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)

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	Robert O Rourke, CRU (15 min)
AOB	14:40	Jonathan O' Sullivan, EirGrid (10 min)
Closing Remarks	14:50	Jonathan O' Sullivan, EirGrid (10 min)

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TYNAGH ENERGY LIMITED

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)

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

	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	$K_m * V_m$
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	$K_m * V_m$
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	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	0.4

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	0

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%**

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

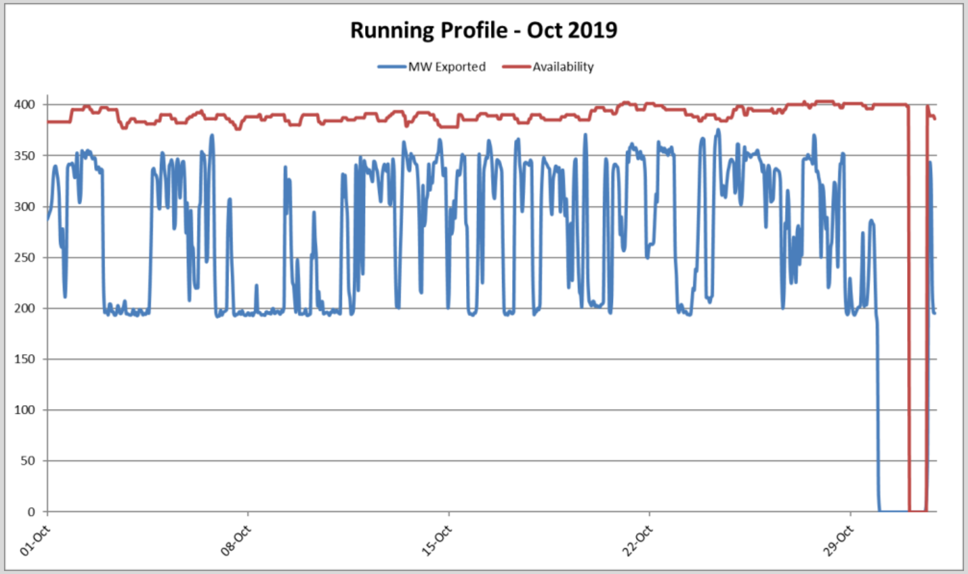
Month	P_E	Monthly Lost Revenue %	Annualised
1	90%	10.00%	1%
2	92%	8.00%	1%
3	94%	6.00%	1%
4	96%	4.00%	0%
5	98%	2.00%	0%
6	100%	0.00%	0%
		Total	**2.5%**

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

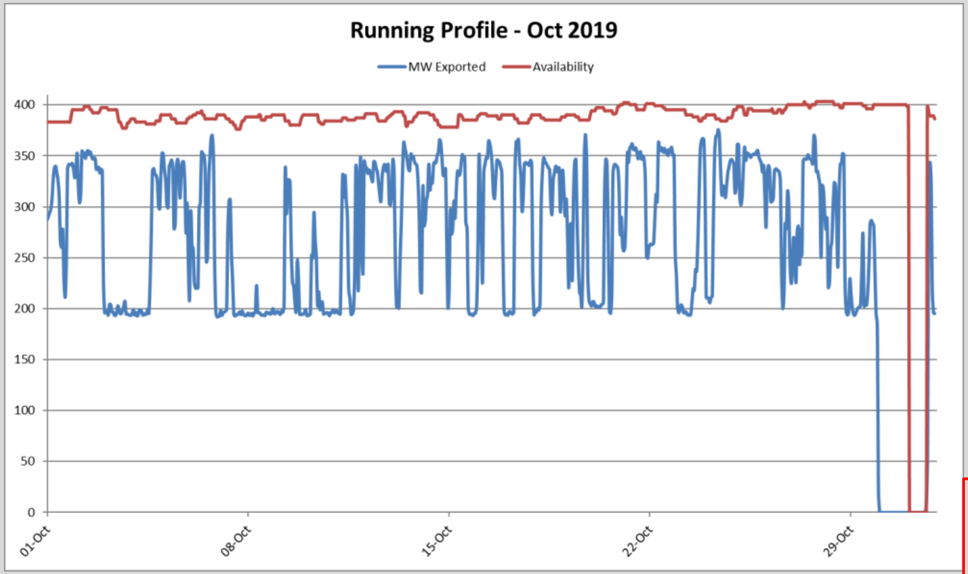
Not Hypothetical – Real world example



	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



	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	

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.

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Irish Wind Energy Association

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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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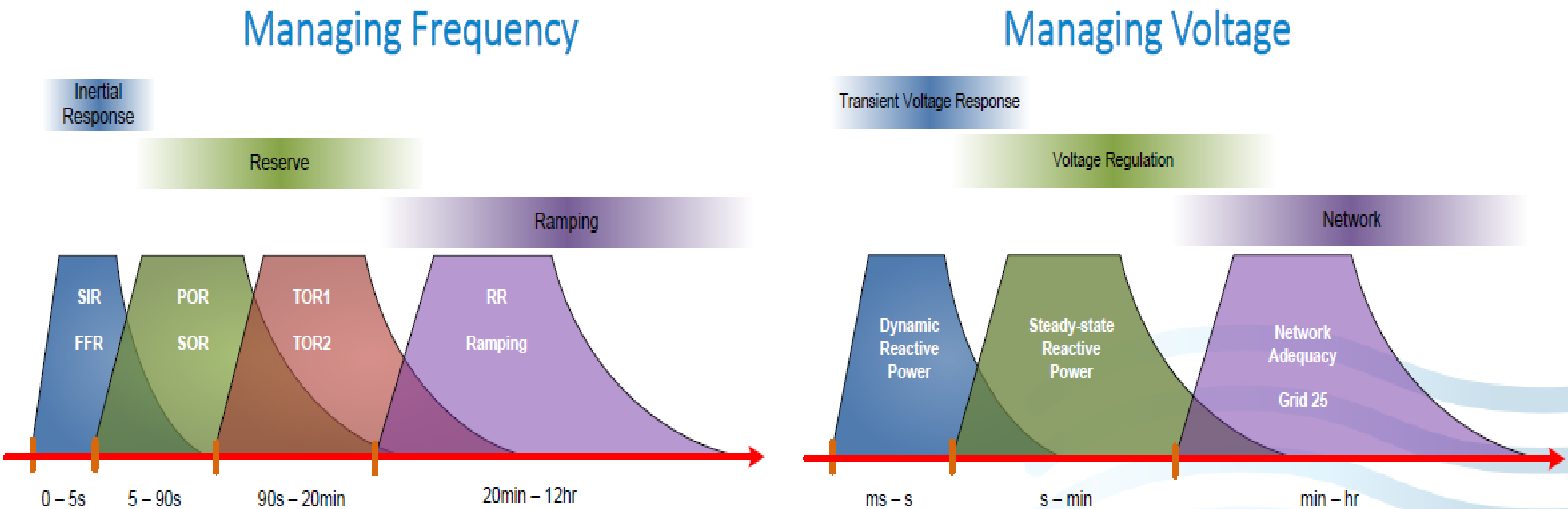
Bord na Móna – Naturally Driven
ESB – Energy for generations
Energia Group
ScottishPower
enel x
Nordex
Vestas
Statkraft
everoze
ABO Wind
Coillte – Grow·Transform·Sustain
res – power for good
innogy
Enerco Energy
Enercon – Energy for the World
Eversheds Sutherland
MullanGrid Consulting
ENGIE
Brookfield
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



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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

Irish Wind Energy Association

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

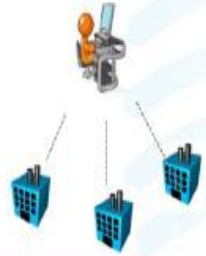
Zero Carbon Technologies to provide System Services

Battery Storage

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

Renewable Generation

Demand Side Response



For 2030 likely to require:
700 - 1,000MW of Reserves over a 500ms to 1 hour timeframe

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

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

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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	
Ramping	

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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


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

Renewable Generation

Synchronous Condensers

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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

	Zero Carbon Technologies
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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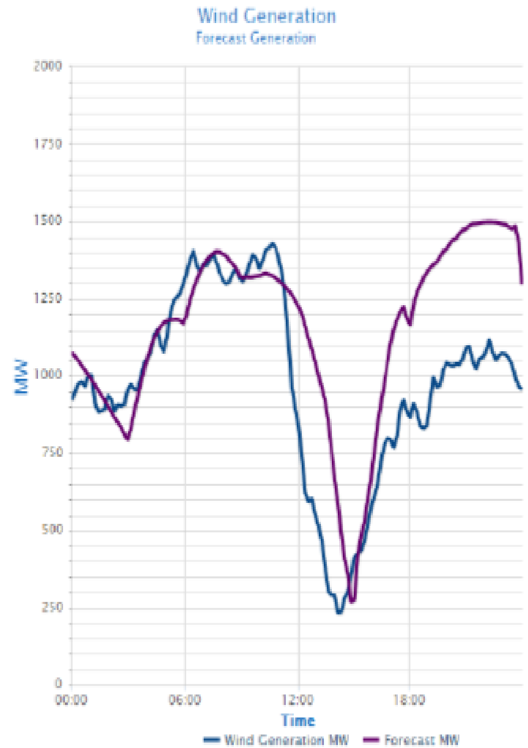
Long Term Frequency Control – Ramping

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



Forecasting is very important for Ramping Requirements – example is from Storm Darwin in 2014

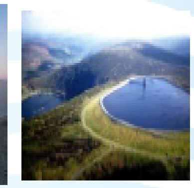
Zero Carbon Technologies to provide System Services

Long Duration Storage

Pumped Hydro Storage

Demand Side Response

Renewable/Hydrogen Gas



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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

