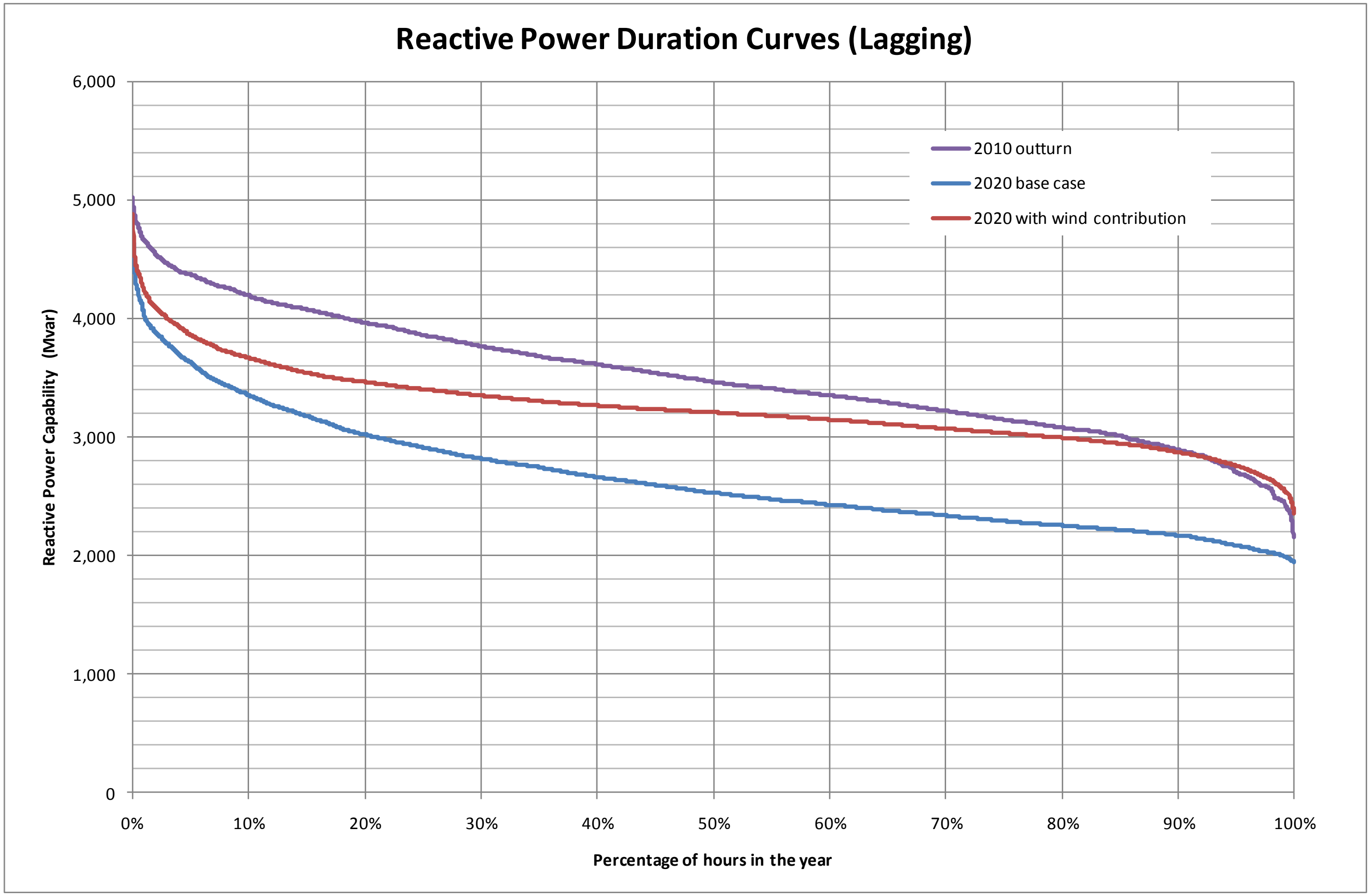
Reactive Power Availability



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Reactive Power Available – 2010 vs 2020

- Table shows average Mvar availability (i.e. from on-line generation) in 2010 and 2020 (with percentage increase/decrease)

	Lagging Mvar		Leading Mvar	
2010	3510		1570	
2020 (conventional)	2650	**(-24%)**	1310	**(-16%)**
2020 (Tx wind)	3240	**(-8%)**	2000	**(+21%)**
2020 (all wind)	3830	**(+9%)**	2480	**(+58%)**

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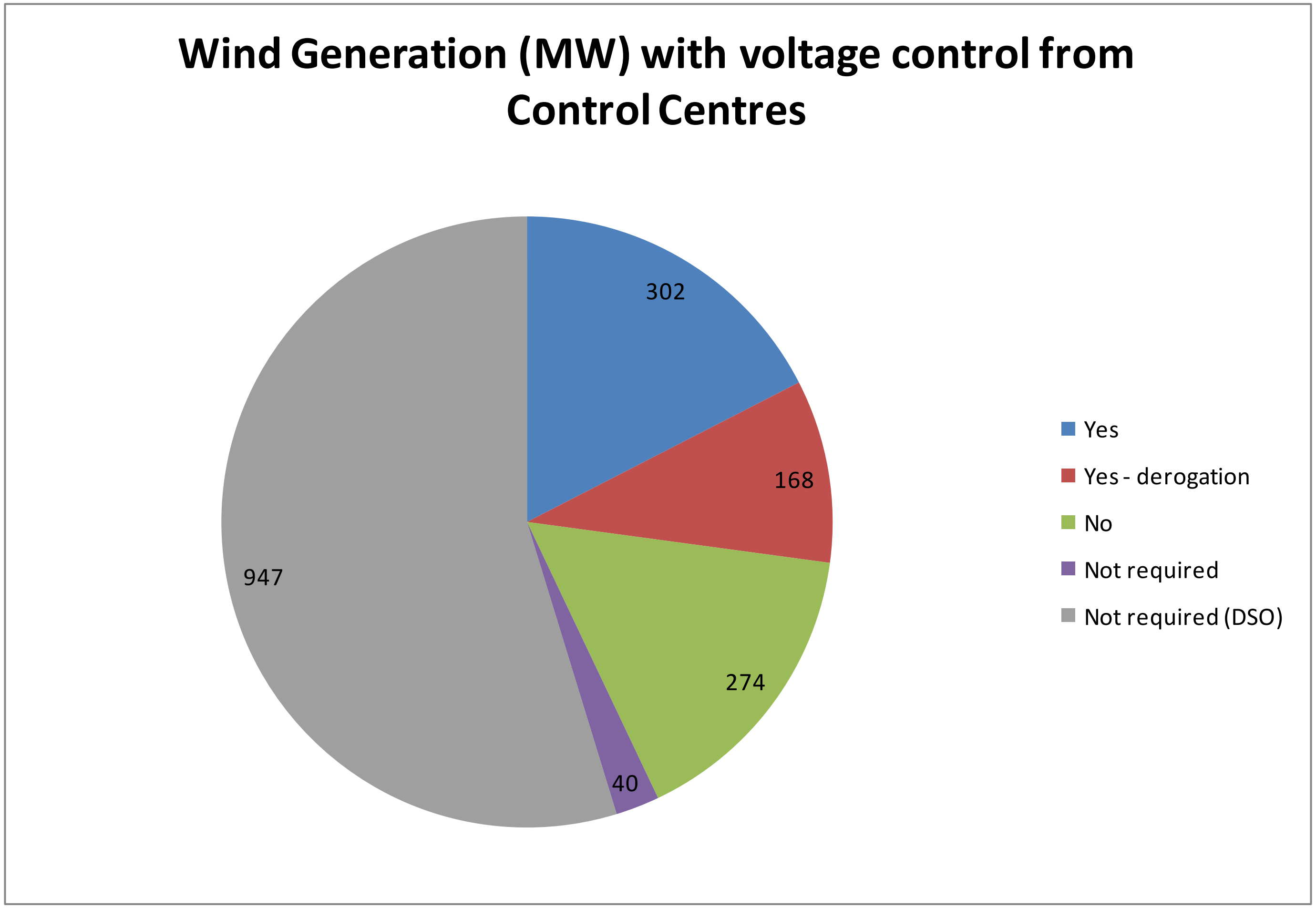
Reactive Power – Windfarm Control



Areas of analysis

Frequency Response

- Synchronous Inertia
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Ramping Services

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- Wind Variability & Forecasting

Key Findings

Portfolio shortfall for leading RP (30%)

Synchronous RP will reduce (25%)

Only ¼ of windfarms provide RP control

Dynamic RP is critical for stability

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Areas of analysis

Frequency Response

- Synchronous Inertia
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Areas of analysis

Frequency Response	• Synchronous Inertia • Operating Reserve
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Ramping Services	• Generator Ramping • Wind Variability & Forecasting

System Ramping Requirements

Variability
- Demand
- Wind
- Interconnector
- Disp Generation

Forecast Error
- Demand
- Wind
- Interconnector
- Disp Generation

Ramping Requirement

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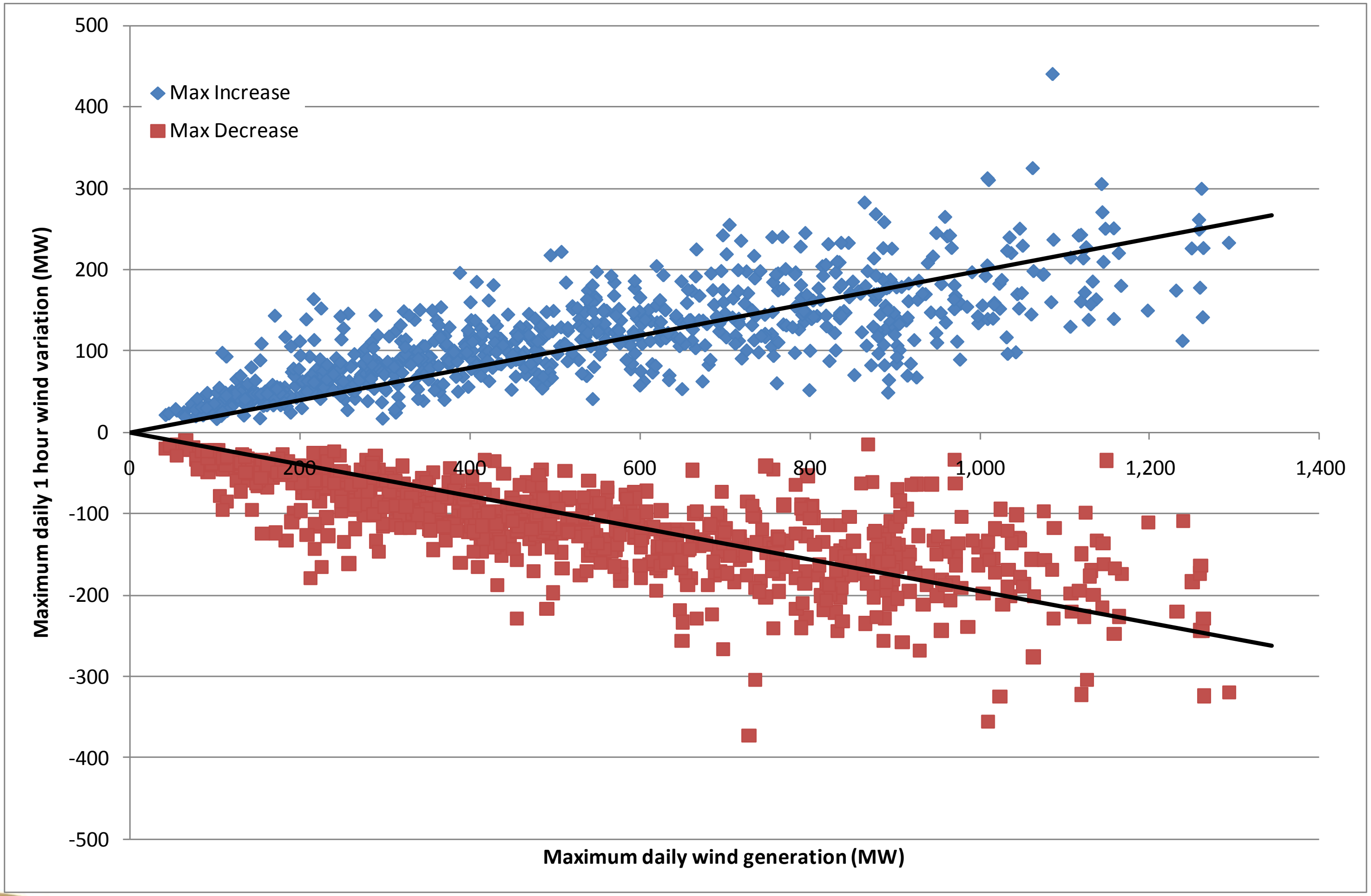
System Ramping Requirements

