DS3 Advisory Council – Meeting 26

Conference Centre SONI Ltd.

12 Manse Road, Belfast, Co Antrim, BT6 9RT

26 February 2020

EIRGRID **SONI**

Agenda - Morning

Topic	Time	Speaker
Tea/Coffee	10:30	Tea/Coffee
Introduction & Welcome	11:00	Jonathan O' Sullivan, EirGrid (15 min)
Industry Discussion	11:15	Colin D' Arcy, (20 mins) Noel Cunniffe, IWEA (20 min)
Rate of Change of Frequency (RoCoF)	11:55	ESBN (10 min) NIEN (10 min) EirGrid (10 min)
DS3 Programme Update	12: 25	Ian Connaughton, EirGrid (30 min)

EIRGRID SONI

Agenda - Afternoon

Topic	Time	Speaker
LUNCH	12:55	45 min
FFR	13:40	Jonathan O' Sullivan, EirGrid (15 min)
SysFlex 2030	13:55	Jonathan O' Sullivan, EirGrid (15 min)
FlexTech	14:10	John Lowry, EirGrid(15 mins)
Future Arrangements	14:25	Dylan Ashe, CRU (15 min)
AOB	14:40	Jonathan O' Sullivan, EirGrid (10 min)
Closing Remarks	14:50	Jonathan O' Sullivan, EirGrid (10 min)

EIRGRID SONI
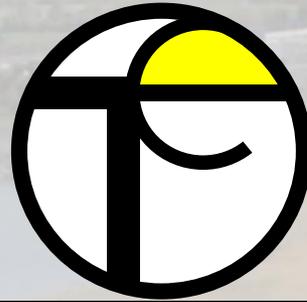
DS3 Performance Scalars (TOR2 – RM8)

Proportionality & Suitability

DS3 Advisory Council

Colin D'Arcy   **26/02/2020**

Ramping Margin Performance Assessment

- Quotes from DS3 System Services Protocol 1st May '19

- Ramping Margin Performance Assessment methods are applied for TOR2, RRS, RM1, RM3, RM8 and RRD.

- **Once an enduring assessment methodology** is developed, a similar method of Performance Assessment will be employed for each of these DS3 System Services.

- Until such a method is developed, TOR2, RRS,RM3, RM8 and RRD will use the RM1 Performance Incident Scaling Factor (Qi) that is based upon an EDIL 'Fail to Sync' Instructions assessment.

Performance Incident Response Factor (PE)

$$P_E = \max(1-\text{sum}(K_m \cdot V_m), 0)$$

	Syn Instruction	Fail To Sync Q_i
01-Jan	1	0
05-Jan	1	0
11-Jan	1	1
17-Jan	1	0
25-Jan	1	0
Average (K_m)		0.2

| Number of Months between Performance Incident Month and Scalar Assessment Month 'M'	Dynamic Time Scaling Factor 'V_m'
1	1
2	0.8
3	0.6
4	0.4
5	0.2
6+	0

Month 1		
V_m	K_m	$K_m \cdot V_m$
1	0.2	0.2
0.8	0	0
0.6	0	0
0.4	0	0
0.2	0	0
0	0	0
P_E	0.8	0.2

Month 2		
V_m	K_m	$K_m \cdot V_m$
1	0	0
0.8	0.2	0.16
0.6	0	0
0.4	0	0
0.2	0	0
0	0	0
P_E	0.84	0.16

Worked Example #1

	Syn Instruction	Fail To Sync Q_i
M	2	1
M-1	8	0
M-2	5	0
M-3	5	0
M-4	5	0
M-5	5	0
Total	**30**	**1**

Month 1		
V_m	K_m	K_m*V_m
1	0.5	0.5
0.8	0	0
0.6	0	0
0.4	0	0
0.2	0	0
0	0	0
P_E	0.5	

Month 2		
V_m	K_m	K_m*V_m
1	0	0
0.8	0.5	0.4
0.6	0	0
0.4	0	0
0.2	0	0
0	0	0
P_E	0.60	

Month 6		
V_m	K_m	K_m*V_m
1	0	0
0.8	0	0
0.6	0	0
0.4	0	0
0.2	0	0
0	0.5	0
P_E	1.00	

Month	P_E	Monthly Lost Revenue %	Annualised
1	50%	50.00%	4.2%
2	60%	40.00%	3.3%
3	70%	30.00%	2.5%
4	80%	20.00%	1.7%
5	90%	10.00%	0.8%
6	100%	0.00%	0.0%
		Total	**12.5%**

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Worked Example #2

	Syn Instruction	Fail To Sync Q_i
M	10	1
M-1	5	0
M-2	5	0
M-3	5	0
M-4	5	0
M-5	0	0
Total	**30**	**1**

Month 1		
V_m	K_m	K_m*V_m
1	0.1	0.1
0.8	0	0
0.6	0	0
0.4	0	0
0.2	0	0
0	0	0
P_E	0.9	0.1

Month 2		
V_m	K_m	K_m*V_m
1	0	0
0.8	0.1	0.08
0.6	0	0
0.4	0	0
0.2	0	0
0	0	0
P_E	0.92	0.08

Month 6		
V_m	K_m	K_m*V_m
1	0	0
0.8	0	0
0.6	0	0
0.4	0	0
0.2	0	0
0	0.1	0
P_E	1.00	0

Month	P_E	Monthly Lost Revenue %	Annualised
1	90%	10.00%	1%
2	92%	8.00%	1%
3	94%	6.00%	1%
4	96%	4.00%	0%
5	98%	2.00%	0%
6	100%	0.00%	0%
		Total	**2.5%**

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Monthly Granularity - Impact

- Timing of failed start can have significant impact – example 10% annual revenue.

- Why should an event on the 1st of a month have such a potential weighting compared to the last day of previous month?

- Is this fair – should all starts not be treated equally?

- CCGT potential overall annual revenue impact differential due to monthly granularity.

Assumed overall Annual DS3 revenue	€2,500,000
% Revenue of affected product	50%
Annual revenue from affected products	€1,250,000
Potential impact due 1 event & "Timing Issue" – 10%	€125,000.0

Not Hypothetical – Real world example

Running Profile - Oct 2019
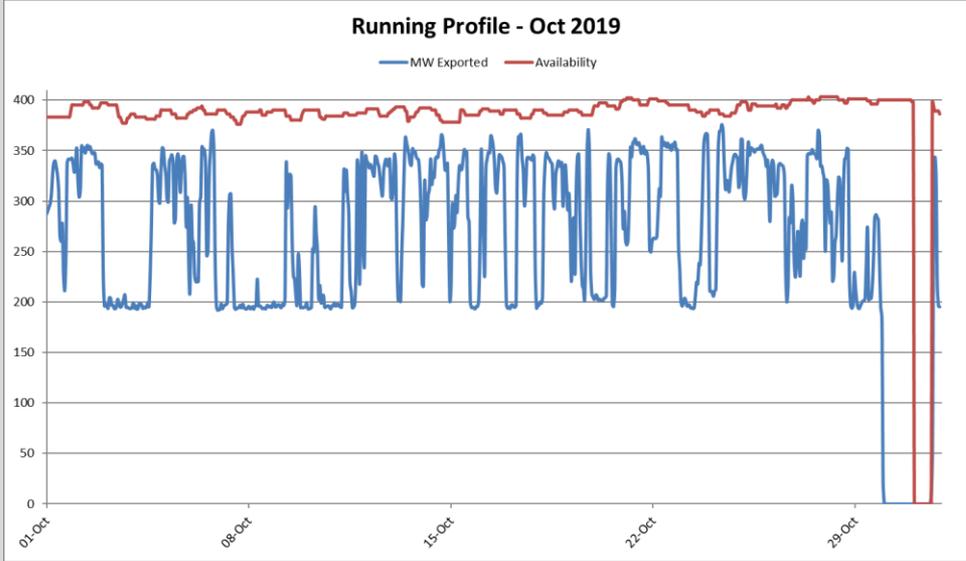
		OCT	NOV
		Actual	
P_F		0.5	0.83
		Worst Case (restart unsuccessful)	
P_F		0	0.83
		Event 1 day later	
P_F		1	0.75

TYC	151	21/11/2019 05:00	SYNC		0
TYC	151	19/11/2019 05:30	SYNC		0
TYC	151	18/11/2019 02:30	SYNC		0
TYC	151	15/11/2019 06:31	FAILSYN		1
TYC	151	15/11/2019 06:30	SYNC	N/A	
TYC	151	12/11/2019 07:30	SYNC		0
TYC	151	05/11/2019 06:00	SYNC		0
TYC	151	31/10/2019 15:30	SYNC		0
TYC	151	31/10/2019 04:01	FAILSYN		1
TYC	151	31/10/2019 04:00	SYNC	N/A	

Failure to restart -Worst Case

Running Profile - Oct 2019

— MW Exported — Availability
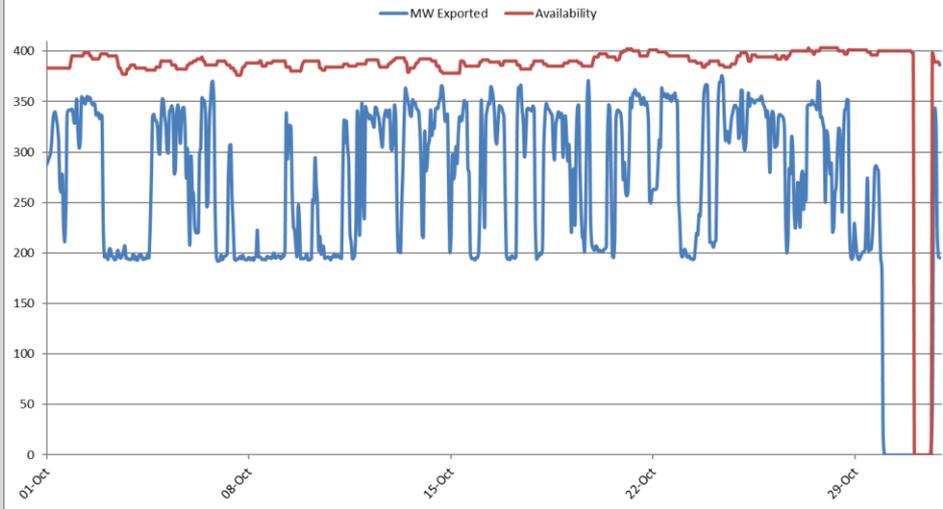
	OCT	NOV
	Actual	
P_F	0.5	0.83
	Worst Case (no restart)	
P_F	0	0.83
	Event 1 day later	
P_F	1	0.75

Failure to start within day / month would have resulted in further 12.5% annual revenue lost – circa €150K

TYC	151	21/11/2019 05:00	SYNC	0
TYC	151	19/11/2019 05:30	SYNC	0
TYC	151	18/11/2019 02:30	SYNC	0
TYC	151	15/11/2019 06:31	FAILSYN	1
TYC	151	15/11/2019 06:30	SYNC	N/A
TYC	151	12/11/2019 07:30	SYNC	0
TYC	151	05/11/2019 06:00	SYNC	0
TYC	151	31/10/2019 15:30	SYNC	0
TYC	151	31/10/2019 04:01	FAILSYN	1
TYC	151	31/10/2019 04:00	SYNC	N/A

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Suitability of current performance metric

CCGT Starts Metric Alignment – Are starts relevant to provision?

Products	Aligned	Comment
TOR2	No	Due to time CCGT does not provide from Off
RRS	No	By definition, must be synchronised
RM1	No	Due to time restriction most (if not all) CCGTs do not provide from off
RM3	Partial	Depending on running regime
RM8	Partial	Depending on running regime
RRD	Yes	By definition, starts are related.

Enhanced Monitoring – lessons learnt?

- Performance measurement must be appropriate and relevant.

- Monthly granularity can have disproportionate impacts.

- Data poor status for months with low events or utilisation of long run averages.

- The starts appropriateness as a metric was raised as an issue during consultation.

- Rigorous scenario testing of future performance monitoring measures – identify unintended consequences and mitigate. e.g. Data Poor Status.

