

# Frequency Risk and Control Report

April 2021 edition

Report consultation webinar

**Slido: #W238**

## We'll cover the following topics

- Summary of GSR027 changes
- Aims
- Structure
- Industry consultation questions
- Proposals
- How to respond
- Q&A

# Summary of GSR027 changes

(the source of the requirement for the FRCR)

### SQSS modification GSR027 developed to address actions from 9 Aug 2019 Ofgem/E3C reports

#### Key changes:

- Update the operational chapters of the SQSS and the definition of 'Unacceptable Frequency Conditions' to reference the Frequency Risk and Control Report (FRCR)
- Define that the FRCR will set out the contingencies that the ESO will secure operationally
- Clarify that consequential losses of distributed energy resources associated with any event will be included in FRCR considerations
- Provide standing to the FRCR and the FRCR methodology that will be used to produce this and set out the processes for their preparation, engagement and approval

# Aims

### **This first edition of the FRCR has three key aims:**

- To establish a clear, objective, transparent process for assessing reliability vs. cost of operating the National Electricity Transmission System with respect to frequency, to ensure the best, most cost-effective outcomes for consumers
- To make inclusion in this assessment of the risk from inadvertent operation of Loss of Mains protection transparent
- To identify specific quick, short-term improvements in reliability vs. cost

**Policy**

Gives transparency around current operation, and sets the baseline for the methodology



**Methodology**

Sets out the criteria that will be considered within the report and how the assessment within this will be carried out; consulted on and recommended by the Panel in Jan 2021



**Report**

Carries out the assessment described in the methodology; the subject of this consultation

# Consultation



Milestone	Date
Methodology consultation	21 Dec – 13 Jan 2021
SQSS Panel meeting – decision on recommendation of methodology for use in preparing FRCR	29 Jan 2021
FRCR consultation	1 <sup>st</sup> – 12 <sup>th</sup> Mar 2021
SQSS Panel meeting – decision on recommendation of FRCR	30 Mar 2021
Submission of FRCR to Ofgem	1 Apr 2021

★ we are here

1. Overall, do you agree that the FRCR represents appropriate development in determining the way that the ESO will balance cost and risk in maintaining security of supply while operating the system?

2. Do you agree that the FRCR has been prepared appropriately taking account of the requirements set out in the methodology?

3. To help structure comments, do you agree with and what is your feedback on the specific proposals in the FRCR?

**a. Proposal 1: minimum national inertia requirement**

*Continue with current Policy:*

Minimum inertia at 140GVA.s

**b. Proposal 2a: frequency limit for different size infeed loss risks**

*Update current Policy to:*

Allow specific risks of a loss of a BMU-only, BMU+VS outage or BMU+VS intact event to potentially result in a frequency deviation outside the lower limit of 49.5Hz.

**c. Proposal 2b: individual loss risk controls**

*Update current Policy to:*

- Apply individual loss risk controls to BMU-only events to keep resulting frequency deviations within 49.2Hz and 50.5Hz
- Do not apply individual loss risk control to BMU+VS outage or BMU+VS intact events

4.The FRCR also makes certain other recommendations. Again to help structure comments, do you agree with and what is your feedback on these?

**a. Proposal 3: Dynamic Containment Low**

*The new fast acting service, Dynamic Containment launched in October 2020, is delivering value today and continues to provide value into the future.*

- The ESO should continue to increase its use of the Dynamic Containment low frequency service (Dynamic Containment Low) beyond 500MW in line with the anticipated pipeline

**b. Proposal 4: ALoMCP**

*The Accelerated Loss of Mains Change Programme has been running for over a year and has already created significant value by removing nearly 10GW of Vector Shift protection settings. There is still a substantial volume of protection changes to be made to minimise the risk posed by the VS and RoCoF protection on distributed generation.*

- The ALoMCP should continue during 2021 for both RoCoF and Vector Shift

5.Do you have any suggestions for further areas that can be addressed in future editions of the FRCR?

6.Do you have any further comments?

# FRCR Summary

The outcome of this assessment is to recommend application of frequency controls with an indicative total cost of £244m for 21/22. The level of frequency risk on the system is expected to be:

#	Deviation	Relevance	Duration	Likelihood
H1	50.5 > Hz _____	Frequency standard as per SQSS	Any	1-in-1,100 years
L1	49.2 ≤ Hz < 49.5	Current SQSS implementation	up to 60 seconds	2 times per year
L2	48.8 < Hz < 49.2	Frequency Standard set out in System Operator Guidelines	Any	1-in-22 years
L3	47.75 < Hz ≤ 48.8	Activation of Low Frequency Demand Disconnection (LFDD)	Any	1-in-270 years

The analysis also demonstrates:

- that delivery of ALOMCP throughout 2021 will significantly decrease system risk, in particular ROCOF risk
- the value of Dynamic Containment

and presents a suite of proposals which will reduce the requirement for the ESO to intervene in the market dispatch of power stations.