Ramping Duty + Forecast Error = Ramping Requirement

Illustration

Wind Variability (1 hour)



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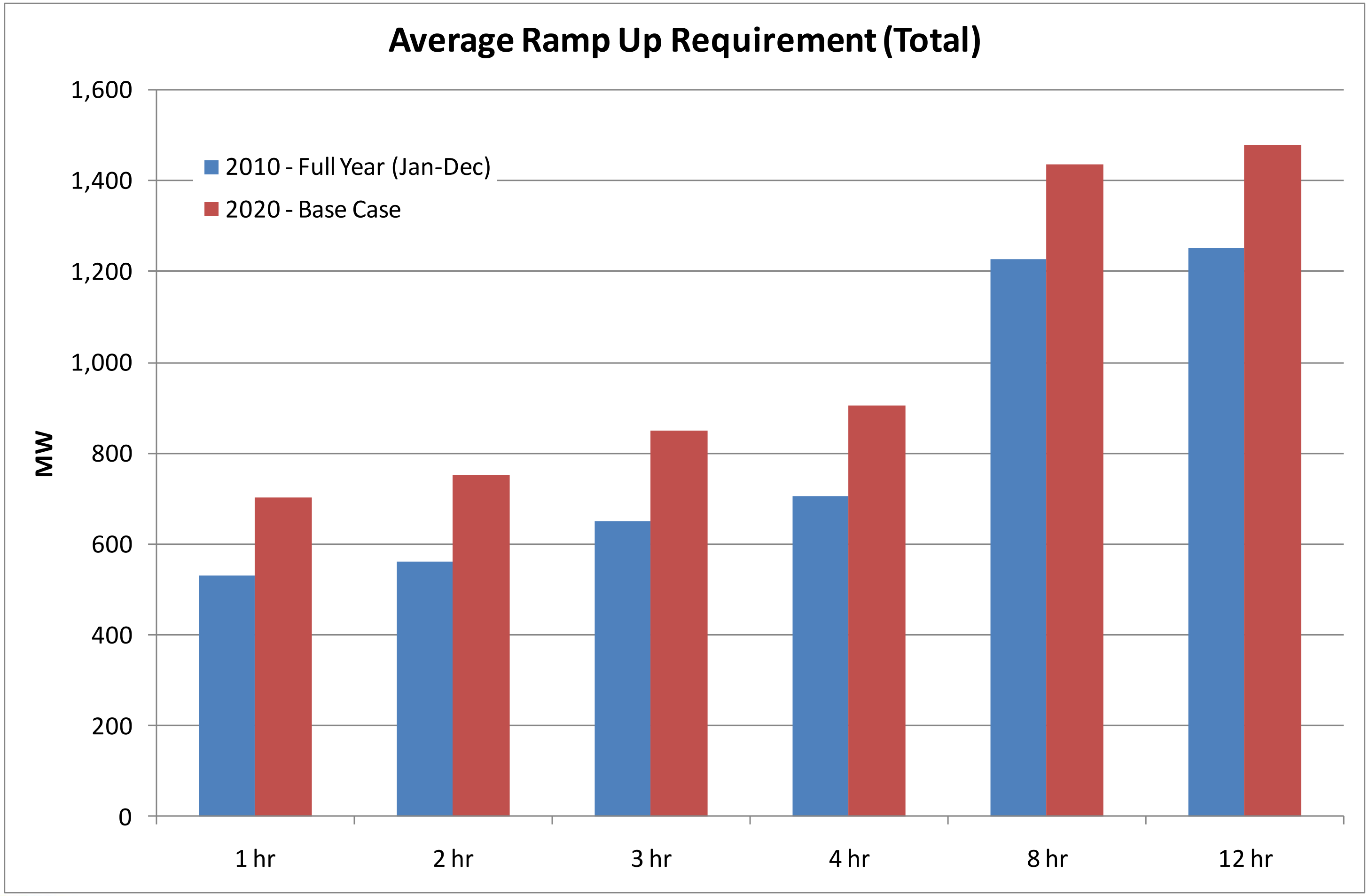
Ramping Requirement



Generator Ramping Availability

- Ramping deficit = requirement - availability
- 2010: system is dispatched to ensure requirement is met
  - Deficits arise following disturbances
- 2020: few instances of deficit
  - Due to assumed portfolio evolution (additional “flexible” generation)
  - Sensitivity studies illustrate potential issues

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Wind – Ramping Capability

- Wind generation can contribute to ramping requirement
  - Capable of being curtailed → can ramp down
  - When being curtailed → can ramp up **or** down
- Wind contribution to ramping requirement reduces requirement from conventional generation
  - Lower curtailment
- Reliable active power control is essential

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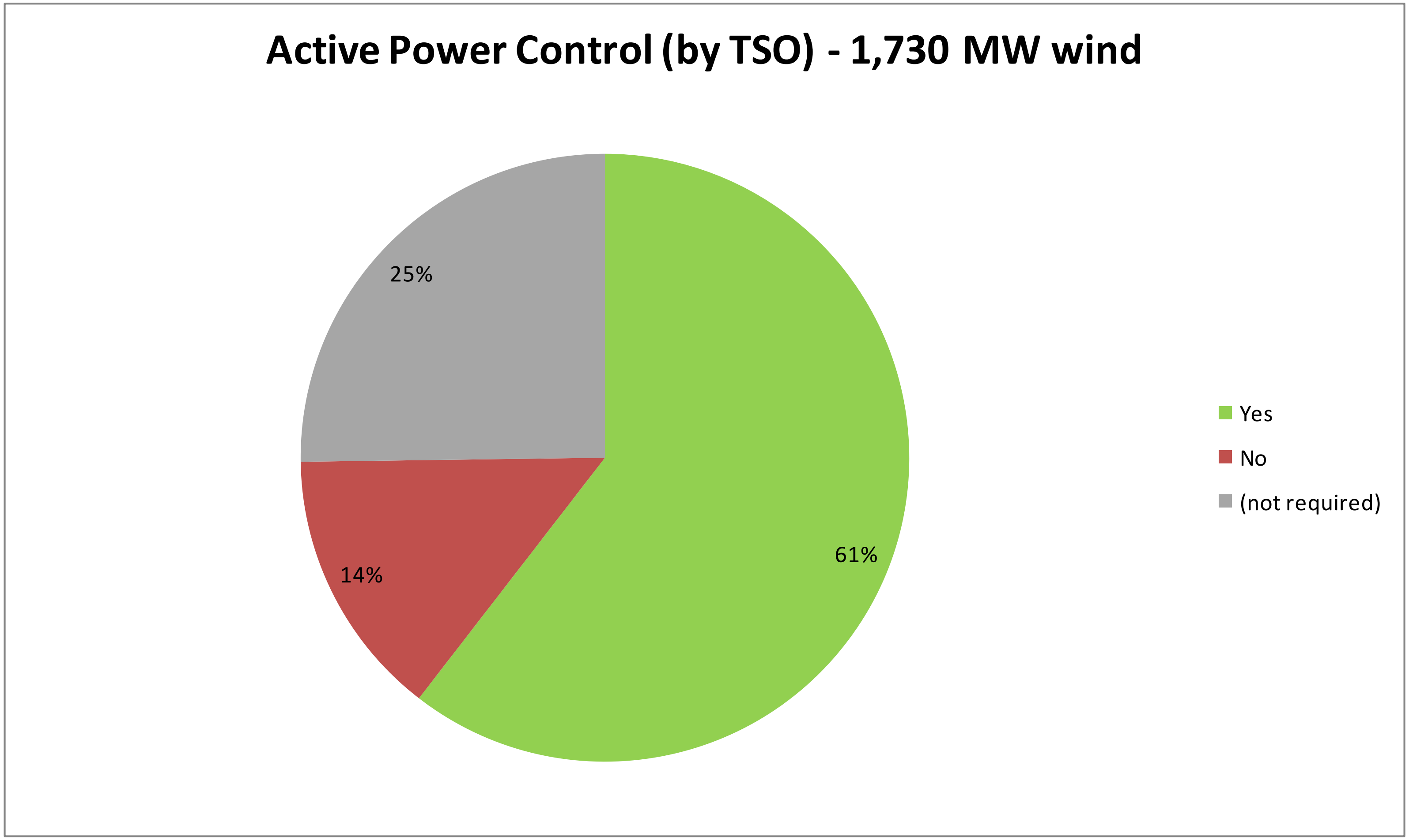
Wind – ramping capability



Areas of analysis

Frequency Response

- Synchronous Inertia
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Ramping Services

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Key Findings

Ramping requirement will increase with increasing wind

Both variability and uncertainty influence ramping requirement

Active Power Control of windfarms is essential

Areas of analysis

Frequency Response

- Synchronous Inertia
- Operating Reserve

Voltage Control

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Ramping Services

- Generator Ramping
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Electricity **S**ystem

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DS^3 – Delivering a Secure Sustainable System

System Issues

Frequency Response
- Reduced Synchronous Inertia
- Poor Generator Reserve Performance
- RoCoF Protection Relays

Voltage Control
- Portfolio Reactive Power Capability
- Wind farm Controllability
- Type of Reactive Power Capability

Ramping Services
- Windfarm active power control
- Need for Ramping Capability
- Forecast and Variability of portfolio output