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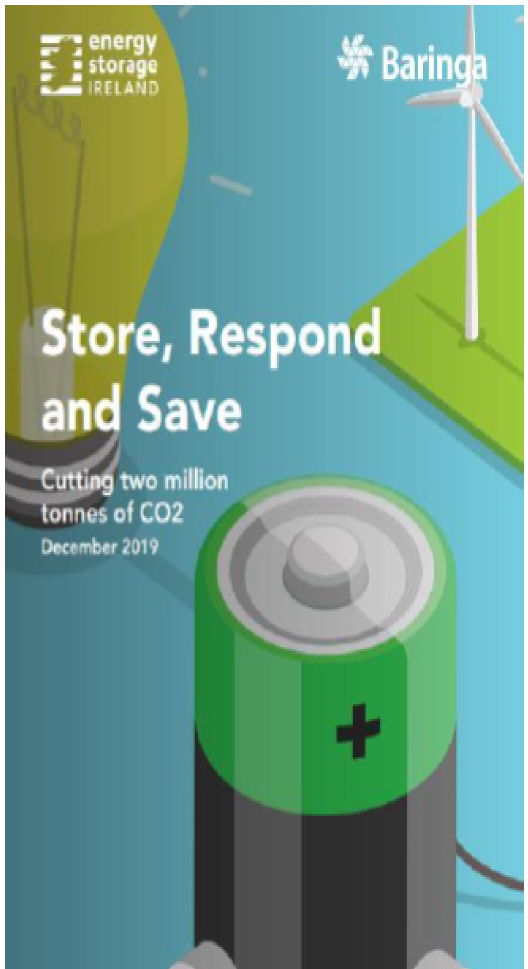
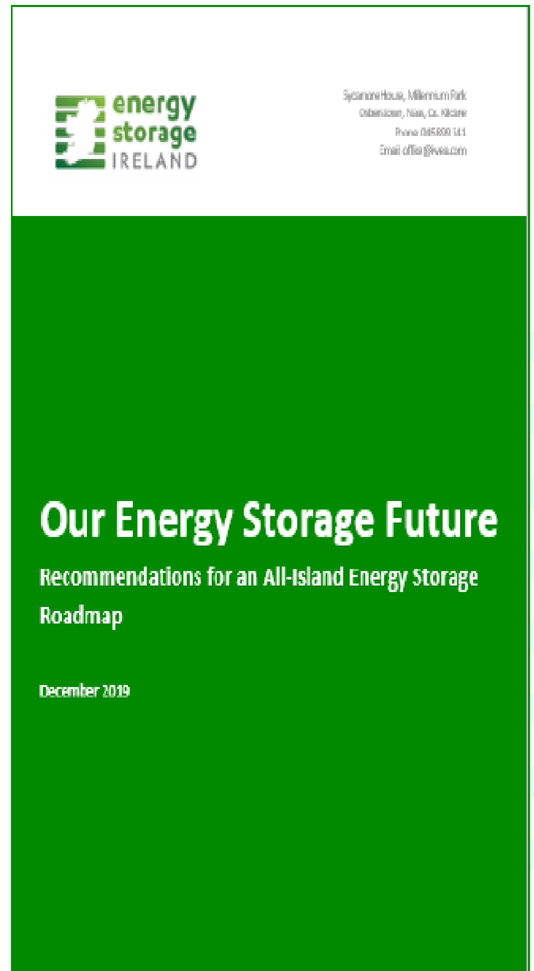
- Analysis carried out by Baringa Partners investigating the benefits of zero carbon reserves & System Services
- Builds off Baringa's 70by30 Study and shows large savings in operational costs and CO_2 and a reduction in curtailment





- 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

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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

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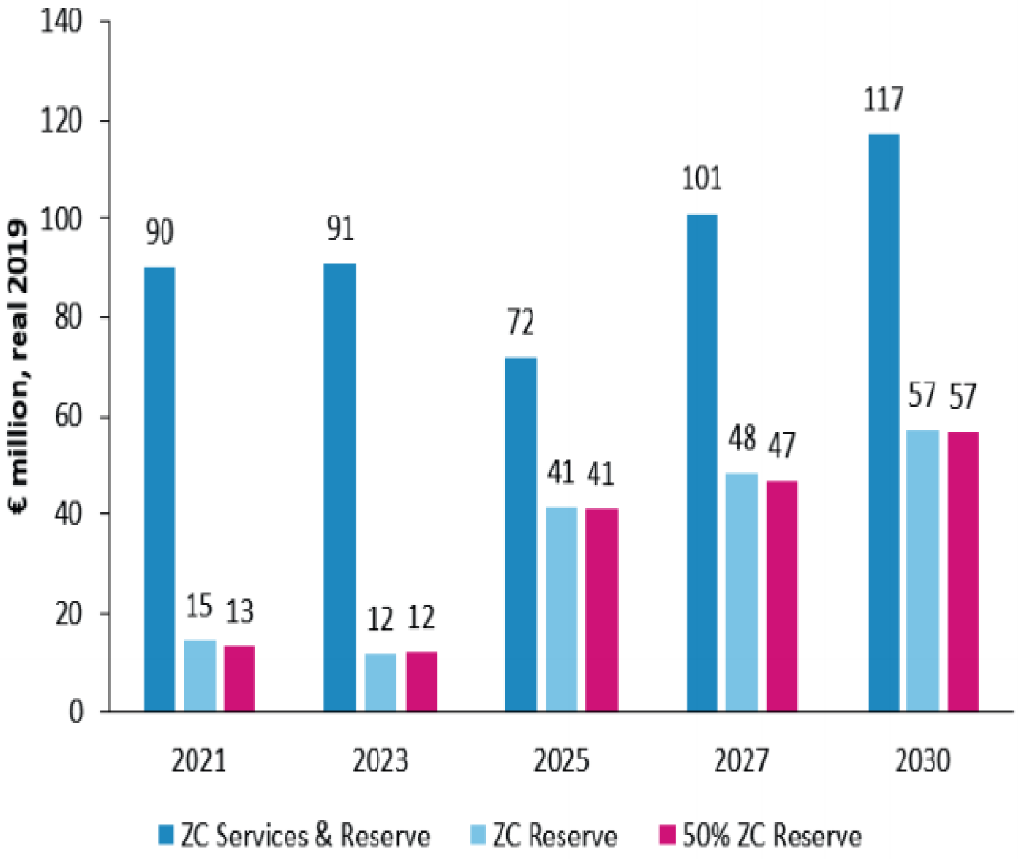
Analysis shows the Annual Operational Cost Savings is significant…



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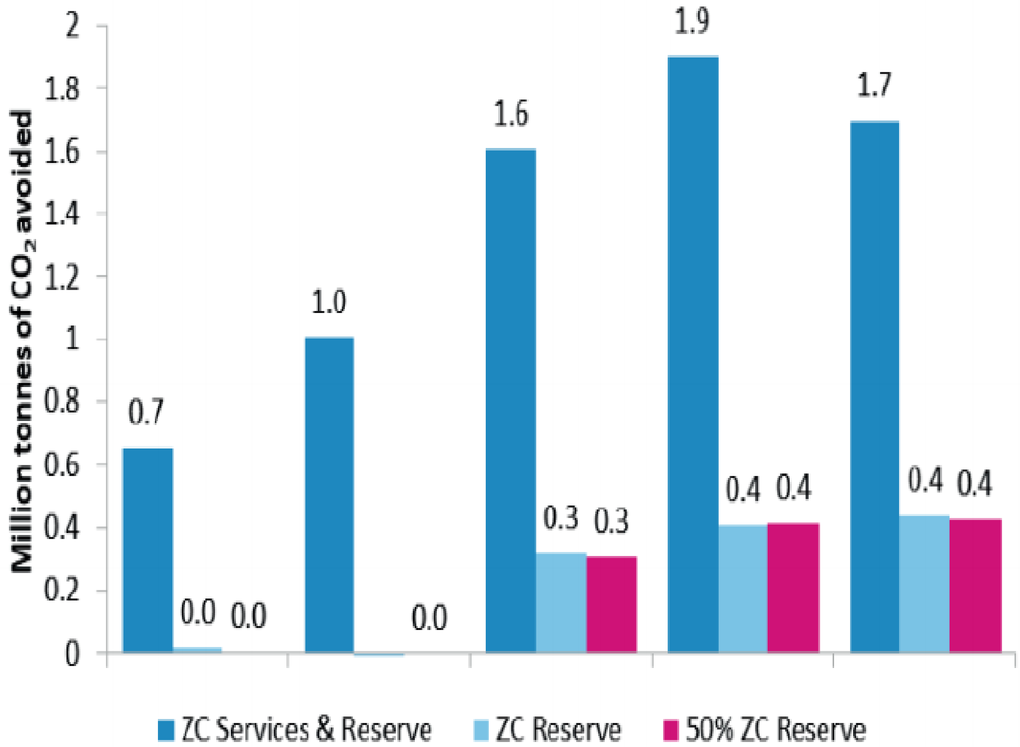
...and it can save up to 2 Million Tonnes of CO2 per year



- 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**

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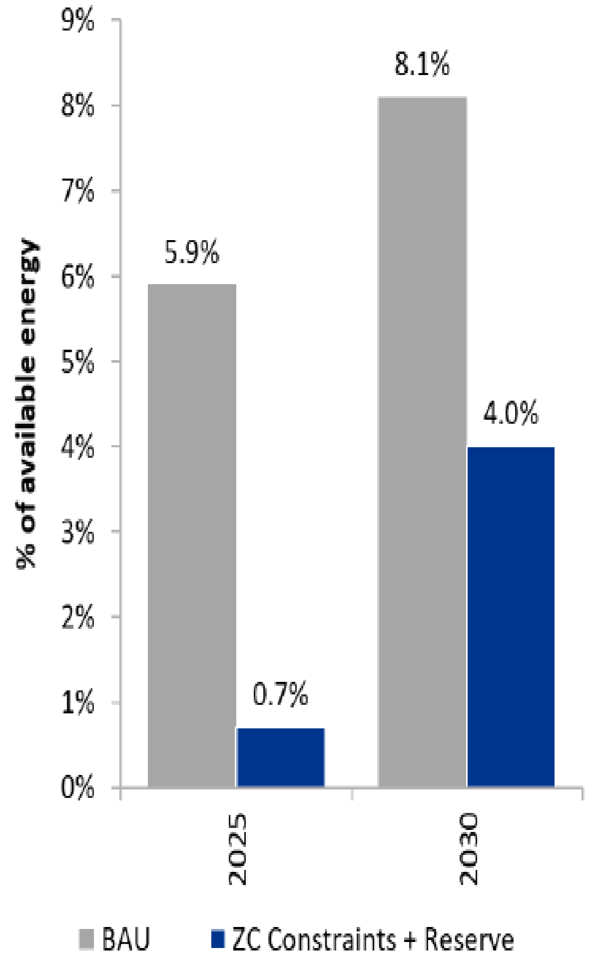
There are also benefits to renewable curtailment