The combined impact of the recommendations, delivery of the Accelerated Loss of Mains Change Programme and the introduction of Dynamic Containment is a reduction in risk at an indicative cost of £244m

# FRCR Main Recommendations

## Proposal 1: minimum inertia

Continue with current *Policy*:

- Minimum inertia at 140GVA.s

## Proposal 2: individual loss risks

### 2a) Frequency limit for different size infeed loss risks

Continue with current *Policy*:

- Don't apply individual loss risk controls to BMU-only, BMU+VS outage and BMU+VS intact events to keep resulting frequency deviations within 49.5Hz

### 2b) Individual loss risk controls

Update current *Policy* to:

Apply individual loss risk controls to BMU-only events to keep resulting frequency deviations within 49.2Hz and 50.5Hz

Do not apply individual loss risk control to BMU+VS outage or BMU+VS intact events

The proposals are made in line with the concept of value set out in the Methodology

# FRCR Other Recommendations

## Proposal 3: Dynamic Containment Low

The ESO should continue to increase its use of the Dynamic Containment low frequency service (Dynamic Containment Low) beyond 500MW in line with the anticipated pipeline

## Proposal 4: ALoMCP

The ALoMCP should continue during 2021 for both RoCoF and Vector Shift

The proposals are made in line with the concept of value set out in the Methodology

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# Resulting Policy

These proposals come together to form a *Policy* as follows:

- **Maintain** a minimum inertia of 140GVA.s
- To **consider** allowing BMU-only *infeed* loss risks to cause a consequential RoCoF loss, if the resulting loss can be contained to 49.2Hz and 50.5Hz
- removing the tighter limit for smaller losses, and instead only applying the wider limit of 49.2Hz to all BMU-only *infeed* losses
- And apply the following treatment to events:

	BMU-only	VS-only	BMU+VS outage	BMU+VS intact
Considered by policy	Yes	Yes	Yes	Yes
Mitigated in real-time	Yes	n/a <sup>4</sup>	No	No
Prevent consequential <u>RoCoF</u> loss	Allowing where controllable	n/a	No	No
Main control(s)	Frequency response and Reduce BMU loss size	Inertia	Reduce <u>LoM</u> loss size	Reduce <u>LoM</u> loss size
Additional control(s)	Inertia	Frequency response	n/a	n/a

<sup>4</sup> as the VS-only risk is fully mitigated by minimum inertia policy

# Baseline assumptions

The analysis uses a set of baseline assumptions to determine the overall cost and risk for each scenario being assessed.

Variable	Baseline assumption
Minimum inertia	maintained at 140GVA.s
Frequency response	per current Policy, with the addition of the expected pipeline of Dynamic Containment Low in 2021 (allowing larger losses including consequential RoCoF losses to be secured)
Dynamic containment	The anticipated pipeline reaches 500MW in May 2021 and 900MW in July 2021
LoM capacity	as the forecast for 01 April 2021, for both RoCoF and Vector Shift
2019 Vs 2020	Given the latest available information on COVID-19 restriction roadmaps, the 2019 dataset (pre-COVID) has been used as the baseline for the <i>Report</i> .
2021 system	Adjustments to time series data for expected changes in 2021 have been made e.g. new connections

- To simplify the analysis of the range of frequency risks resulting in consequential Vector Shift and/or ROCOF losses events have been categorised as:
  - BMU-only
  - BMU+VS intact
  - BMU+VS outage



# Proposal 1: minimum inertia policy

2 options were assessed:

- Maintain at 140GVA.s
- Increasing minimum inertia to 160GVA.s

Scenario	140 GVA.s	160 GVA.s
System-wide controls cost	£ 240m	£ 340m
Individual loss risk controls cost	£ 27m	£ 20m
Total cost	£ 267m	£ 360m
Remaining risk: 48.8Hz	1-in-270 years	1-in-275 years
Remaining risk: 49.2Hz	1-in-22 years	1-in-22 years
Remaining risk: 49.5Hz	1-in-4.6 years	1-in-5 years
Remaining risk: 50.5Hz	1-in-1,100 years	1-in-1,100 years

There is little to no benefit in risk reduction by adopting a higher minimum inertia policy of 160GVA.s, but that there is a significant increase in cost. This would not present good value to the end consumer.

