TSO Recommendation System Services

26th June 2013

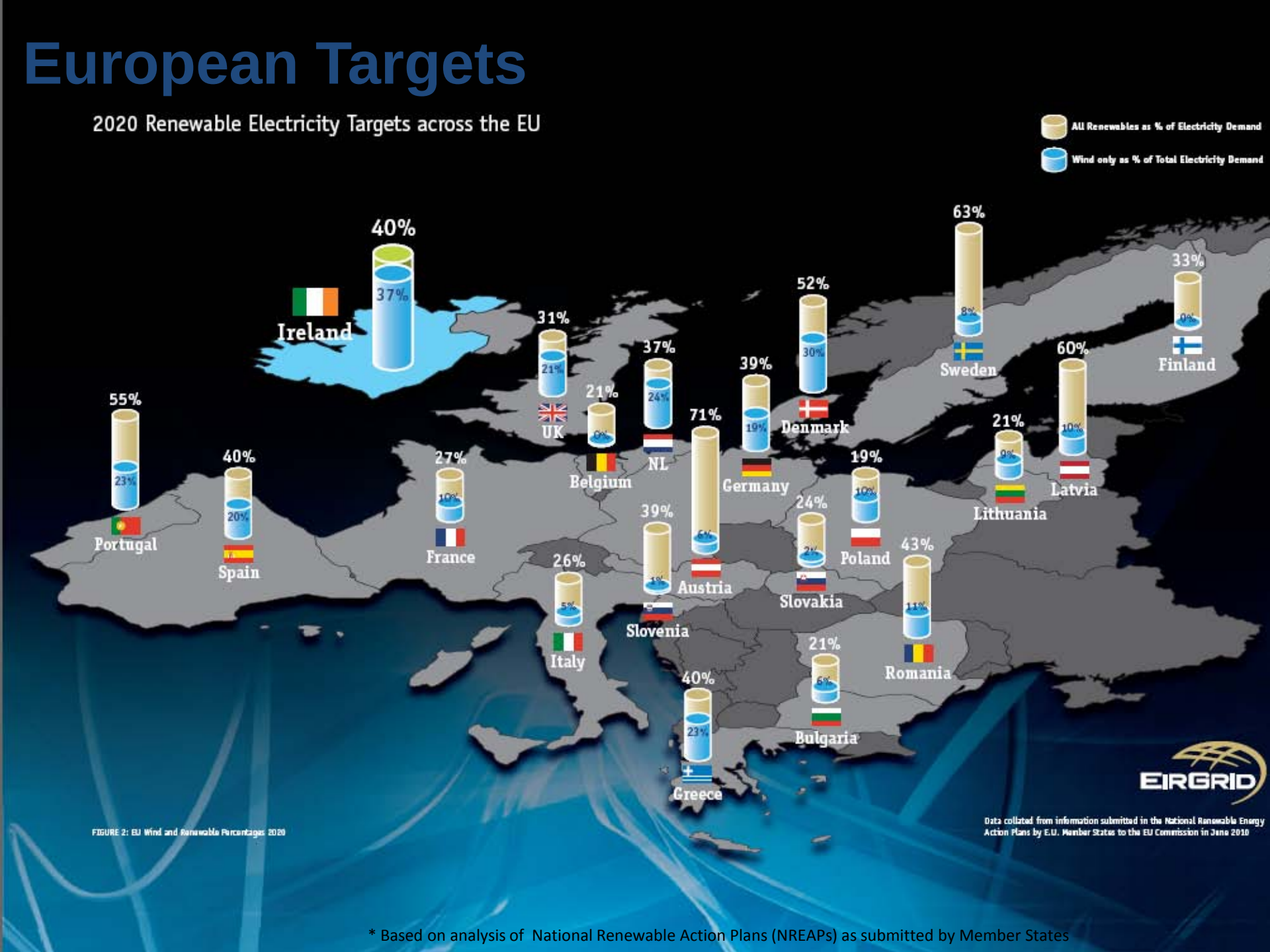
Agenda

1. Context and background
2. Consultation Process
3. Main consultation elements
4. Key Responses to Third Consultation
5. Recommendations
6. Economic Modelling
7. Recap of Proposed Products

System Services and DS3 Context

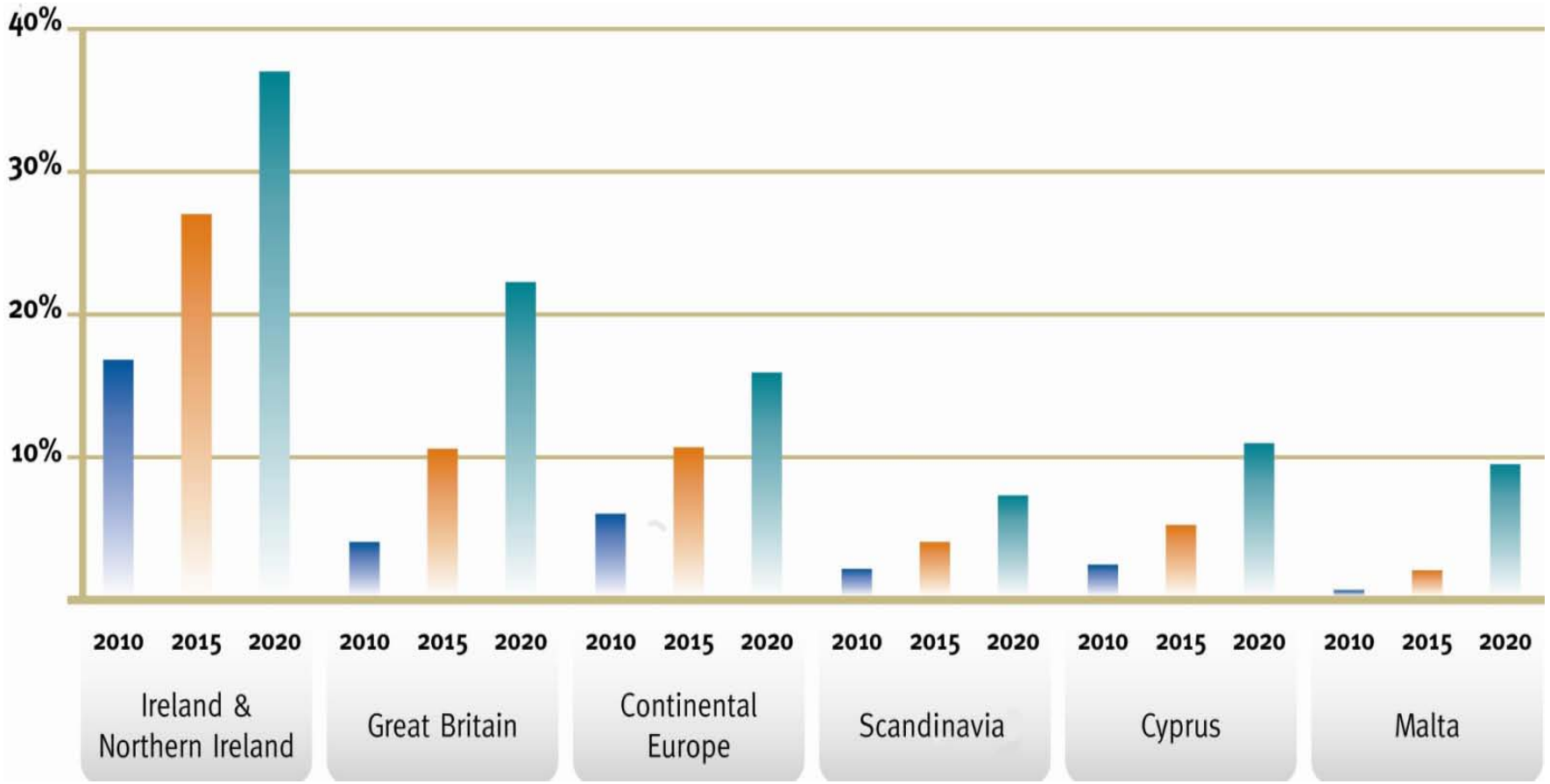
Mark Gormley

European Targets



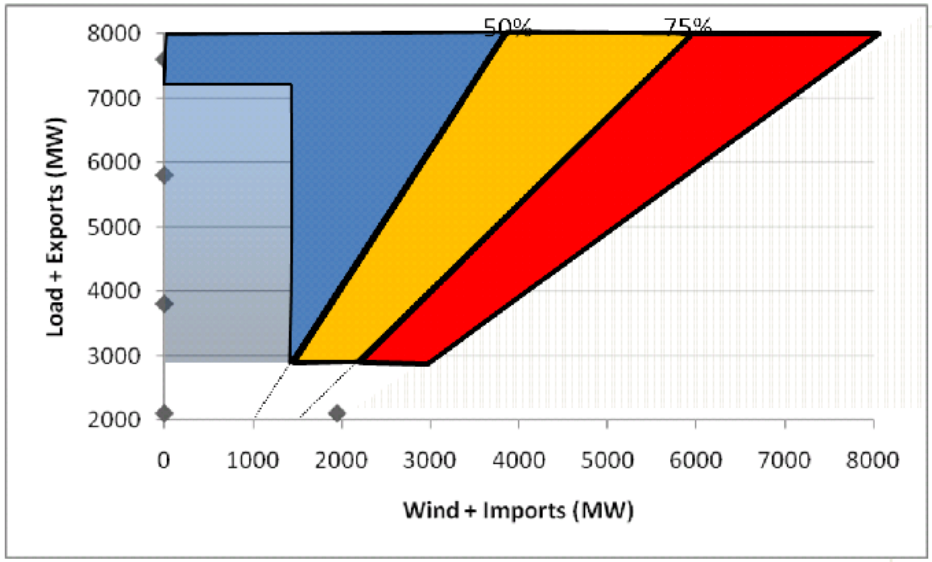
* Based on analysis of National Renewable Action Plans (NREAPs) as submitted by Member States

European Targets

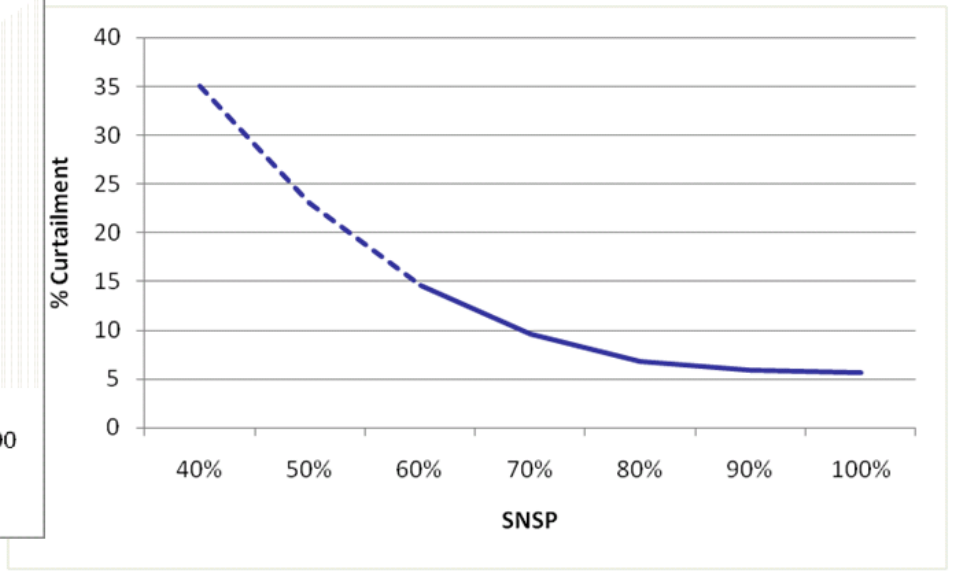


* Based on analysis of National Renewable Action Plans (NREAPs) as submitted by Member States

Real Time Operational Limits and Impact on RES-E



Maximum Allowable Real Time Wind Level



Wind Curtailment Levels

Background – Operations and DS3

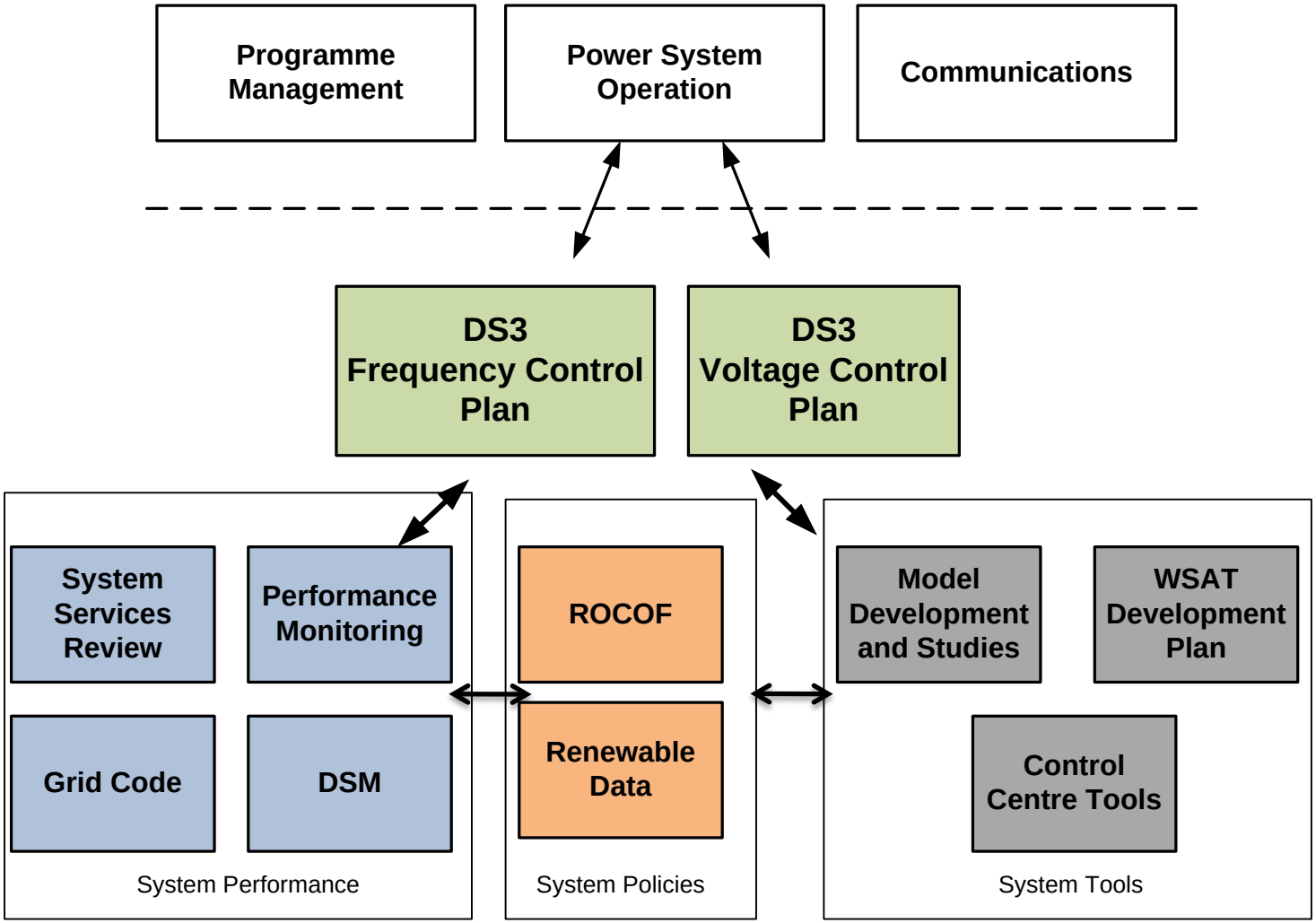
Detailed Technical Analysis

2008 - All Island Grid Study
2010 - Facilitation of Renewables
2011 - Ensuring a Secure Sustainable System

Delivering a Secure Sustainable System

- 2011 – Programme established
- Meeting the RES Policy Objectives efficiently while maintaining system security
- Holistically considering technical, commercial and regulatory needs of the system
- Engaging with all industry stakeholders

DS3 Programme Overview



What are System Services?