- 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%**

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

2 million tonnes of CO_2 per year avoided

Equivalent to removing one third of power sector emissions

At least €117m per year operational cost saving

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

50% reduction in renewable curtailment

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

- **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

Status 26-1-20: Non-wind High Priority ROCOF

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

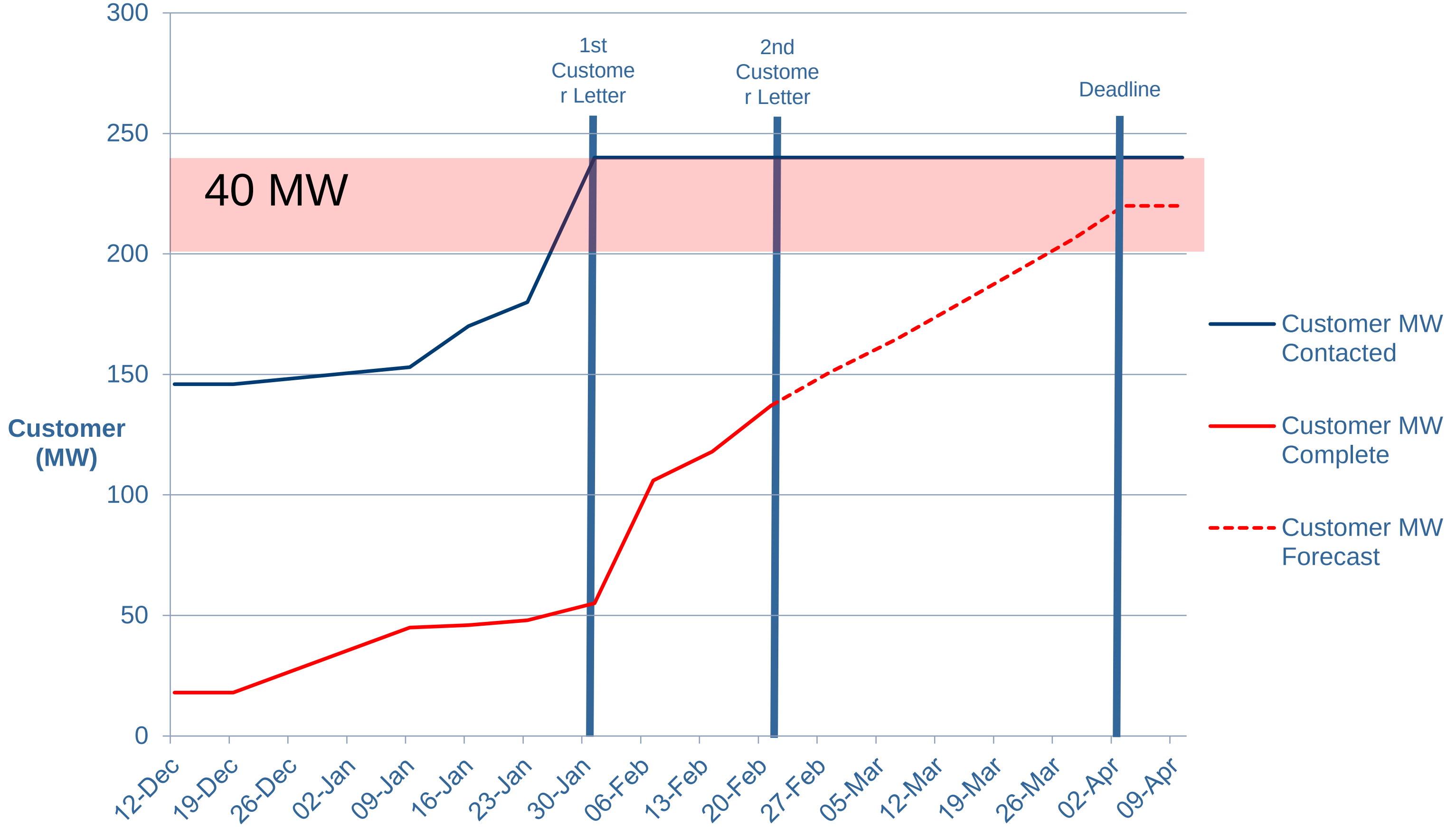
Status 26-1-20: Non-wind High Priority Vector Shift

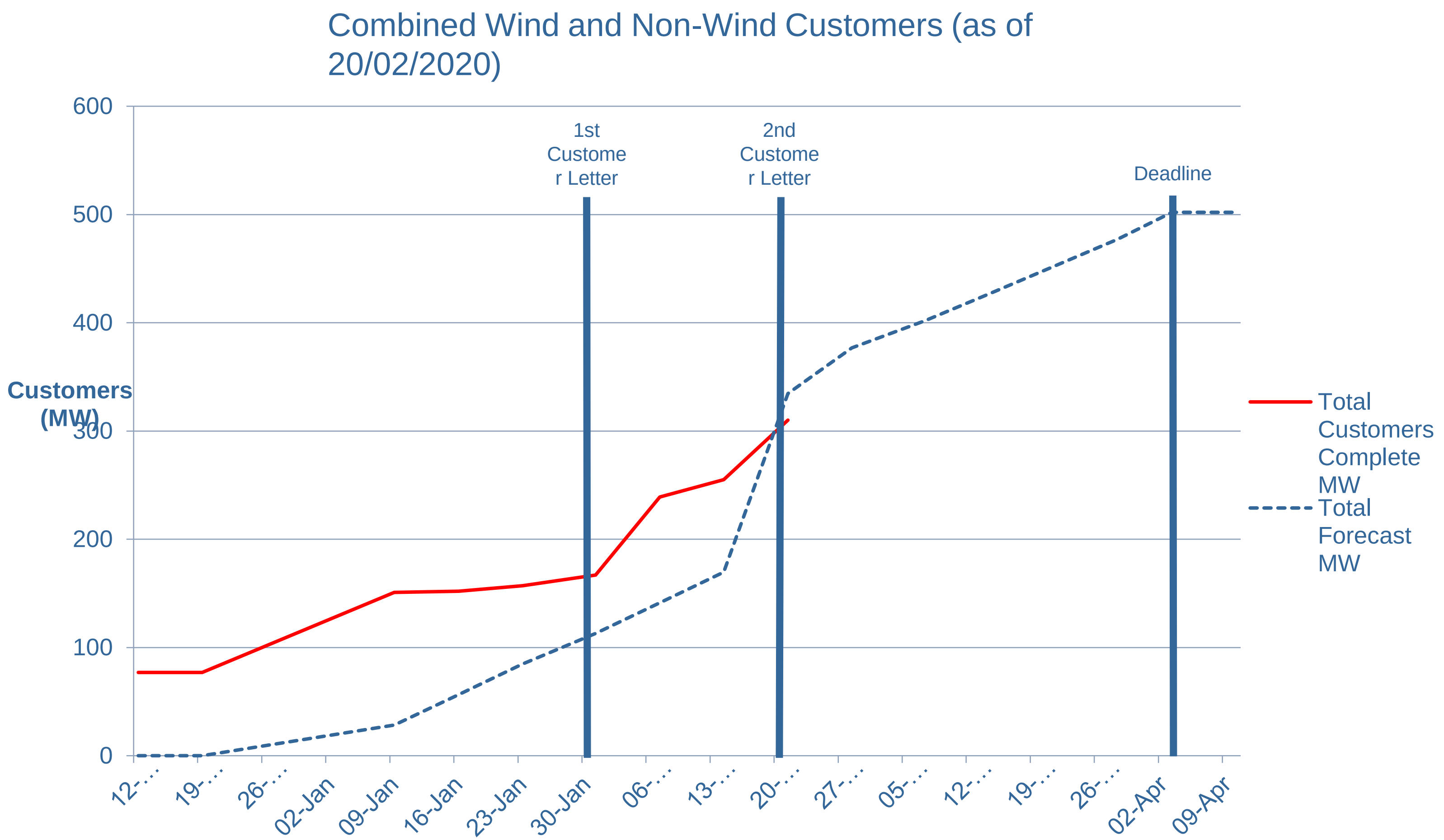
Sub-category	Target Totals	
	Number of sites	MW
Vector Shift	174	181

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

NETWORKS

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





Combined Wind and Non-Wind Customers (as of 20/02/2020)
Customers (MW)
600
500
400
300
200
100
0
1st Custome r Letter
2nd Custome r Letter
Deadline
Total Customers Complete MW
Total Forecast MW
12-…
19-…
26-…
02-Jan
09-Jan
16-Jan
23-Jan
30-Jan
06-…
13-…
20-…
27-…
05-…
12-…
19-…
26-…
02-Apr
09-Apr

Status 26-1-20: Sites where further information is needed

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

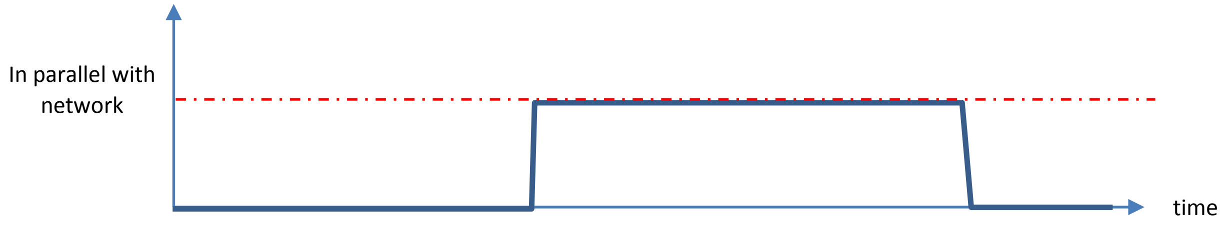
Information to enable a close-out proposal for this sub-task , is expected for this for next week's report

Questions?

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

High Risk:

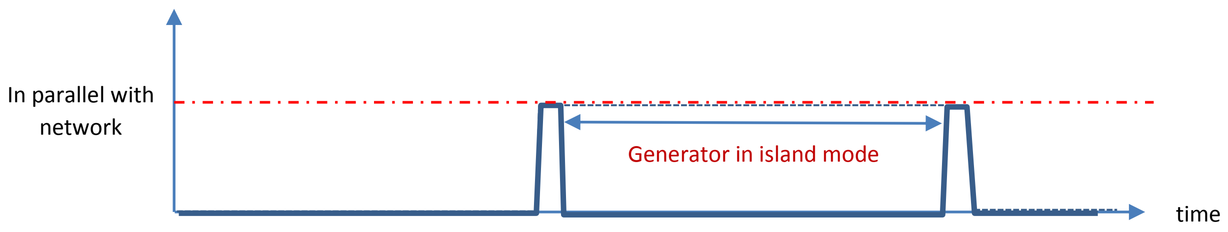
- **High likelihood of running**
- **Operating in “shaving” mode i.e. operates in parallel for entire duration of running**



“Shaving”

Low Risk

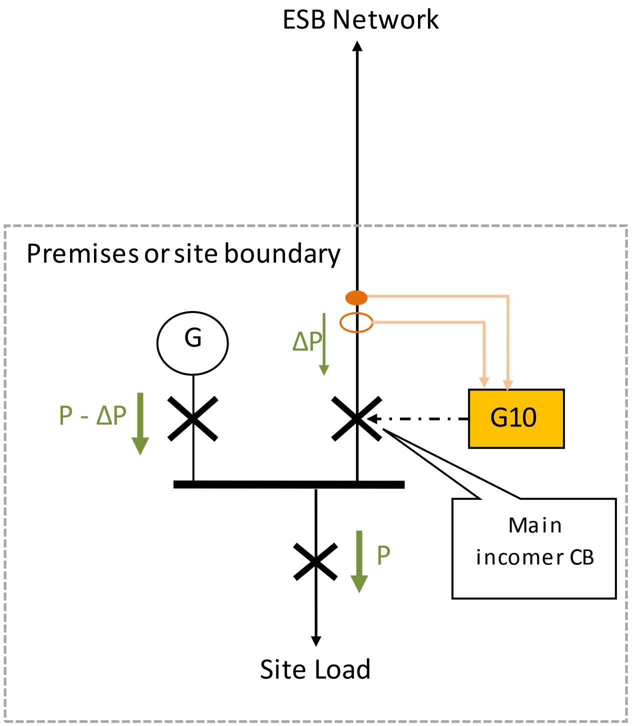
- **Lower likelihood of running**
- **Operating in “lopping” mode i.e. only operates in parallel for some minutes when going into and out of island mode**



“Lopping”