Store, Respond and Save

Noel Cunniffe, Head of Policy

26 February 2020
DS3 Advisory Council

IWEA represents 95% of Wind in Ireland

- Members across existing assets, development & supply chain for onshore & offshore:

  - Wind farm developers
  - Asset owners
  - Supply Chain:
    - Turbine manufacturers
    - Construction companies
    - Supply companies
    - Accountants
    - Insurance
    - Consultancy
    - Legal firms
    - Banks

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Energy Storage Ireland – New All-Island Energy Storage Association

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BORD NA MÓNA
Naturally Driven

ESB Energy for generations

enErgia GROUP

SCOTTISHPOWER

enel x

NORDEX

Vestas

Statkraft

everoze

ABO WIND

COILLTE
GROW·TRANSFORM·SUSTAIN

res
power for good

innogy

Enerco Energy

ENERCON
ENERGY FOR THE WORLD

EVERSHEDS SUTHERLAND

MullanGrid
CONSULTING

ENGIE

Brookfield

DP ENERGY

GE Renewable Energy

GALETECH
ENERGY SERVICES

ECOPOWER

SIEMENS Gamesa
RENEWABLE ENERGY

natural power

CORNWALL INSIGHT
CREATING CLARITY

Electricity EXCHANGE

ElectroRoute
a subsidiary of Mitsubishi Corporation

DS3 System Services were created to help the power system

Managing Frequency

Inertial Response

Reserve

Ramping

| SIR | POR | TOR1 | RR |
| FFR | SOR | TOR2 | Ramping |

0 – 5s   5 – 90s   90s – 20min   20min – 12hr

Managing Voltage

Transient Voltage Response

Voltage Regulation

Network

| Dynamic Reactive Power | Steady-state Reactive Power | Network Adequacy |
| | | Grid 25 |

ms – s   s – min   min – hr

DS3
SYSTEM PERFORMANCE
SYSTEM POLICIES
SYSTEM TOOLS

IWEA
Irish Wind Energy Association

DS3 introduced 14 different System Services to help to manage the system at high renewables and increase the SNSP limit

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System Services Categories & Zero Carbon Technologies

Reserve

Inertia

Reactive power

Ramping

Short Term Frequency Control – Reserve + Inertia

Reserve

- Multiple time categories from **500 ms to 1 hour** – today this is primarily fossil fuels with some wind & demand side management

- Zero Carbon technologies for Reserve are well-established & low-cost

Zero Carbon Technologies to provide System Services

Battery Storage

- Very fast acting technology
- Significantly decreasing costs
- Multiple uses – System Services, Energy Balancing, Network Deferral

Renewable Generation

Demand Side Response

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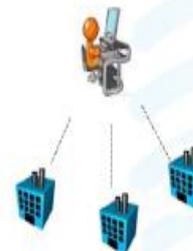
Short Term Frequency Control – Reserve + Inertia

Inertia

- Today's minimum system inertia requirement is **23,000 MWs**

- DS3 plans to reduce this to **20,000 MWs**, then **17,500 MWs** and potentially lower moving towards 2030

Zero Carbon Technologies to provide System Services

Synchronous Condensers

- Two types:
- Bespoke modular devices
- Re-purposed fossil fuel generators

- Modular Synchronous Condensers are about **500 MWs** per device

One Gas Generator ~ 3,000 MWs

=

Six Modular Synchronous Condensers

For 2030 likely to require:
20,000 MWs of Inertia which is equivalent to 40 Synchronous Condensers

System Services Categories & Zero Carbon Technologies

Zero Carbon Technologies to provide System Services

Reserve

- Batteries, Demand Side Response, Renewable Generation (Wind, Solar, Hydro)

Inertia

- Synchronous Condensers

Reactive power

Ramping

System Voltage Control – Reactive Power

Reactive Power

- Voltage is controlled on the network by **producing or absorbing Reactive Power** – measured in Megavars (Mvar)

- Historically this was done by fossil fuel generators but increasingly it is done using renewables and network devices

Zero Carbon Technologies to provide System Services

STATCOMs, Capacitor Banks, Reactors, SVCs

- These are Power Electronic devices which can be added to the network
- Widely used across the network at present – STATCOMs at many wind farms, and there are two SVCs in Letterkenny & Castlebar

Renewable Generation

Synchronous Condensers

STATCOMs and SVCs can produce or absorb reactive power to control voltage up or down

Capacitor Banks provide reactive power and can increase voltage
Reactor Banks absorb reactive power and decrease voltage

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For 2030 likely to require:
± 3,600 Mvar – Mostly in cities & areas with high renewables

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System Services Categories & Zero Carbon Technologies

Zero Carbon Technologies to provide System Services

Reserve
- Batteries, Demand Side Response, Renewable Generation (Wind, Solar, Hydro)

Inertia
- Synchronous Condensers

Reactive power
- STATCOMS, SVCs, Synchronous Condensers, Renewable Generation (Wind, Solar, Hydro)

Ramping

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Long Term Frequency Control – Ramping

Ramping

- Ramping is the ability of the power system to adapt quickly as a result of sudden changes

- These changes are usually based on low probability events or weather events – higher or lower forecasted demand or renewables

Wind Generation
Forecast Generation

— Wind Generation MW   — Forecast MW

Forecasting is very important for Ramping Requirements – example is from Storm Darwin in 2014
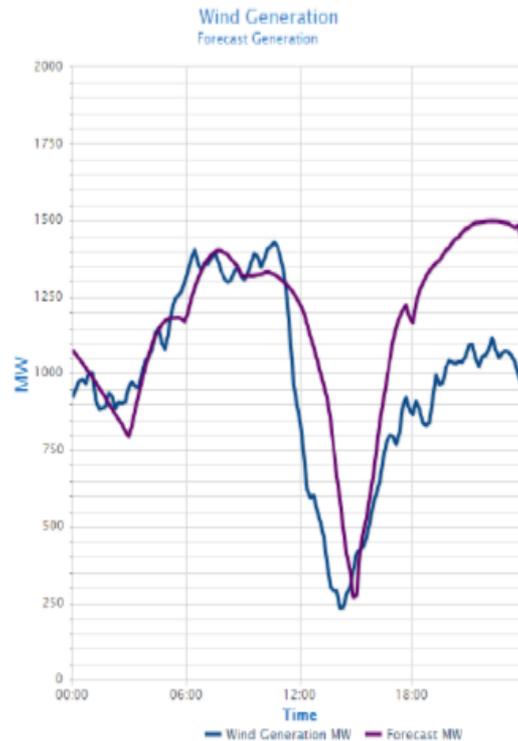
Zero Carbon Technologies to provide System Services

Long Duration Storage

Pumped Hydro Storage

Demand Side Response

Renewable/Hydrogen Gas

For 2030 likely to require:
1,500 MW – 1 hour, 3000 MW – 3 hours, 4,000 MW – 8 hour

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System Services Categories & Zero Carbon Technologies

Zero Carbon Technologies to provide System Services

Reserve
- Batteries, Demand Side Response, Renewable Generation (Wind, Solar, Hydro)

Inertia
- Synchronous Condensers

Reactive power
- STATCOMS, SVCs, Synchronous Condensers, Renewable Generation (Wind, Solar, Hydro)

Ramping
- Long-duration batteries (4-8 hours), Pumped Hydro Generation, Demand Side Response, Flexible Hydrogen Gas Power Plants

Store, Respond & Save & Our Energy Storage Future

energy storage :: IRELAND

- Analysis carried out by Baringa Partners investigating the benefits of zero carbon reserves & System Services

- Builds off Baringa's 70by30 Study and shows large savings in operational costs and CO_2 and a reduction in curtailment

Store, Respond and Save
Cutting two million tonnes of CO2
December 2019

Our Energy Storage Future
Recommendations for an All-Island Energy Storage Roadmap

December 2019
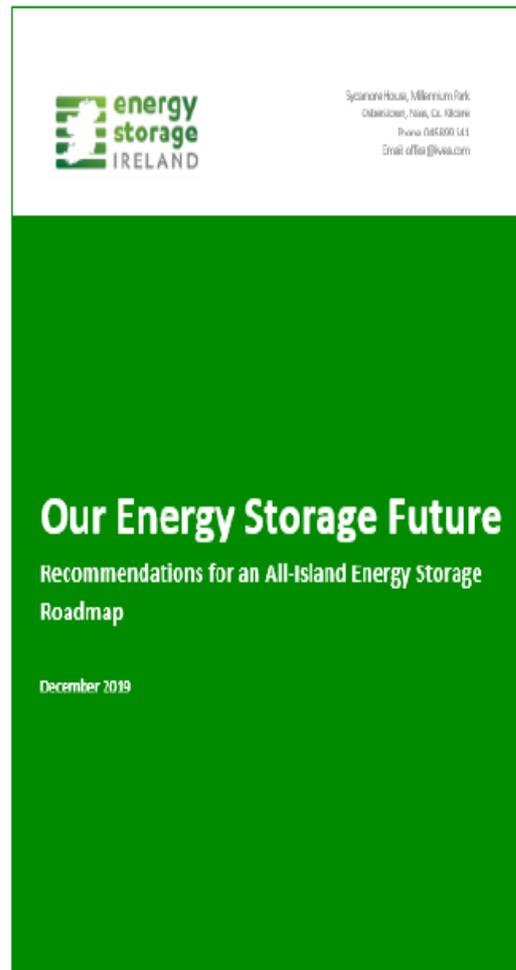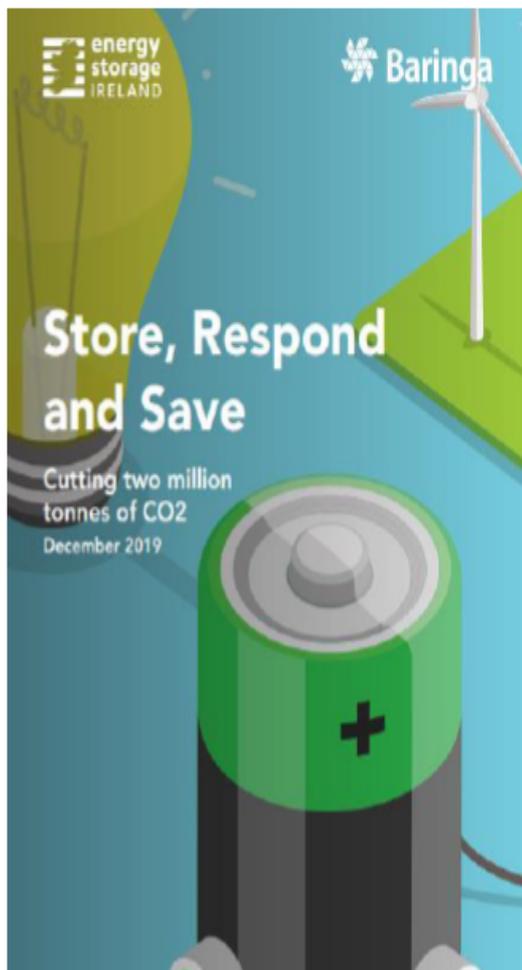
- Roadmap for breaking down policy, regulatory and technical standard barriers to deliver more Energy Storage in Ireland and Northern Ireland by 2030

- Developed by Energy Storage Ireland members

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Store, Respond & Save - Key Assumptions

Table 1   Key universal assumptions in 2030

	ROI	NI	All-Island
% RES-E	70%	70%	70%
% RES	25%	25%	25%
Total Electricity Demand (TWh)	38.8	10.6	49.4
Wind Power (MW)	8,000	2,190	10,190
Solar Power (MW)	2,500	400	2,900
Interconnection (MW) – All Island	2,030	2,030	2,030
Electric Vehicles (nr)	426,000	203,398	629,398
Heat Pumps (nr)	279,000	117,302	396,302
Small Scale Battery Storage[13] (MW)	400	100	500
Large Scale Battery Storage[13] (MW)	960	240	1,200

Store, Respond & Save - Key Assumptions...For the dedicated

Constraint	2020	2025	2030
RoCoF Limit	1Hz/s	1Hz/s	1Hz/s
Min Inertia	20,000 MWs	NA	NA
Min Reserve (POR,SOR,TOR)	184MW Day / 124MW Night	184MW Day / 124MW Night	184MW Day /124MW Night
Negative Reserve	150MW	150MW	150MW
	2020	2025	2030
Min Units ROI	5	NA	NA
Min Unit NI	2	NA	NA
Min Units All-Island	NA	5	4
	2020	2025	2030
Dublin Generation 1	1 of DB1, HNC, HN2	1 of DB1, HNC, HN2	1 of DB1, HNC, HN2
Dublin Generation 2	2 of DB1, HNC, HN2, PBA, PBB	2 of DB1, HNC, HN2, PBA, PBB	2 of DB1, HNC, HN2, PBA, PBB
Dublin Generation 3	2 of DB1, HNC, PBA, PBB	2 of DB1, HNC, PBA, PBB	1 of DB1, HNC, PBA, PBB
Dublin Generation 4	3 of DB1, HNC, HN2, PBA*, PBB*	3 of DB1, HNC, HN2, PBA*, PBB*	2 of DB1, HNC, HN2, PBA, PBB
South Generation 1	1 Gas Unit	1 Gas Unit	1 Gas Unit
South Generation 2	2 Gas Units	2 Gas Units	2 Gas Units
South Generation 3	3 Gas Units	3 Gas Unit, 2 from 2025	3 Gas Unit, 2 from 2025
South Generation 4	3 Gas Units	2 Gas Units	2 Gas Units
Moneypoint	1 of MP1, MP3, TYC	NA	NA
NorthWest Generation	Coolkeeragh on load if NI Demand > 1608 MW & NI wind generation < 450 MW	NA	NA

Analysis shows the Annual Operational Cost Savings is significant...