- Used to manage voltage and frequency
- Also known as Ancillary Services or System Support Services
- Voltage Product
  - Reactive Power
- Frequency Products – Reserves
  - Primary Operating Reserve (POR)
  - Secondary Operating Reserve (SOR)
  - Tertiary Operating Reserve (TOR1 & TOR2)
  - Replacement Reserve (Synchronised and De-synchronised)

DS3 System Services – Consultation process

First paper (Dec 2011)

- Scope & Principles
- Bilateral meetings (Feb 2012)
- DNV Kema International SS Review

Second paper (Jun 2012)

- Products & Technical aspects
- Workshop (July 2012)

Multi-stage Consultation

Third paper (Dec 2012)

- Financial aspects
- Bilateral meetings (Jan 2013)
- DNV Kema Capital Cost Paper

Recommendation (April 2013)

- Response to queries
- Price regulation with review
- Products/Rates/Next Steps

EIRGRID semo SONI

First Consultation (Proposed approach)

- **First consultation** published In December 2011
- Six week period
- Fact-finding paper
- Presented background and context, and proposed approach to the review
- Issues for consideration were split into three areas:
  - Remuneration approach
  - Contractual arrangements
  - Eligibility of providers

First Consultation (Response)

- 28 responses received
  - 19 generation affiliations
  - 11 of which included wind plant
  - 2 demand affiliations
  - Remainder Consultants, associations and academia
- 15 Bilateral meetings held
- All Non-confidential responses published

Second Consultation (Products)

- **Second consultation** published June 2012
- Eight week period
- Proposed a number of new system services
- Focused on:
  - Design and technical aspects of new services
  - Contractual Arrangements
  - Enhanced focus on reliability
- Industry forum on System Services held in July 2012

Second Consultation (Response)

- 26 responses received
  - 17 generation affiliations
  - 10 of which included wind plant
  - 3 demand affiliations
  - Remainder from consultants, associations, Interconnector and academia

- All Non-confidential responses published

Third Consultation (Finance Arrangements)

- **Third consultation** published December 2012
- Eight week period
- Paper looks at valuing required System Services
- Focused on:
  - Economic modelling and analysis
  - Revenue allocation
  - Possible approaches to service remuneration
  - Contractual arrangements
  - TSOs proposed final product designs
- Provided an indication of incremental capital costs
- KEMA independent Report published February 2013

Third Consultation (Response)

- 26 responses received
  - 20 generation affiliations
  - 11 of which included wind plant
  - 2 demand affiliations
  - Remainder from consultants, associations interconnector and academia
- 22 Bilateral meetings held
- All Non-confidential responses published

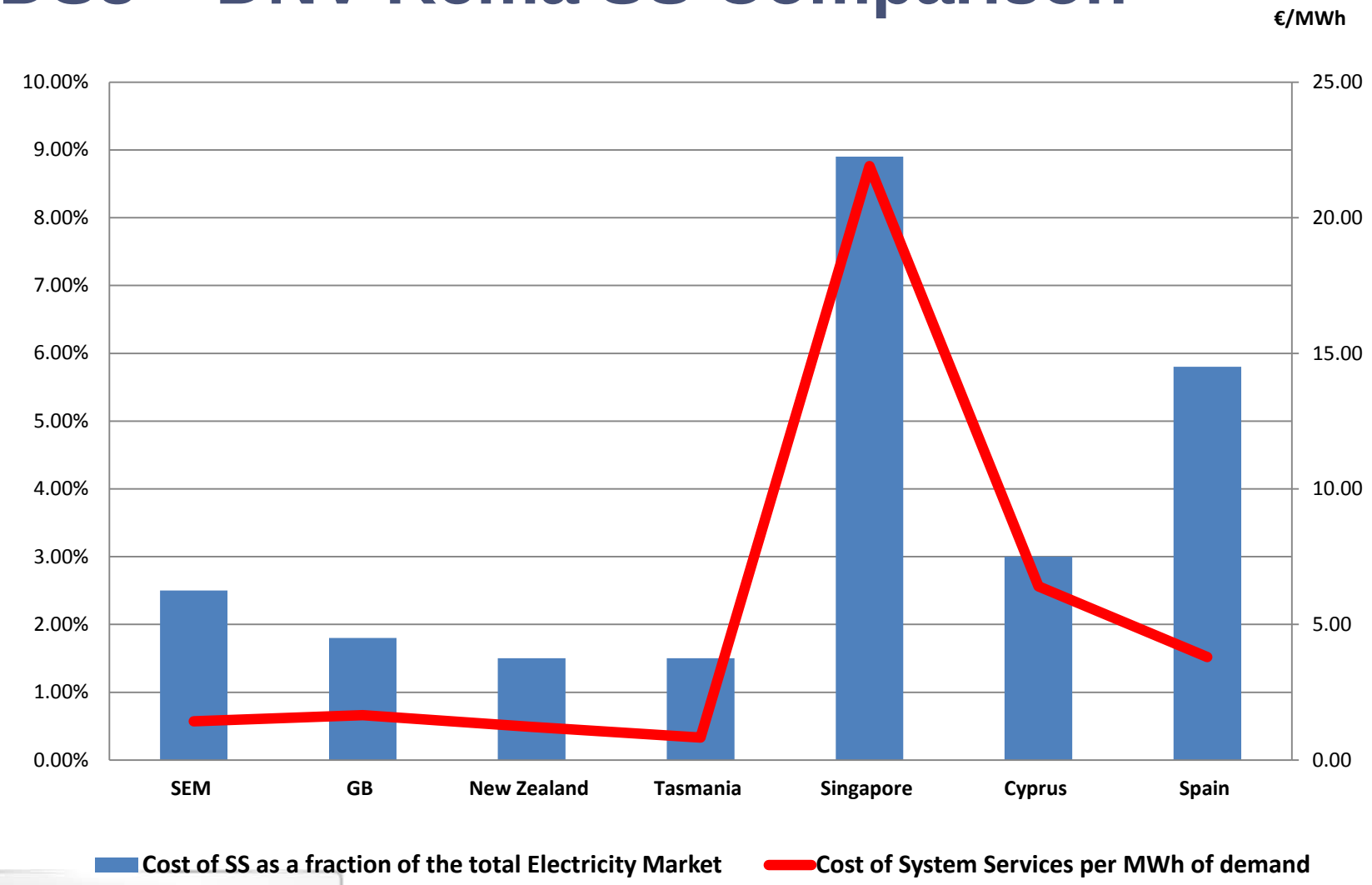
TSO Recommendations Paper

- TSO Recommendations Paper published May 2013
- Papers provided for information purposes only and are not issued for consultation
- System Services workshop held with Industry held on 26th June 2013
- A final SEM Committee decision on the new System Services structures, products and remuneration is expected in Q4 2013