Key Action Areas

- **System Performance**
- **System Policies**
- **System Tools**

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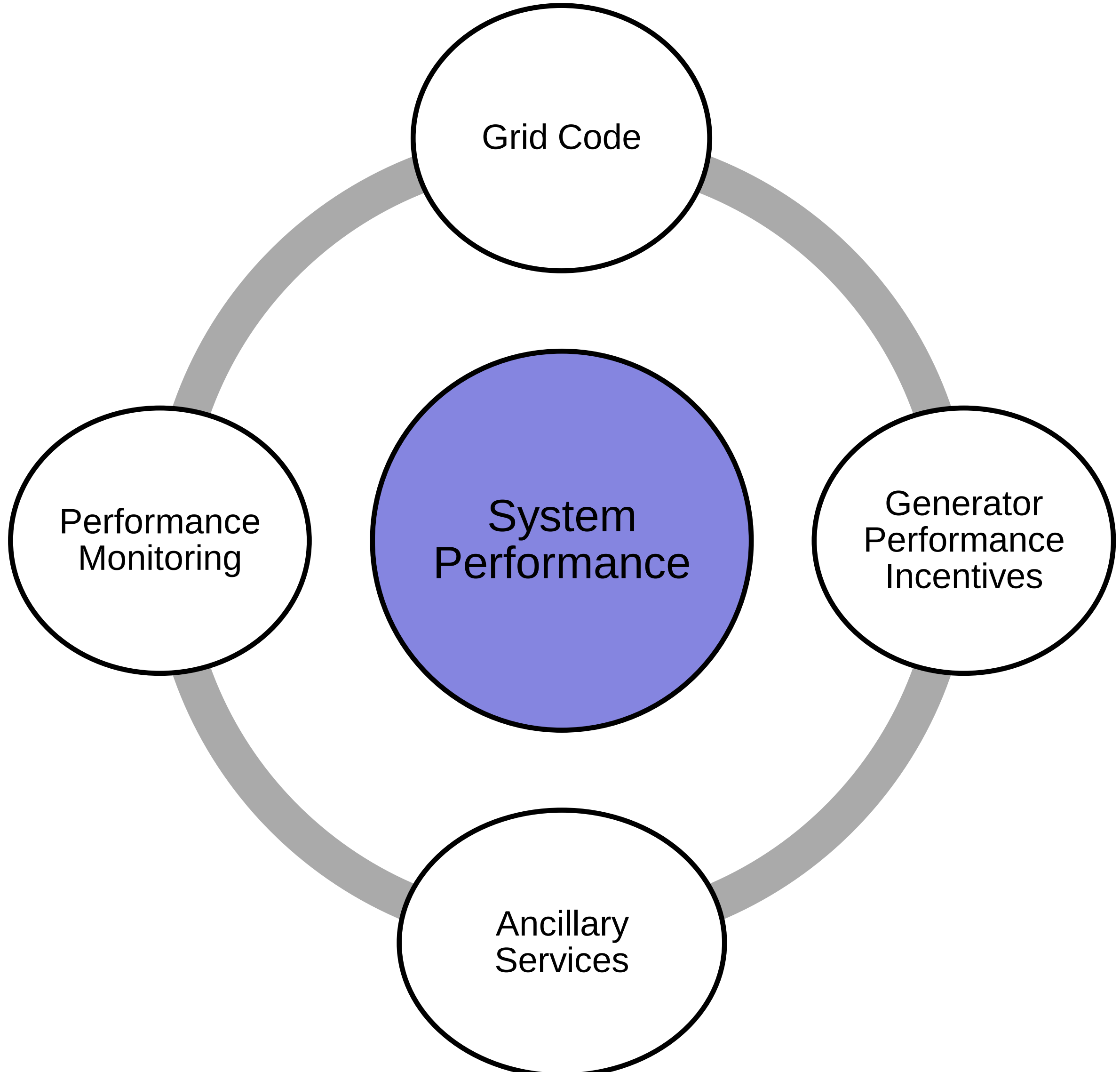
Knowledge of System Performance

Enforcement of performance standards

Incentivise greater performance capability

Management of complexity, uncertainty



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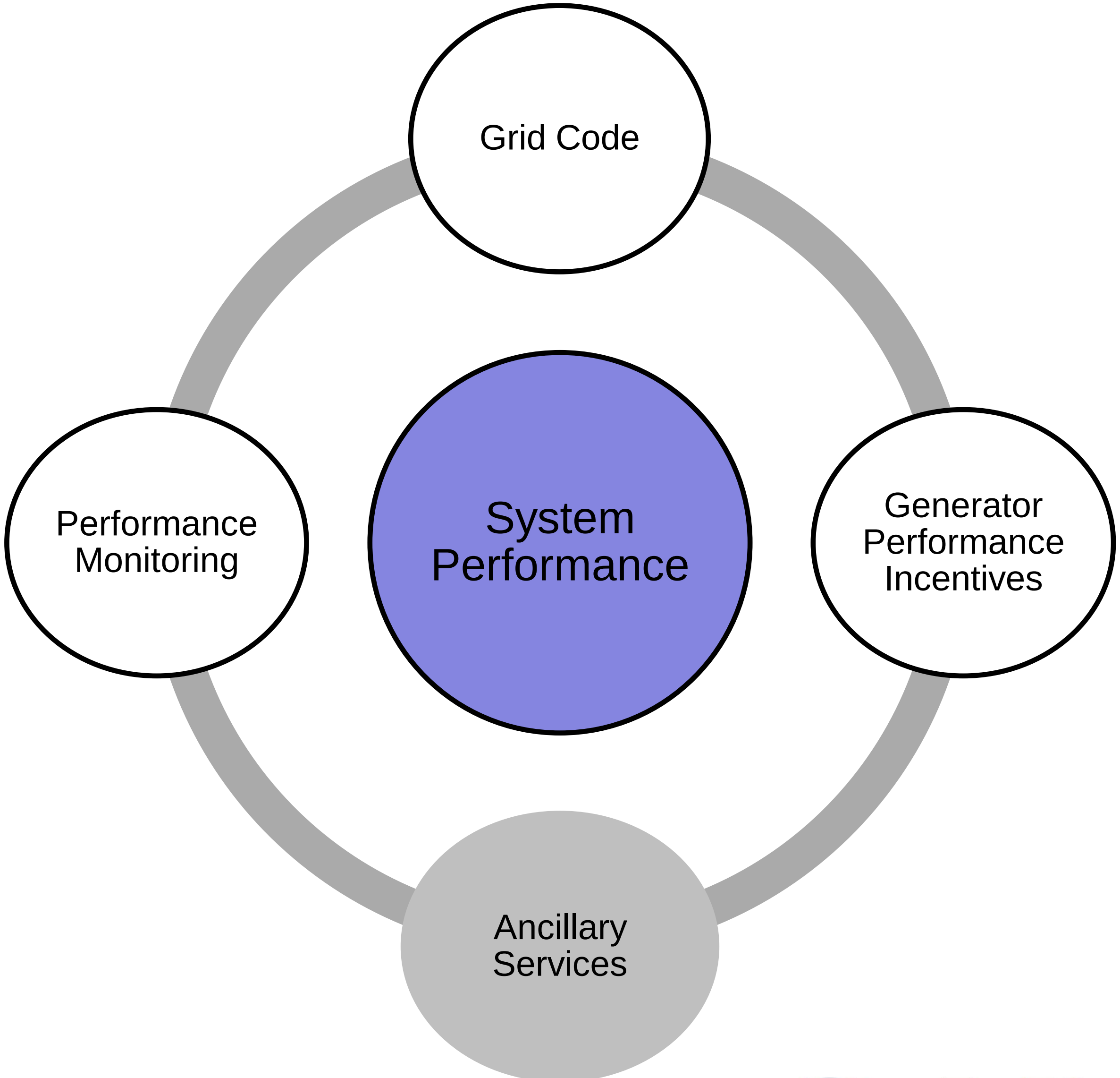

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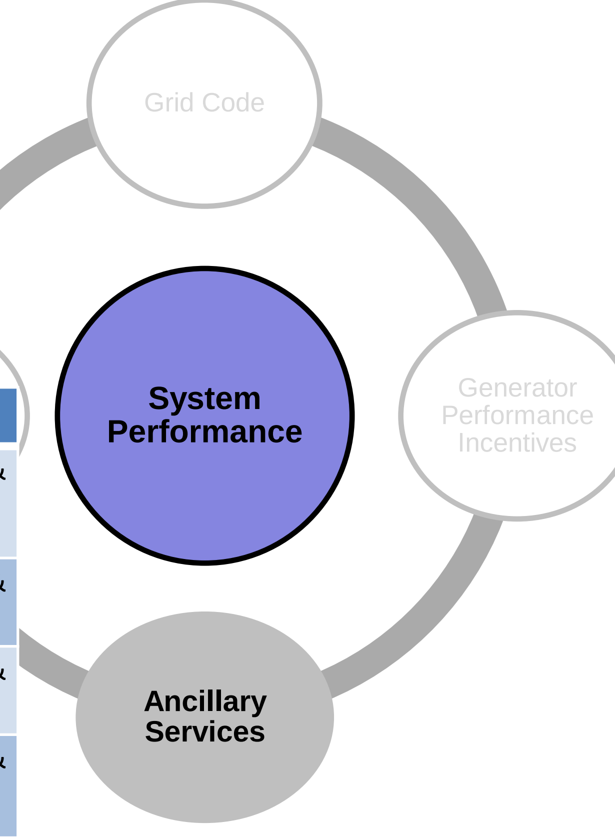

Programme	Key Actions	Timeline	Actor(s)
Commercial Design	Consultation paper on Ancillary Services	2011	EirGrid & SONI
	Financial valuation of system services	2011/12	EirGrid & SONI
	Commercial Mechanisms	2011/12	EirGrid & SONI
	All island consultation on proposed ancillary services payment structures	2012	EirGrid & SONI
	Decision on future ancillary services funding	2012	Regulatory Authorities
	Decision on ancillary services implementation methods	2012	EirGrid & SONI / Regulatory Authorities
	Implementation of new ancillary services arrangements	2013	EirGrid & SONI

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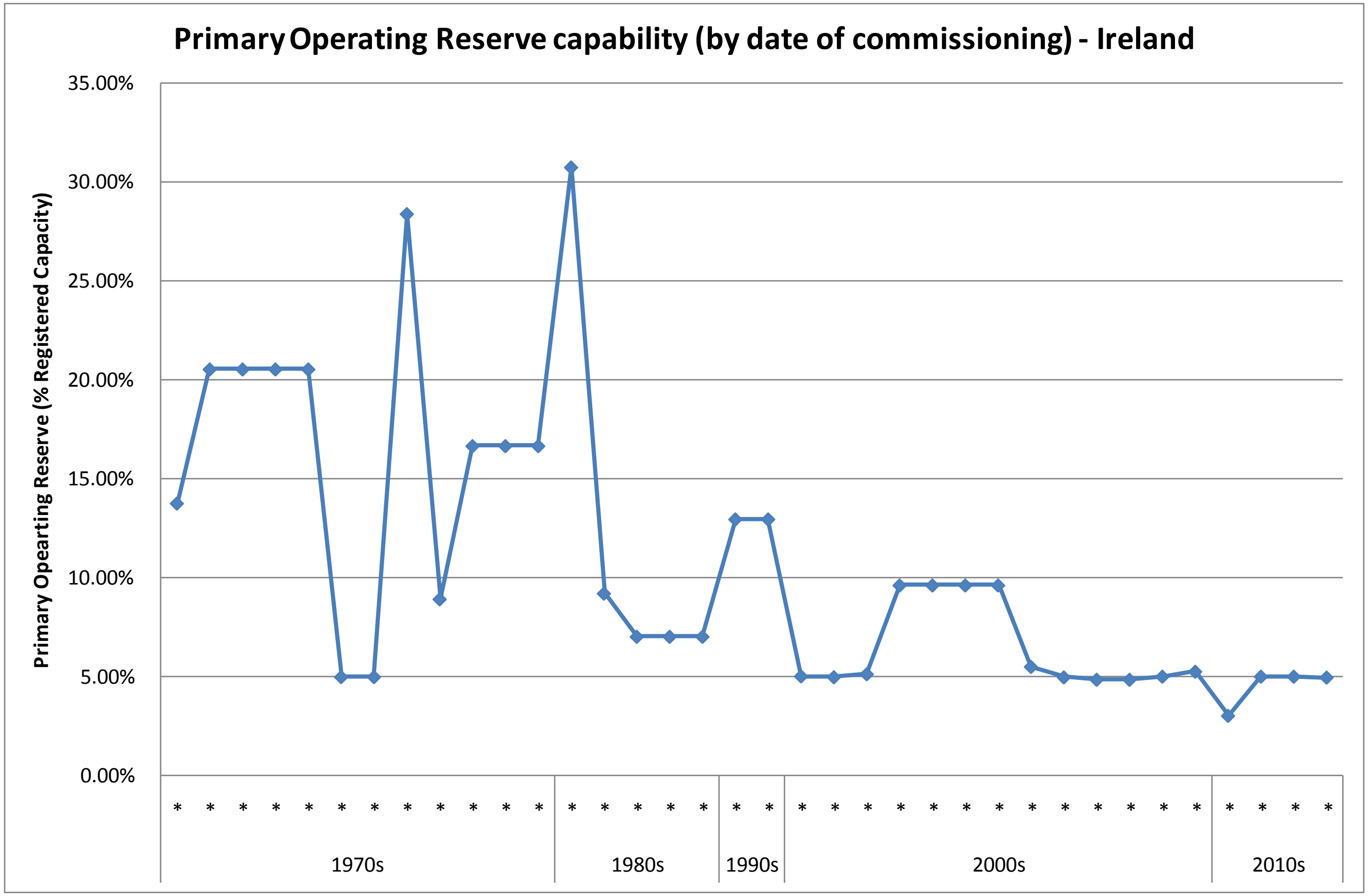
Reserve Capability of Generators (Ireland only)