Bar chart: € million, real 2019 by year

Year	ZC Services & Reserve	ZC Reserve	50% ZC Reserve
2021	90	15	13
2023	91	12	12
2025	72	41	41
2027	101	48	47
2030	117	57	57

Legend: ■ ZC Services & Reserve ■ ZC Reserve ■ 50% ZC Reserve
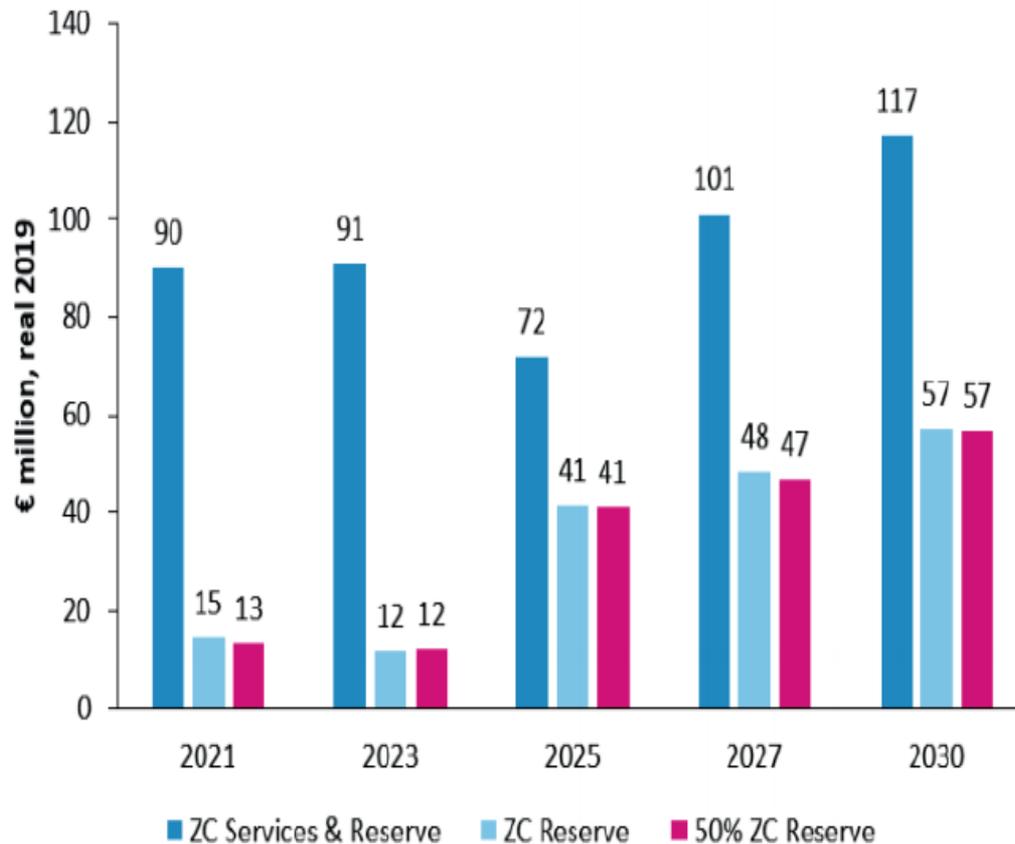
- Moving just **50%** of reserve services to zero carbon technologies gives a benefit of almost **€60m per annum by 2030**

- Increasing this to **all reserve services** coming from zero carbon sources only **marginally increases the benefit** – this is due to other system constraints for voltage and inertia keeping fossil fuel generation on giving "free" reserve

- However, a saving of **€117 million per annum by 2030** would occur if **all Systems Services could come from zero carbon sources**

- This is derived primarily from **avoided fuel and carbon costs** from holding part-loaded fossil-fuelled plant

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...and it can save up to 2 Million Tonnes of CO2 per year

Legend: ZC Services & Reserve ■ ZC Reserve ■ 50% ZC Reserve
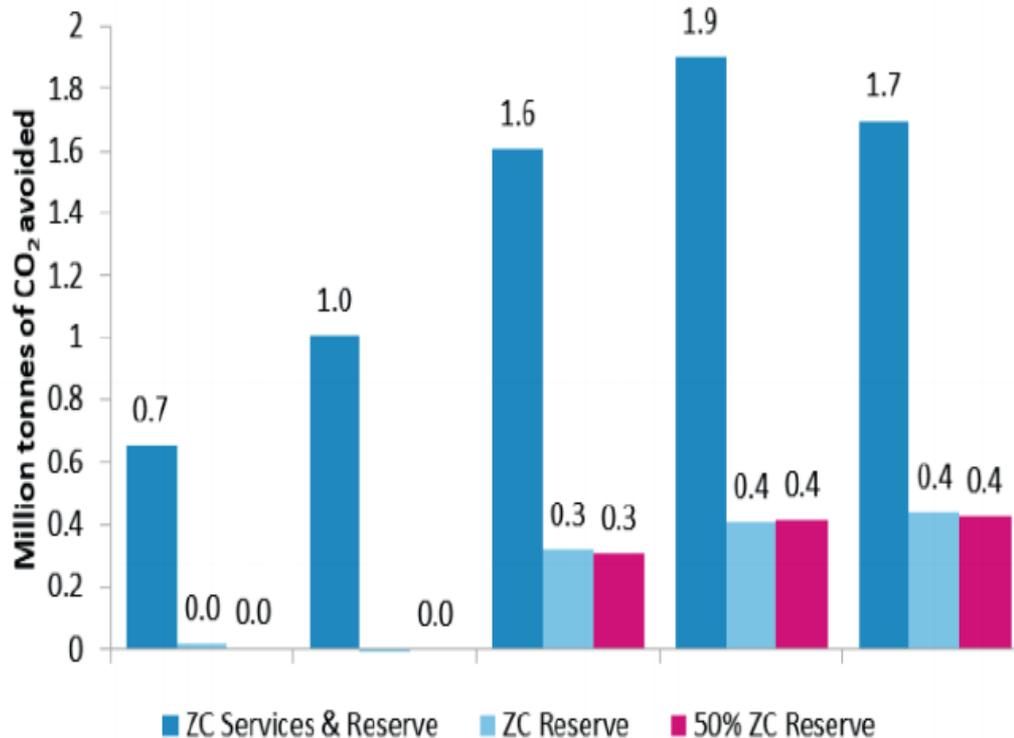
- Analysis indicates that the **Zero-Carbon Model** would avoid up to **2 million tonnes of CO2 emissions per year** – around **a third of power sector emissions by 2030**

- Equivalent to taking **600,000 fossil-fuelled cars** off the road

- This equates to as much as **1218 tCO2 avoided per annum per MW** of zero carbon capacity deployed

- Deploying **1 MW of zero-carbon reserve** over the period 2025-2030 is the **equivalent** of planting around **6,000 trees and ensuring their survival for 100 years**

There are also benefits to renewable curtailment
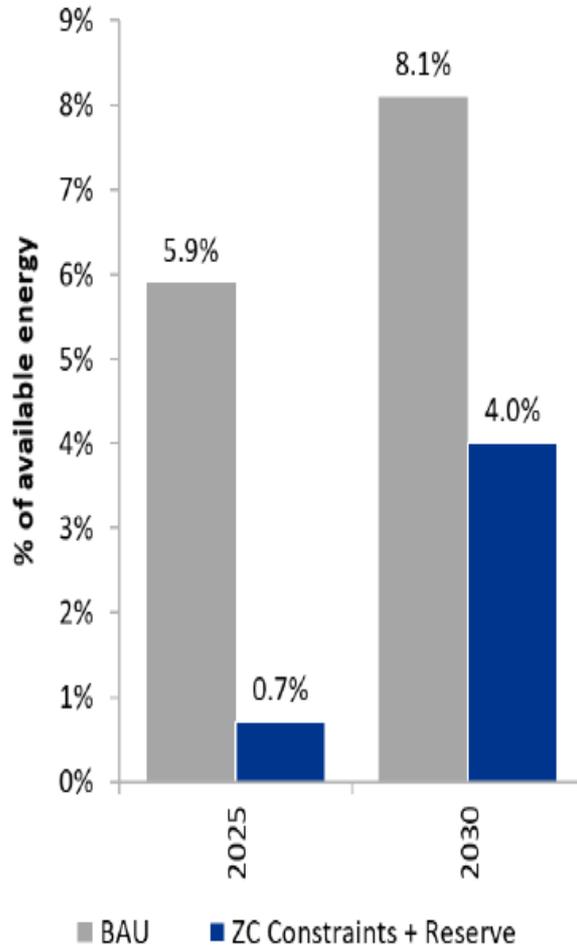
- Results also show the potential benefits of reduced renewable curtailment of meeting all system constraints using zero carbon providers

- A reduction in renewable curtailment in 2025 from approximately 6% to 0.7%, and in 2030 from 8% to 4%

Store, Respond & Save – How to save two million tonnes of CO2

2 million tonnes of CO$_2$ per year avoided

At least €117m per year operational cost saving

50% reduction in renewable curtailment

Equivalent to removing one third of power sector emissions

Half of this annual saving is realised by deployment of zero-carbon reserve alone

Enough energy to meet the annual needs of over 300,000 domestic customers

- The **results are entirely technology agnostic**, but zero-carbon providers such as demand side response units, battery storage, synchronous condensers, flywheels and renewable generation are already available today

- The analysis has **not examined the market design and commercial framework** under which zero-carbon service providers could be remunerated

- However, it demonstrates that **long-term frameworks which provide investment certainty** for zero-carbon providers to deliver **would be beneficial in achieving power sector decarbonisation goals**

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ROCOF Implementation Programme

DS3 Advisory Group meeting 26/02/20

Tony Hearne

TSO-DSO Interface Manager

Update since Mis-communication on ROCOF targets

- **Much dialogue between ESBN - CRU – UR**

- **Two main strands of work underway**

- **[1] TSO-DSO Validation strand**

- **[2] Major project to bring the remaining generators to compliance**

Validation Strand

- **Various strands of validation and clarifications about the cohort of non-wind generators which are considered to be "Low Risk"**

- **Such issues as;**

  - Validation of records

  - Level of DSU participation

  - Extent of Micro-generation

  - Nature of Trickle-Feed sites

- **Much work and data gathering carried out**
- **Strand now considered to be closed out**

ROCOF–VS change project

NETWORKS

- **In ESB, Engineering and Major Projects [EMP] tasked with bringing the remaining sites into compliance.**

- **Project being lead by Eoghan O'Callaghan with supporting team**

- **Major support on customer engagement provided by ESBN local senior management**

- **Four sub-tasks identified;**

- Sub-task 1: Vector Shift – Wind. Not in scope of original project; Either remove or move to 12 degree setting

- Sub-task 2A: Non-wind High Priority list ROCOF

- Subtask 2B: Non-wind High Priority list Vector Shift

- Sub-task 3: Status of sites where further information is needed

- **Reporting to CRU and EirGrid every week**

Overall Engagement Steps

- 250 customers (wind and non-wind)
  - Approx. 2 phone calls per customer
  - 2 Formal Written Notices
  - Phone and Mail engagement with contractor/agent for each site (approx. 0.5 per customer)
  - 3 Formal group meetings with Synchronous Generators Ireland (SGI)
  - Notice to inform of compliance on completion

Status 26-1-20: Vector Shift Wind

Target Totals	
Number of sites	MW
43	282

Milestones complete	Number of sites	MW	Forecast MW
Engagement with WF owner	43	282	282
Permission to speak to OEM/Agent received	38	269	282
Technical Agreement to remove or change settings	34	237	282
OEM/Contractor engaged by owner	22	173	282
Confirmation of all changes received	22	173	226

NETWORKS

Sub-category	Target Totals	
	Number of sites	MW
ROCOF	60	79

Milestones complete	Number of sites	MW	Forecast MW
Engagement with site owner	60	79	79
Permission to speak to OEM/Agent received	38	62	79
Short Topology Questionnaire returned by OEM/Agent	24	52	79
OEM/Contractor engaged	17	36	79
Confirmation of all changes received	11	30	47

Sub-category	Target Totals	
	Number of sites	MW
Vector Shift	174	181

Milestones complete	Number of sites	MW	Forecast
Engagement with site owner	174	181	181
Permission to speak to OEM/Agent received	104	154	181
Technical Agreement to remove VS functionality or move to 12 deg. setting.	53	122	181
OEM/Contractor engaged	53	122	181
Confirmation of all changes received	47	112	54

Non-Wind Customers (as of 21/02/2020)
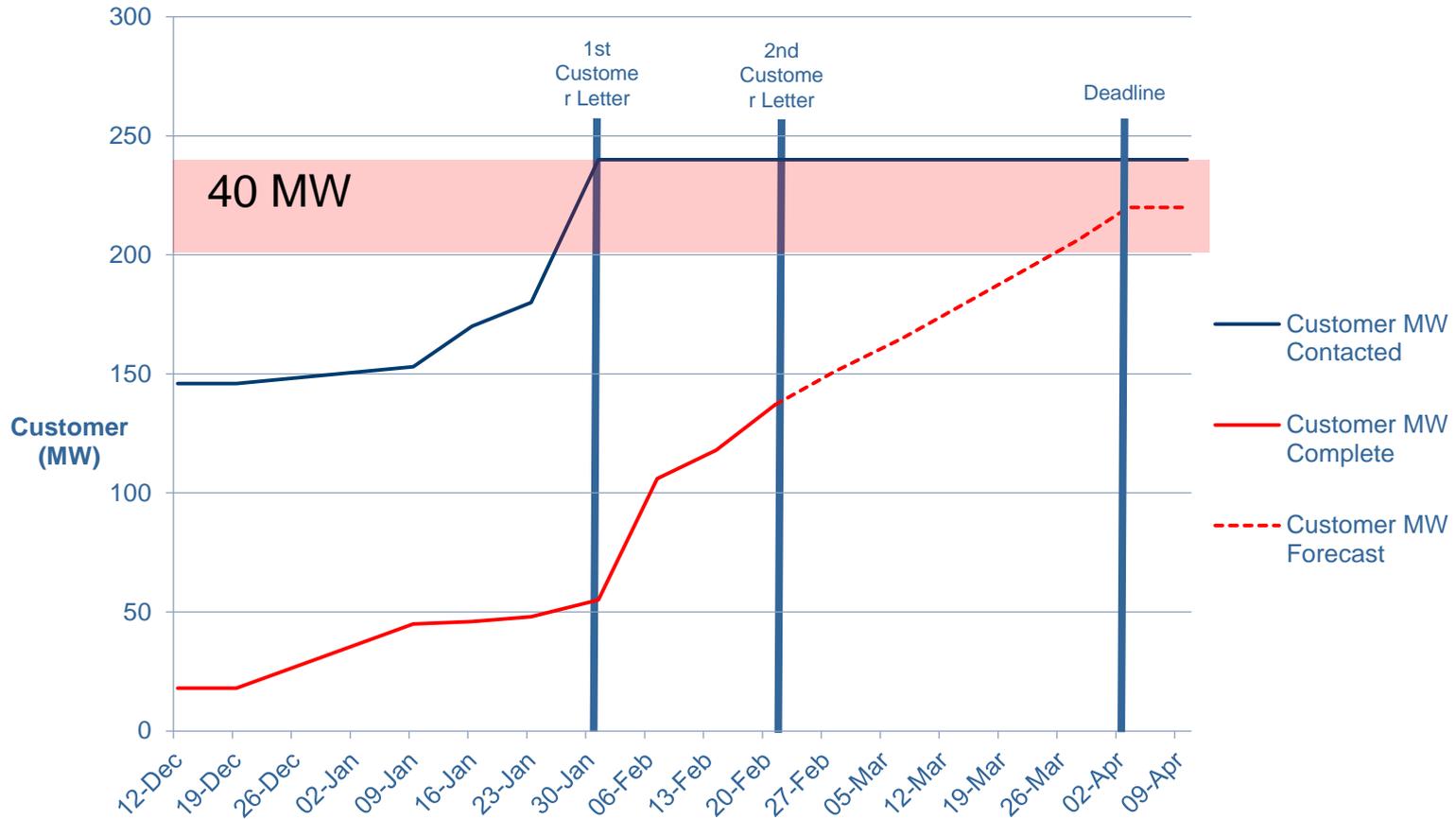
Combined Wind and Non-Wind Customers (as of 20/02/2020)