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



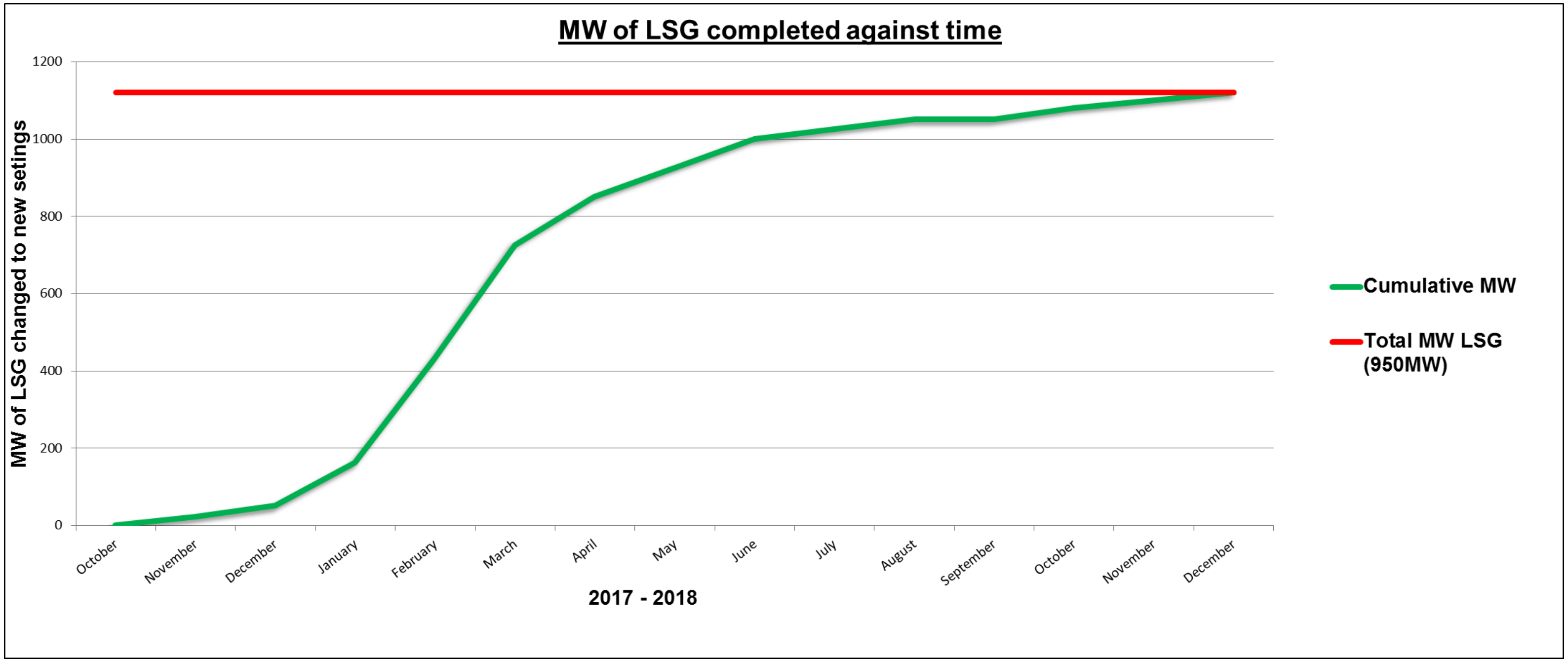
ROCOF IMPLEMENTATION PROGRAMME

Update 26/02/2020

David Hill

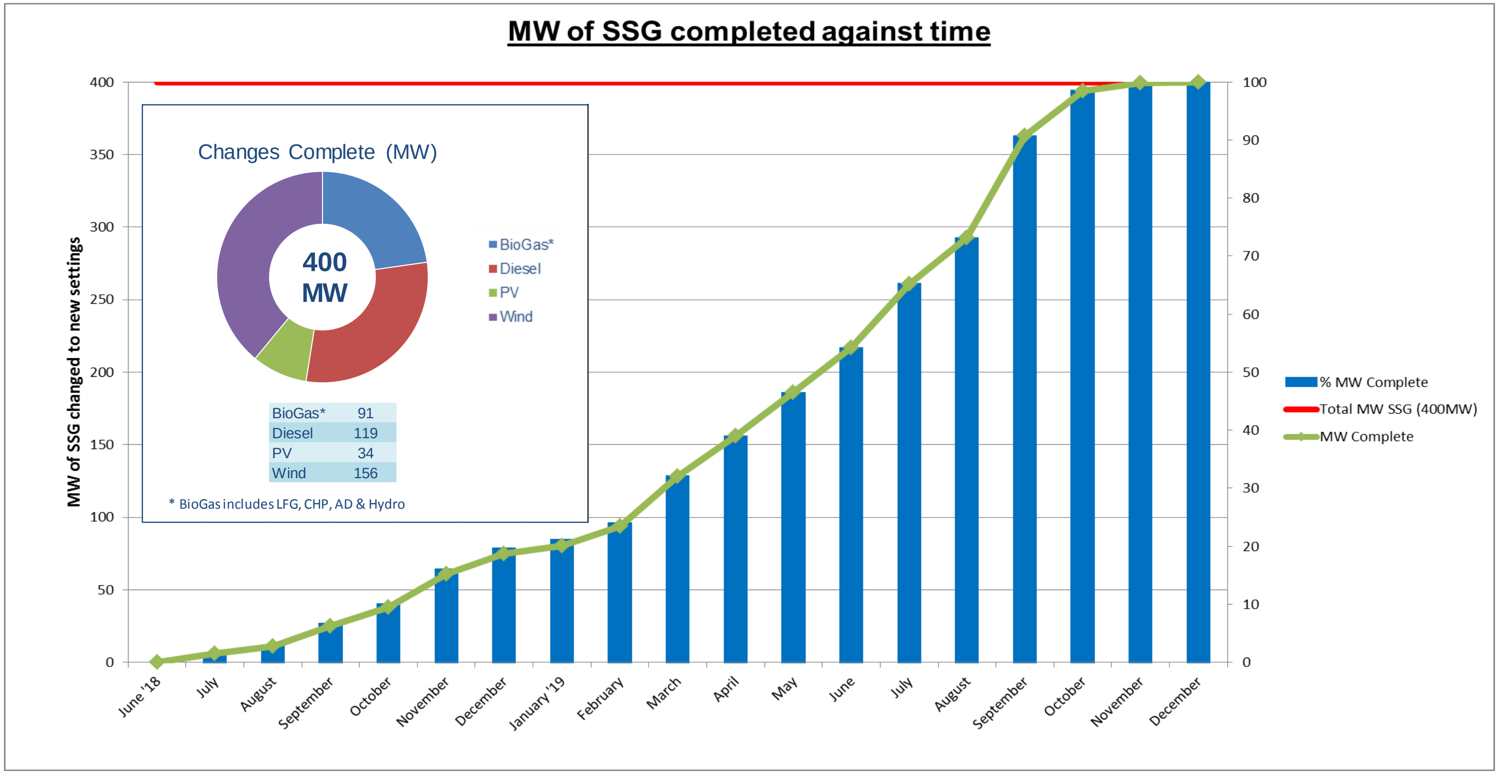
LSG RoCoF – Complete

- 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)



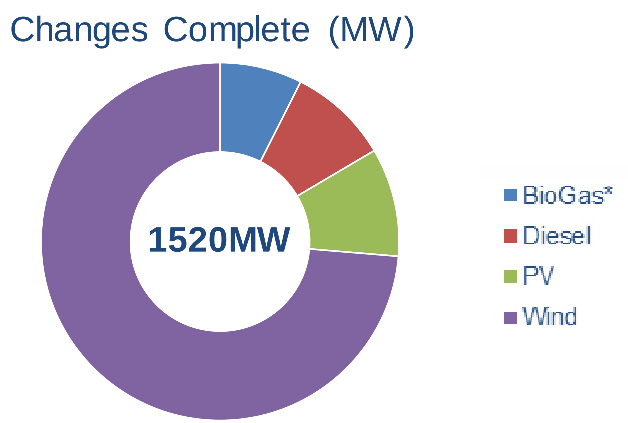
SSG RoCoF – Complete

- 1345 SSG's have been changed to new RoCoF setting
- 400 MW SSG now changed to 1Hz/s RoCoF setting



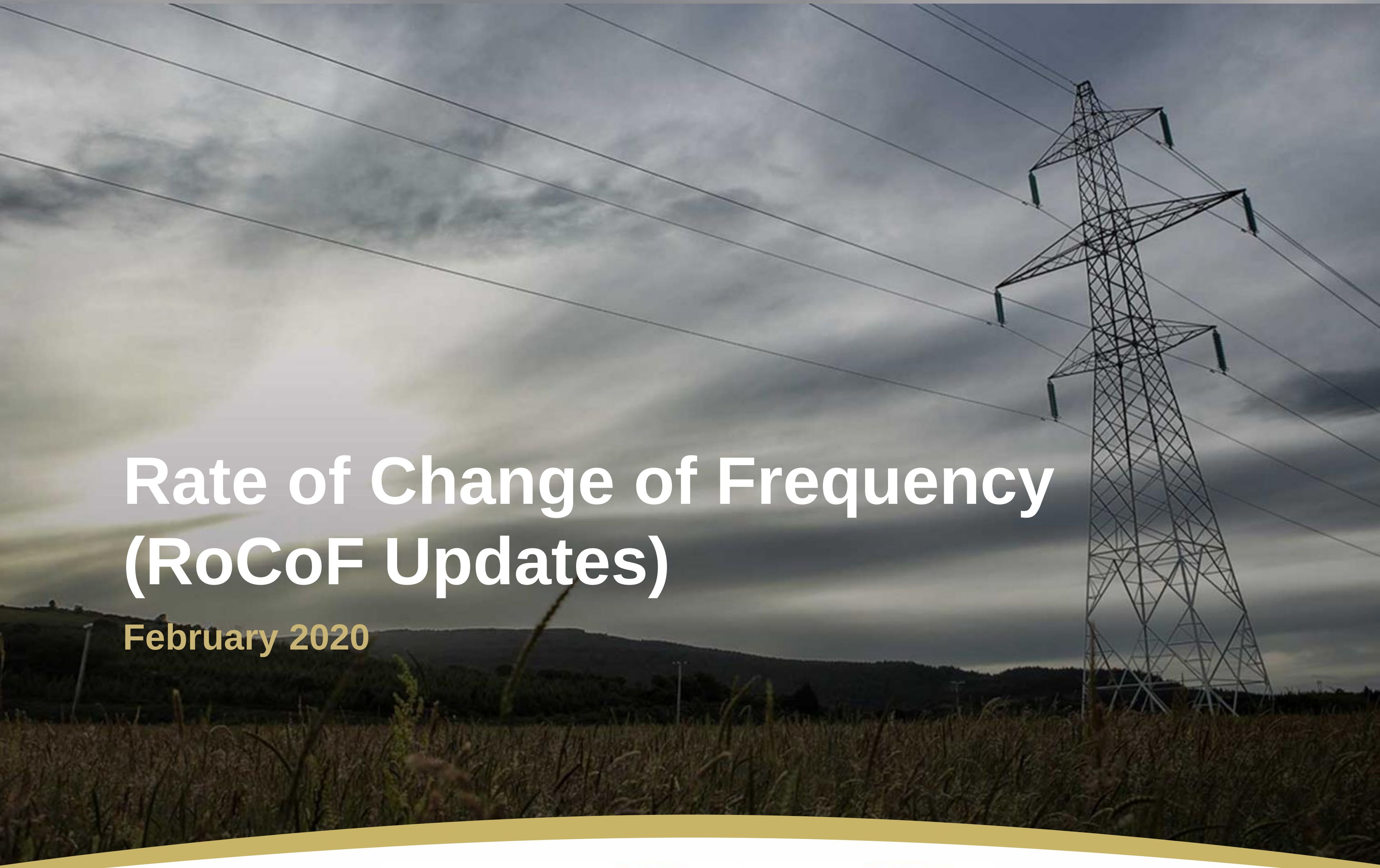
Total RoCoF (LSG & SSG) – Complete

- 1413 Generators have been changed to new RoCoF setting
- 1520 MW Generation now changed to 1Hz/s RoCoF setting