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Generator Performance Incentives

- Improvements observed since the introduction of GPIs
  - Particularly in Ireland (see table)

Characteristic	*Improvement (as of Dec 2010)*
Reactive Power (Leading)	100 Mvar
Reactive Power (Lagging)	100 Mvar
Primary Operating Reserve	25 MW
Secondary Operating Reserve	40 MW
Minimum load for reserve provision	50 MW

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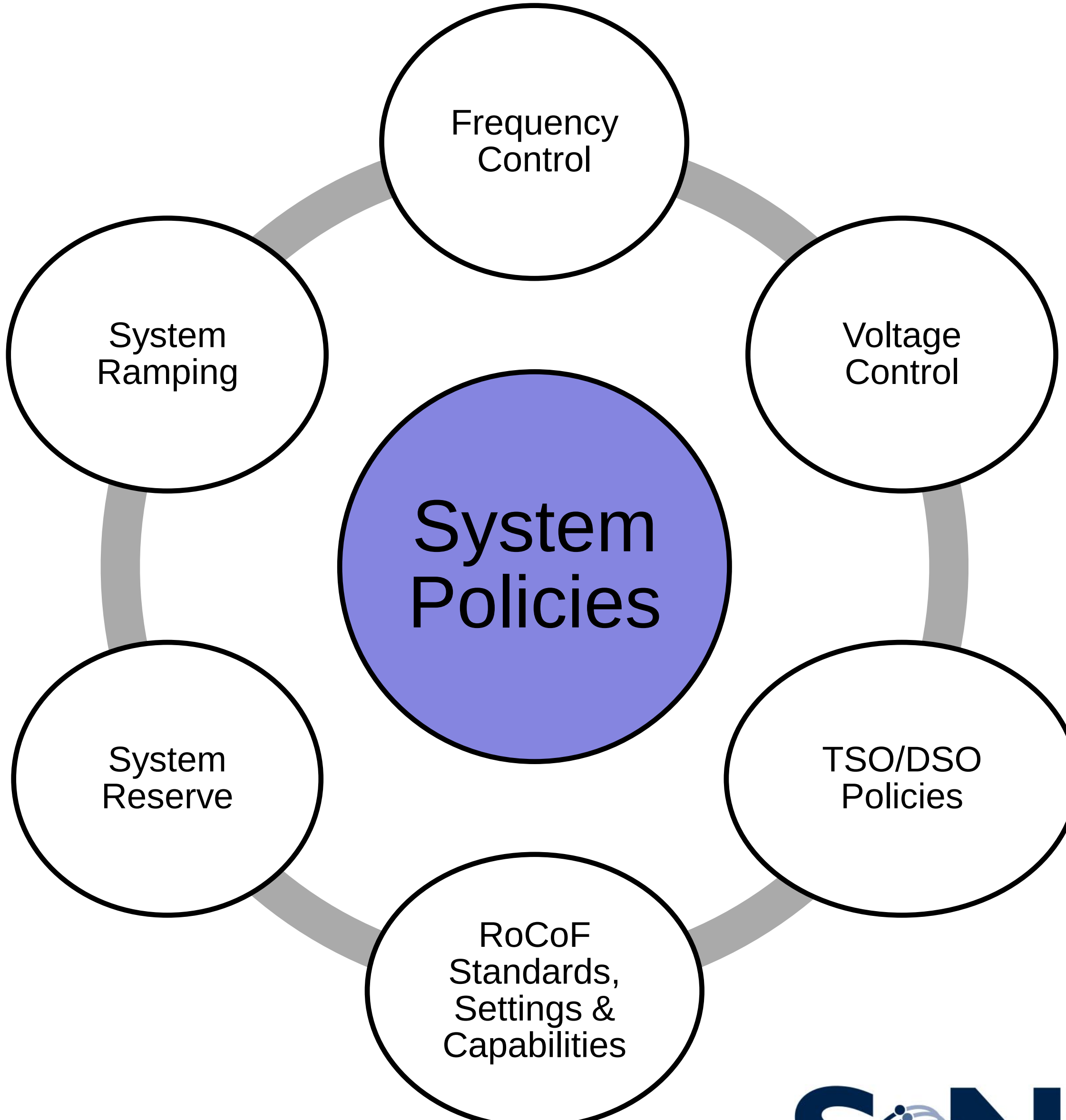
Less Synchronous Inertia

Reserve Performance

RoCoF protection relays

Less dynamic reactive support



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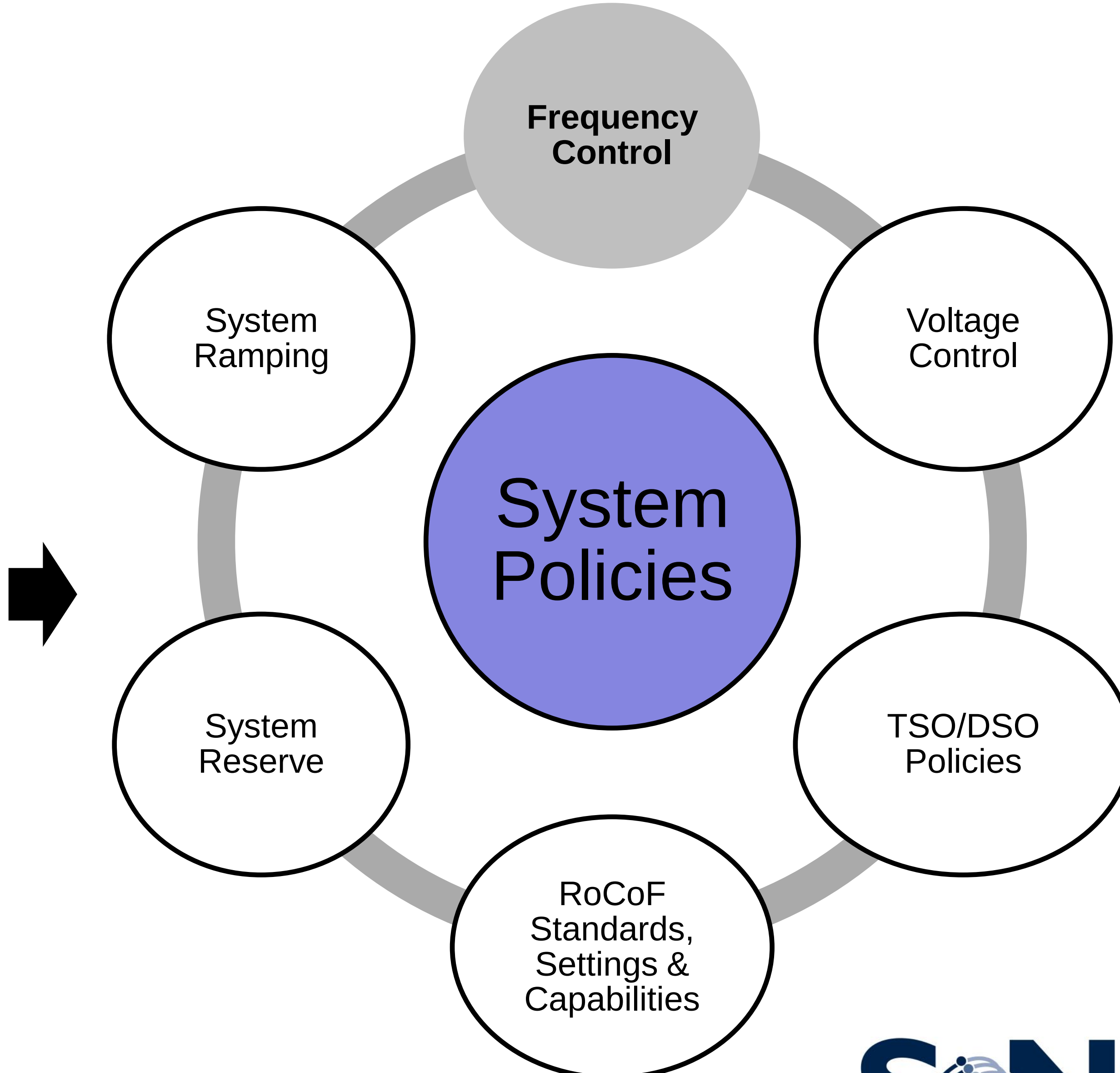
Delivering a Secure Sustainable Electricity System

- Less Synchronous Inertia
- Reserve Performance
- RoCoF protection relays
- Less dynamic reactive support