NETWORKS
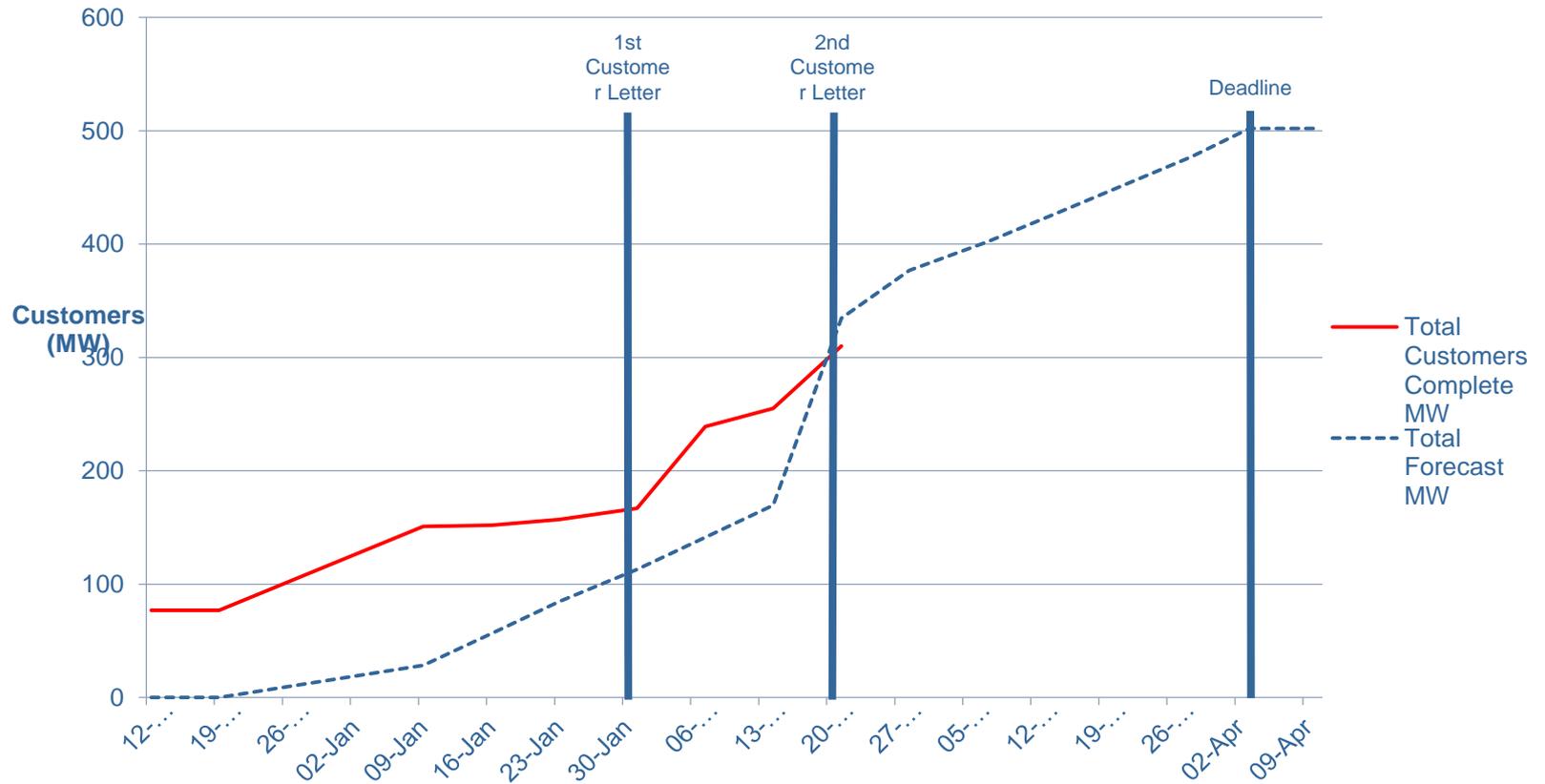
Sub-category	MW
Verification Required	120

Milestones complete	MW
Engagement with site owner	45
Permission to speak to OEM/Agent received	45
Classify as required	39

Information to enable a close-out proposal for this sub-task , is expected for this for next week's report

Questions?

Non-wind, Non-exporting: High vs low risk

High Risk:

- **High likelihood of running**

- **Operating in "shaving" mode i.e. operates in parallel for entire duration of running**

In parallel with network

"Shaving"
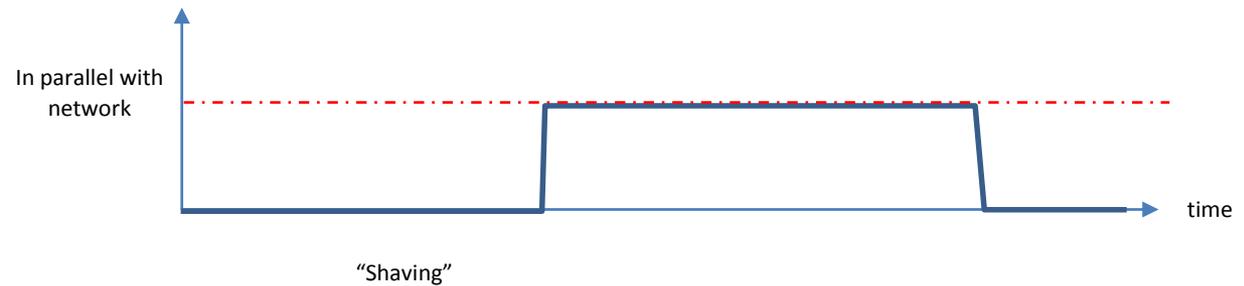
Low Risk

- **Lower likelihood of running**

- **Operating in "lopping" mode i.e. only operates in parallel for some minutes when going into and out of island mode**

In parallel with network

Generator in island mode

"Lopping"

time
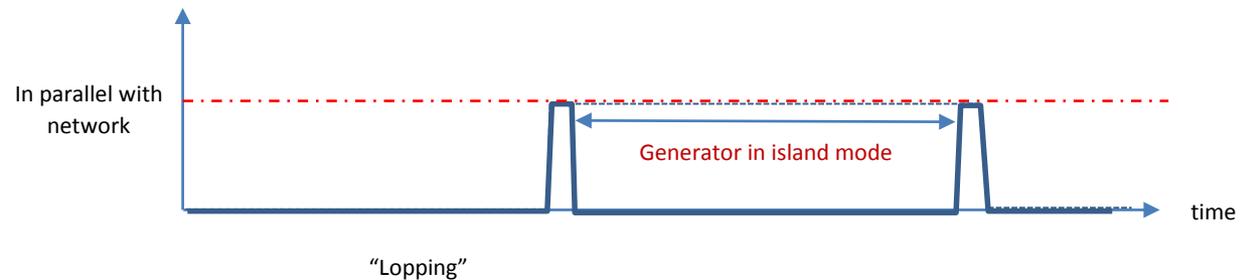
Emergence of "Trickle Feed" sites

- During engagements with Non-wind , Non-exporting Generators, the occurrence of a particular kind of site – setup, was encountered.

- Where this arrangement exists, the generator can take the whole site load and could go into island mode but instead, they choose to keep a small trickle import (typically ~30KW).

- Also, crucially, the Main Incomer CB opens.

- From ESBN perspective, this makes detection of a genuine local island more difficult – hence a tendency to leave legacy ROCOF settings in place

- From EirGrid perspective, system impact of CB opens is quite benign, with a loss of demand load of the trickle only.

- Where confirmed, these sites were deemed to be completed

ESB Network

Premises or site boundary

G

ΔP

P - ΔP

G10

Main incomer CB

P

Site Load
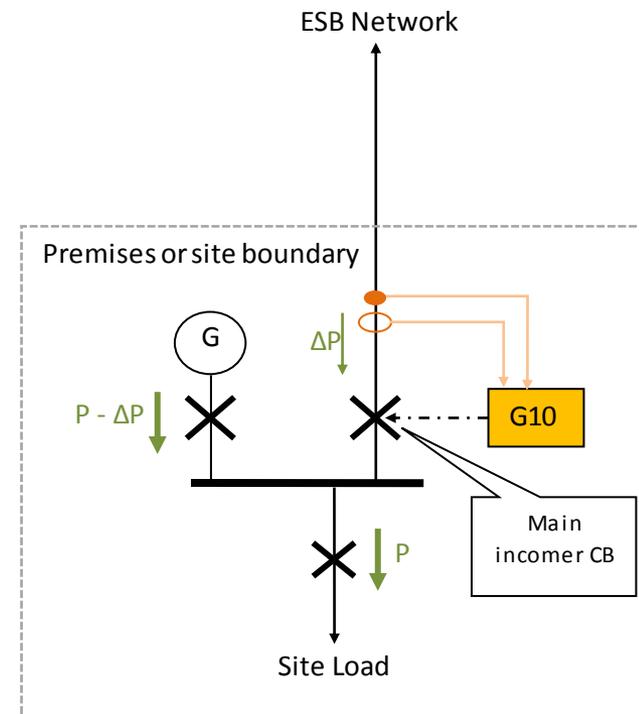
ROCOF IMPLEMENTATION PROGRAMME

**Update 26/02/2020**

David Hill

LSG RoCoF – Complete

- All LSG sites >5MW have been changed to new RoCoF setting

- 1120 MW changed to 1Hz/s RoCoF setting (including new LSG's connected during the programme)
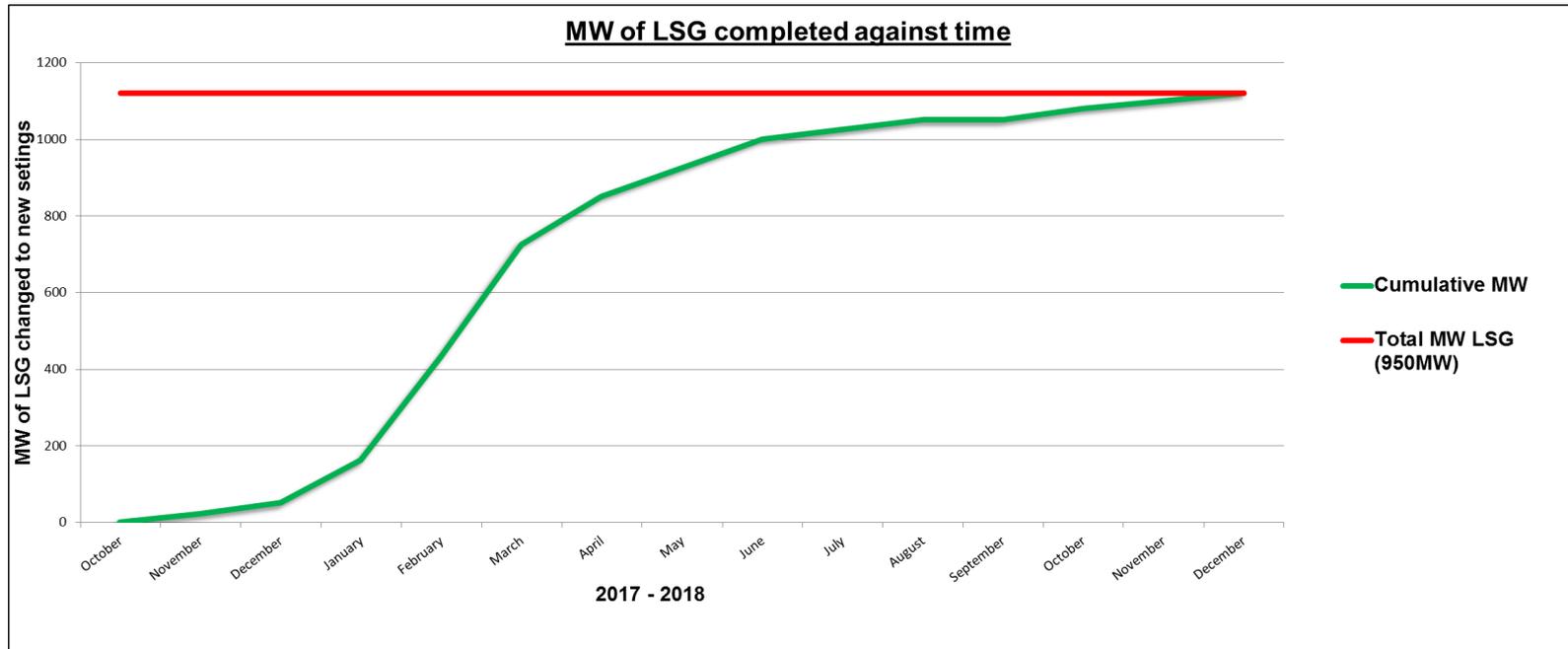
SSG RoCoF – Complete