Consultation Main Themes

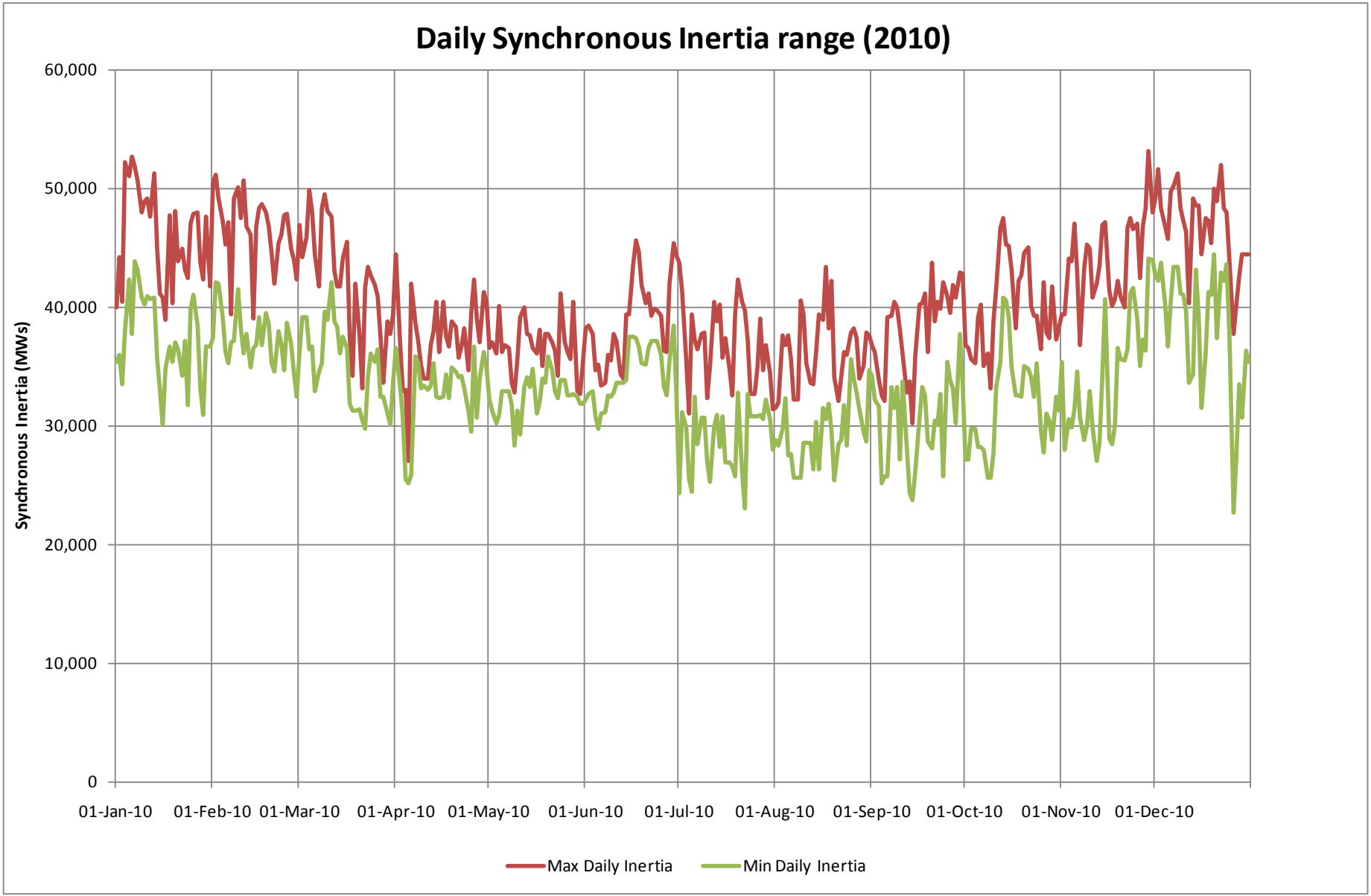
Jonathan O’Sullivan

DS3 – DNV Kema SS Comparison



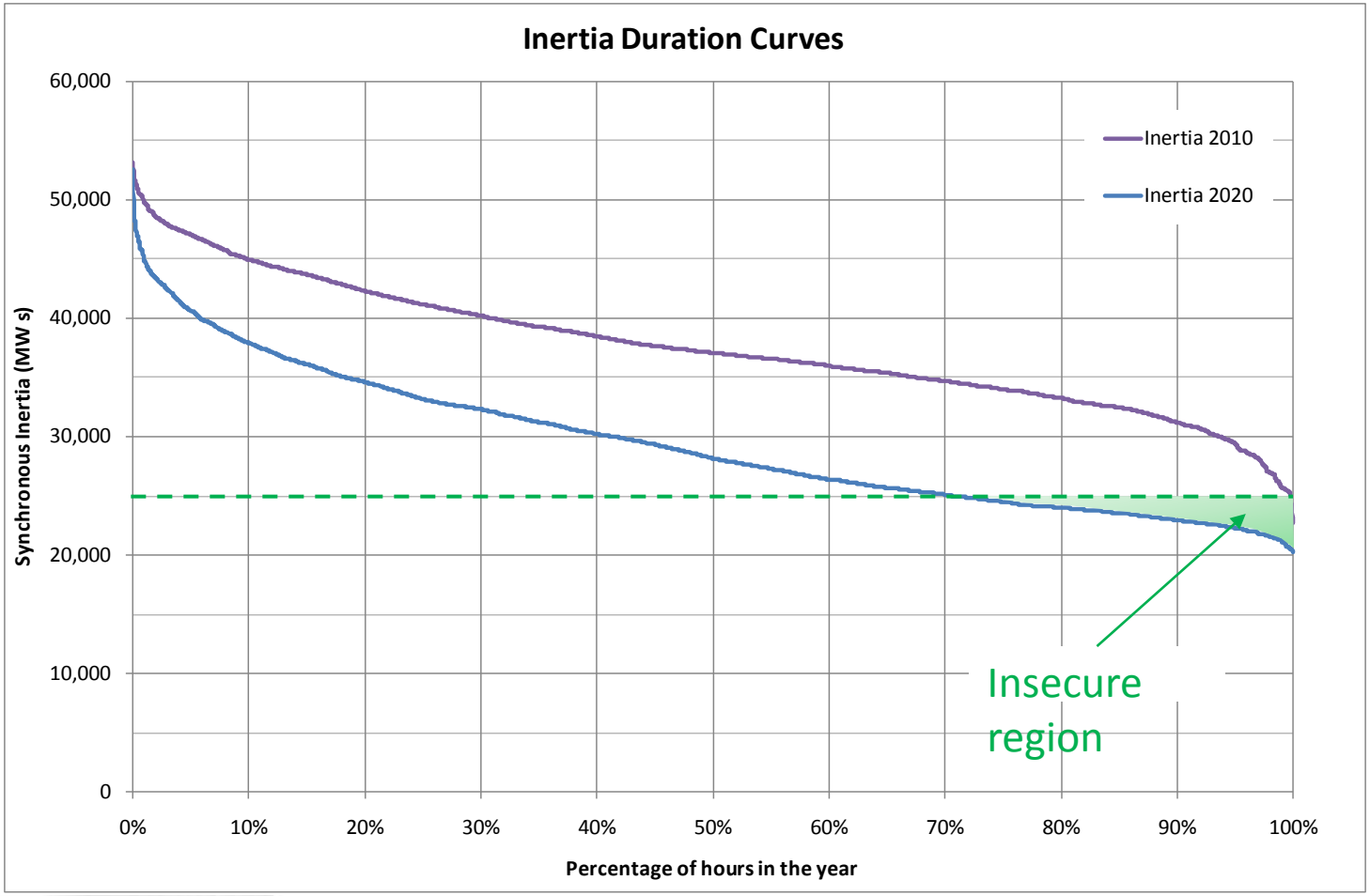
DS3 ESSS: Frequency Control

Managing the system frequency and Inertia levels



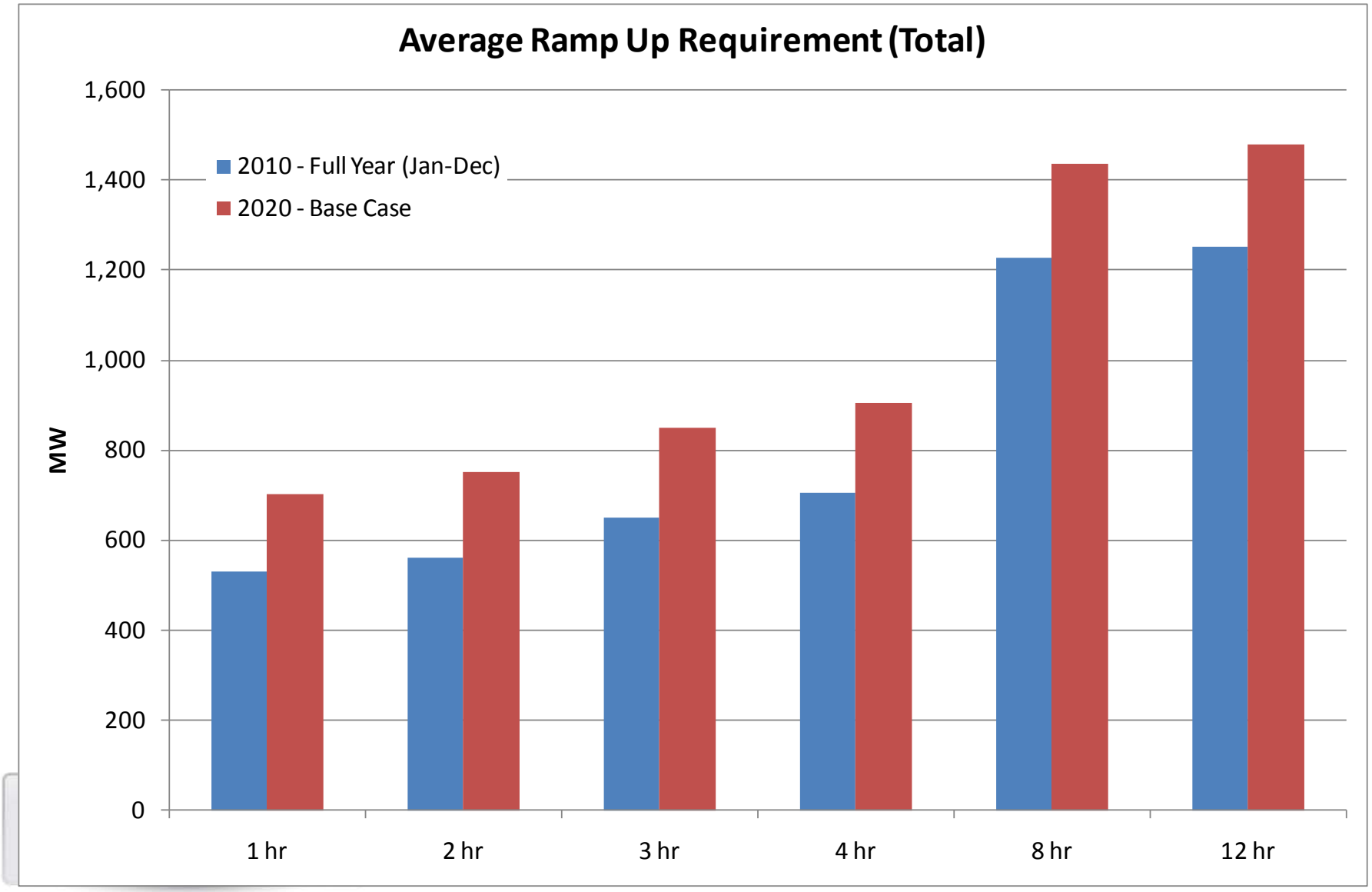
DS3 ESSS: Frequency Control

Managing the system frequency and Low Inertia levels

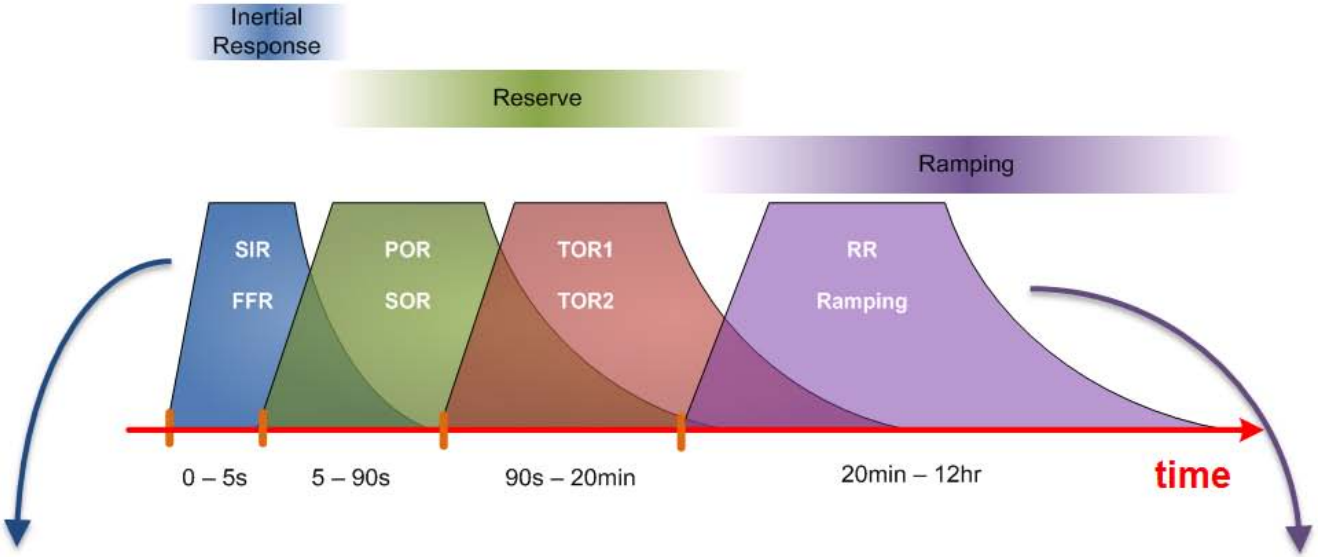


DS3 ESSS: Frequency Control

System Ramping Requirements



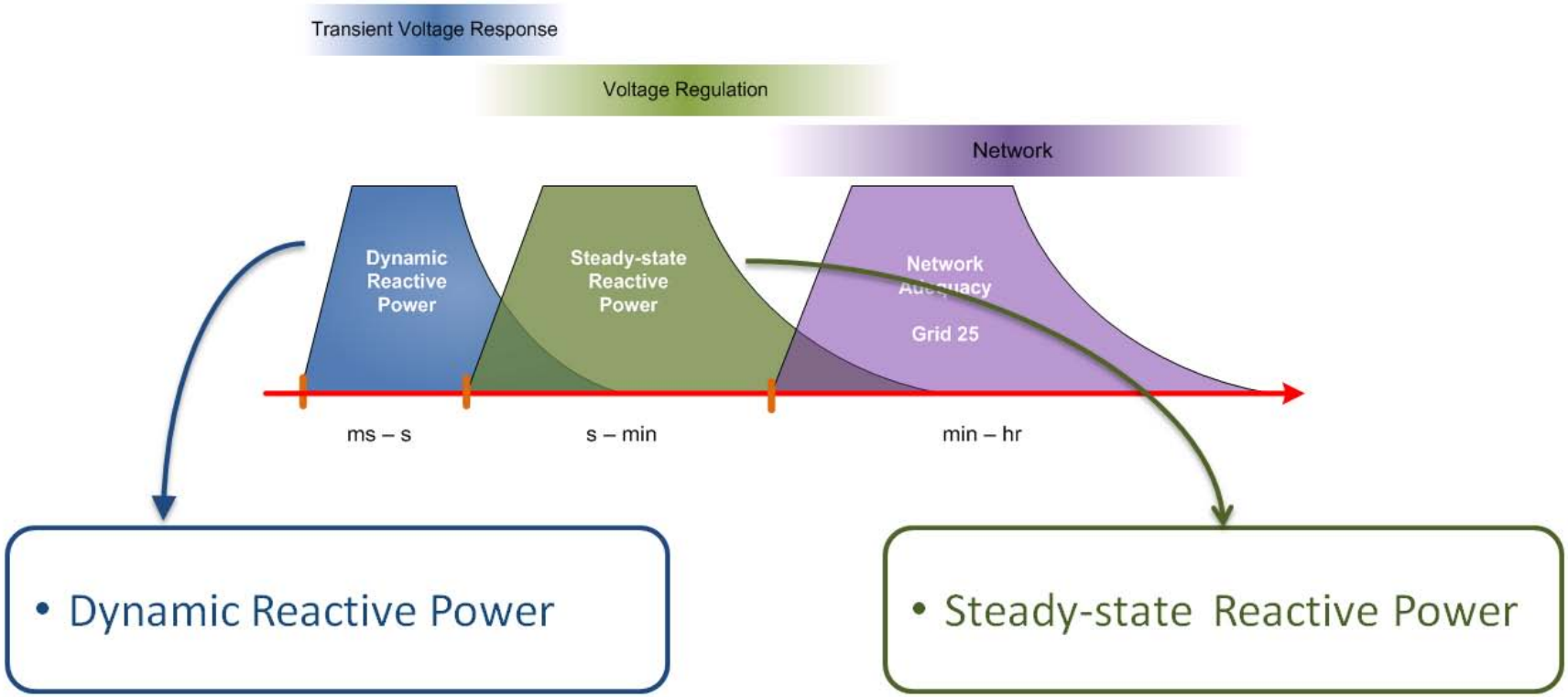
DS3 Cons 2: Frequency Control



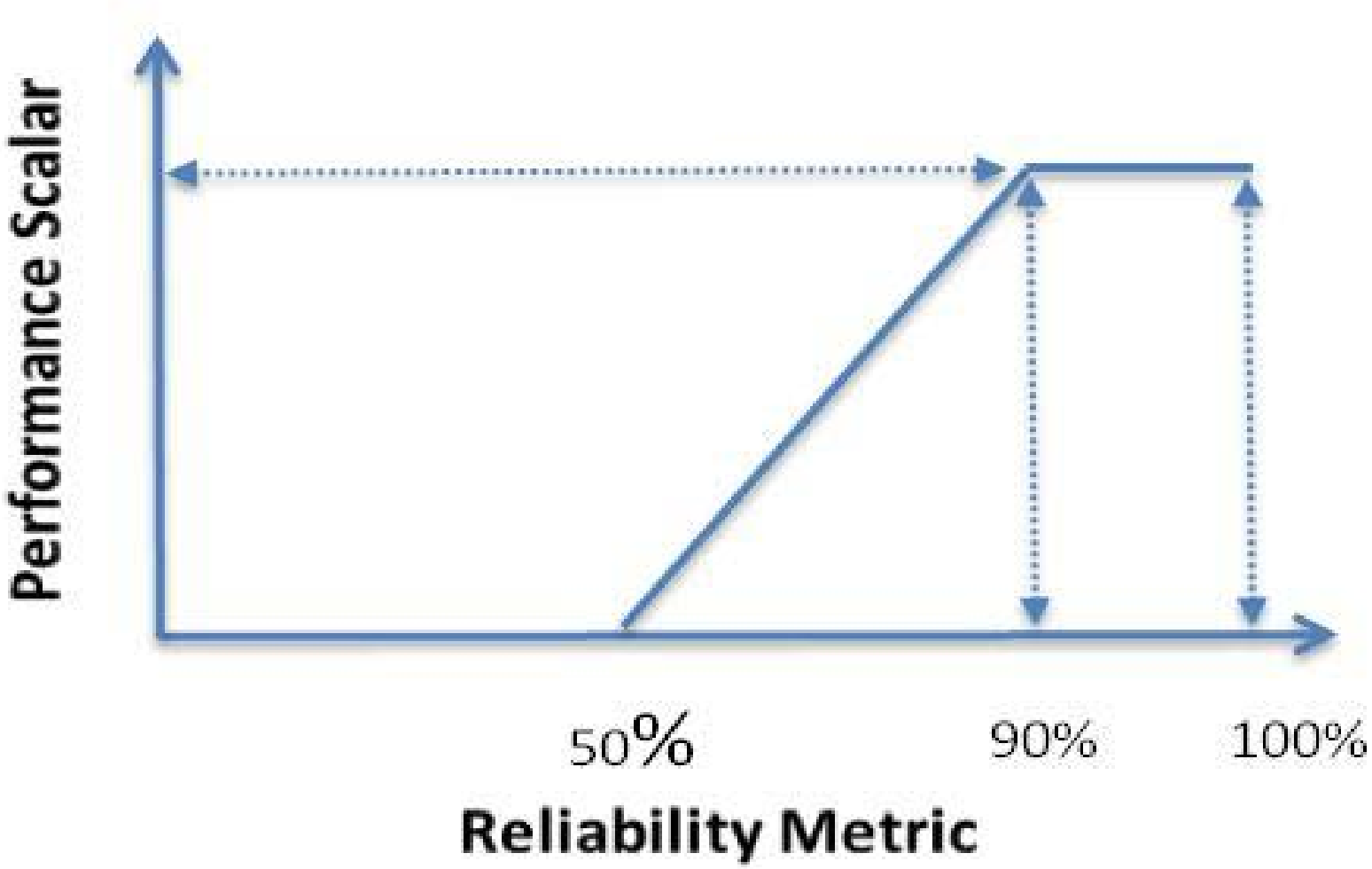
- Synchronous Inertial Response
- Fast Frequency Response
- Fast Post-Fault Active Power Recovery