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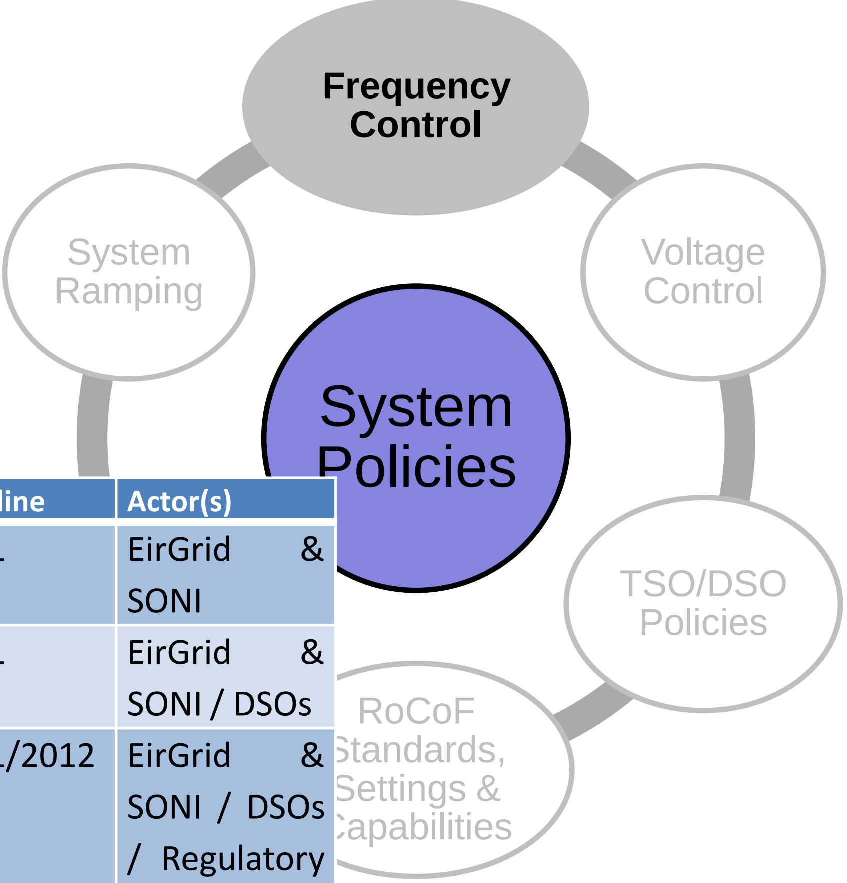

Programme	Key Actions	Timeline	Actor(s)
Frequency Control	Review of RoCoF protection settings and capability	2011	EirGrid & SONI
	Engagement with the DSO on RoCoF protection settings	2011	EirGrid & SONI / DSOs
	Agree new settings for RoCoF relays/Agree to disable RoCoF relays	2011/2012	EirGrid & SONI / DSOs / Regulatory Authorities
	Implementation of changes to RoCoF settings	2012	Industry
	Review system reserve policy for Control Centres in the context of high levels of variable renewable generation	2012	EirGrid & SONI
	Investigate the system ramping requirements (long term reserve) and associated policy	2012	EirGrid & SONI

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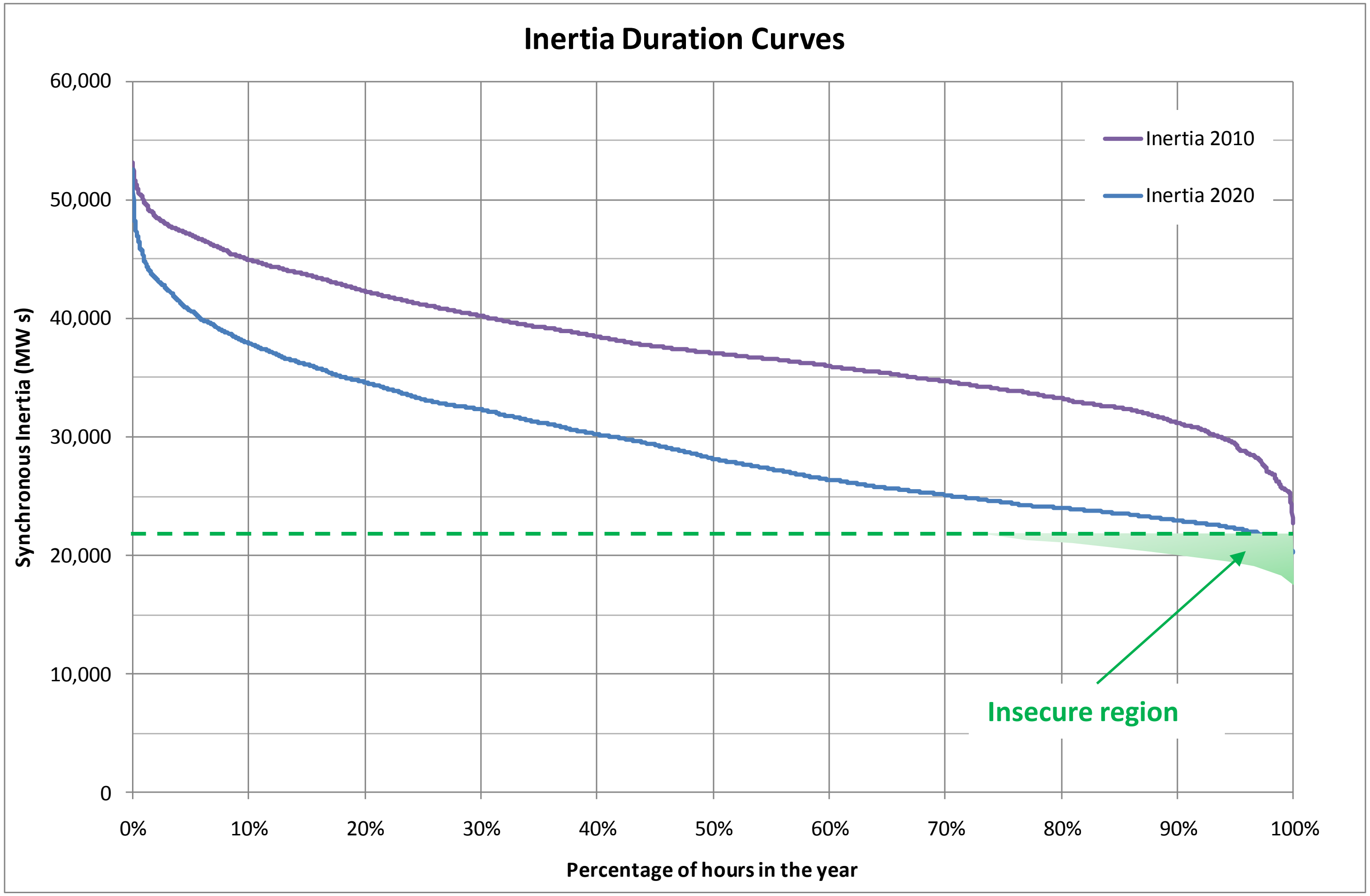
Frequency Response: Inertia



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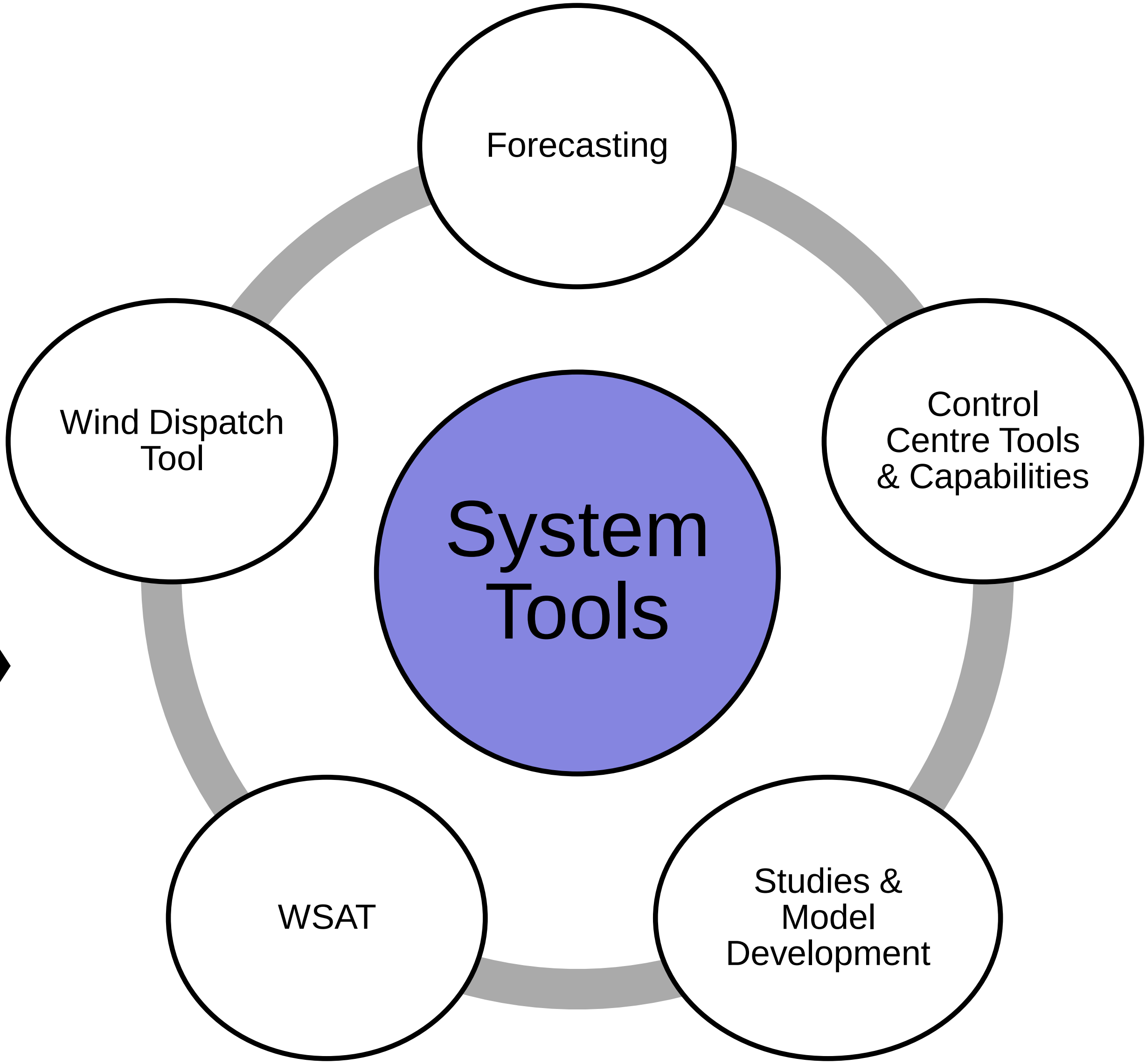
Greater Embedded Generation

Change in Generation Portfolio

Controllability

Model Refinement



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Delivering a Secure Sustainable Electricity System – DS³ Programme

System Performance

- **Performance Monitoring**
- **Grid Code Standards**
- **Commercial Incentives**

System Policies

- **System Security**
- **Voltage Control**
- **RoCoF relays**

System Tools

- **Wind Dispatch**
- **Control Centre Capabilities/Controllability**
- **Studies / model development**