- 1345 SSG's have been changed to new RoCoF setting

- 400 MW SSG now changed to 1Hz/s RoCoF setting

MW of SSG completed against time

Changes Complete (MW)

400 MW

- BioGas*
- Diesel
- PV
- Wind

BioGas*	91
Diesel	119
PV	34
Wind	156

* BioGas includes LFG, CHP, AD & Hydro

- % MW Complete
- Total MW SSG (400MW)
- MW Complete
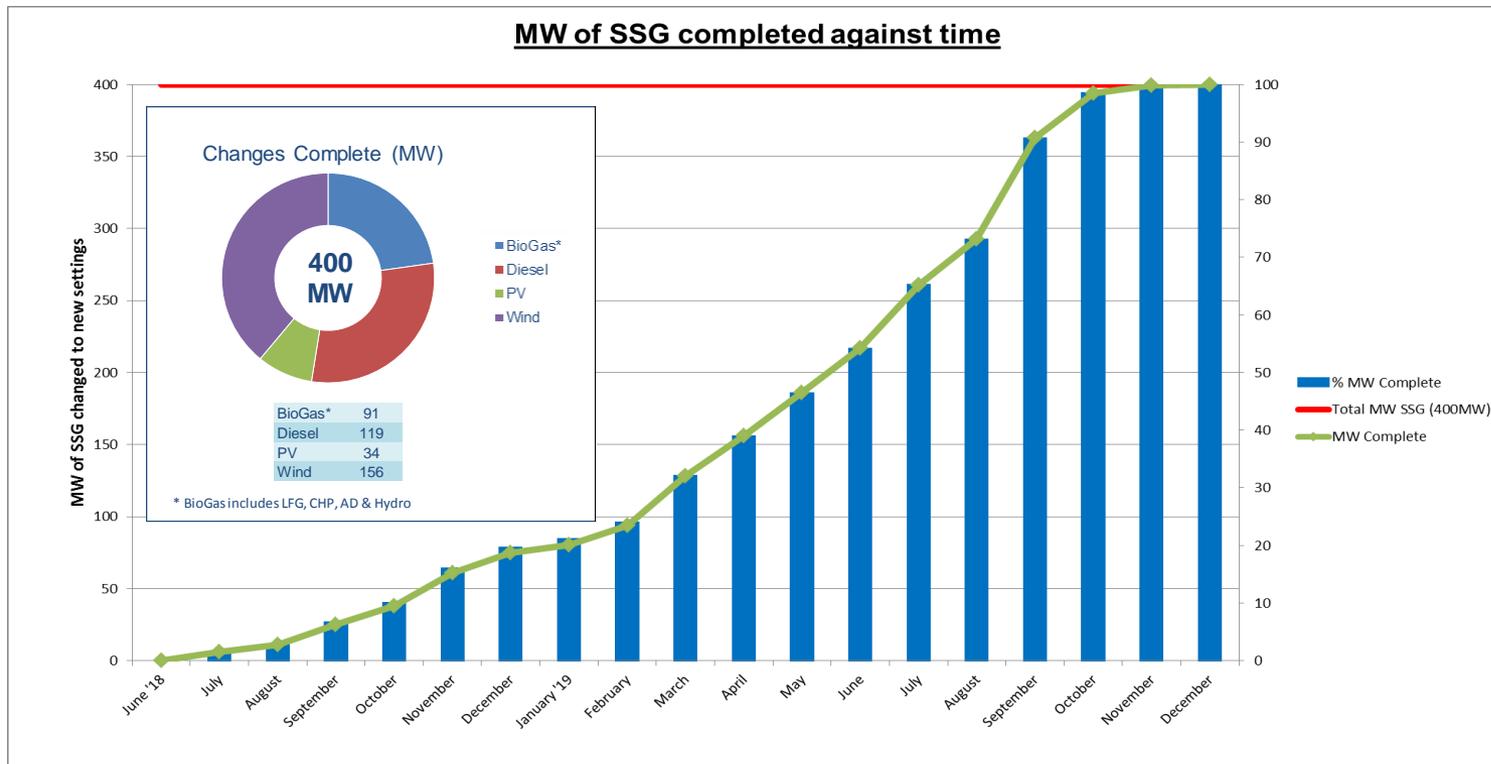
Total RoCoF (LSG & SSG) – Complete

- 1413 Generators have been changed to new RoCoF setting

- 1520 MW Generation now changed to 1Hz/s RoCoF setting

Changes Complete (MW)

1520MW

- BioGas*
- Diesel
- PV
- Wind

BioGas*	113
Diesel	138
PV	149
Wind	1120

* BioGas includes LFG, CHP, AD & Hydro
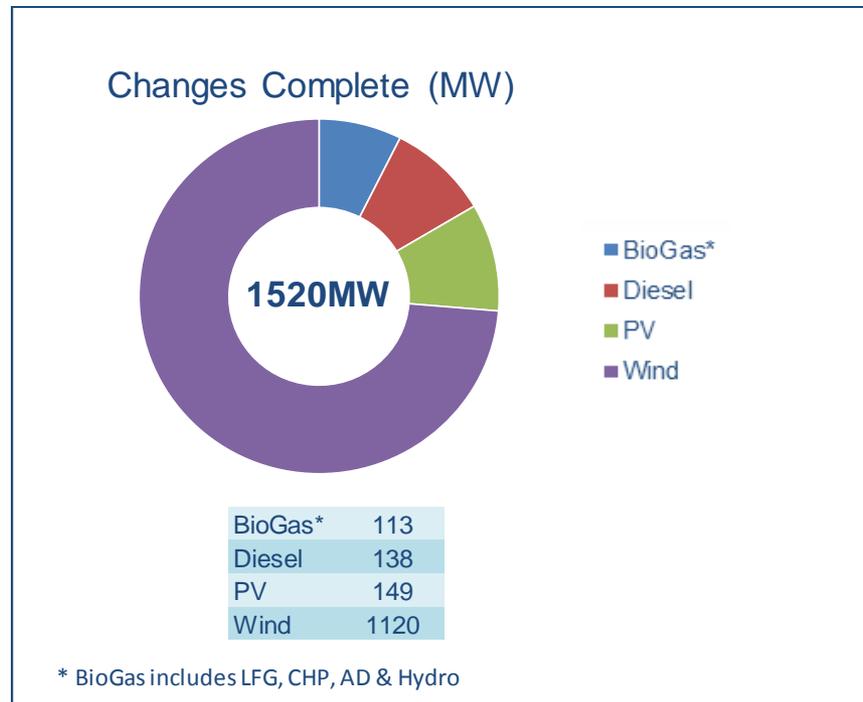
Rate of Change of Frequency (RoCoF Updates)

February 2020

RoCoF Physical Changes Status – Feb 2020

Overall TOTAL (approx. 11,641MW)
11,084MW (95%) complete

557 MW remaining

Conventional Generation (8,638MW total)
8389 MW (97%) complete
Roll-out completed in IE

249 MW (1 Units) remaining in NI

Wind (2,223 MW total)
2114 MW (95%) complete
Roll-out completed in NI

109 MW (21Sites) remaining

Small-scale/embedded (approx. 660 MW total)
542MW (82%) complete
400MW in NI Complete (confirmed by D. Hill, NIEN)

118MW (176 Sites) remaining

Sites where further information is needed (120 MW)
39MW (33%) complete

81 MW remaining

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TSO RoCoF Validation Status

	Complete Information	Evaluated by TSO	RoCoF Go/No go
TX Consumers Ireland	🟢	🟢	🟢
TX Generation Ireland	🟢	🟢	🟢
DX LSG Generation Ireland	🟠	🟢	🟢
DX SSG Ireland	🟠	🟠	🟠
TX Generation Northern Ireland	🟠	🟢	🟠
DX LSG Generation Northern Ireland	🟢	🟢	🟢
DX SSG Ireland Northern Ireland	🟢	🟢	🟢
System Interactions Trial Readiness	🟠	🟢	🟠

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DS3 Discussion

February 2020

Wind Generation (2019)

- Wind Generation accounted for **32%** of All-Island system demand, a record **47%** of demand was provided by wind in February,

- At times, wind generation provided up to **84%** of All island demand with the maximum output of **3996** MW in December. With an average of **1,365 MW** across January to December 2019,

- The Power System was operated above 50% SNSP for **23%** of the time and between 25% and 50% for **50%** of the time, an increase of 10% from 2018.

- In 2019, almost 1GWh of additional wind energy was generated compared to the same reporting period in 2018.

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DS3 Plan February 2020

	2019		2020				2021	
	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2

System Services Procurement

- Gate 1
- SS VC
- Gate 2 – 1 April 2020
- Gate 3 – 1 October 2020

- QTP September 2019 Trial

System Changes

- Control Centre Tools - LSAT
- Control Centre Tools - Ramping
- Control Centre Tools - Ramping – Interim Workaround
- Control Centre Tools - VTT

Operational Implementation

- RoCoF .5 - 1HZ Physical Changes
- RoCoF .5 - 1HZ – Trials (Phase 1 and 2)
- 70% trial
- 75% trial

C.A.P Milestone: Flex Tech Integration Initiative

C.A.P Milestone: 75% System Non-Synchronous Penetration - SNSP

C.A.P Milestone: Technical analysis - 90% SNSP by 2030

EIRGRID · SONI
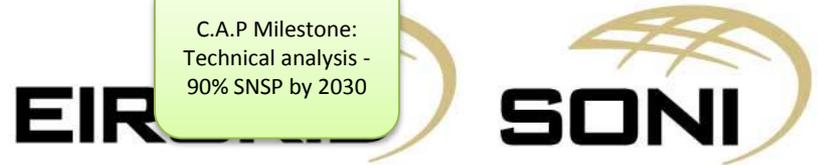
Volume Uncapped Gate 2

- Gate 2 tender is currently in progress

- Several withdrawals from Gate 2, primarily related to ability of units to test

- Tender evaluation outcome letters to be issued to tenderers week beginning 24/02/2020

- Some 'Pass' evaluations are subject to conditions, such as an approved test report or DSO letter of consent

- Expected that total number of Providing Units in Framework will increase by approximately 10% following this Gate

- Gate 2 outcome will be published in April after contracts have been executed on 01/04/2020

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DS3 Control Centre Tools Overview
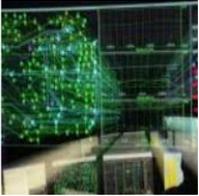
Design, procure & deliver enhanced capability to the Control Centres

Fully capitalised, approved by both RA, will increment opex in FY2020

Collaborate with external vendors to deliver, supported by internal business partners

Key pillar of DS3 project & essential to increasing SNSP

DS3

SYSTEM PERFORMANCE
SYSTEM POLICIES
SYSTEM TOOLS

Key Deliverables

Ramping Margin Tool
Enhanced Frequency Control

Look-Ahead Stability Assessment Tool
Enhanced Stability Analysis

Voltage Trajectory Tool
Enhanced Voltage Control

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DS3 Control Centre Tools - Milestone Plan

Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct

Look-Ahead Security Assessment Tool

- Design Agreed
- Phase 1 Application Build
- Phase 1 SAT Approved
- Phase 1 UAT Complete
- Phase 1 Go-Live
- Phase 2 Application Build
- Phase 2 SAT Approved
- Phase 2 UAT Complete
- Phase 2 Go-Live

X M A S

Ramping Margin Tool

- Solution Validation
- Notice to Market Complete
- Tender Process Complete
- Contract Award
- Agile Delivery Cycles
- SAT Complete
- UAT Complete
- Tool Go-Live

Negotiated Procedure

- - - WORKAROUND SOLUTION - - -

N E W   Y E A R

Voltage Trajectory Tool

- Tender Issued
- Tender Clarification
- Tender Evaluation
- Contract Award
- Application Design
- Application Build
- SAT Complete
- UAT Complete
- Tool Go-Live

Negotiated Procedure

Data Feeds from MMS Delivered (CR94)

Control Centre Tools - Status Update

Look-ahead Security Assessment Tool:
- Project delivery phase commenced in Nov 2019.
- Acceptance testing is scheduled to start in Mar 2020.
- Go live in both control centres is due in May 2020.

Ramping Margin Tool - Interim:
- Project delivery phase progressing well. Initial test report of parallel running is due to be presented to operations management in Mar 2020.
- Full rollout in both control centres is due by Jun 2020.

Ramping Margin Tool - Enduring:
- Design for Ramping Margin Tool has been validated by third party in Dec 2019.
- Procurement is underway and go live in both control centres is due in Oct 2020.

Voltage Trajectory Tool:
- Procurement is in final stage and go live in both control centres is due Sep 2020.