- Ramping Margin

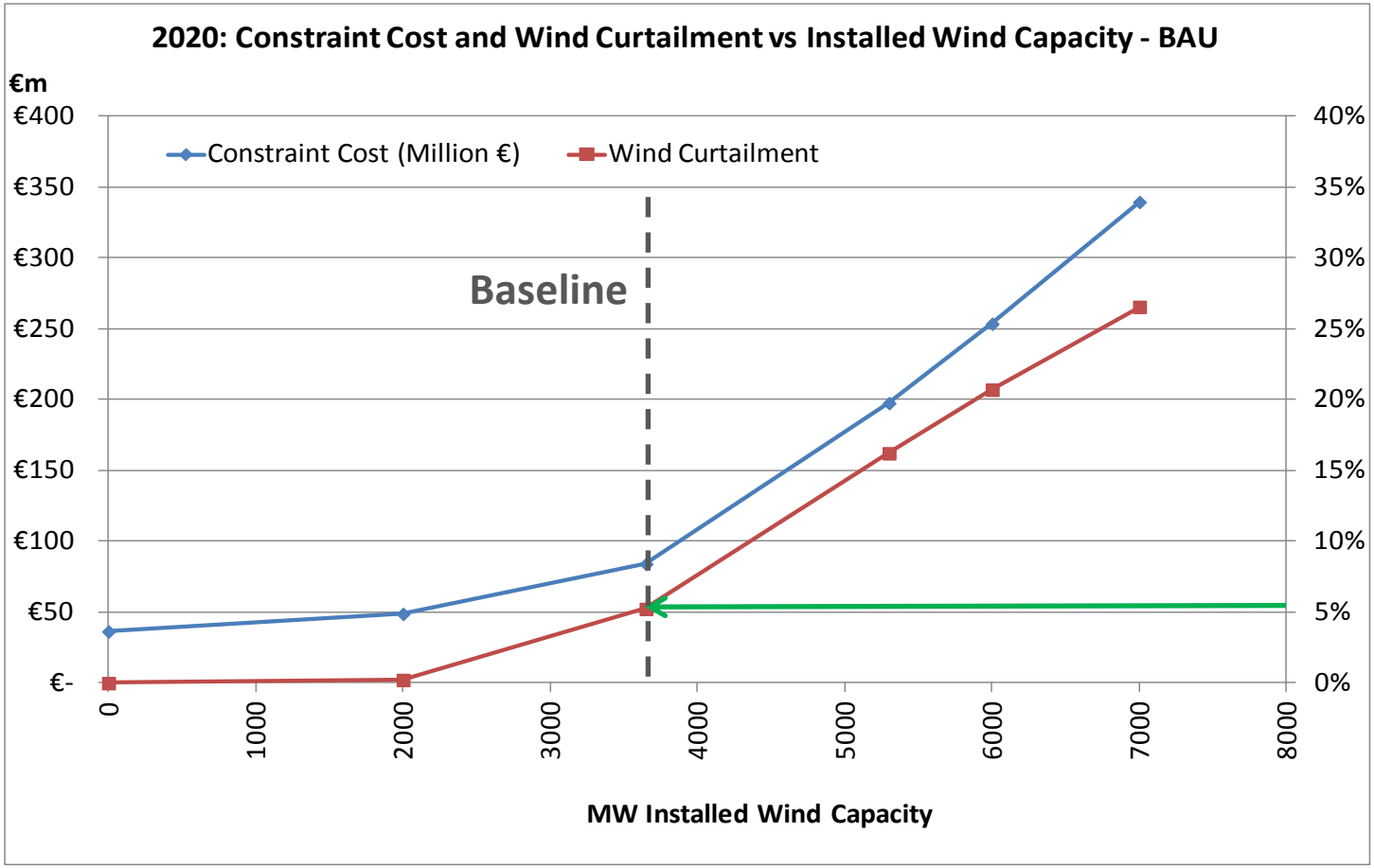
DS3 Cons 2: Voltage Control



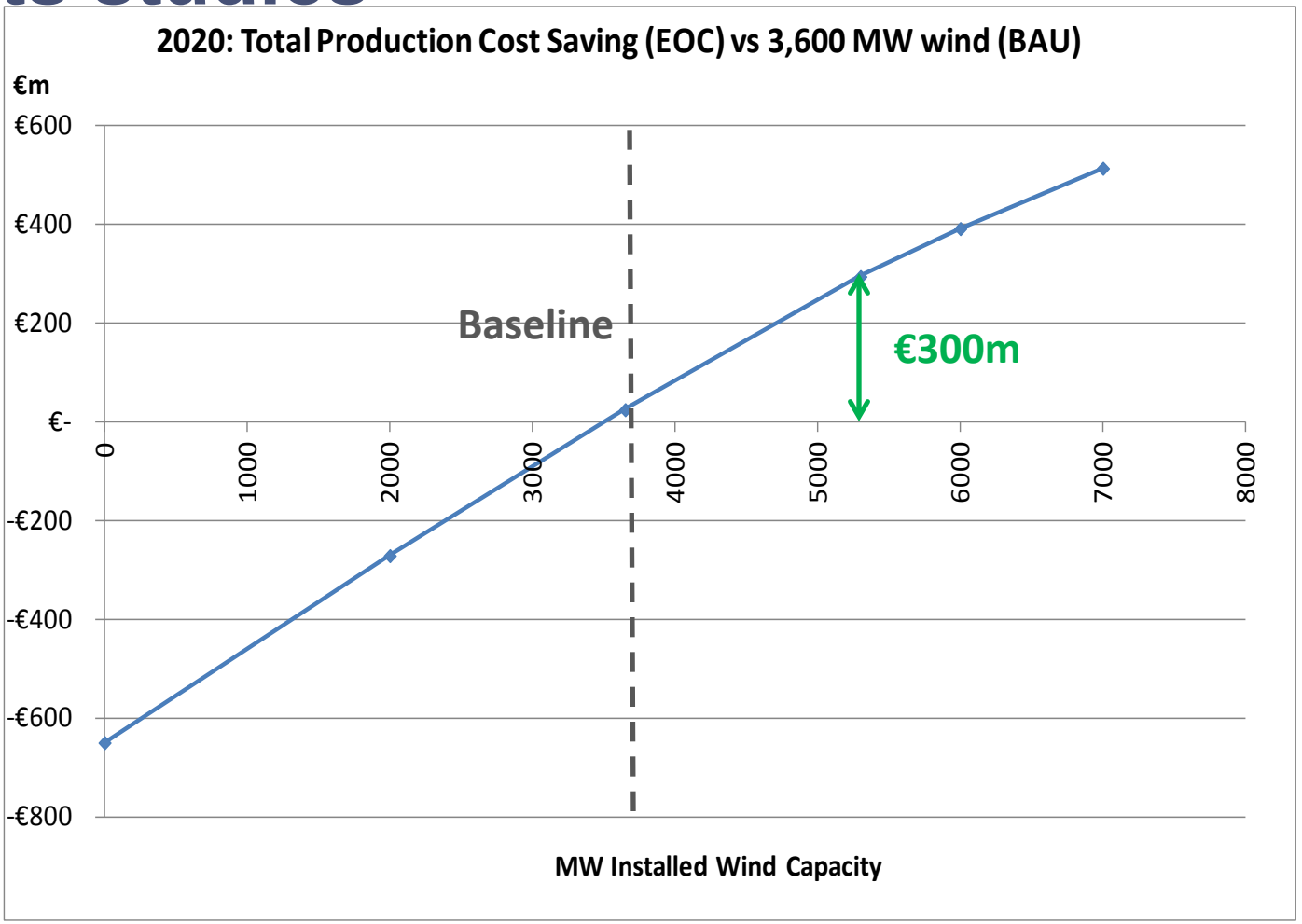
DS3 Cons 2: Focus on Reliable Performance



DS3 Cons 3: Valuation from production costs studies

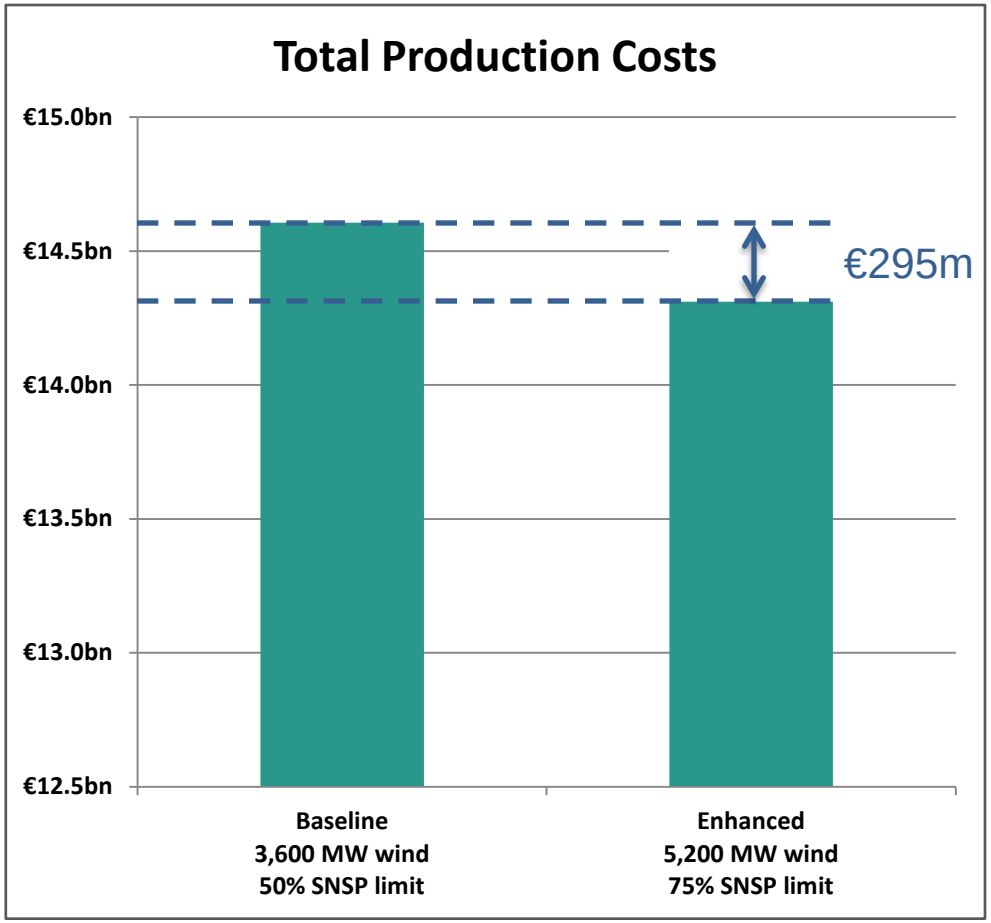


DS3 Cons 3: Valuation from production costs studies



DS3 Cons 3: Value of System Services

- Annual benefit of €295m
  - New services
- In addition to €60m for existing services
- Total value: **€355m**



DS3: DNV Kema Incremental Capital Costs

Summary			
Generation Technologies	Units Size	Base Case	Enhanced
[Name]	[MW]	[Normalised Cost, EUR/kW]	
Wind	2	2,125	139
CCGT_new	450	800	30
CCGT_existing	450	800	122
OCGT_new	50	650	74
OCGT_existing	50	650	143
Thermal (Coal)	650	1,300	83[2]
Network Technologies	Units Size	Total Cost	
[Name]	[MW or MVA or MVAR]	[EUR]	[EUR/kW, EUR/kVA, EUR/kVAR]
Flywheel (5 MWh)	20	15,328,000	766
STATCOM	50	5,428,000	109
Synchronous Condenser	75	4,726,500[2]	63[2]
Batteries (10 MWh)	40	33,170,000	829

DS3 Cons 3: System Costs

Generation Scenario	Alternative Scenario

• **Market-driven**
  • New build conventional
  • New build wind
  • Refurbish conventional
• *Supplemented with some network devices*
	• **Network alternatives required**
	• Synch Comps / Flywheels
	• STATCOMs
	• Batteries
	• *OCGTs (strategic reserves)*

€535m	**€1.2bn**

DS3 Cons 3: Allocation between System Services

1. Equal division between products
   - No link to underlying system needs
2. TSO experience
   - TSO judgement ⇒ may be perceived as adding uncertainty
3. Relative DBC impact of each System Service
   - Linked to benefit and system needs
4. Detailed Optimal Revenue Allocation
   - Difficult to implement and presupposes portfolio required

TSOs' preference: option 3

(applied to new and existing products)

Key response areas and TSO response

Jonathan O’Sullivan

DS3 Cons3 Key Response Areas

- ***Dispatch Dependent vs. Capability System Service Products***

  Dispatch-dependent payments unpredictable and unbankable

- ***Interaction with Capacity Payments***

  Many respondents believed that System Services revenues had to be kept separate from Capacity Payments.

- ***Miscellaneous Comments***

  How does this interact with this Target Model and how does it fit with the recent EU Consultation on the internal market, capacity mechanisms and generation adequacy.

DS3 Cons 3 Key Response Areas

Network Limitations

Concern that network limitations were not modelled in the analysis.

Eligibility of Distribution-Connected Plant

Distribution-connected plant should be eligible to provide System Services.

Funding by demand customers

System Services revenues should be funded by the demand customer not the generator.

System Security Issue in Northern Ireland after 2015

What about the issues in NI by 2016. Why are they not reflected in the recommendation.

Capability vs. Dispatch-Dependent

- Dispatch Dependent
  - Targeted payment
  - Rewards service providers who can provide at times when needed
  - Uncertainty for investors
  - Low Cost for consumers

- Capability
  - Rewards all service providers irrespective if they can realise the service at a point in time
  - Requires more money for same impact
  - More certain for investors
  - High Cost to consumers

Rate Scalar

$$Rate\ Scalar = \frac{Reference\ Price - Provider\ Unit\ Price}{Reference\ Price}$$

Reference Price is between average full load MWh production cost of BNE Peaker and SEM price cap

Provider Unit Price is average MWh production cost of the provider (floor value of zero)

Rate Scalar - Example

Reference Price - €170/MWh

	BNE Peaker	CCGT	Wind	Pumped Storage
Provider Unit Price (€/MWh)	170	50	0	???
Rate Scalar	(170 – 170) / 170	(170 – 50) / 170	(170 – 0) / 170	(170 – ???) / 170
	0	0.71	1	???