Communications

- **Industry Forums**
- **RAs/DSOs Engagement**
- **Advisory Council**

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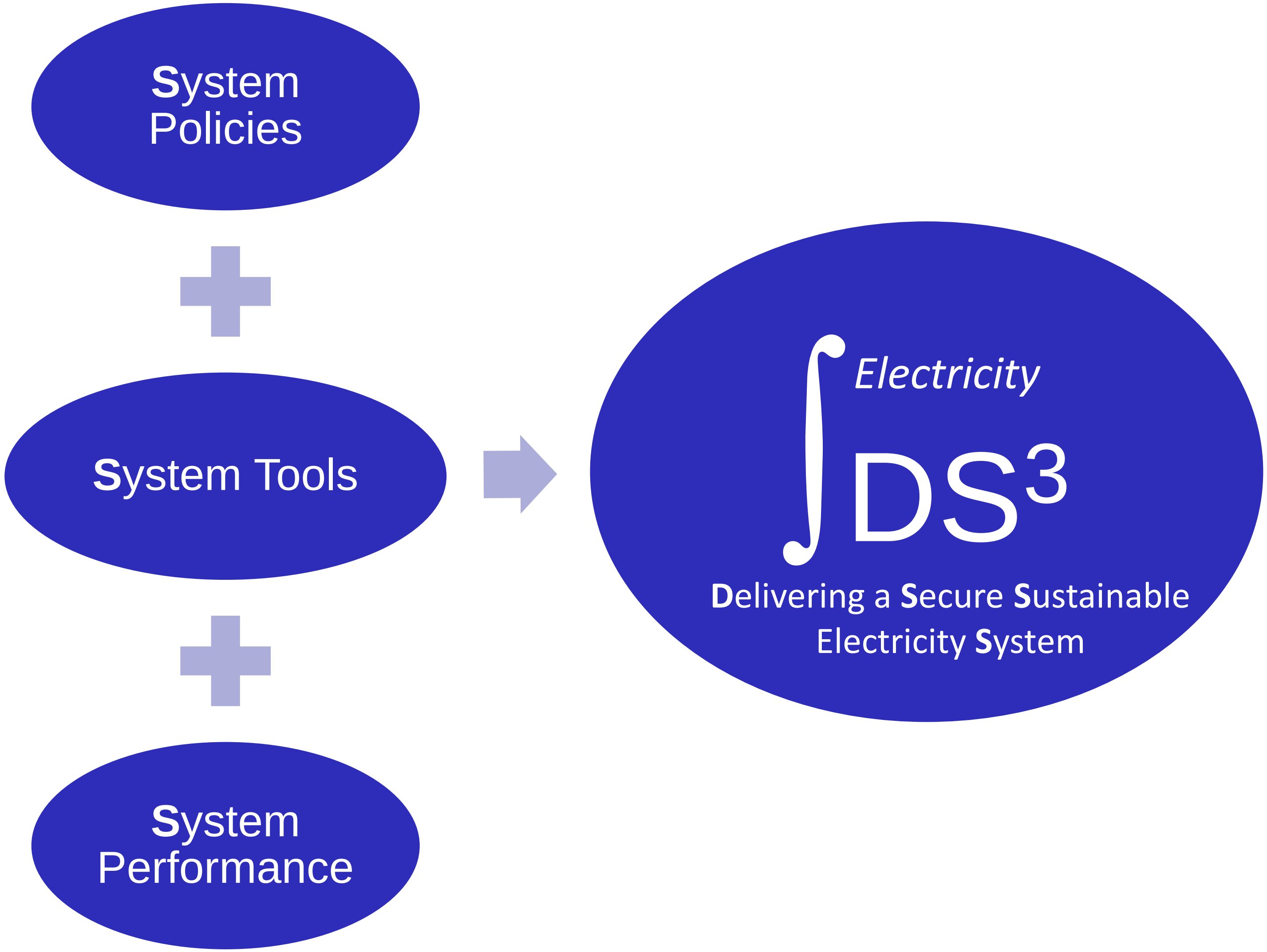
Advisory Council

- A forum to facilitate wide stakeholder input across the electricity sector in Ireland and Northern Ireland
- Independent panel of experts that help to guide the DS^3 programme
- Members of the group participate as individuals and not as representatives of organisations
- Deadline for expressions of interest: 31 August 2011
- Kick off meeting: October 2011



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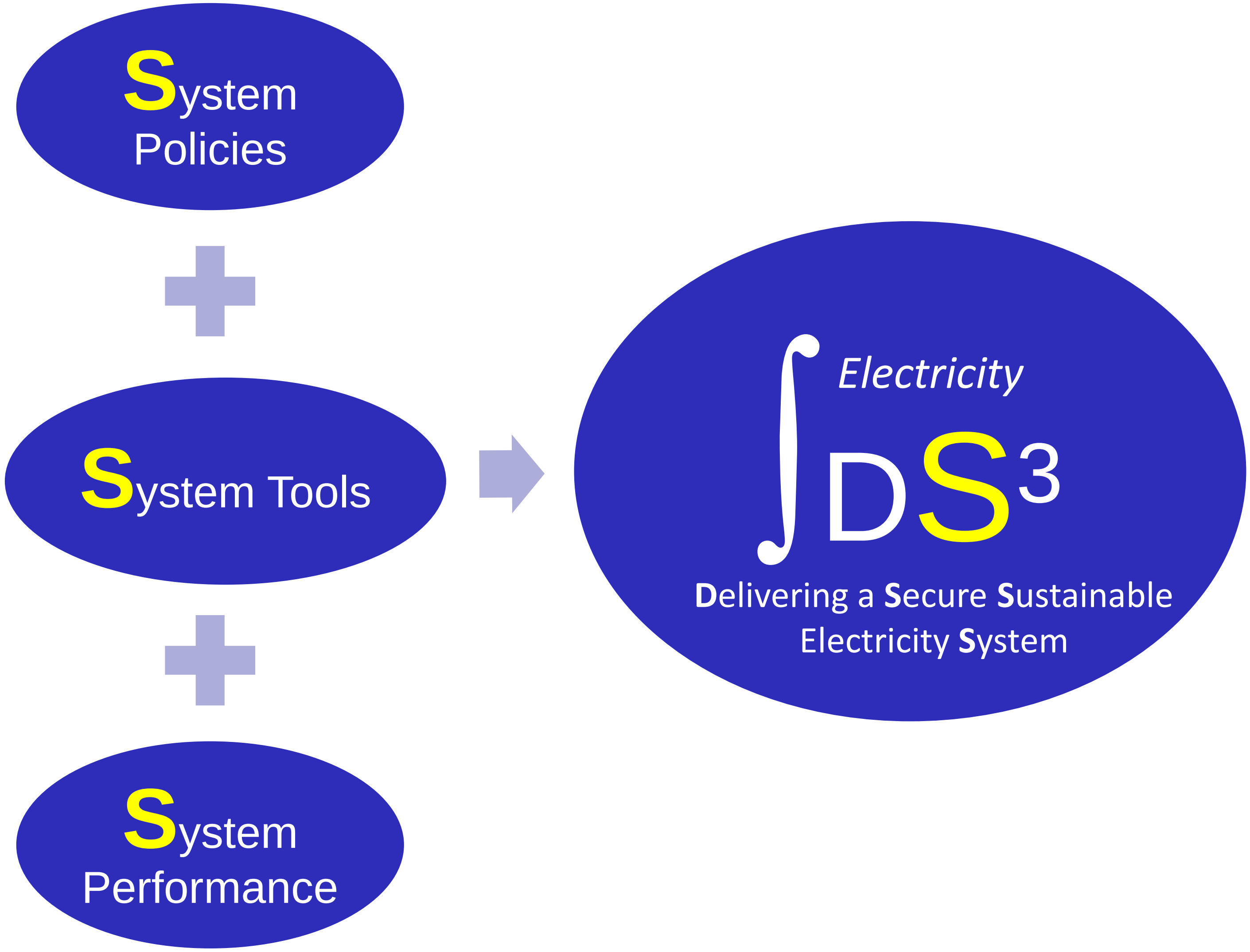

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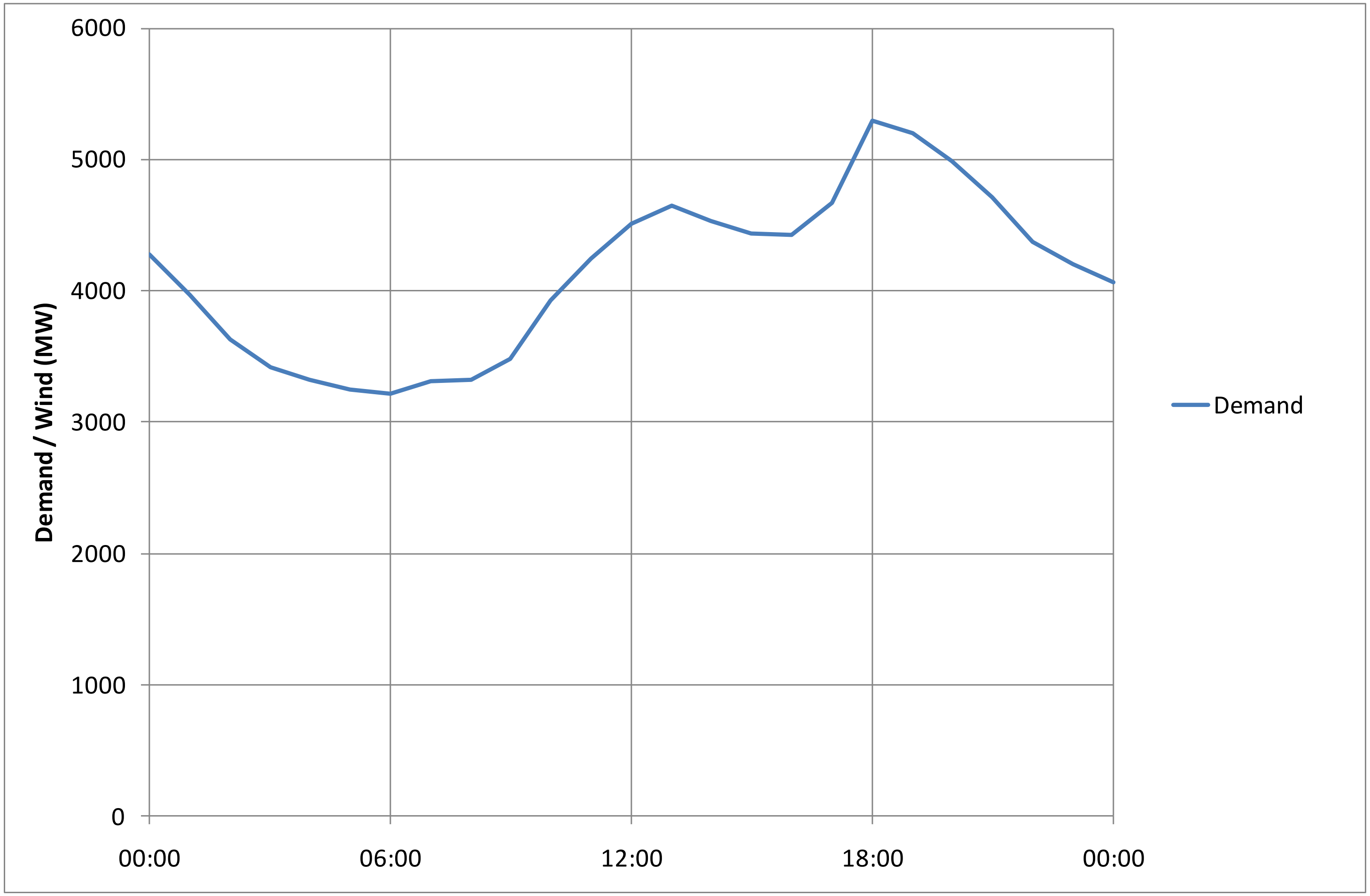
END