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Fast Frequency Response

February 2020

Background & Introduction

❑ Faster reserves required with reducing inertia, hence the FFR service

❑ Aim of FFR service: to avoid frequency collapse until slower reserve sources kick in

❑ Traditionally the first contingency reserve category is POR, its magnitude is linked to LSI, POR requirement being 75% of LSI (Based on operational experience)

❑ FFR has now become the first contingency reserve , the FFR magnitude requirement is to be determined based on :

- Min number of units,
- System inertia and
- Infeed loss magnitude

No precedents or operational experience is available currently to determine FFR magnitude

Frequency (Hz) vs Time (s)
— High inertia system
— Low inertia system
-- Low inertia system with FFR
Governor kicks in
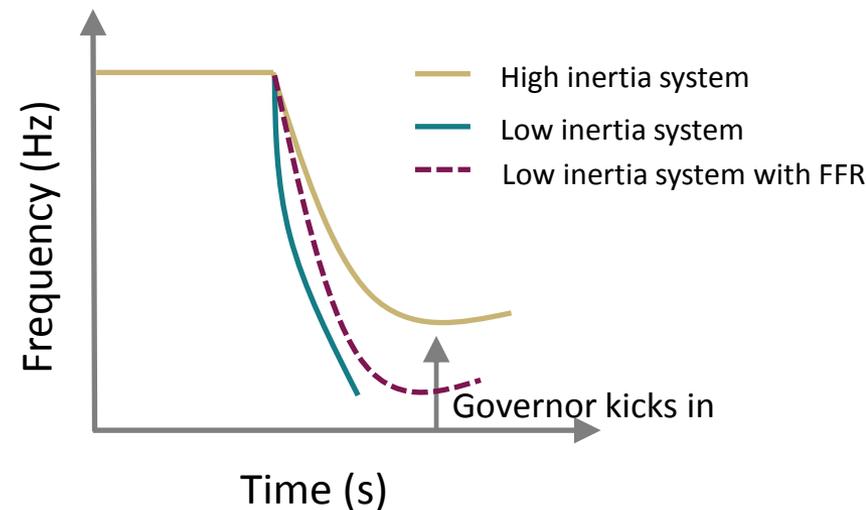
Evaluation procedure

First principles based approach

$$df = \frac{f_0}{2RE} \int P_{inj} - P_{loss}$$

464 MW trip

MW loss

23 GWs & 20 GWs

System inertia

System MW response
(Constructed)

Frequency profile

49 Hz

Frequency insecure

No

FFR requirement established

System MW response is constructed manually to maintain tractability with contracted volumes

Yes

Amend system MW response

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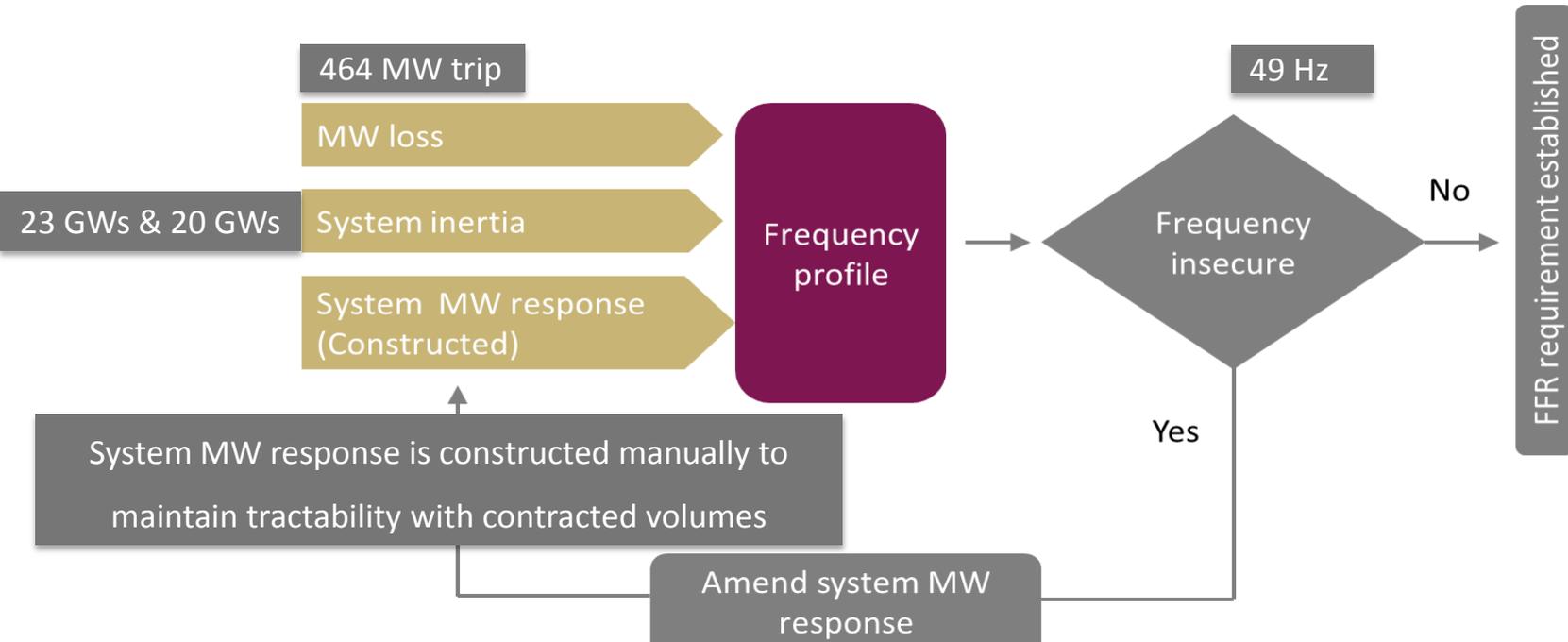
Key Outcomes

- ❏ FFR volume required is influenced by system inertia & infeed loss. Hence FFR requirement is linked to inertia floor & LSI, it needs to revised if either of them changes

- ❏ The magnitude of FFR required for system security, changes with the speed/manner of delivery, hence the "quality of FFR" determines the "quantity of FFR" required.

Same MW delivered at 2s, enough in 1 case, not so for other

Left chart — Power injection (MW) vs Time (s), with legend: P_Case 1, P_Case 2, P_Case 3

Right chart — Frequency (Hz) vs Time (s), with legend: Case 1, Case 2, Case 3
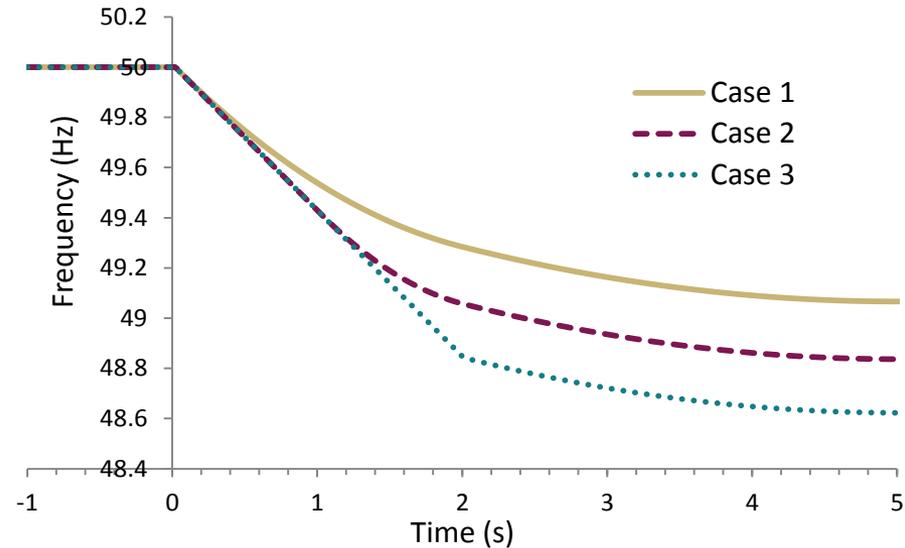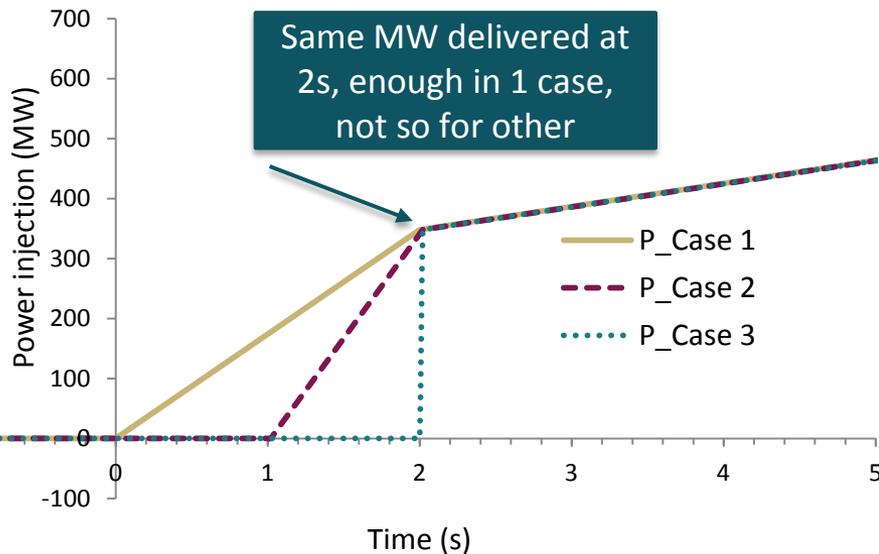
If FFR requirement is to be based on magnitude (MW), then that required changes with changing FFR portfolio (due to varying response trajectories)

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Key Outcomes

❑ Although there is no unique FFR magnitude which ensures system frequency stability, there however is a minimum energy injection (Power injection x time) required within a certain amount of time to ensure secure system operation.
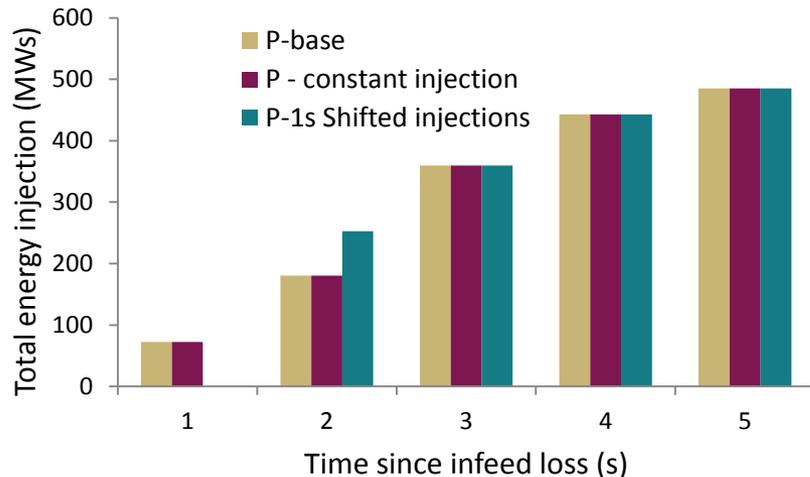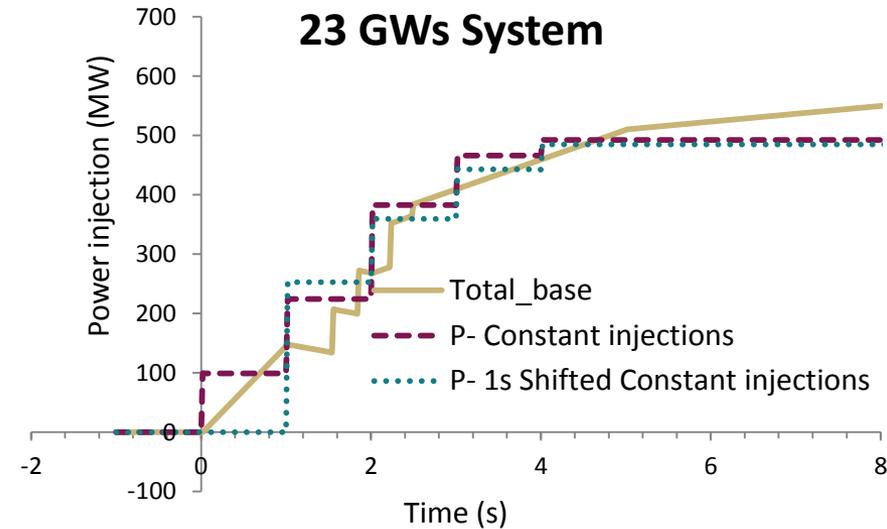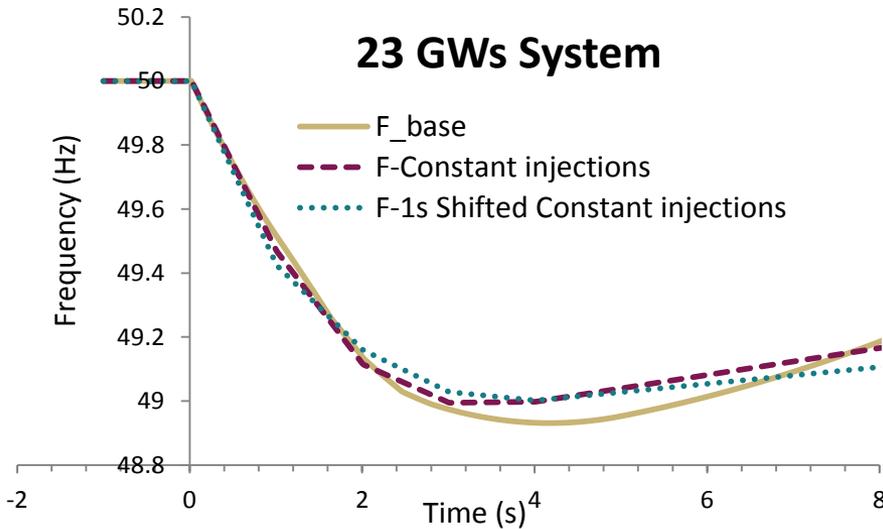
Key Outcomes