Necessary Return on Regulated investment

- Necessary return
  - Principal and capital
- Cost of Capital
  - Market or Project Finance
- WACC
  - External and company specific
  - Company specific
    - Surety of future revenues
    - Operational Risk
    - Project risk

Estimates of Required Return

	Base Case	Scenario A	Scenario B
WACC	9.7%	10.6%	11.8%
Annual % Return	15.6%	16.7%	17.6%

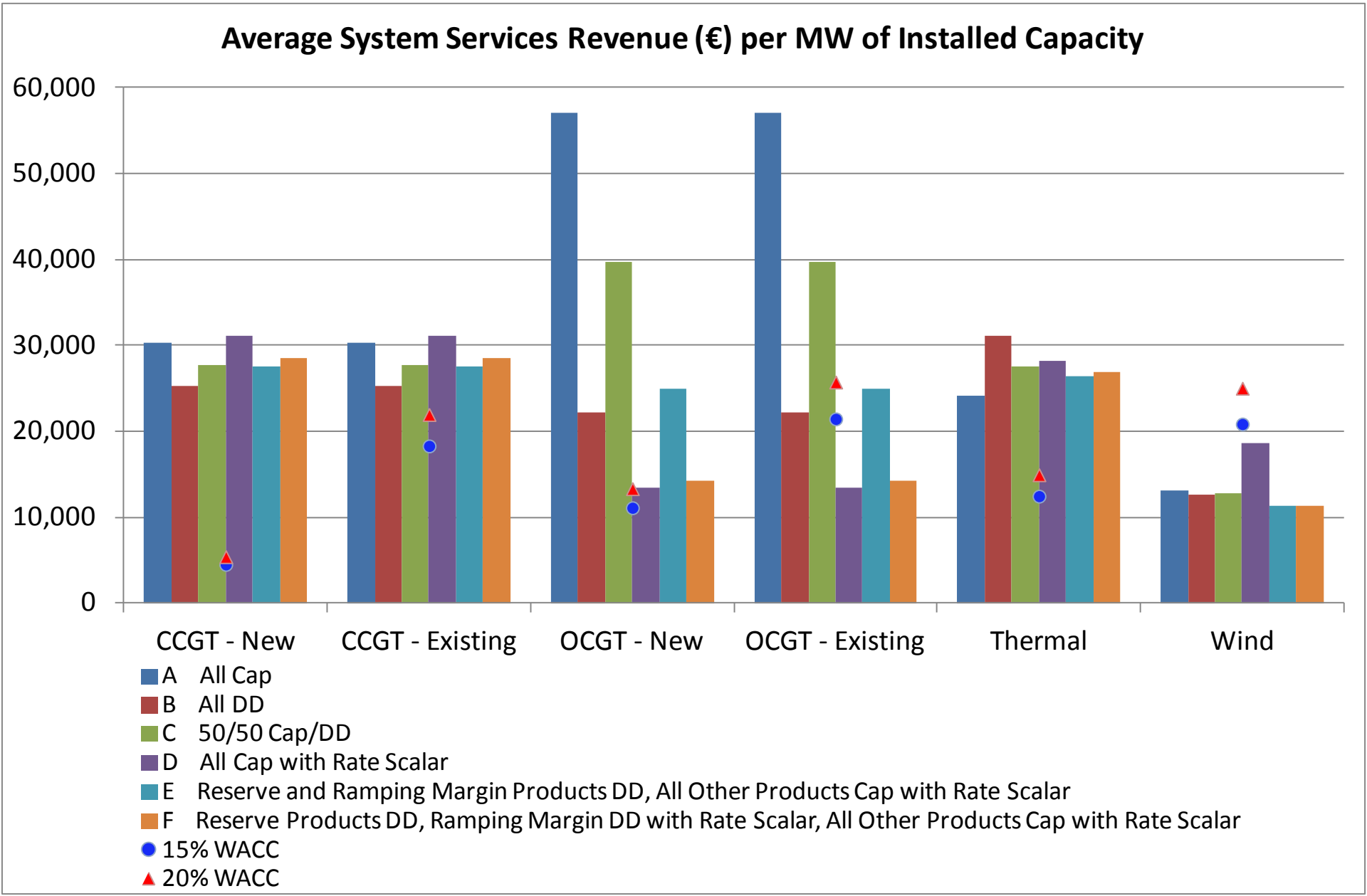
Annualised Cost Estimates

Service Provider	Capacity (MW)	Capital Cost	Enhanced Cost	Normalised Enhanced Cost (€/MW)	Annual Return = 15%	Annual Return = 18%
Enhanced Wind	2	4,200,000	278,000	139,000	20,850	25,020
CCGT New	450	360,000,000	13,446,172	30,000	4,500	5,400
CCGT Existing	450	360,000,000	54,690,497	122,000	18,300	21,960
OCGT New	50	32,500,000	3,699,440	74,000	11,100	13,320
OCGT Existing	50	32,500,000	7,163,575	143,000	21,450	25,740
Thermal	650	845,000,000	53,663,920	83,000	12,450	14,940

SS Rec: Rates and Product Volumes

Product	Unit	Total Payment (€)	Rates (€/unit)			
			Capability	Dispatch-Dependent	Capability with Rate Scalar	Dispatch-Dependent with Rate Scalar
SIR	MWs^2h	8,000,000	0.00100	0.00220	0.00144	0.00291
FFR	MWh	41,000,000	6.3633	19.8642	9.4451	22.4207
POR	MWh	39,000,000	3.8876	14.2693	5.9743	16.6604
SOR	MWh	24,000,000	1.7620	7.4385	2.4665	8.4992
TOR1	MWh	29,000,000	1.9600	8.8763	2.8030	10.0709
TOR2	MWh	27,000,000	1.4886	5.4112	2.3270	5.9079
RR	MWh	4,000,000	0.0593	0.5338	0.0990	0.6536
DRR	MWh	2,000,000	0.2601	0.3132	0.5747	0.8553
RM1	MWh	9,000,000	0.3104	0.4439	0.4452	0.8751
RM3	MWh	18,000,000	0.5607	0.8320	0.8133	1.5918
RM8	MWh	19,000,000	0.5103	0.6487	0.7540	1.1316
FPFAPR	MWh	62,000,000	0.8371	2.1000	1.2263	2.6014
SSRP	Mvarh	38,000,000	0.2823	0.5919	0.3789	0.6790
DRP	MWh	35,000,000	0.4299	0.8003	0.5986	0.9536

TSO Rec: Average Revenues



TSO Rec: Principle

- The system service products are designed by the TSOs to address the needs of the power system to meet policy objectives in an efficient manner
- The system service products are, in so far as possible, technology neutral.
- The existing ancillary services are included as system services in this process with the exception of Blackstart.
- New system services:
  - Synchronous Inertial Response
  - Fast Frequency Response
  - Fast Post Fault Active Power Recovery

  Ramping (1, 3 and 8 hour)
  Dynamic Reactive Power.

TSO Rec: Principle

- A “Value Based” approached is utilised in determining the aggregate value of system services.

- Split of value between consumer and service provider to be informed by the incremental capital and/or operating costs of the enhanced system services required to meet policy objectives.

- The determination of the annual system services pot and resultant payment rates should be fixed for a five year period.

TSO Rec: Principle

- The allocation of the system services pot based on a relative marginal benefit approach.
- Monies are recovered through appropriate regulated consumer tariffs in Ireland and Northern Ireland.
- If the market does not deliver the required system services, or in the event of unexpected circumstances, the TSOs have should be allowed to enter into contracts for services
- A single payment mechanism will be used including a performance scalar.

TSO Rec: Principle

- Product rates should be fixed (i.e. not time-varying)
- Obligation to procure with Minimum Grid Code compliance if a product in it
- TSO discretion for non or above minimum Grid Code capability. This discretion will be exercised transparently with appropriate regulatory approval.

TSO Rec: Detail 2015-2020

- System service rates should be determined by the recommended approach.
- The total benefit from System Services is €355 million and should be used to determine the product tariffs to be employed from 1st Oct 2015.
- The determination of how these revenues interact with Capacity Payments is a matter for the SEMC.

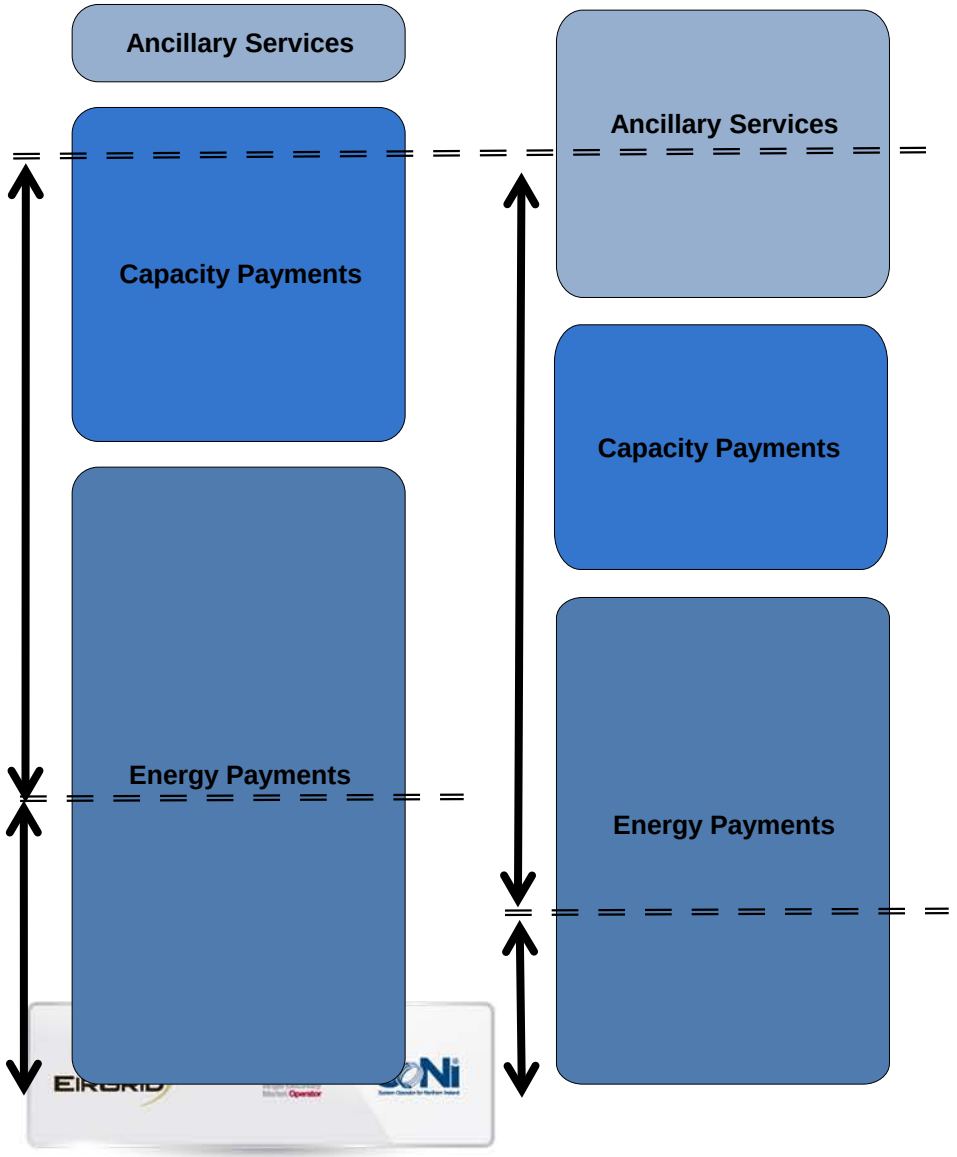
TSO Rec: Details 2015-2020

- Assuming the existing design of the Capacity Payment Mechanism, the following is recommended:
  - The system services remunerated on a Dispatch Dependent basis are:
    - Ramping Margin (1, 3, 8 hour), Primary, Secondary, Tertiary and Replacement Reserves, Fast Frequency Response
  - The system services that are remunerated on a Capability basis are:
    - Synchronous Inertial Response, Dynamic Reactive Power, Fast Post Fault Active Power Recovery, Steady State Reactive Power
  - Capability based payments should employ an additional rate scalar
- October 2015 should be set as a firm target date for “go live” of the new System Service arrangements.

TSO Rec: Further consultation

- The exact portfolios and methodology to be used in determining the allocation between system services.
- The System Services contract framework including termination clauses.
- The process and implementation details for determining the performance scalars.
- The details associated with the implementation of the products and their remuneration.
- The process for determining and setting the rate scalars (including reference price).

Incentivising the Portfolio: Market Signals



- Incentivising performance of plant
- Financial Mix will move to higher capital lower variable cost technologies
- Obtaining the plant mix that matches the system requirements and achieves the policy objectives

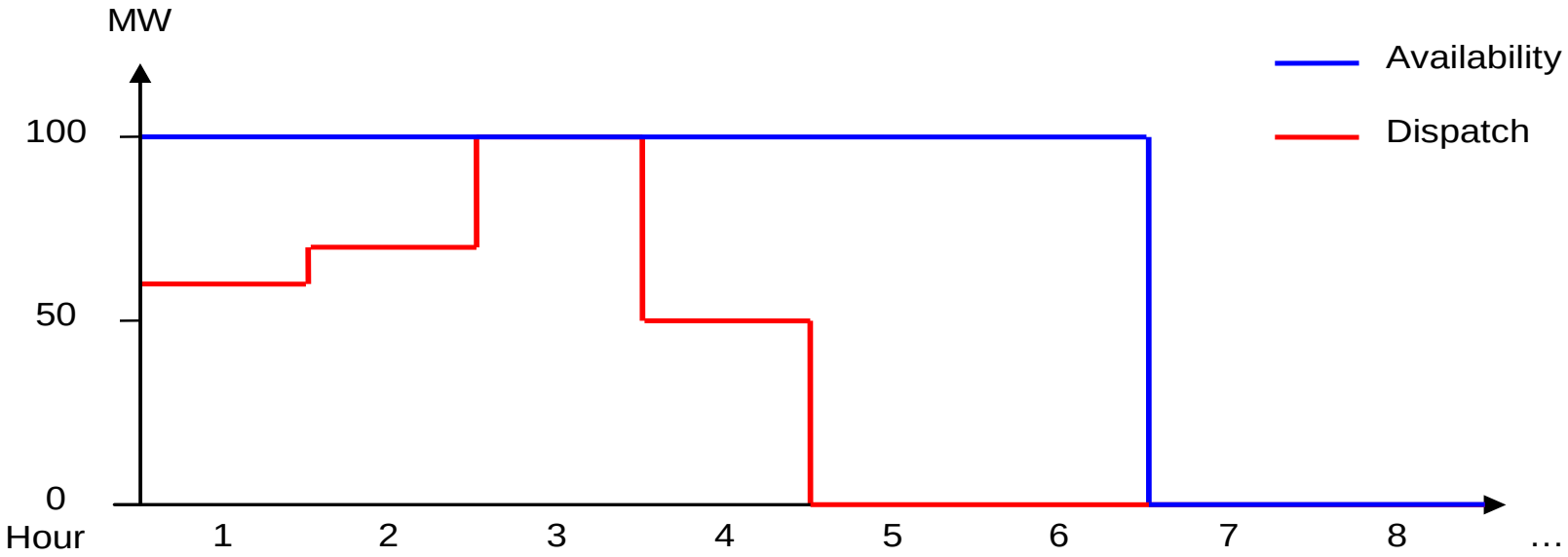
Product Rates Calculation

Seamus Power

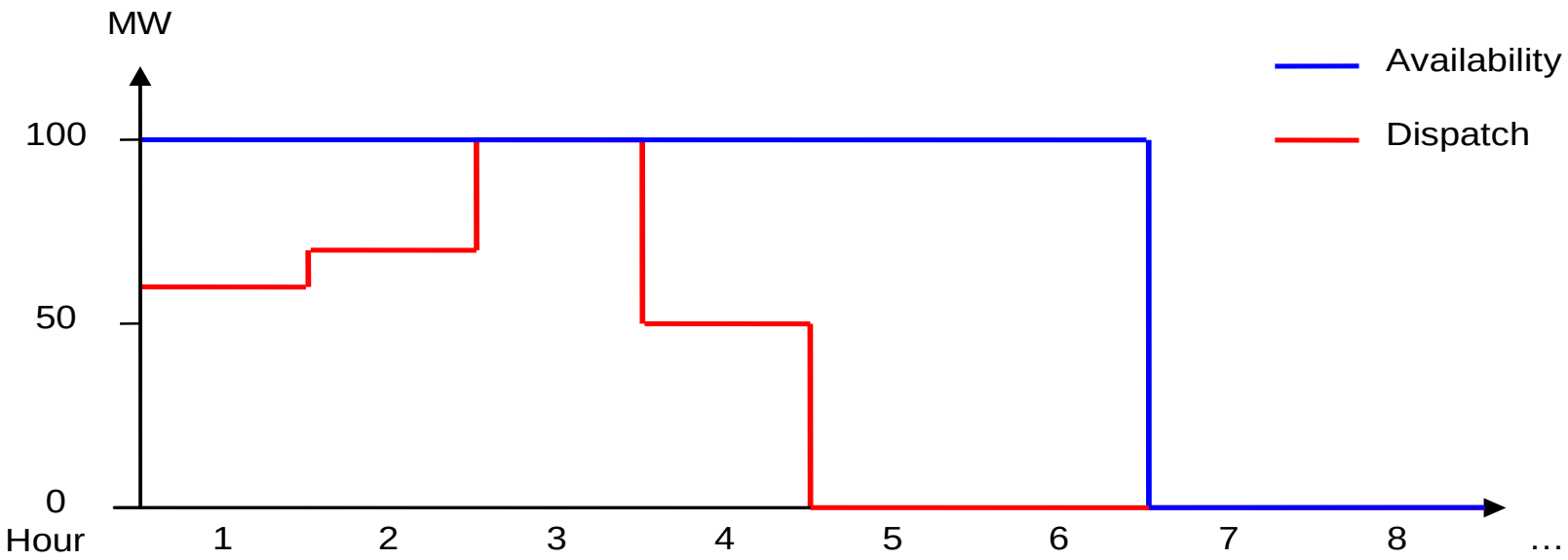
Portfolio and Assumptions

- Portfolio for 2020 Plexos Run as in *Supplementary Modelling Information* note to Third Consultation
  - 2020 portfolio based on Generation Capacity Statement 2012
  - 5,300 MW of installed wind
  - All generators have firm access
  - Fuel & Carbon Prices based on IEA (Nov 2011) 'New Policies Scenario'
- Improved Minimum Generation
  - Coal and CCGT – 35%
  - OCGT – 15%
- Improved Reserves & Ramping
- Reserve and 75% SNSP constraints
- Allocation between products as per Appendix B of Third Consultation Paper