BioGas*	113
Diesel	138
PV	149
Wind	1120

* BioGas includes LFG, CHP, AD & Hydro



Rate of Change of Frequency (RoCoF Updates)

February 2020

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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	🟡	🟢	🟡

DS3 Discussion

February 2020

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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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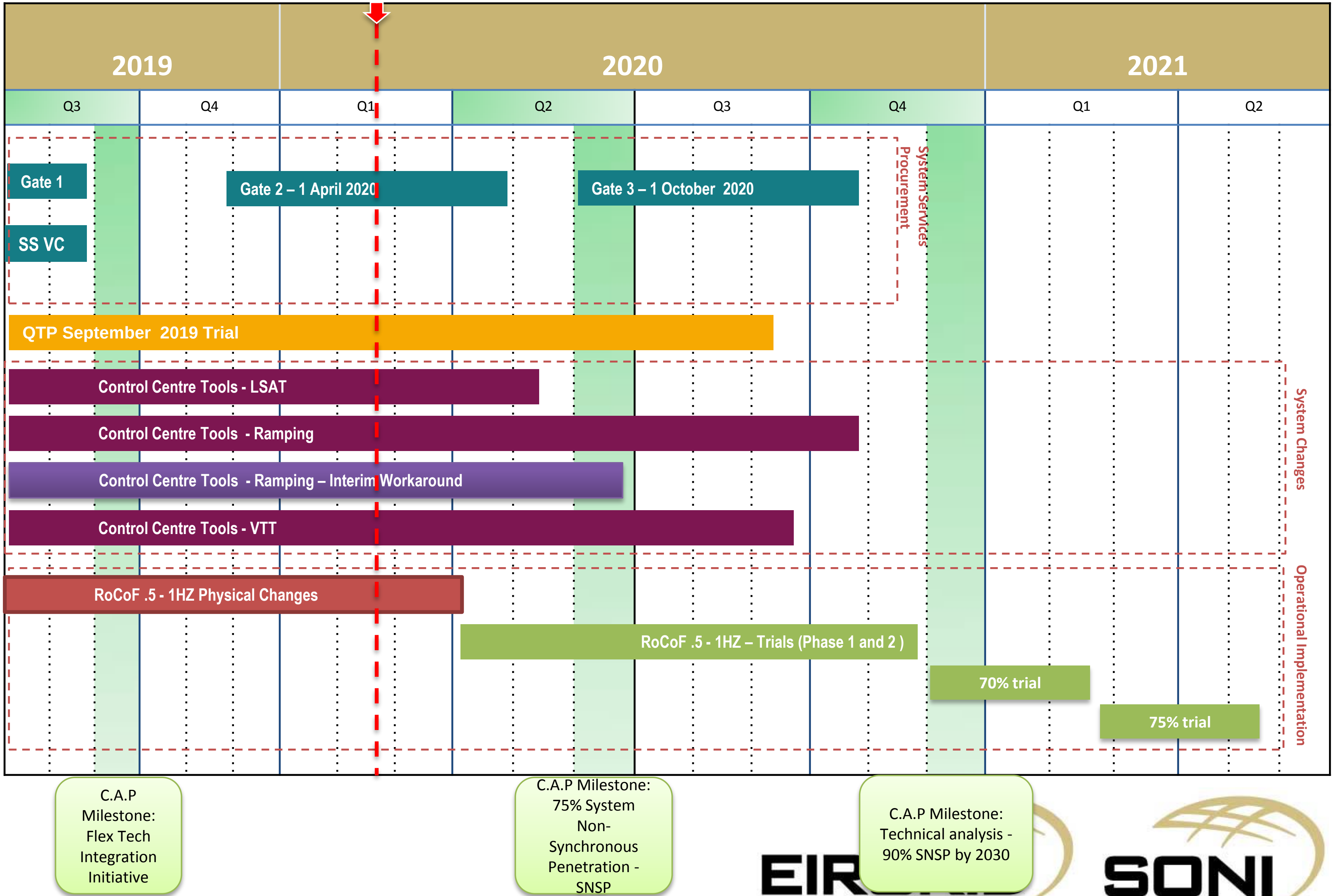
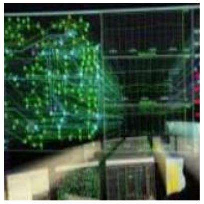
DS3 Plan February 2020



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

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

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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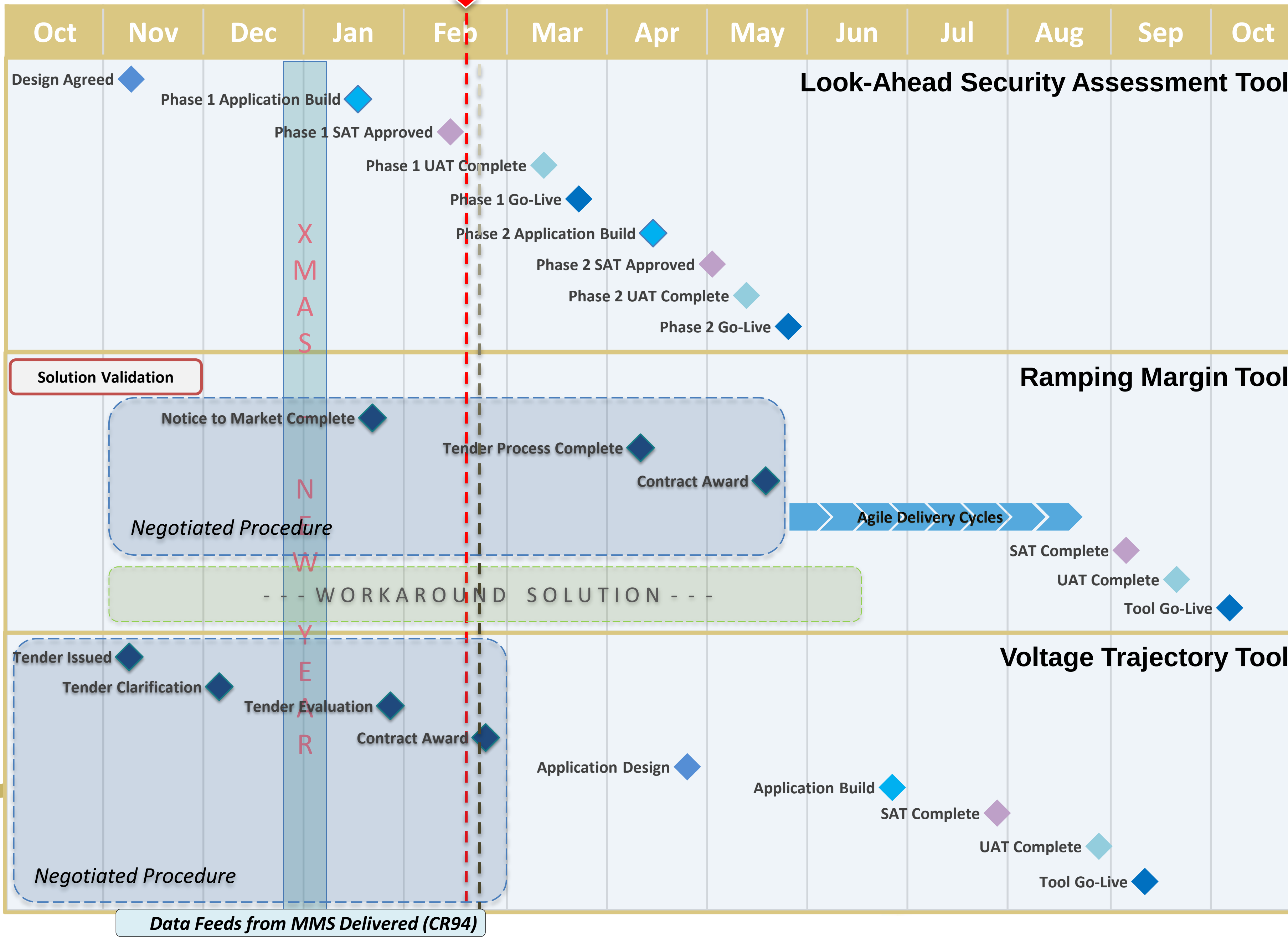
DS3 Control Centre Tools - Milestone Plan



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.

Fast Frequency Response

February 2020

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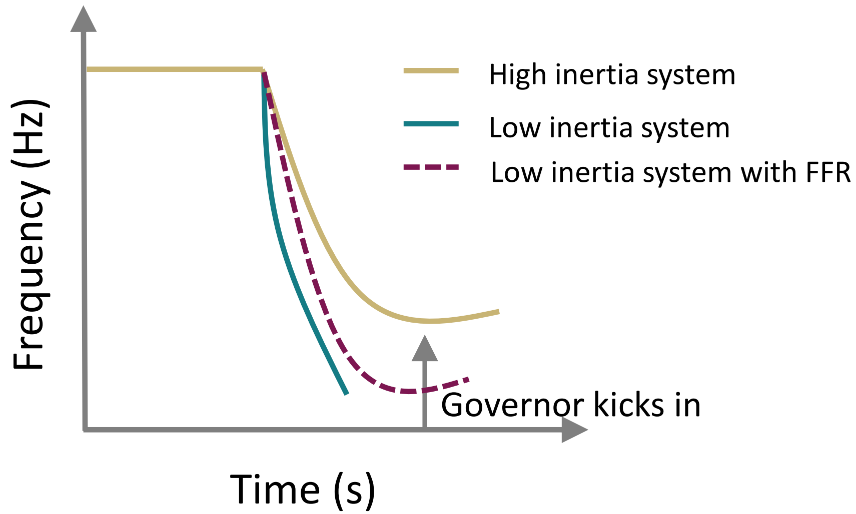
Background & Introduction