❑ For 23 GWs inertia floor, the evaluation is carried out for worst system conditions i.e. 464 MW of LSI and least responsive 8 must run units (based on PMU data) & other FFR sources available. System scheduled for 75% LSI POR only
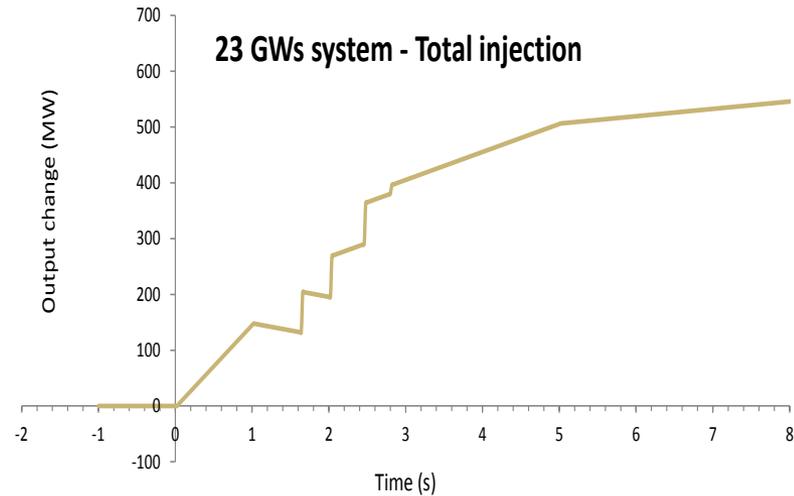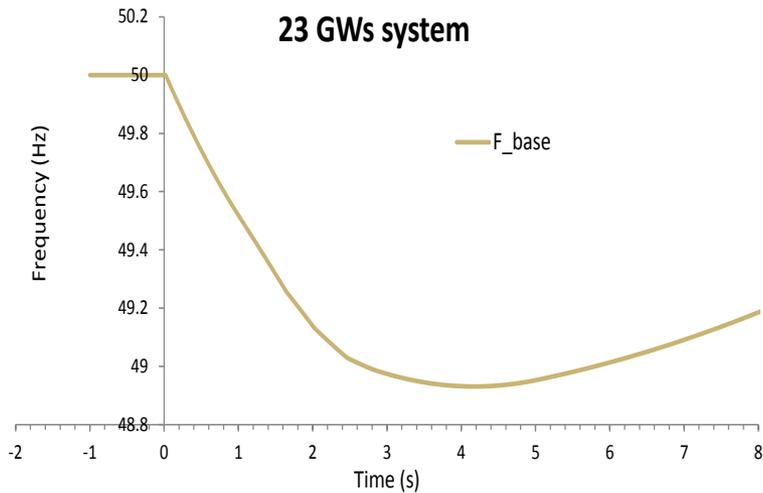
Requisite MWs (252 MWs) are derived within 1.72s in the above case, meaning FFR scheduling not required at 23 GWs, 8 SETS rule

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Key outcomes

❑ For 20 GWs inertia floor 8 SETS rule, FFR scheduling may not be required, this is still in consideration by the OPRC

❑ For 17.5 GWs inertia floor and 7 SETS rule, FFR scheduling will be required and will be evaluated

❑ The speed of MW injection from FFR resources is key to arresting frequency decline

❑ Conventional generation are the most useful FFR resource, due to consistent over-provision beyond the contracted value (owing to testing procedure, inertial kick and 15 mHz Deadband)

❑ Going forward, FFR scheduling may require a scheduling procedure based on energy delivery within a certain time frame, as opposed to the current MW requirement

❑ The current POR requirement is sufficient as long as 8 SETS rule is in place or 20 GWs minimum inertia floor is maintained. Once the reserve portfolio changes sufficiently, the POR requirement may need to be revised

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Why MW requirement worked till now but will not work for FFR?

❑ The MW requirement for contingency reserve, traditionally worked because:

1. There was an inherent assumption regarding the trajectory to get to the MW requirement, it was assumed & observed that the reserve trajectory is sufficient to ensure system security
2. Majority generation was conventional & hence the reserve trajectory to the MW requirement did not change significantly
3. Variations in reserve trajectory did not influence the reserve requirement much due to slower system dynamics (higher inertia)
4. All reserve resources had similar starting positions (Dead bands)

❑ With reducing inertia and changing reserve portfolio

1. The adequate trajectory is unknown
2. The trajectory varies significantly
3. System dynamics are quicker
4. Different resources have different starting positions (Dead bands)

When these changes impact the system enough a re-examination of MW requirement is warranted

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TASK 2.5

26th February 2020

EU-SysFlex Project Structure

WP1 EIRGRID

Management

WP2 EIRGRID

New approaches
for System Operation
with high RES

WP3 VITO Energy Ville

Market Design and
Regulatory Options
for innovative services

WP10 eDF

Flexibility Roadmap

WP4 SONI

Integration of services
into System Operator
Control Centers

NEW ENERGY WORLD **WP7**

Coordination of
Centralized and
Decentralized
Flexibilities

WP6

Coordination
of flexibilities
connected to
distribution innogy

WP11 EURACTIV

Dissemination

Demonstrations

Demonstrations

WP5 elering

Data management

eDF **WP8**

Aggregation of multi-
services of distributed
connected resources

WP9 elering

Cross-borders
and sectors data
exchange

WP12 EIRGRID

Ethics requirements

EIRGRID GROUP

EU-SysFlex

EU-SysFlex Project Structure

- Work Package 2 seeks to answer some key questions for EU-SysFlex:

  1. What are the **technical scarcities** of both the future pan-European System and the Ireland and Northern Ireland Power System?

  2. What is the **value** of future **System Services** provision to operate at high RES-E?

  3. How **valid** are the assumptions made in WP2 in light of developments in other work packages?

  4. What are the **recommendations for the roadmap** in WP10?

Task 2.5 - Overview

"Assess levels of revenues available to fund the large-scale deployment of new technologies"
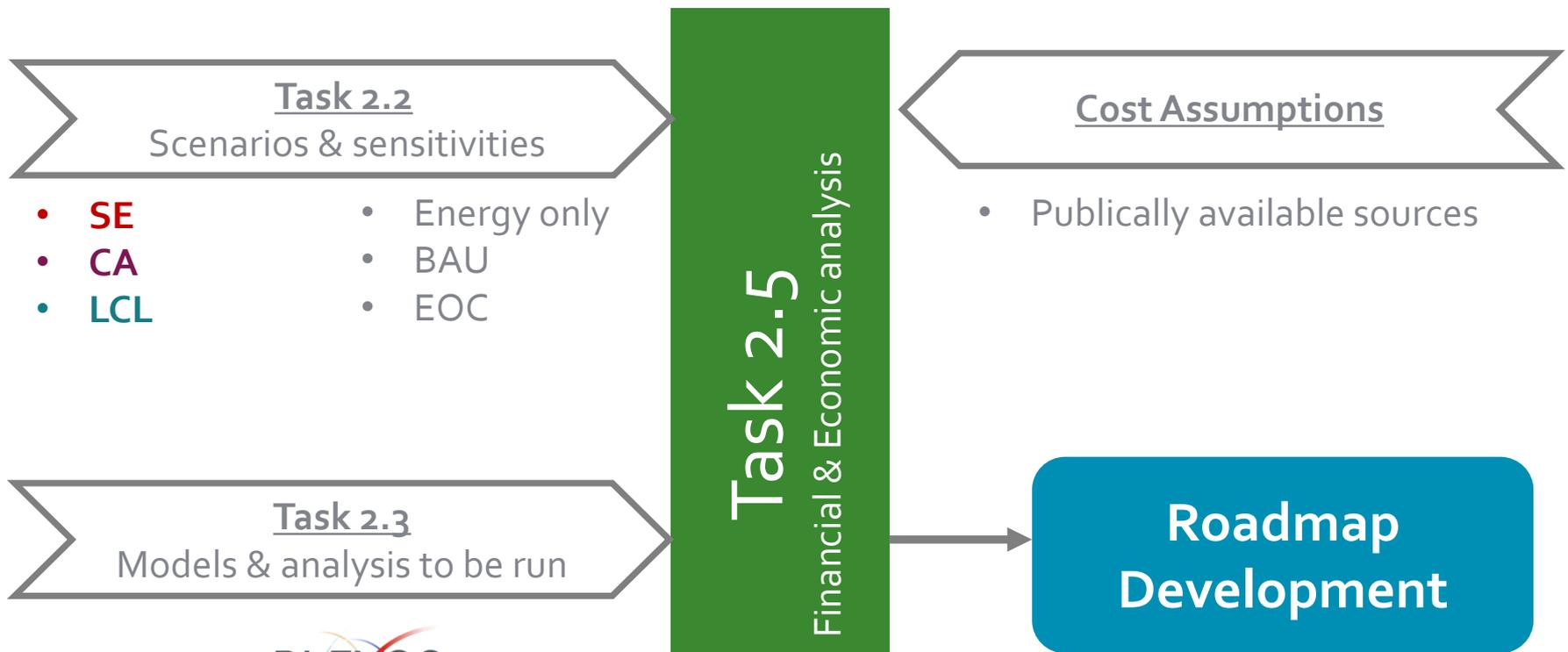
Task 2.2
Scenarios & sensitivities

- **SE**
- **CA**
- **LCL**

- Energy only
- BAU
- EOC

Cost Assumptions

- Publically available sources

Task 2.5
Financial & Economic analysis

Task 2.3
Models & analysis to be run

PLEXOS
BY ENERGY EXEMPLAR

Roadmap Development

EU-**Sys**Flex

Assumptions, Cases & Sensitivities

Operational Assumptions	SNSP Limit	RoCoF Limit	Operating Reserve	Min. Units
2030 Market Run/ Energy Only	-	-	-	-
2030 Business as Usual	75%	1 Hz/s	Yes	7
2030 Enhanced Operating Capability	-	1 Hz/s	Yes	-

3 Scenarios		3 cases		3 wind levels
Steady Evolution		MaRun		7GW
Low Carbon Living	×	BAU	×	8GW
Consumer Action		EOC		10 GW

+

Changing carbon prices, varying solar levels etc.

EU-SysFlex

Main messages as higher levels of wind added….

- Carbon emissions falling

- Dispatch-down levels increasing

- Average marginal prices falling

- Market value factors are decreasing
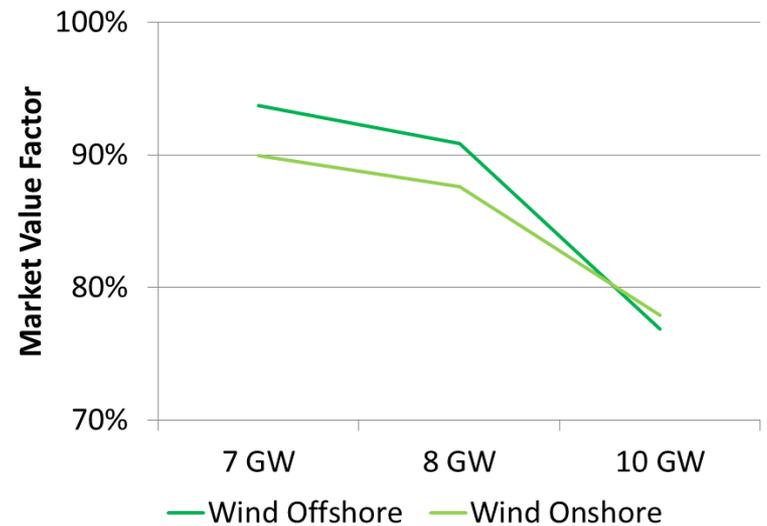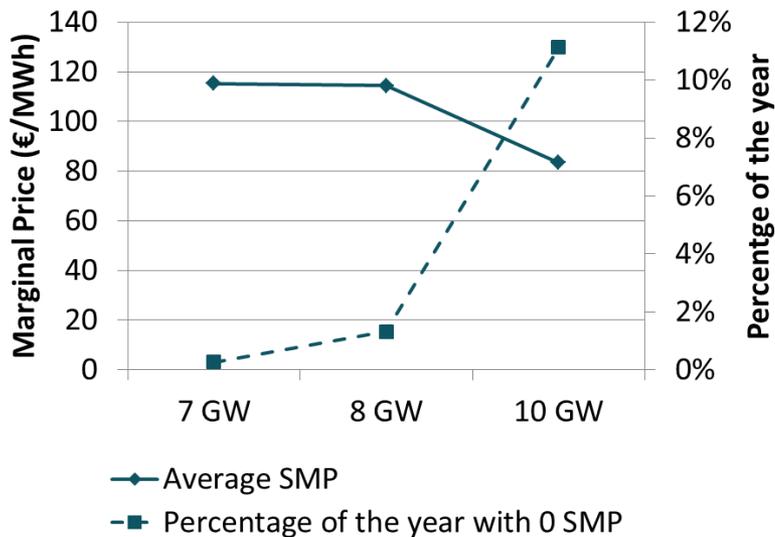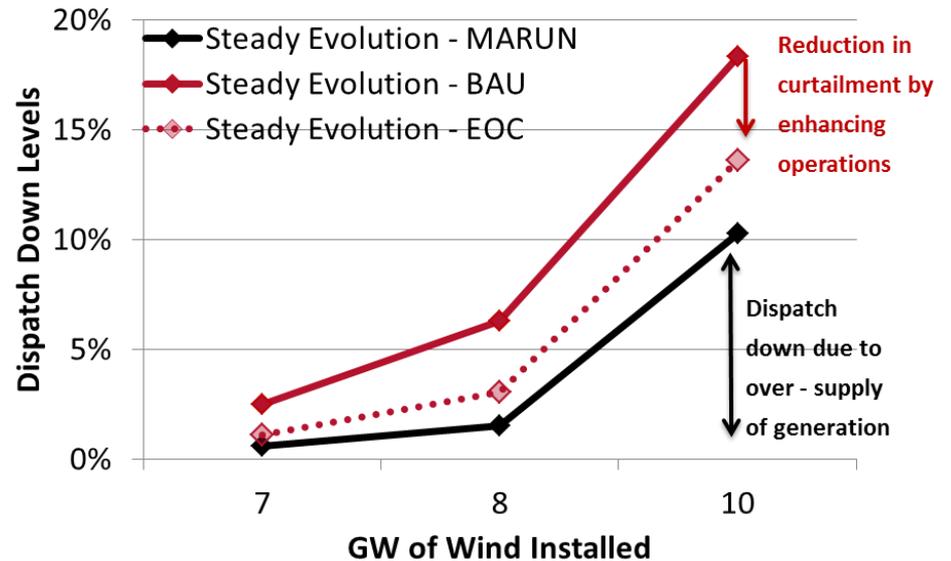
As wind levels increase, market revenues do not cover costs and lead to financial gaps…. and not just for renewables