Example of Plexos Output for single unit

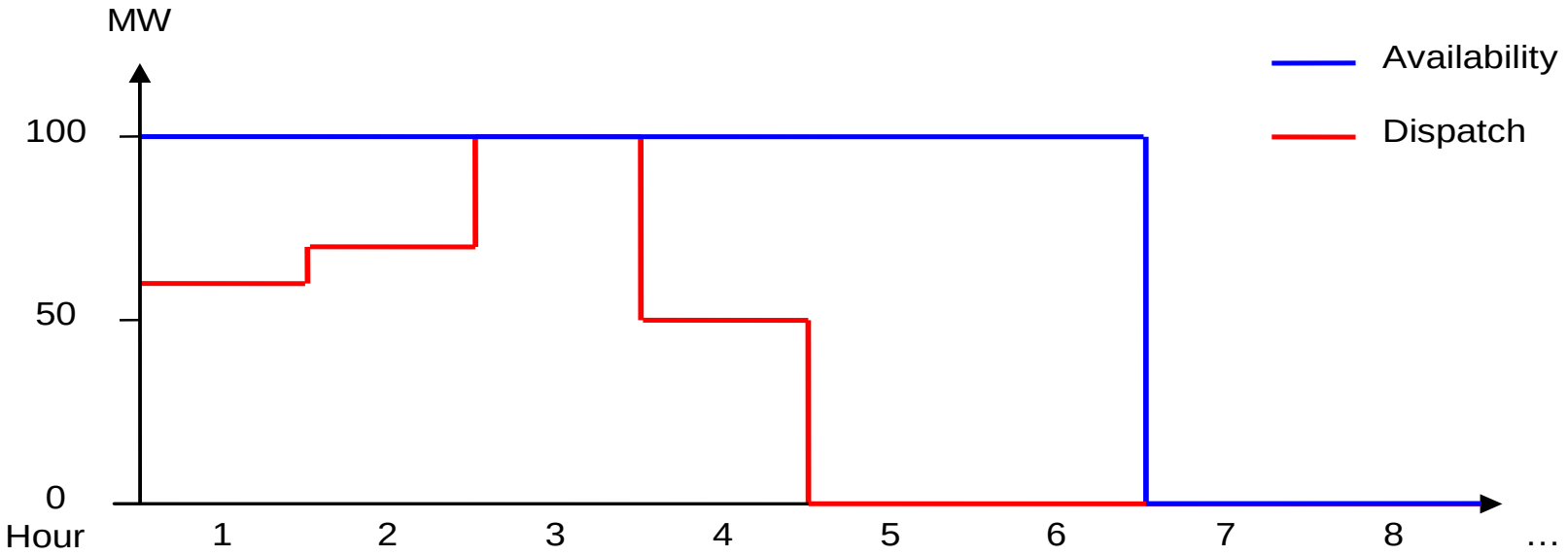


System Services for a single unit



Output		60
POR	Dispatch	5
	Capability	5
RM1	Dispatch	40
	Capability	100
FPFAPR	Dispatch	60
	Capability	100
…		

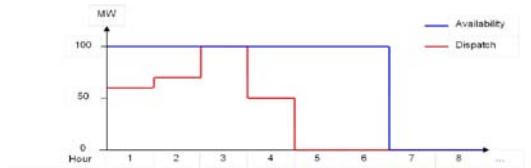
System Services for a single unit



Output		60	70	100	50	0	0	0	0	…
POR	Dispatch	5	5	0	5	0	0	0	0	…
	Capability	5	5	5	5	5	5	0	0	…
RM1	Dispatch	40	30	0	50	0	0	0	0	…
	Capability	100	100	100	100	0	0	0	0	…
FPFAPR	Dispatch	60	70	100	50	0	0	0	0	…
	Capability	100	100	100	100	100	100	0	0	…
…										

System Services for whole system

Unit 1



Output		60	70	100	50	0	0	0	0	...
POR	Dispatch	5	5	0	5	0	0	0	0	...
	Capability	5	5	5	5	5	5	0	0	...
RM1	Dispatch	40	30	0	50	0	0	0	0	...
	Capability	100	100	100	100	0	0	0	0	...
FPFAPR	Dispatch	60	70	100	50	0	0	0	0	...
	Capability	100	100	100	100	100	100	0	0	...
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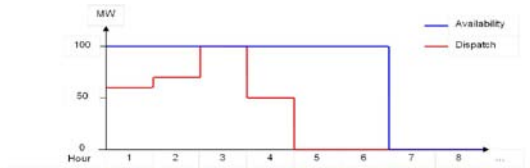
Unit 2



Output		60	70	100	50	0	0	0	0	...
POR	Dispatch	5	5	0	5	0	0	0	0	...
	Capability	5	5	5	5	5	5	0	0	...
RM1	Dispatch	40	30	0	50	0	0	0	0	...
	Capability	100	100	100	100	0	0	0	0	...
FPFAPR	Dispatch	60	70	100	50	0	0	0	0	...
	Capability	100	100	100	100	100	100	0	0	...
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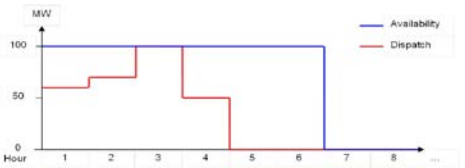
Unit 3



Output		60	70	100	50	0	0	0	0	...
POR	Dispatch	5	5	0	5	0	0	0	0	...
	Capability	5	5	5	5	5	5	0	0	...
RM1	Dispatch	40	30	0	50	0	0	0	0	...
	Capability	100	100	100	100	0	0	0	0	...
FPFAPR	Dispatch	60	70	100	50	0	0	0	0	...
	Capability	100	100	100	100	100	100	0	0	...
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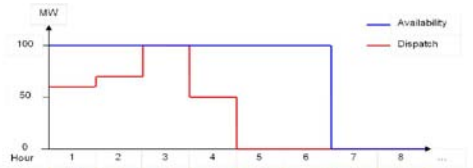
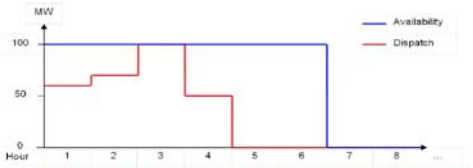
Unit 4



Output		60	70	100	50	0	0	0	0	...
POR	Dispatch	5	5	0	5	0	0	0	0	...
	Capability	5	5	5	5	5	5	0	0	...
RM1	Dispatch	40	30	0	50	0	0	0	0	...
	Capability	100	100	100	100	0	0	0	0	...
FPFAPR	Dispatch	60	70	100	50	0	0	0	0	...
	Capability	100	100	100	100	100	100	0	0	...
...										

+ ..... +

Unit x



Output		60	70	100	50	0	0	0	0	...
POR	Dispatch	5	5	0	5	0	0	0	0	...
	Capability	5	5	5	5	5	5	0	0	...
RM1	Dispatch	40	30	0	50	0	0	0	0	...
	Capability	100	100	100	100	0	0	0	0	...
FPFAPR	Dispatch	60	70	100	50	0	0	0	0	...
	Capability	100	100	100	100	100	100	0	0	...
...										

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Example - POR

	Dispatch-Dependent	Capability
Annual POR Volume of All Plant (MWh)	2,733,139	10,031,848
Annual POR Pot Size (€)	39m	39m
Rate (€/MWh)	14.27	3.89

Relative allocation for products

- Base case with only a 75% SNSP constraint
- Products were modelled individually as various constraints to analyse effect on constrained production cost
- New products were modelled through proxy constraints

Product	Constraint
Fast Post-Fault Active Power Recovery	Limit wind output to < 3,500 MW
Dynamic Reactive Power	Must run units
Ramping Margin	Reserve constraint

Relative allocation for products

Product	System Service Pot (€m)
SIR	8
FFR	41
POR	39
SOR	24
TOR1	29
TOR2	27
RR	6
Reactive Power	38
Dynamic Reactive	35
FPFAPR	62
Ramping RM1	9
Ramping RM3	18
Ramping RM8	19

Impact on Capacity Payment Pot

	Scenario	Capacity Payments Reduction (€m)
A	All products Capability based	**€352**
B	All products Dispatch Dependent	**€163**
C	All products a 50/50 blend of Capability and Dispatch Dependent	**€257**
D	All products Capability based with Rate Scalar	**€0**
E	Reserve and Ramping Margin products Dispatch Dependent, all other products Capability based with Rate Scalar	**€157**
F	Reserve products Dispatch Dependent, Ramping Margin products Dispatch Dependent with Rate Scalar, all other products Capability based with Rate Scalar	**€30**

Impact on Capacity Payment Pot

- *Annual Capacity Payment Sum* =
  BNE Peaker Cost x *Capacity Requirement*

- *BNE Peaker Cost* is the annualised fixed cost, net of estimated IMR and Ancillary Services revenue

- 2020 *Capacity Requirement* estimated at 8,000 MW based on 18% load growth

Impact on Capacity Payment Pot

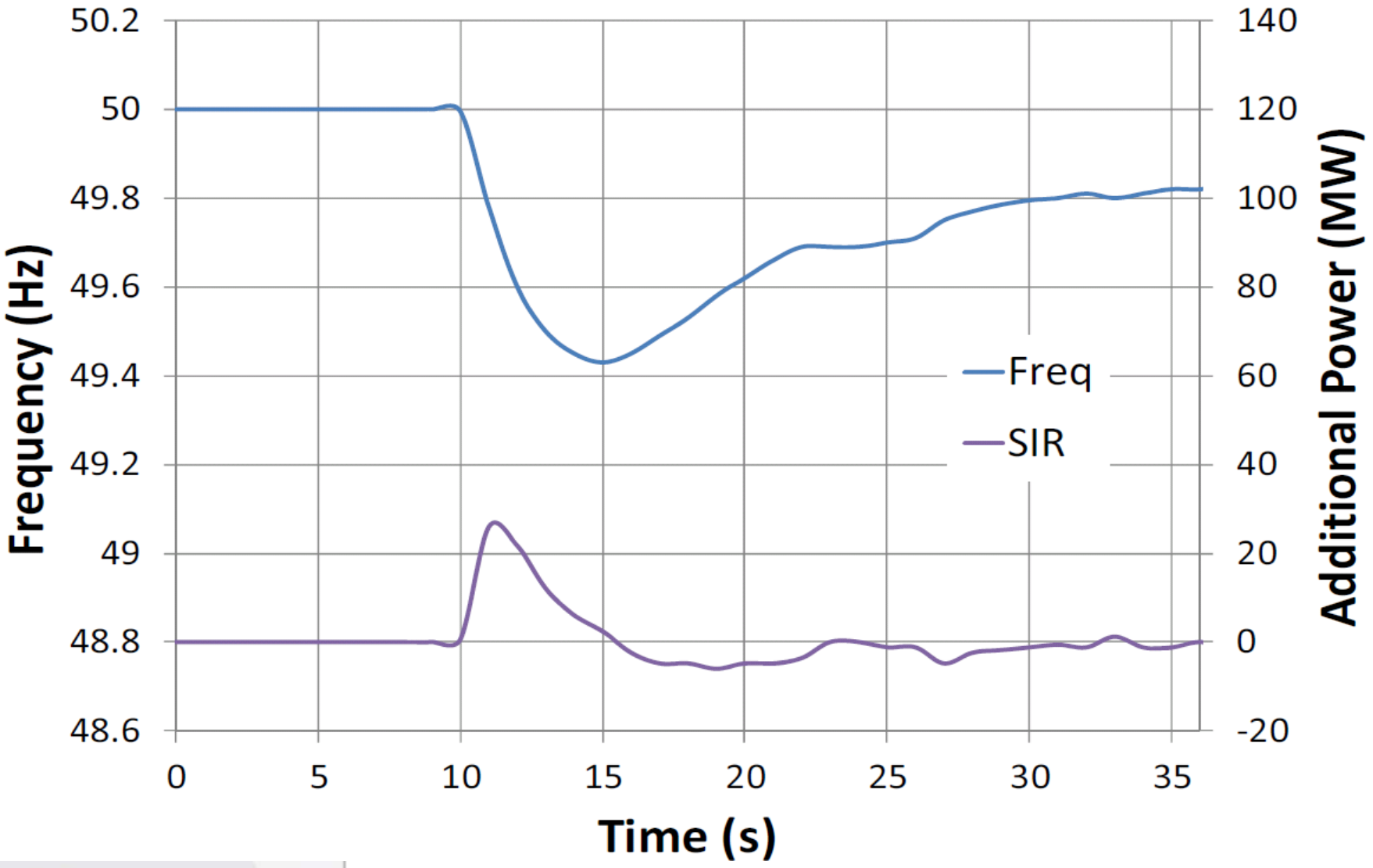
Estimated 2020 System Services revenue for BNE Peaker

	All products capability based	All products dispatch-dependent based
System Services Revenue (€/kW/year)	44.02	20.35
Reduction in Capacity Payment Pot (€m)	44.02 x 8,000	20.35 x 8,000
	352	163

Estimated funding requirements

Scenario	Funding requirement 2015 (70% performance scalar)	Funding requirement 2020 (95% performance scalar)
A	€191	€337
B	€270	€337
C	€230	€337
D	€185	€337
E	€259	€337
F	€259	€337