Ramping illustration

System Ramping: drivers



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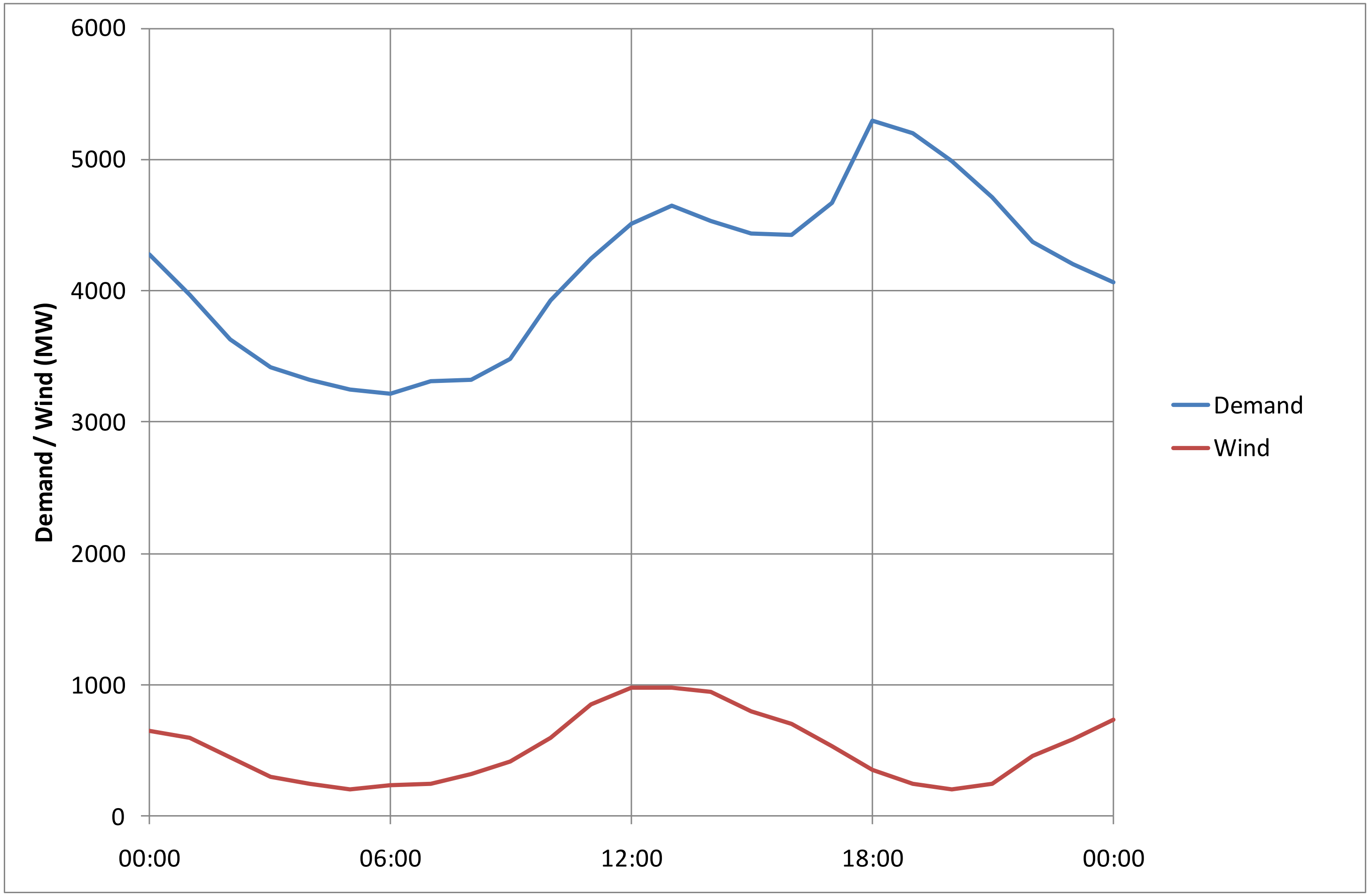
System Ramping: drivers



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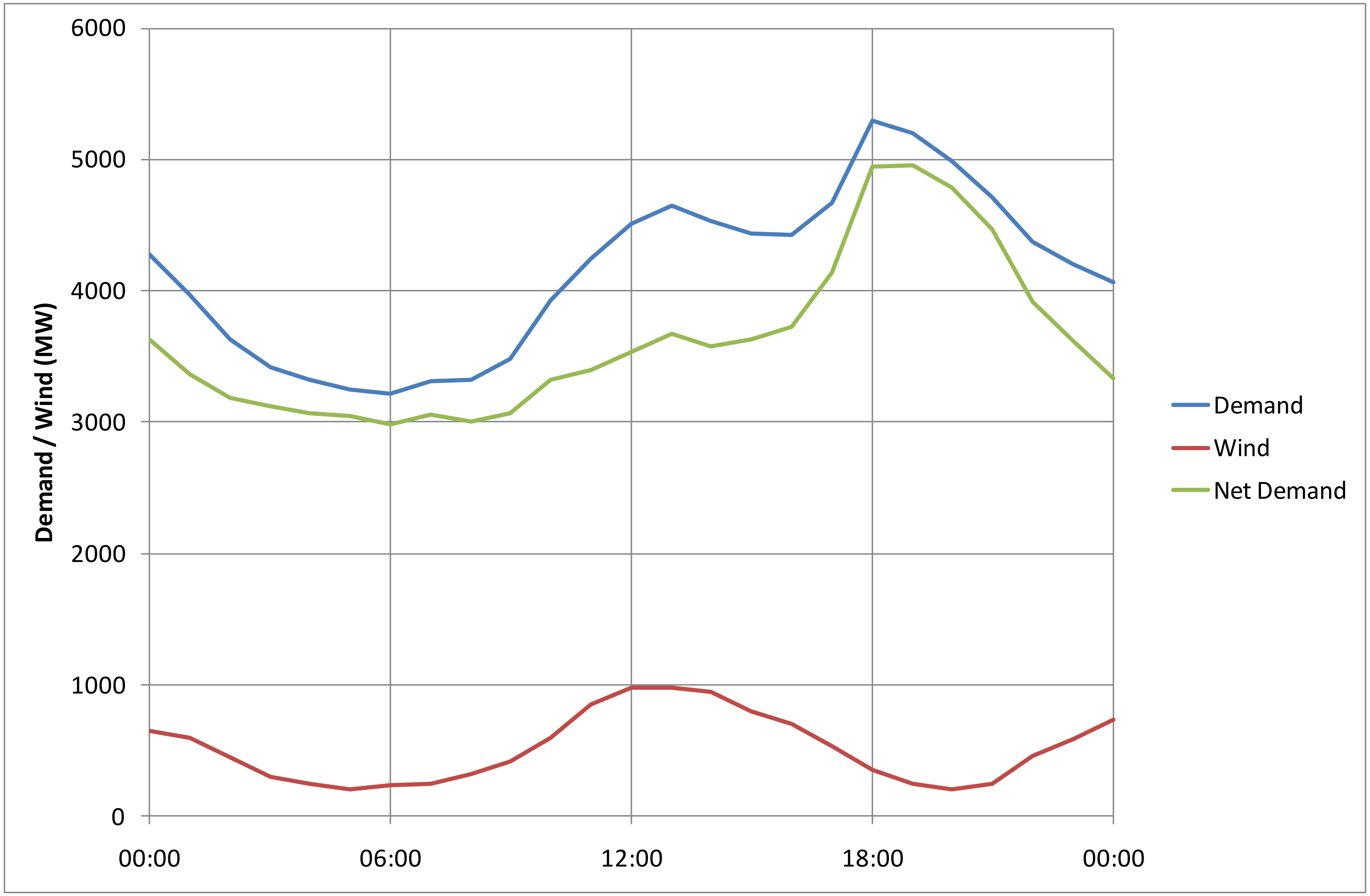
System Ramping: drivers



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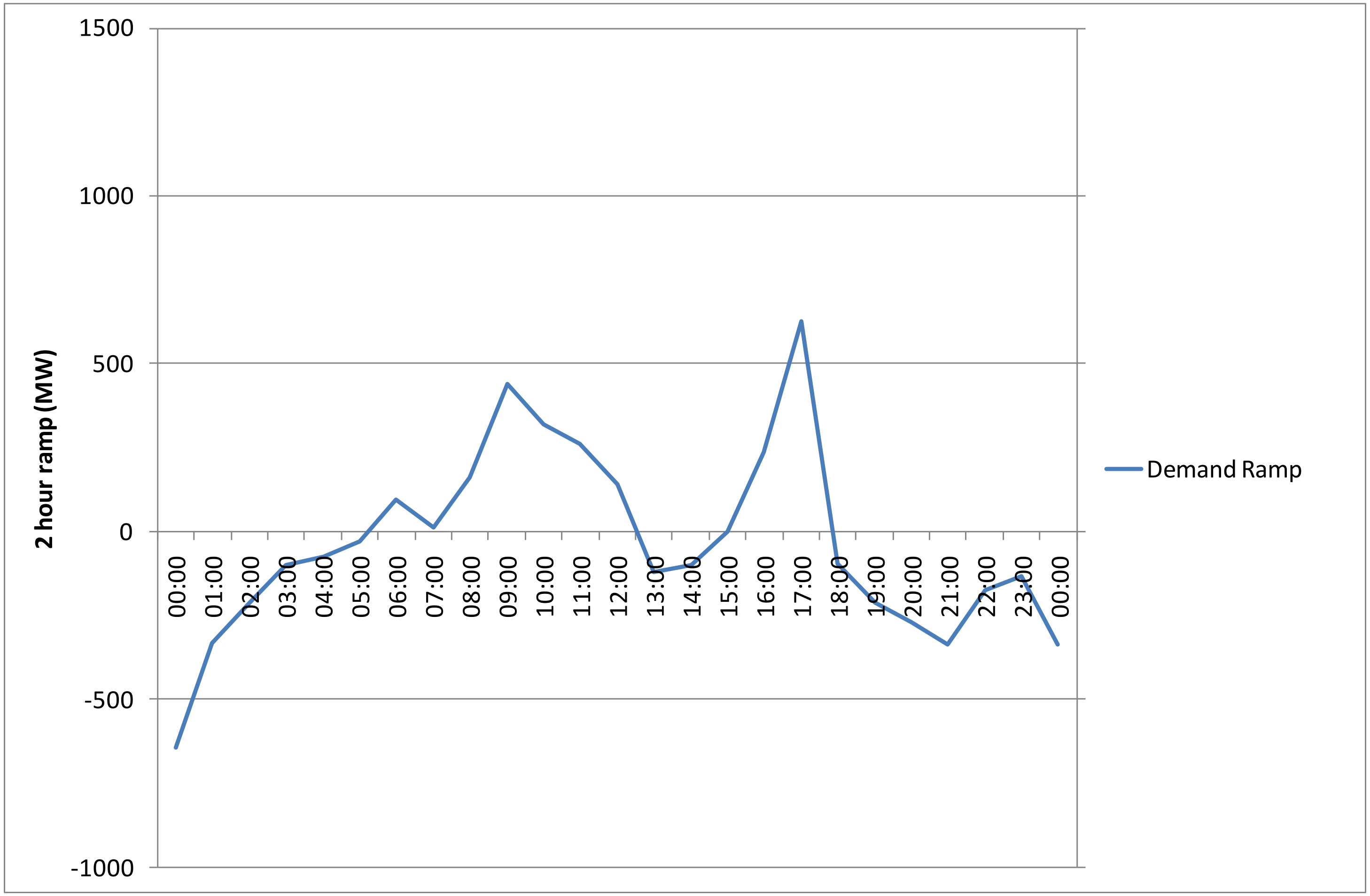
Ramping Duty