Offshore wind sees significant financial gaps that increase with greater penetrations of wind
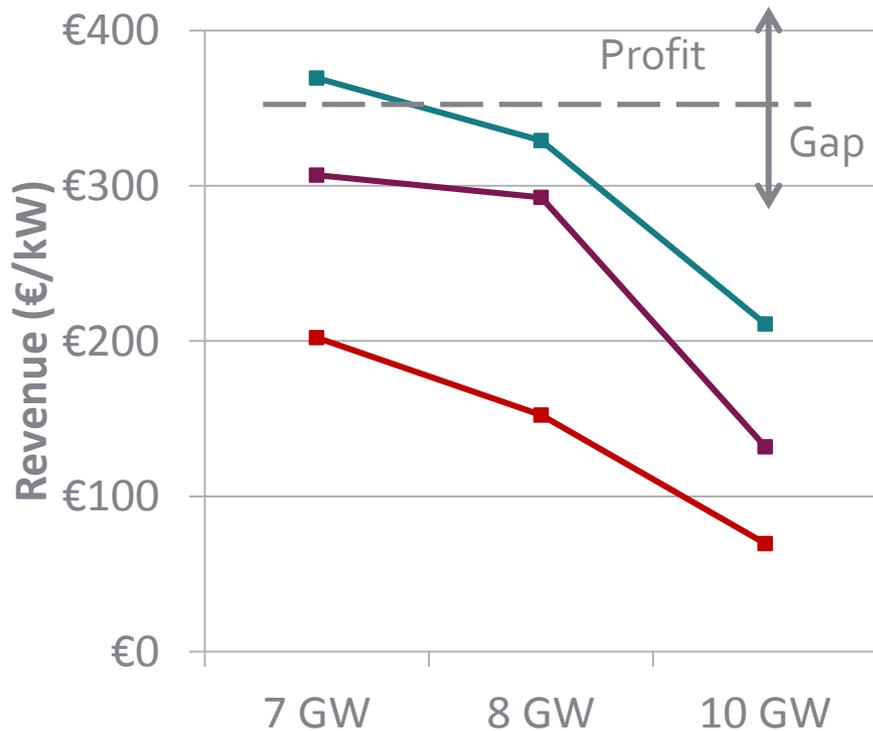
Onshore wind also does not cover costs in all scenarios as wind levels increase
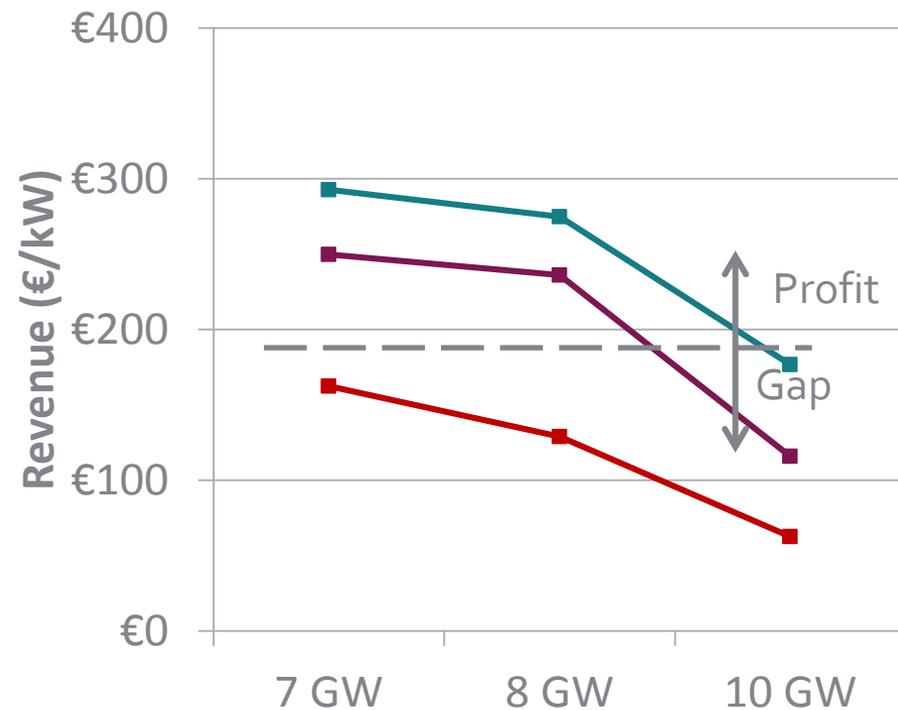
Evaluation of System Services

Production Cost savings in an 'existing operational scenario' (BAU) vs. an 'improved operational scenario' (EOC)

1. BAU Constraints with 7 GW of wind

2. Enhanced Operational Capability with 10 GW of wind

Scenario	Financial Gap (millions)	Value (millions)
Steady Evolution	€297 - €594	€300 +
Low Carbon Living	€285 - €1000	€740 +
Consumer Action	€170 - €419	€600 +

Huge potential for System Services to provide the needed revenue stream, whilst also mitigating the technical scarcities identified in Task 2.4

EU-SysFlex

Conclusions

- **Challenges are not only technical; they are also financial**

  - Downward trajectory of energy market prices

  - Energy revenues falling, leading to financial gaps

  - Clear evidence that an additional revenue stream is needed

- **System services could be one of a range of mechanisms to support mitigation of the technical and financial challenges**

EU-SysFlex

Flexible Technology Integration Initiative

February 2020

FlexTech Integration Initiative

To identify and break down key barriers to integrating new technologies to enable renewable integration

Maximise opportunities for effective use of new and existing technologies

The FlexTech Integration Initiative is a platform of engagement for the Transmission System Operators, Distribution System Operators, industry, regulators and other stakeholders

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FlexTech Integration Initiative

✓ Inform scope development of future Qualification Trials

✓ Inform solution development and implementation

✓ Input to Business Planning Process & Business as usual activity

✓ Collaboration opportunity with DSOs on cross sectoral challenges

✓ Engage Industry, Regulators and Network Operators to address <u>technical</u>, <u>policy regulatory</u> and <u>commercial issues</u> to enable integration of renewables.

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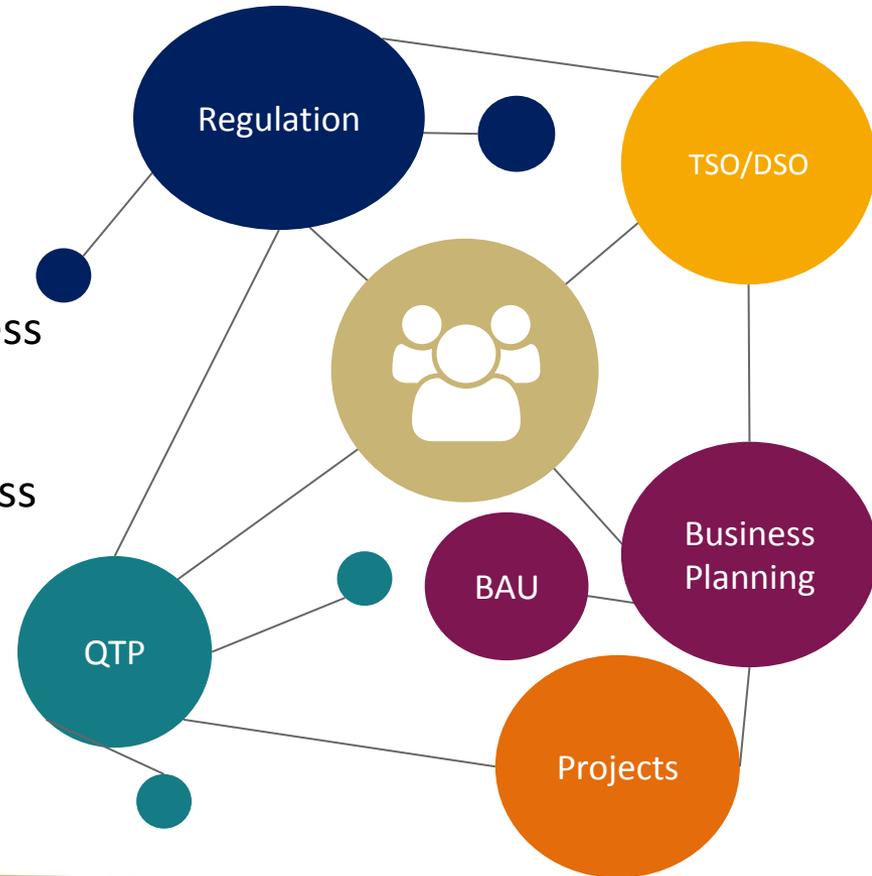
FlexTech – Structure of Engagement
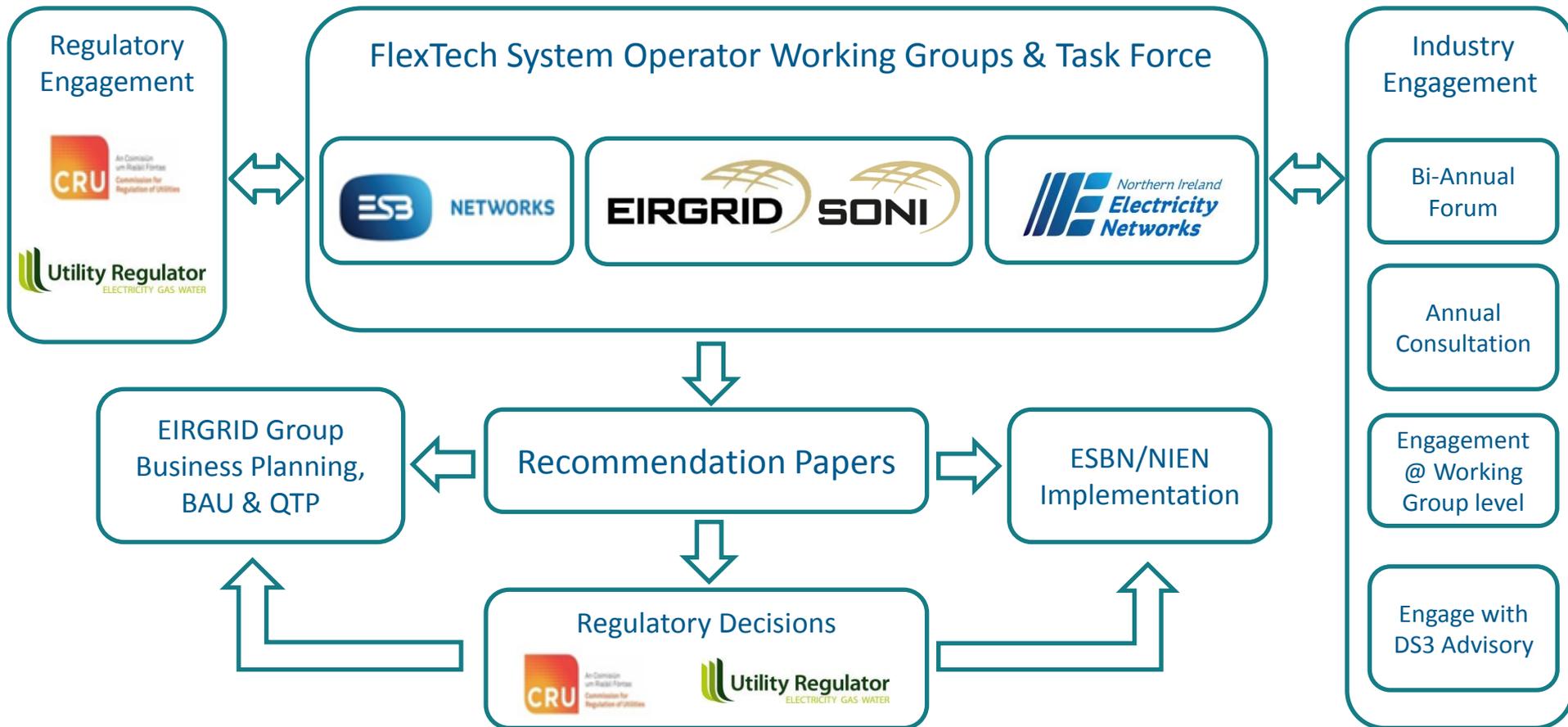
FlexTech – Initial Focus

Renewable/SSG	DSM	Hybrid	Large Energy Users	Storage

- ✓ Held 1st forum
- ✓ Published 1st Consultation Paper
- ✓ Established support for the initiative with ESBN & NIEN
- ✓ Agreed working mechanism of interaction with ESBN & NIEN
- ✓ Currently developing response to consultation and devising a 1 & 3 year plan of action

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# FlexTech – Consultation Feedback
19 Responses

FlexTech – Next Steps

- Publish response to consultation
- Hold 2nd Industry Forum
- Publish 1 & 3 year plans
- Continue work on addressing priority areas and delivering year 1 plan
- Agree engagement mechanism with industry

Supported by

Future Arrangements – Verbal

Dylan Ashe, CRU
26 February 2020

AOB

DS3 Advisory Council meeting dates 2020/2021	
Q1	26 February 2020
Q2	20 May 2020
Q3	30 September 2020
Q4	20 January 2021
Dates may be subject to change	