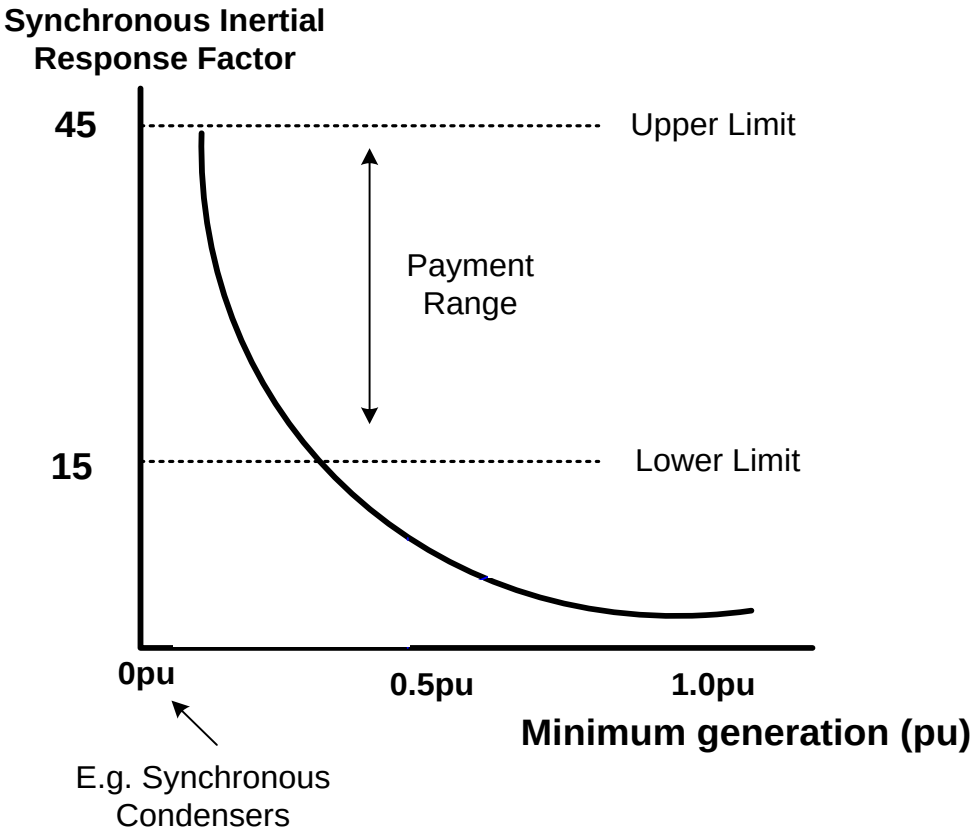
Synchronous Inertial Response (SIR)



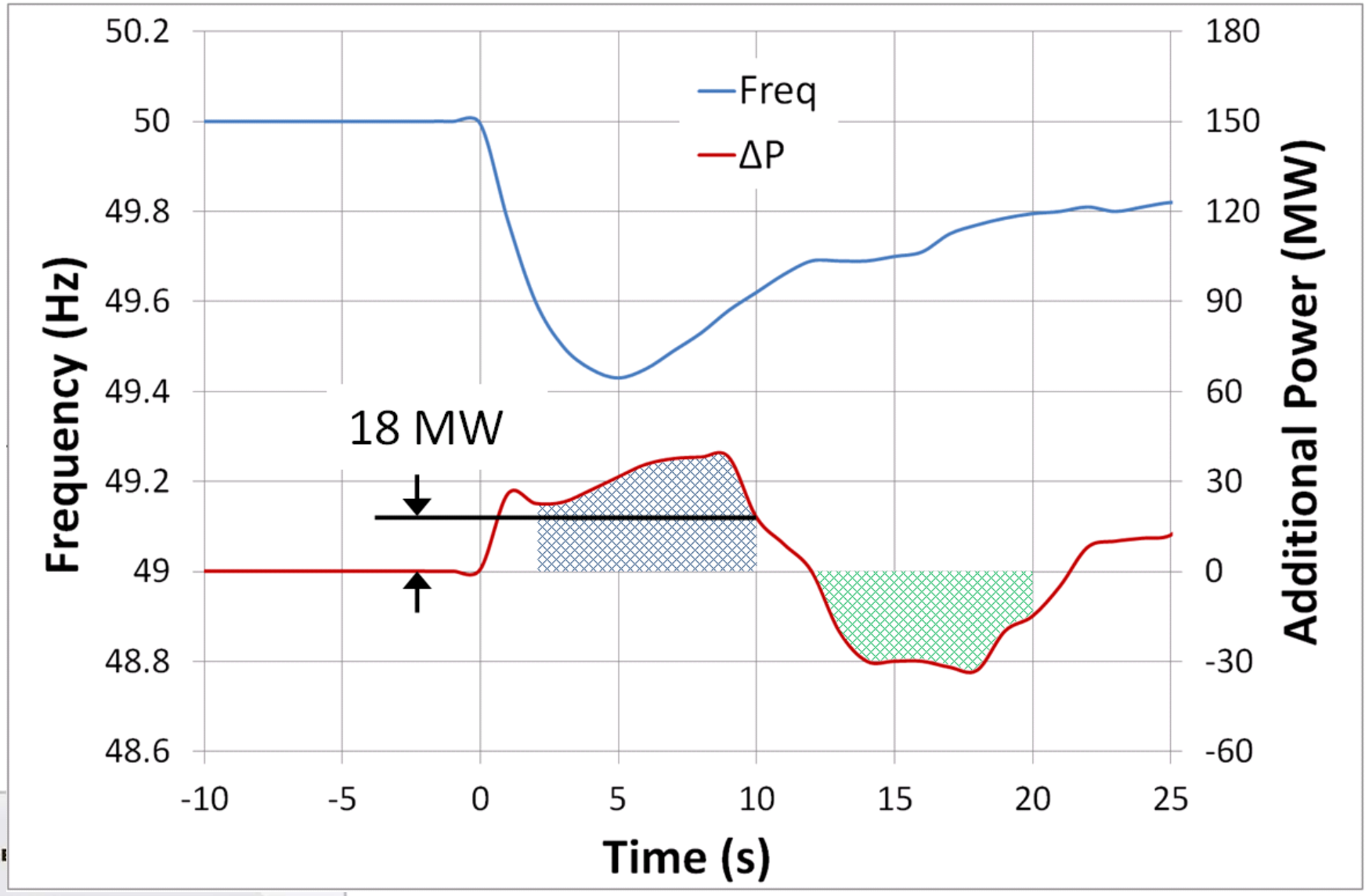
Synchronous Inertial Response (SIR)

- Product Volume = Kinetic Energy x (SIRF - 15)
- SIRF = Kinetic Energy / Minimum Stable Generation

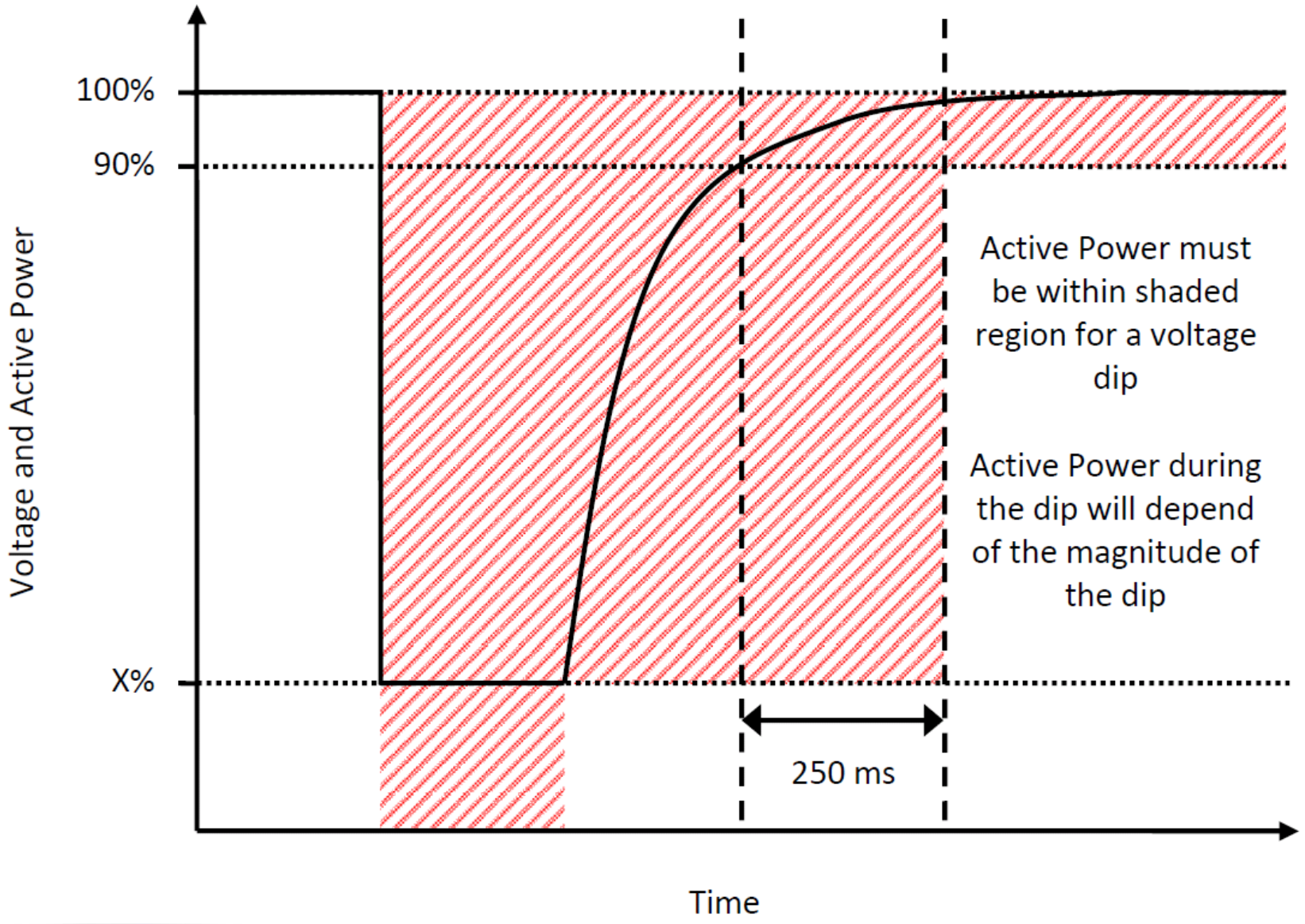
- Thresholds for SIR Payment
  - Zero below SIRF = [15 s]
  - Capped at SIRF = [45 s]
- Payment should incentivise:
  - Higher Inertia
  - Lower minimum generation levels