- 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

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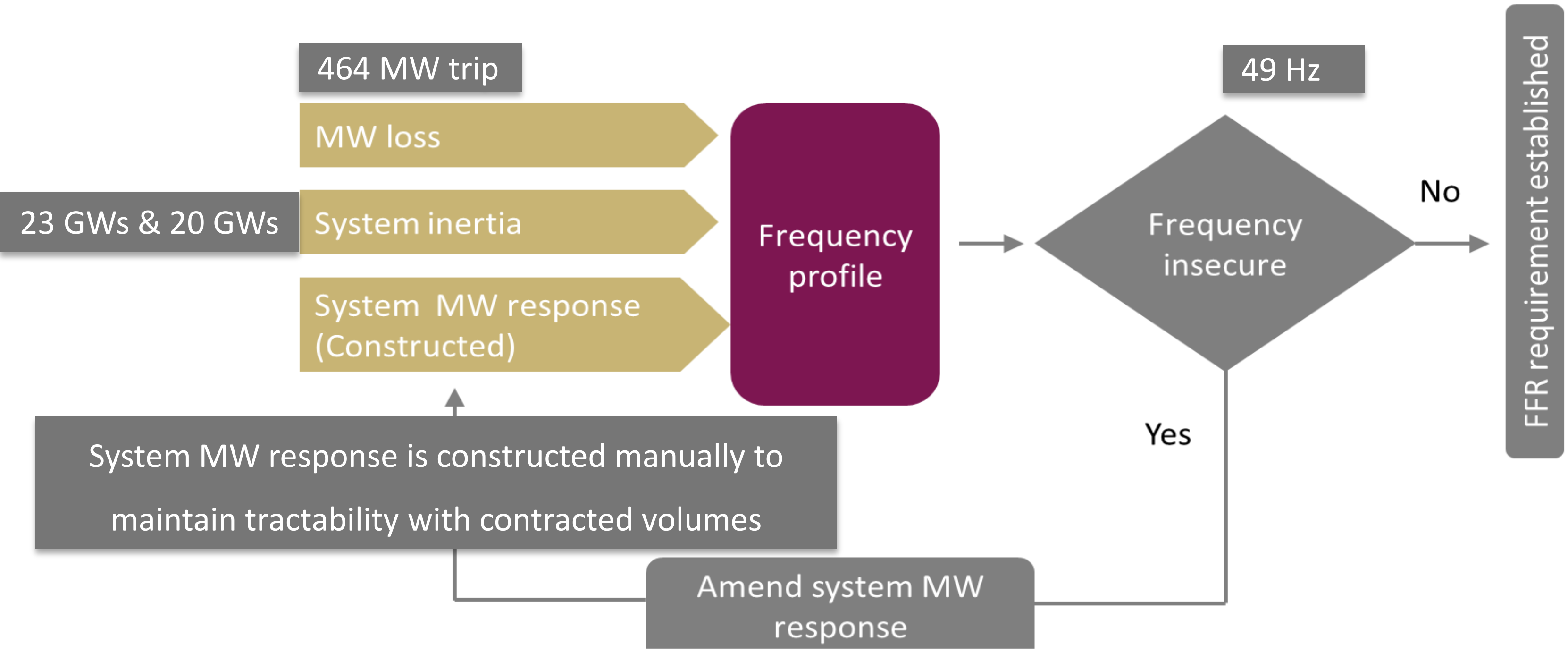
Evaluation procedure

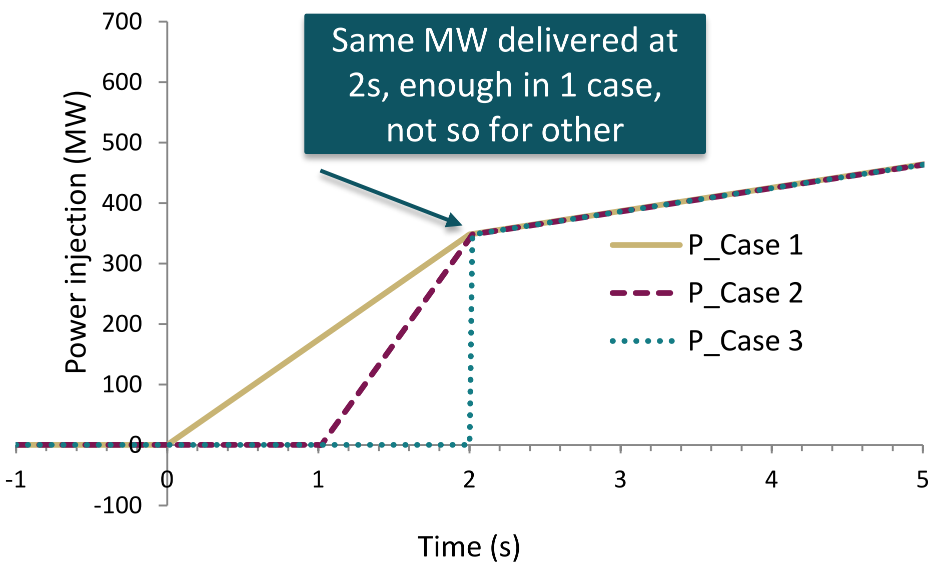
First principles based approach

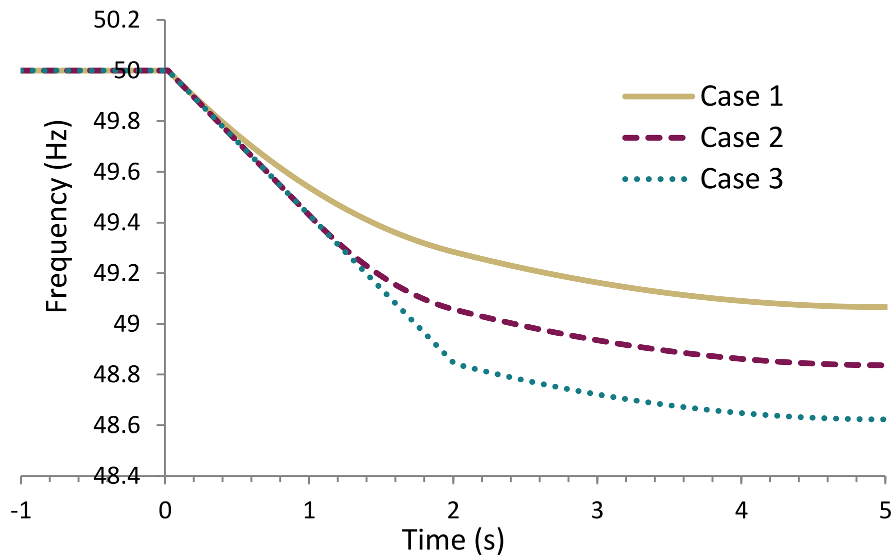
$$df = \frac{f_0}{2RE} \int P_{inj} - P_{loss}$$



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.





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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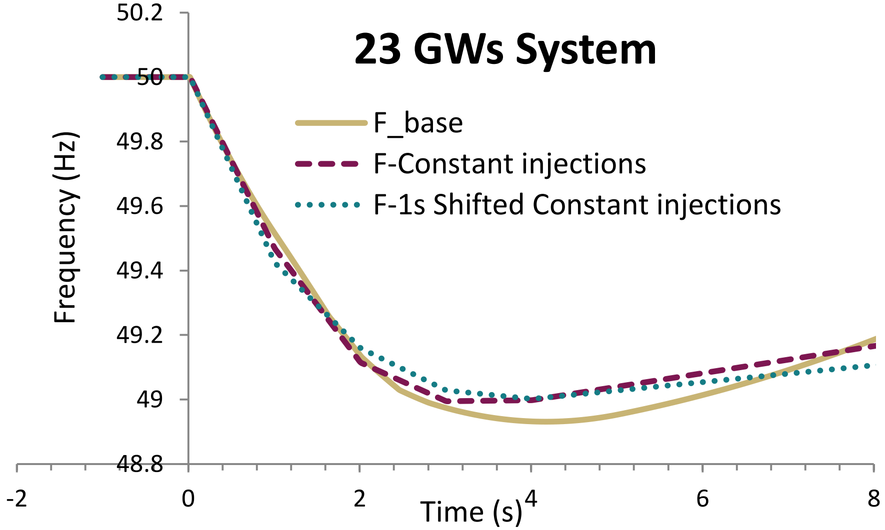
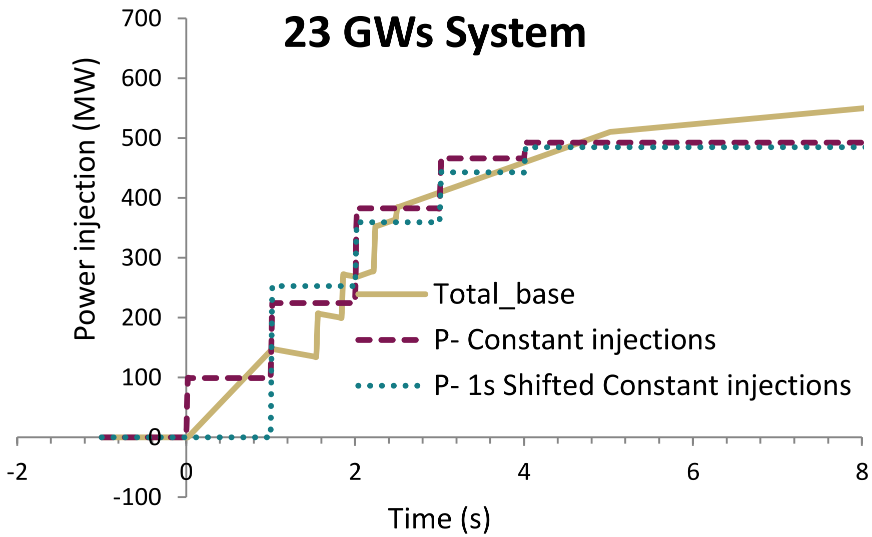
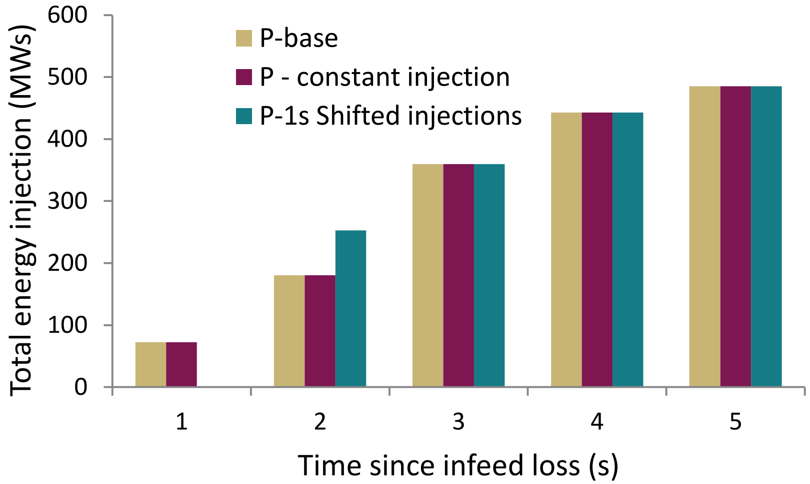
Key Outcomes

- 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.