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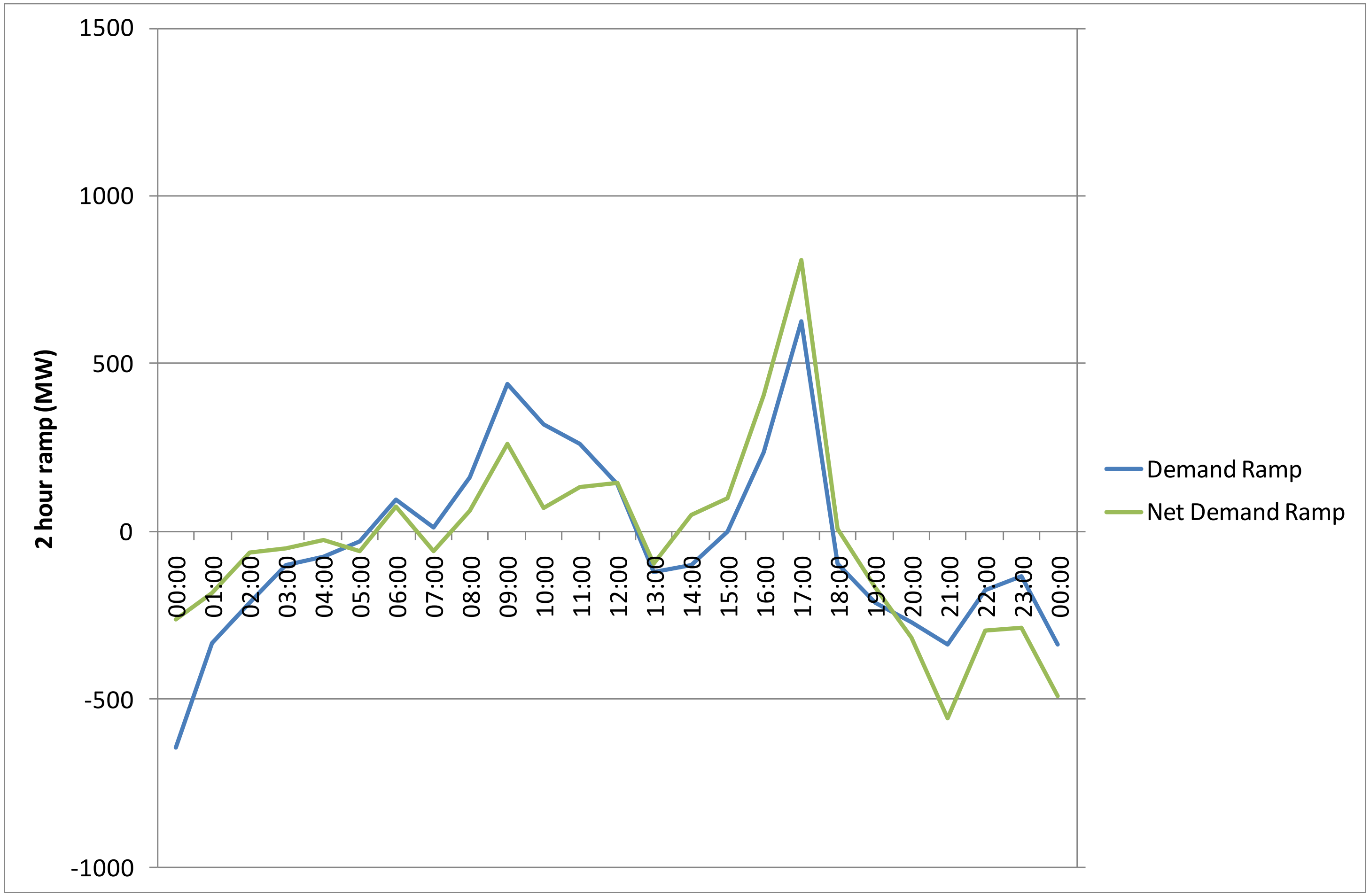

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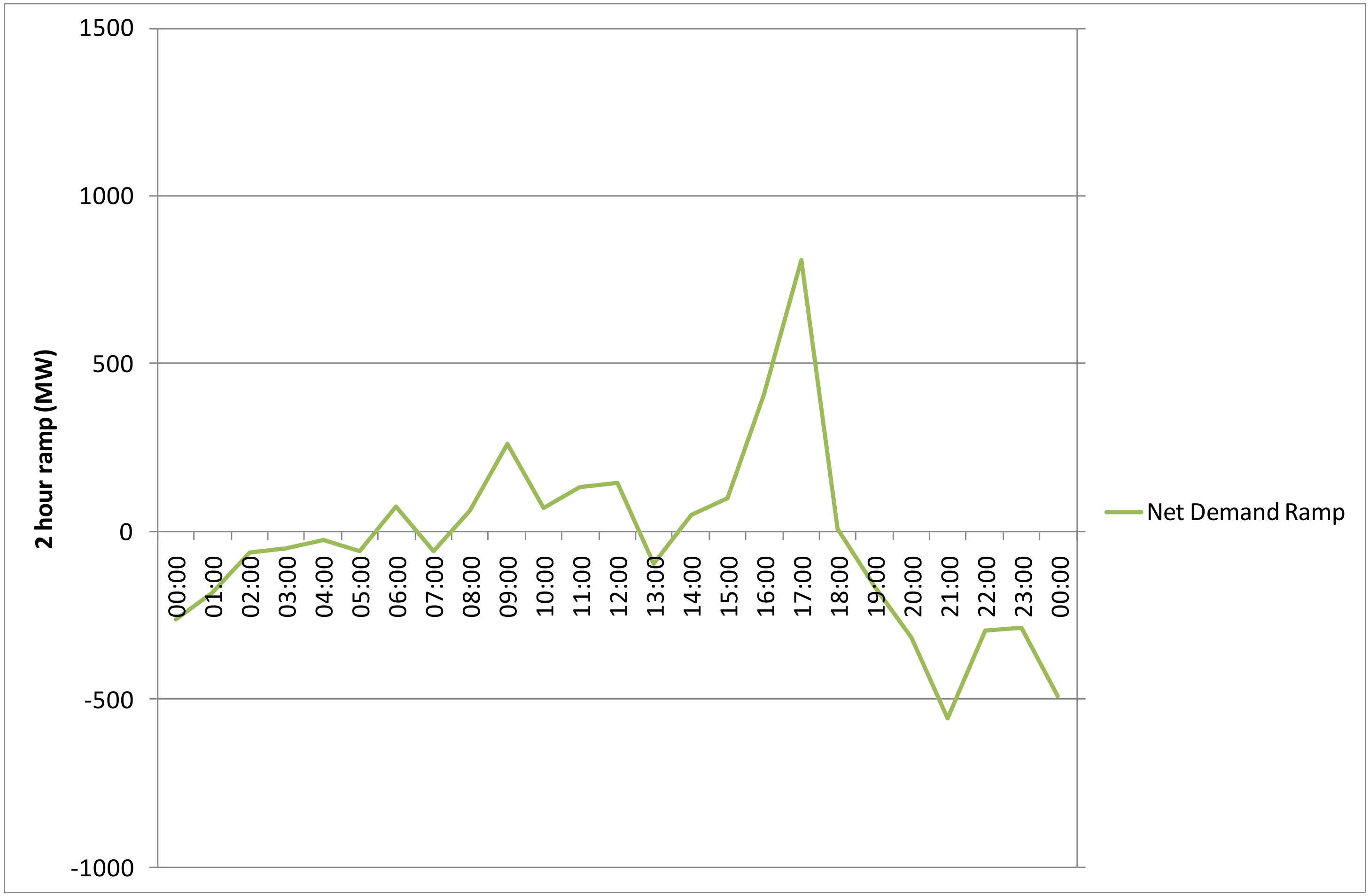
Ramping Duty



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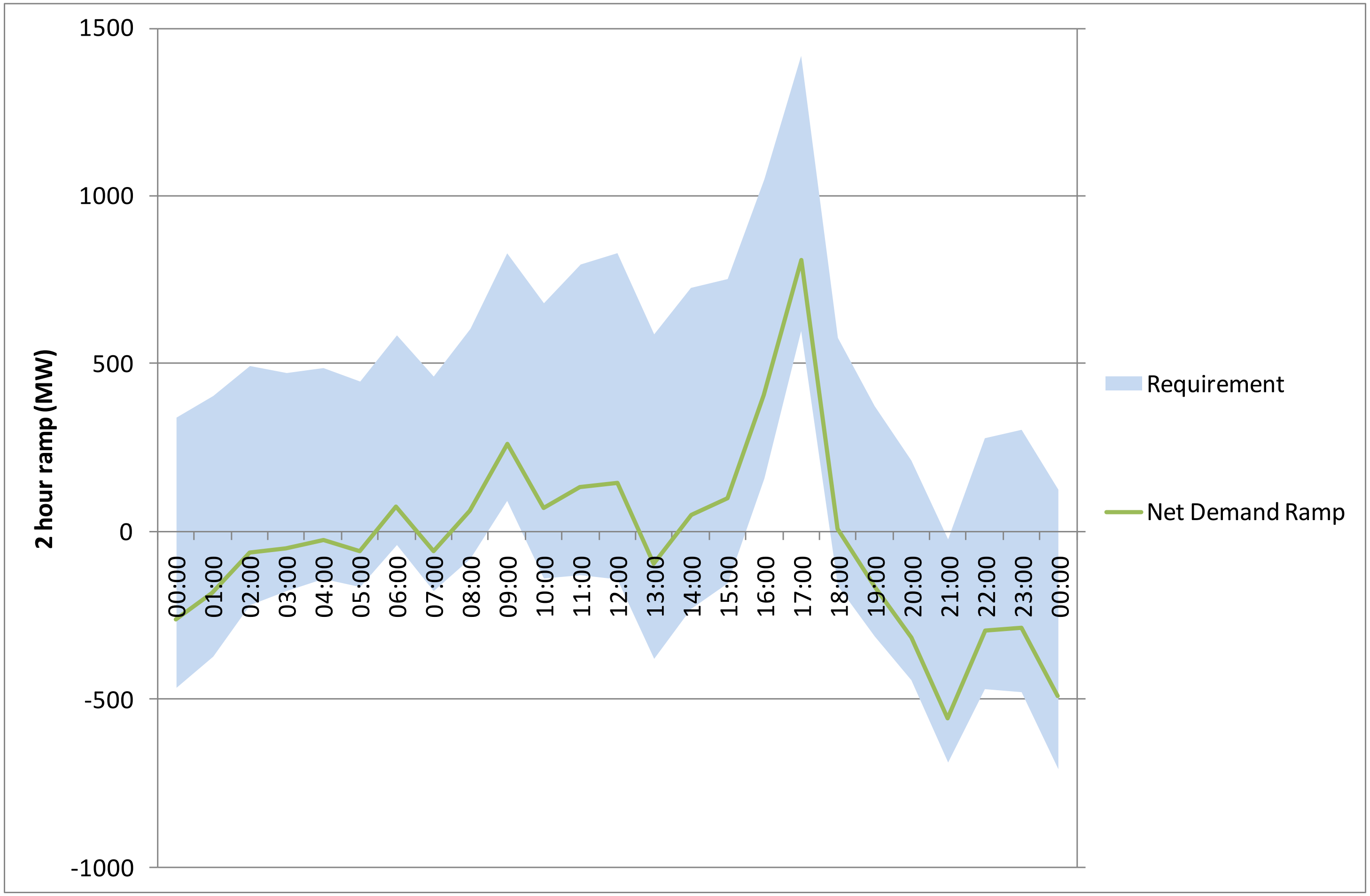
Ramping Requirement = Duty + Errors



EirGrid

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