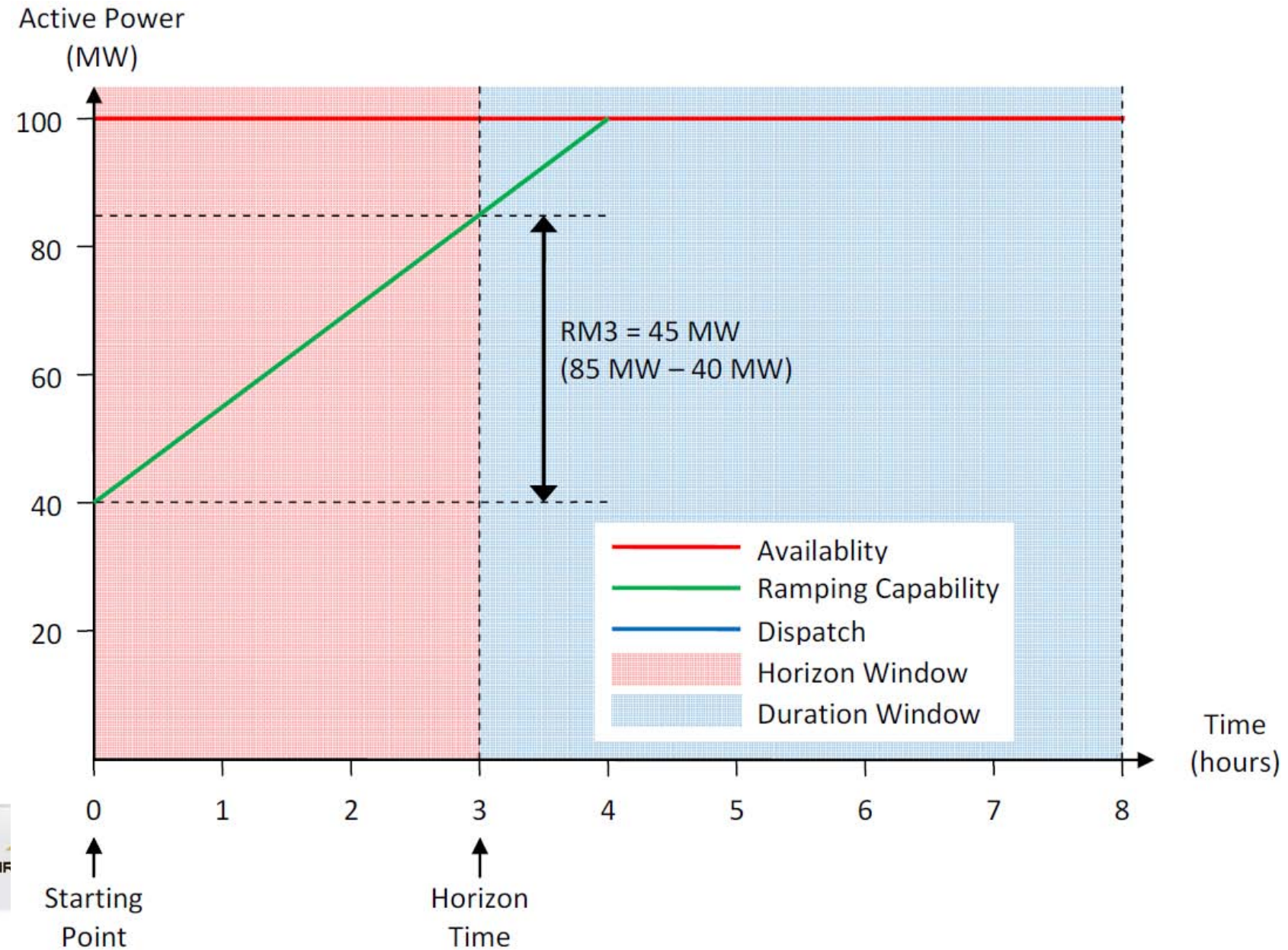
Fast Frequency Response



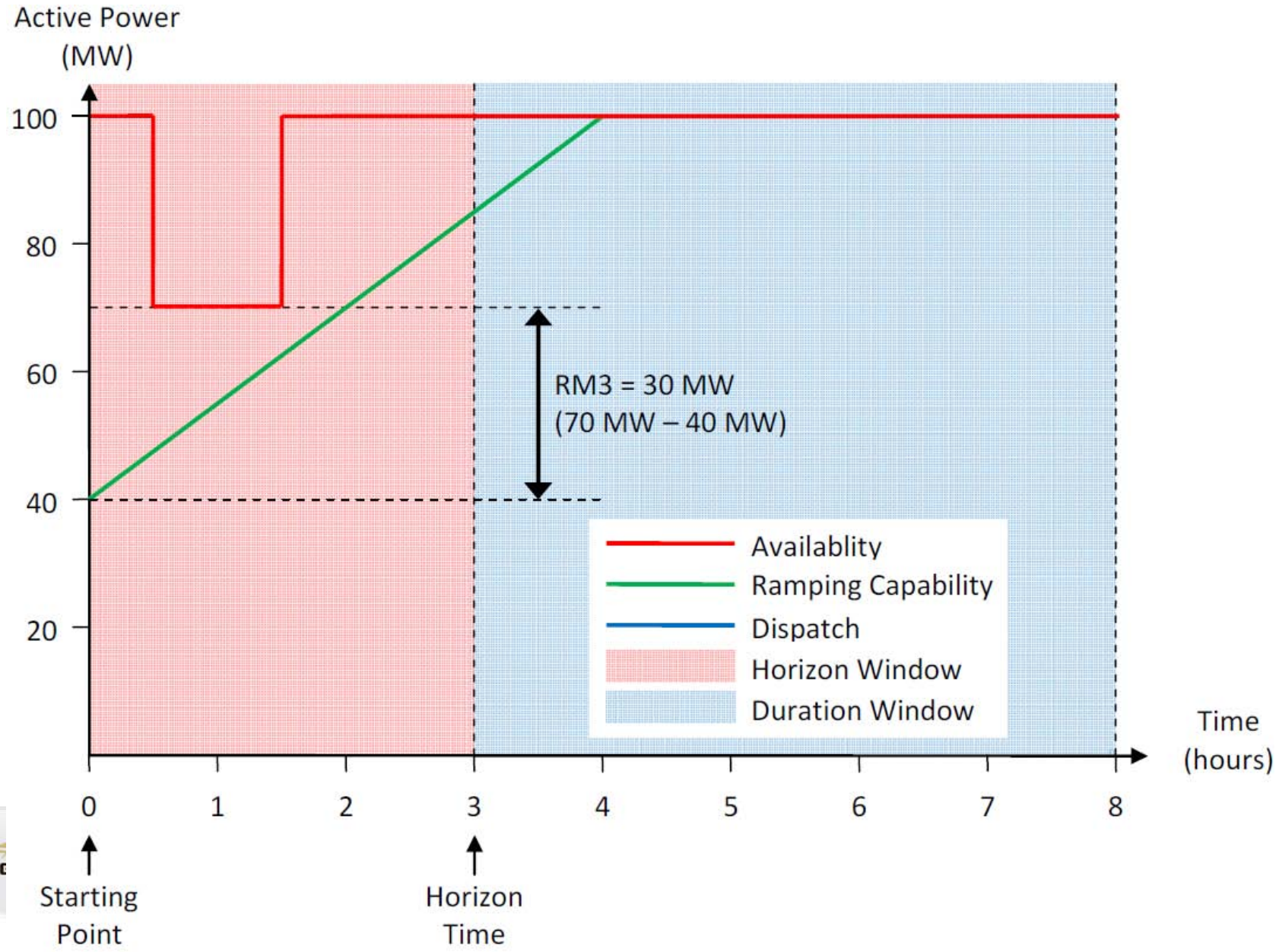
Fast Post-Fault Active Power Recovery



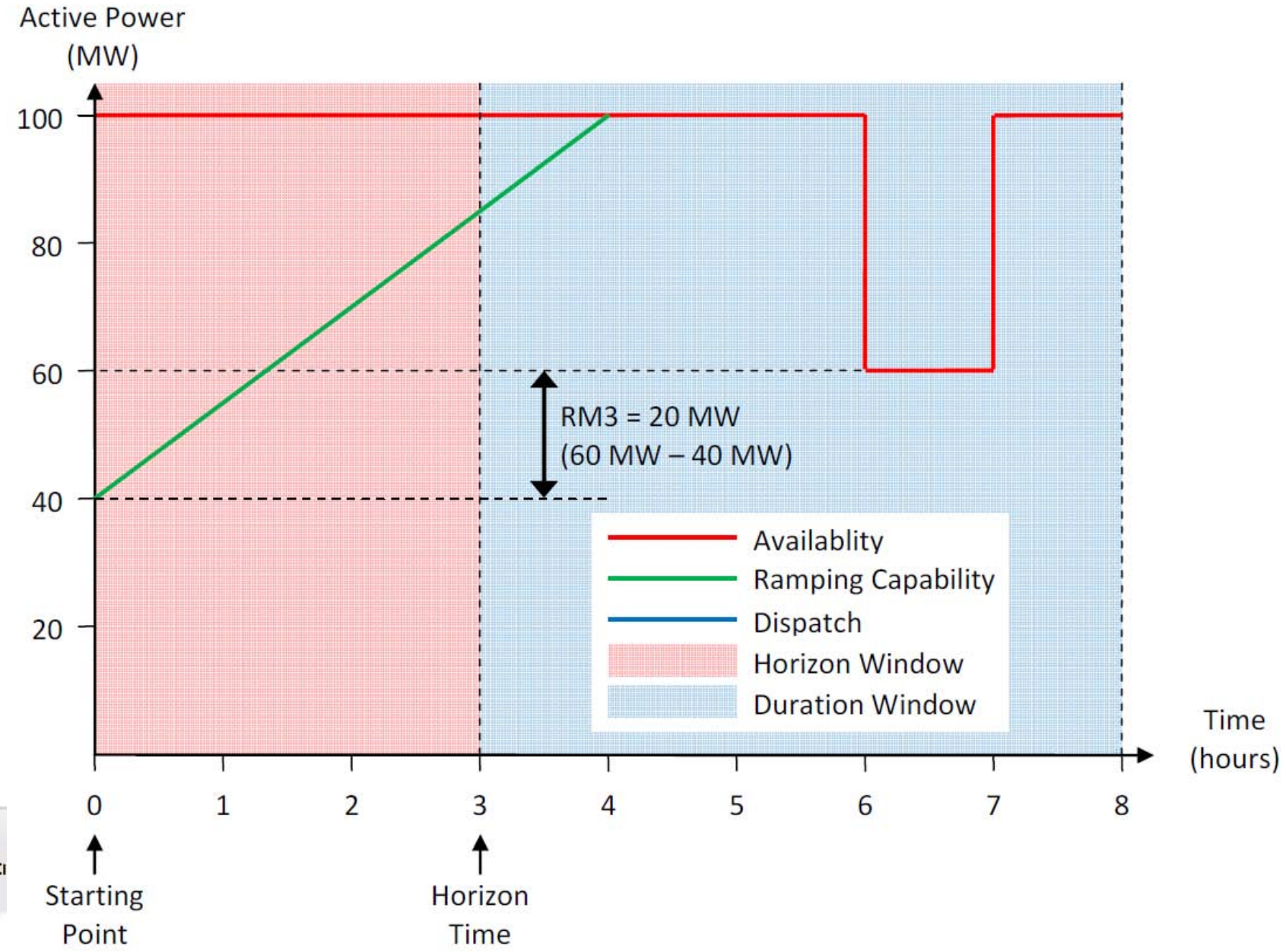
Ramping Margin (RM1, RM3 & RM8)



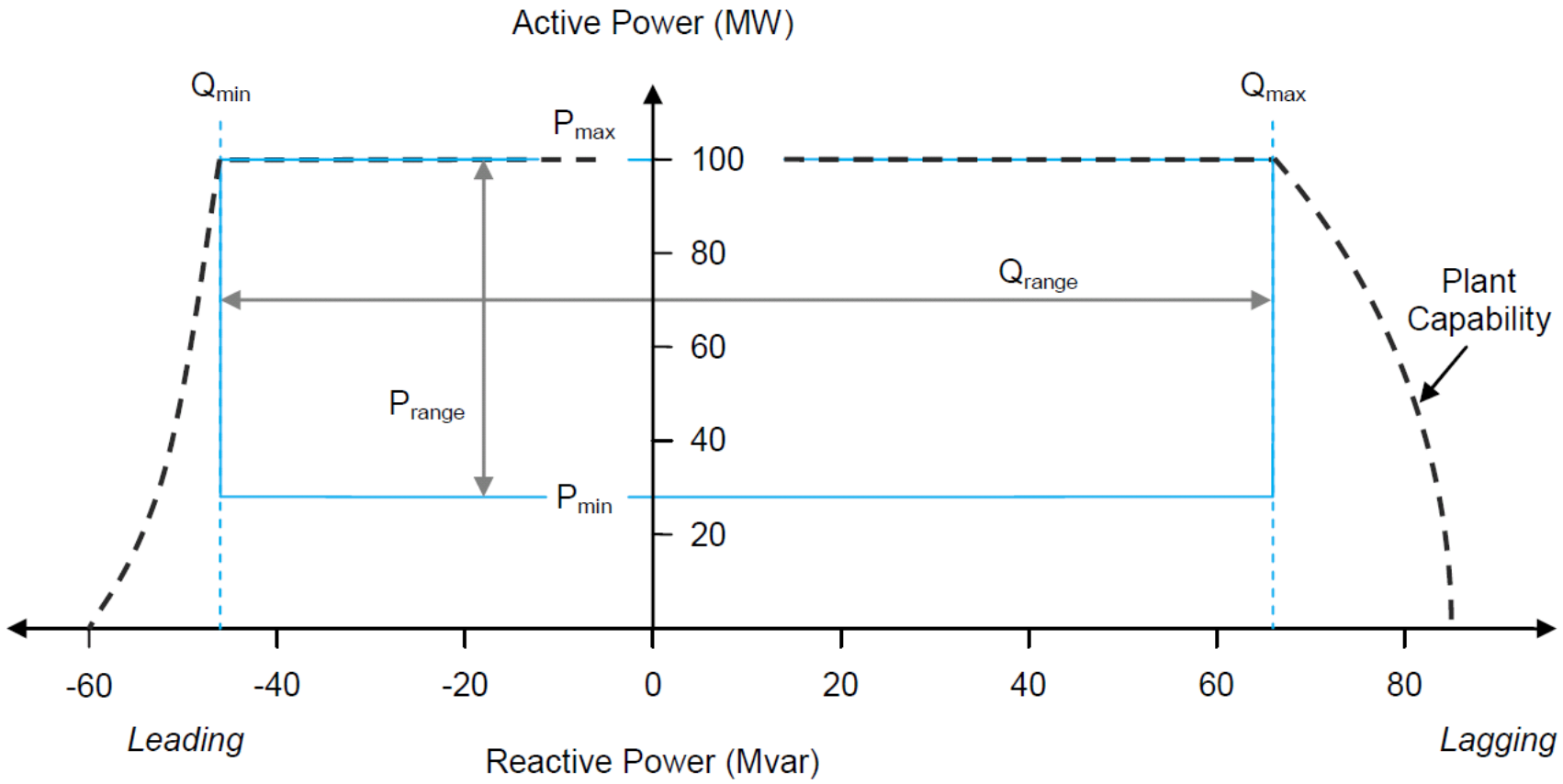
Ramping Margin (RM1, RM3 & RM8)



Ramping Margin (RM1, RM3 & RM8)

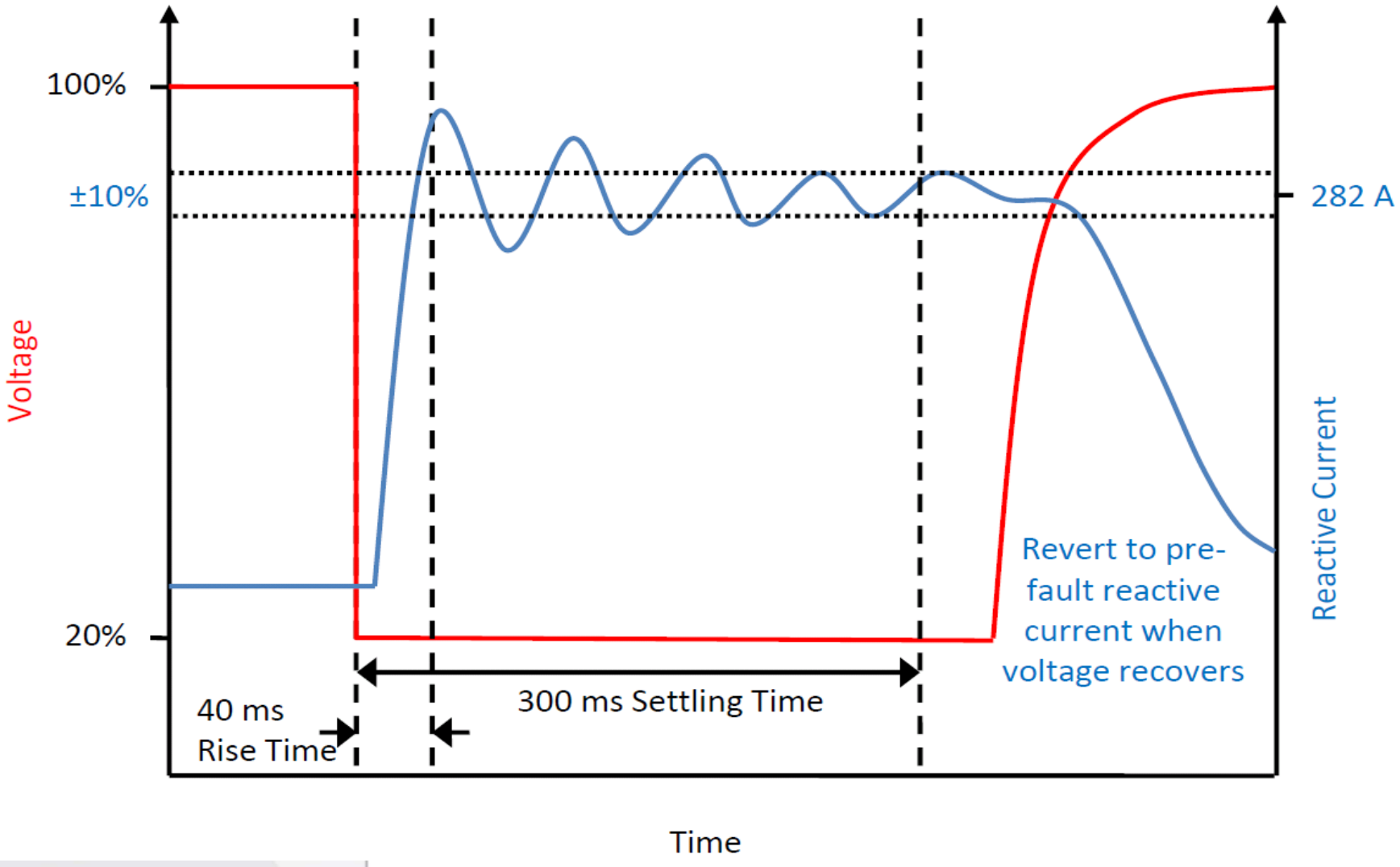


Steady-State Reactive Power



$$Q_{range} \times \frac{P_{range}\ that\ Q_{range}\ can\ be\ provided}{Registered\ Capacity}$$

Dynamic Reactive Response

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semo
Single Electricity
Market Operator
SONI
System Operator for Northern Ireland