Different MW injections (at 2s), but same MWs injection (at 2s) result in similar frequency profiles

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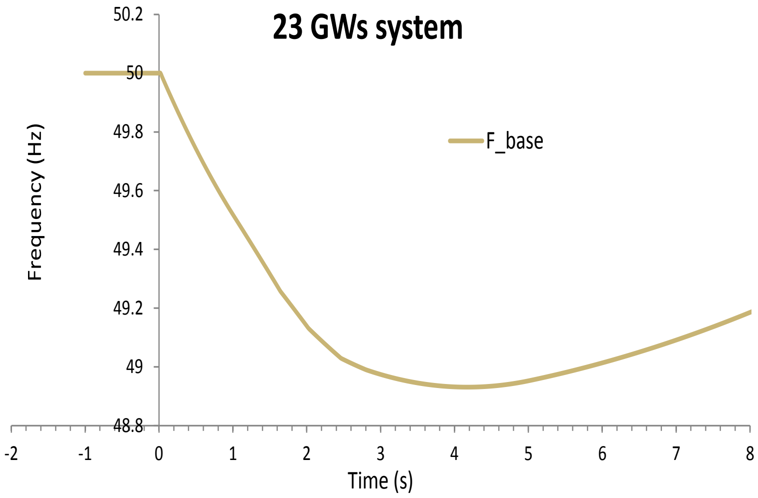
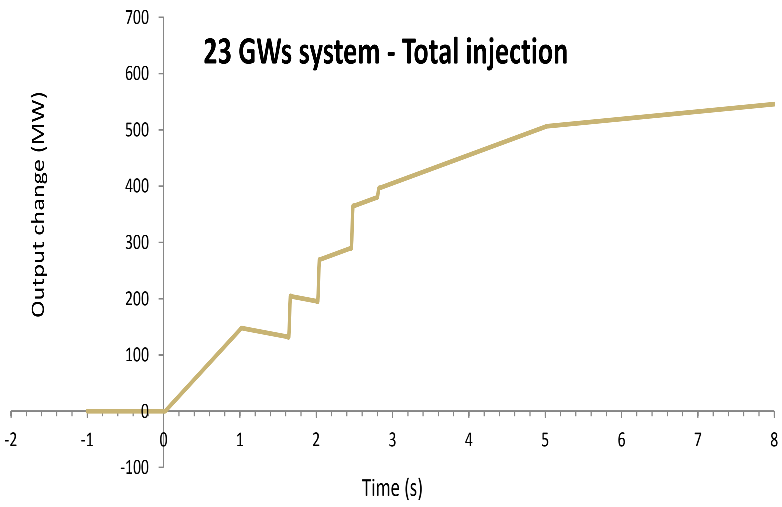
Key Outcomes

- 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

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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EU-SysFlex

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

WP7 NEW ENERGY WORLD
Coordination of Centralized and Decentralized Flexibilities

WP6 innogy
Coordination of flexibilities connected to distribution

WP11 EURACTIV
Dissemination

Demonstrations

Demonstrations

WP5 elering
Data management

WP8 EDF
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

WP2 EIRGRID

New approaches
for System Operation
with high RES

- 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?

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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

Task 2.3
Models & analysis to be run

PLEXOS
BY ENERGY EXEMPLAR

Task 2.5
Financial & Economic analysis

Cost Assumptions

- Publically available sources

Roadmap Development

Disclaimer: This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 773505.

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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 Low Carbon Living Consumer Action	×	MaRun BAU EOC	×	7GW 8GW 10 GW

+

Changing carbon prices, varying solar levels etc.

Disclaimer: This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 773505.

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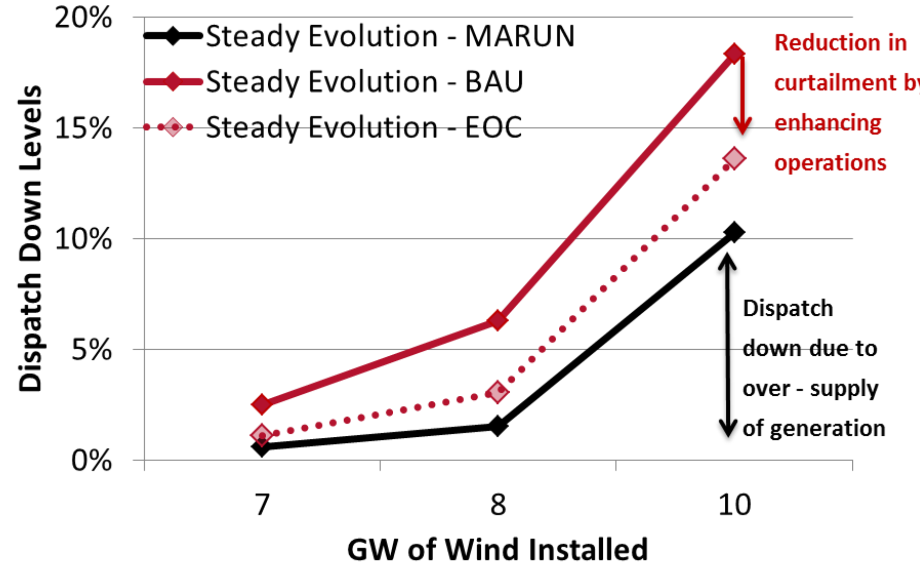
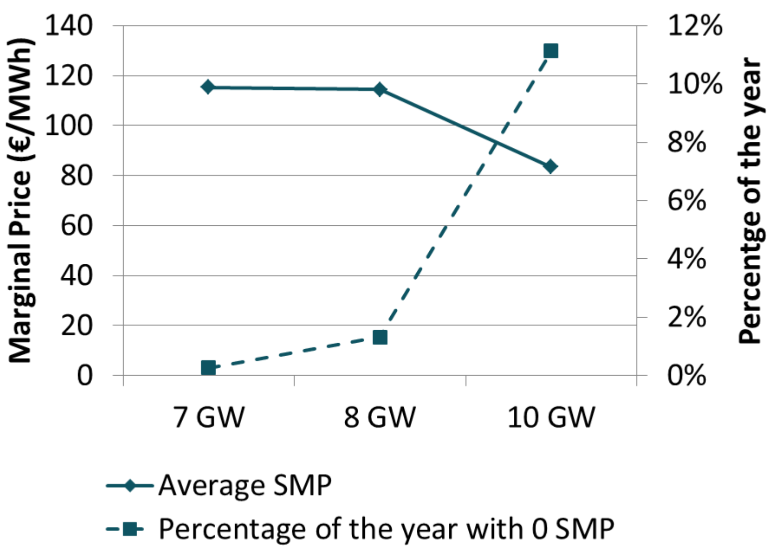
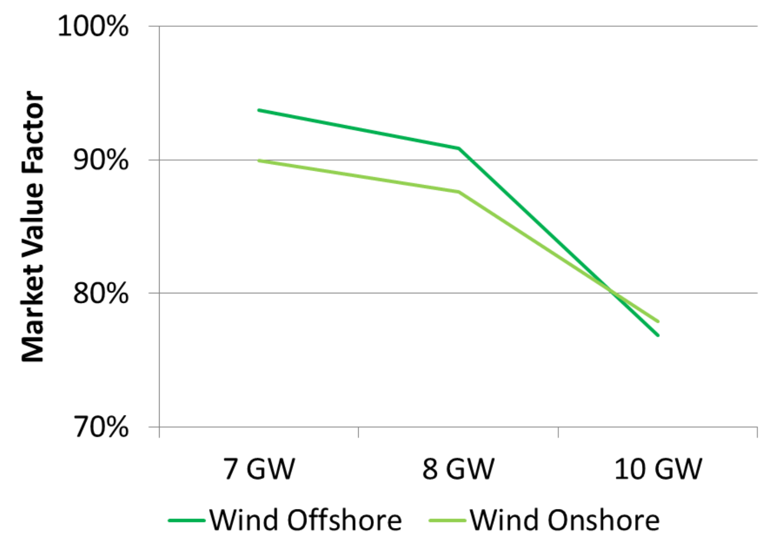
Main messages as higher levels of wind added….

- Carbon emissions falling
- Dispatch-down levels increasing
- Average marginal prices falling
- Market value factors are decreasing

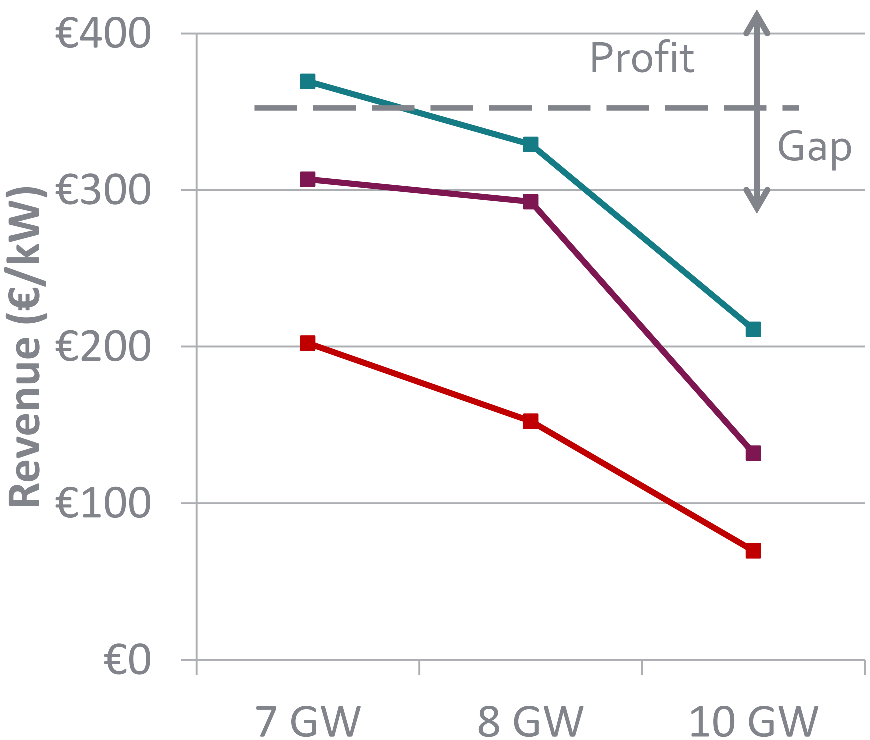




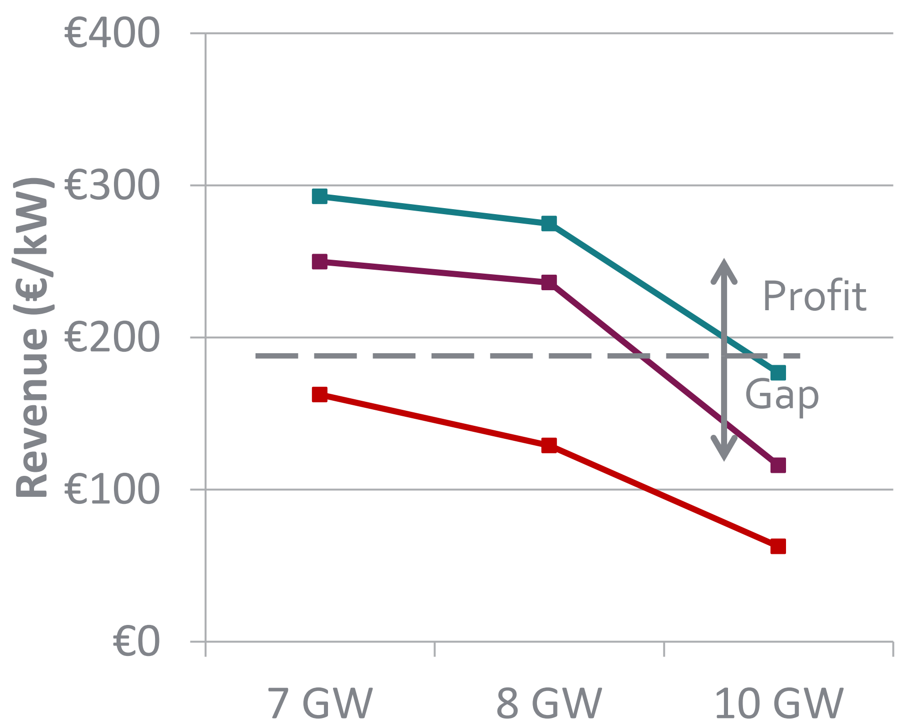


As wind levels increase, market revenues do not cover costs and lead to financial gaps…. and not just for renewables

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

Disclaimer: This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 773505.

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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**

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EU-SysFlex

Flexible Technology Integration Initiative

February 2020

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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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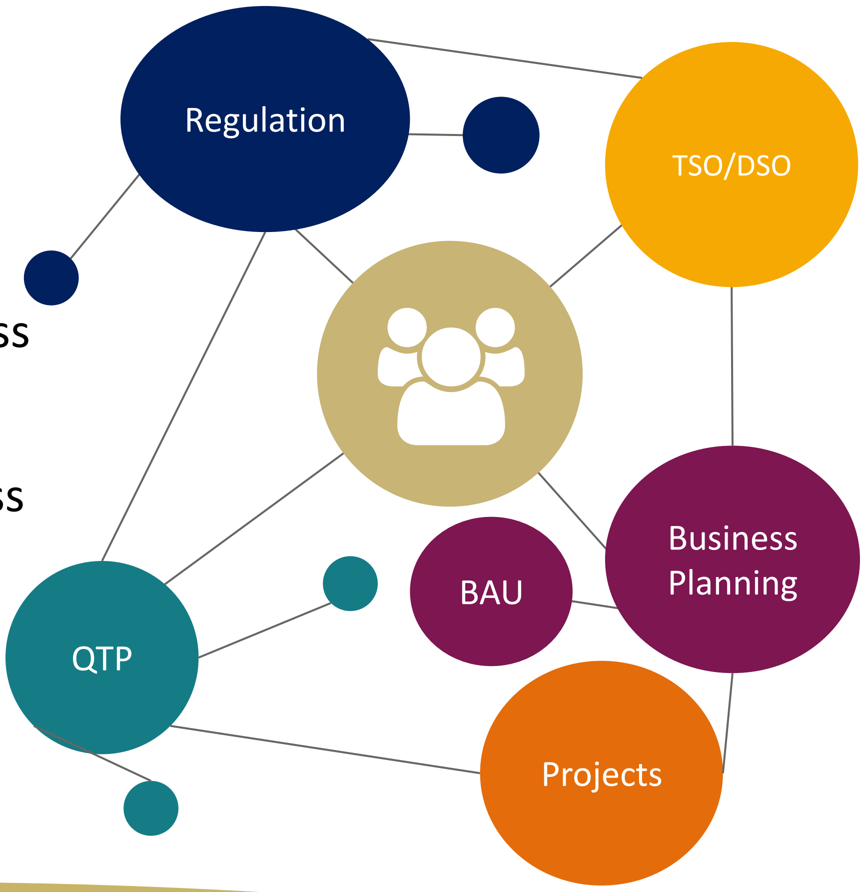
FlexTech Integration Initiative

- ✓ 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 technical, policy regulatory and commercial issues to enable integration of renewables.



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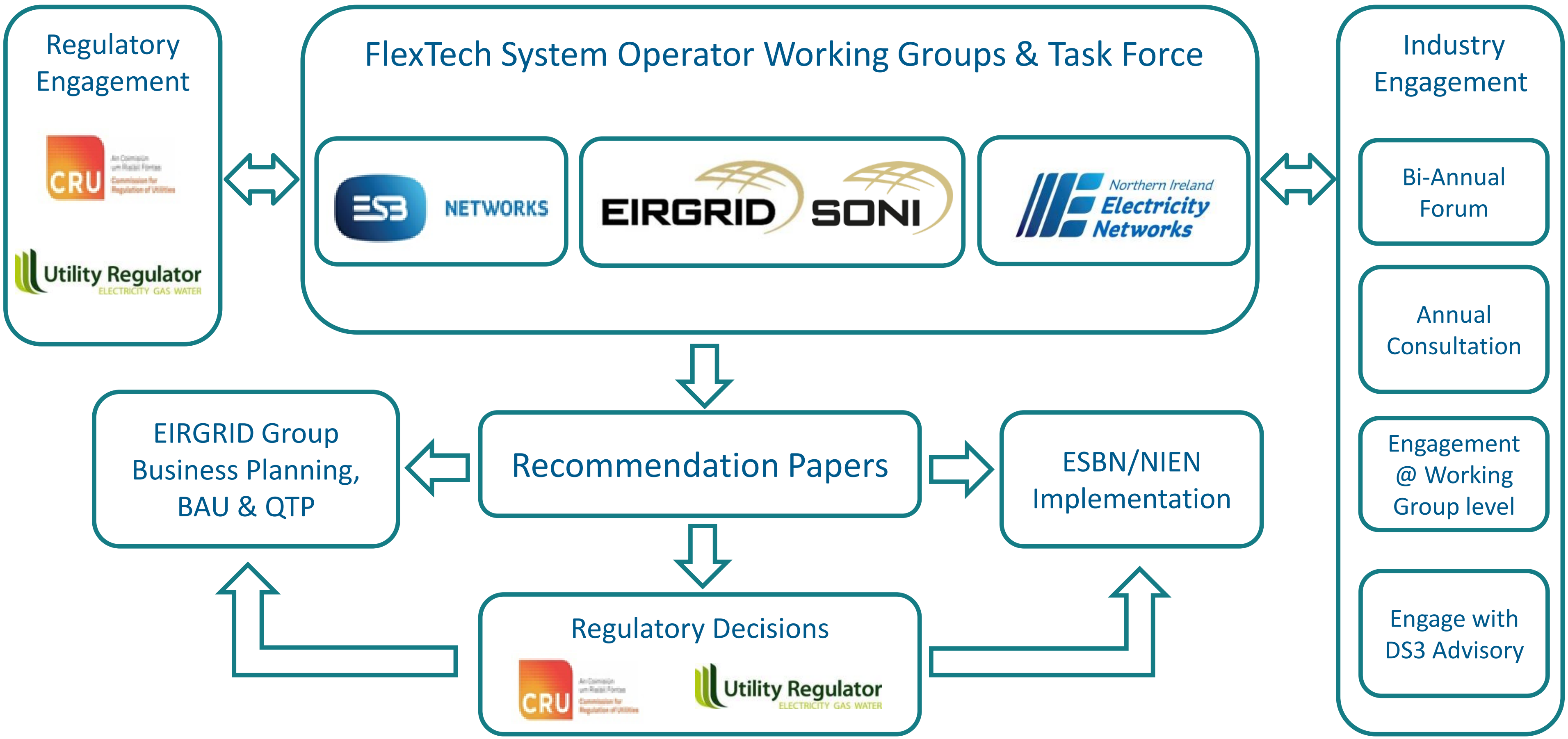
FlexTech – Structure of Engagement



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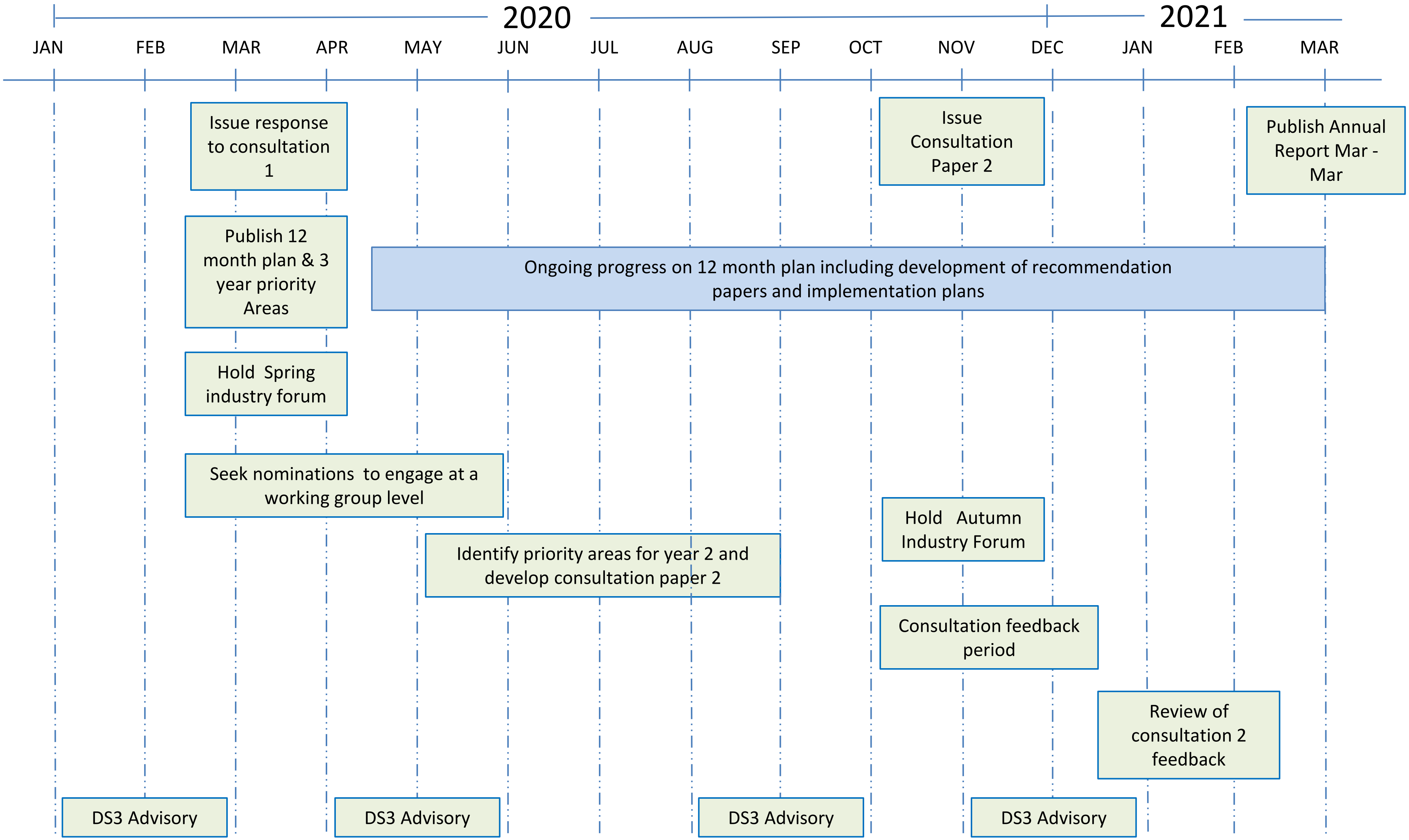
FlexTech – Initial Focus

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

FlexTech – Consultation Feedback
19 Responses


2020
2021
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
JAN
FEB
MAR
Issue response to consultation 1
Publish 12 month plan & 3 year priority Areas
Hold Spring industry forum
Seek nominations to engage at a working group level
Identify priority areas for year 2 and develop consultation paper 2
Ongoing progress on 12 month plan including development of recommendation papers and implementation plans
Issue Consultation Paper 2
Hold Autumn Industry Forum
Consultation feedback period
Review of consultation 2 feedback
Publish Annual Report Mar - Mar
DS3 Advisory
DS3 Advisory
DS3 Advisory
DS3 Advisory

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

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Supported by

ESB NETWORKS Northern Ireland Electricity Networks

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	