# Proposal 2: individual loss risk controls

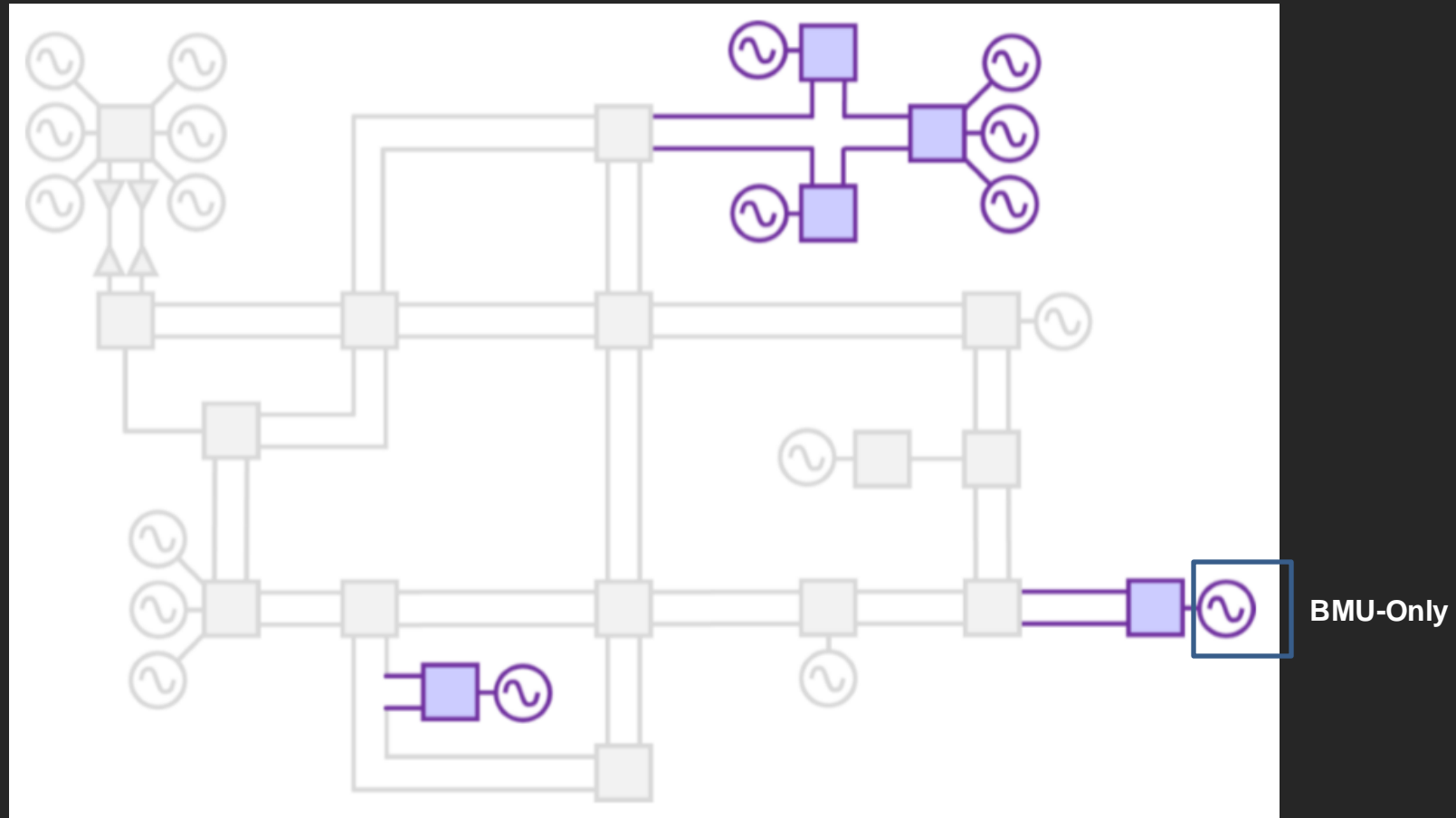
Proposal 2 assesses the benefit of:

- Applying the wider 49.2Hz limit to actively manage all infeed losses (relaxing smaller infeed losses to 49.5Hz) and;
- Applying individual loss risk controls to event categories:
  - BMU-only
  - BMU+VS Outage
  - BMU+VS Intact

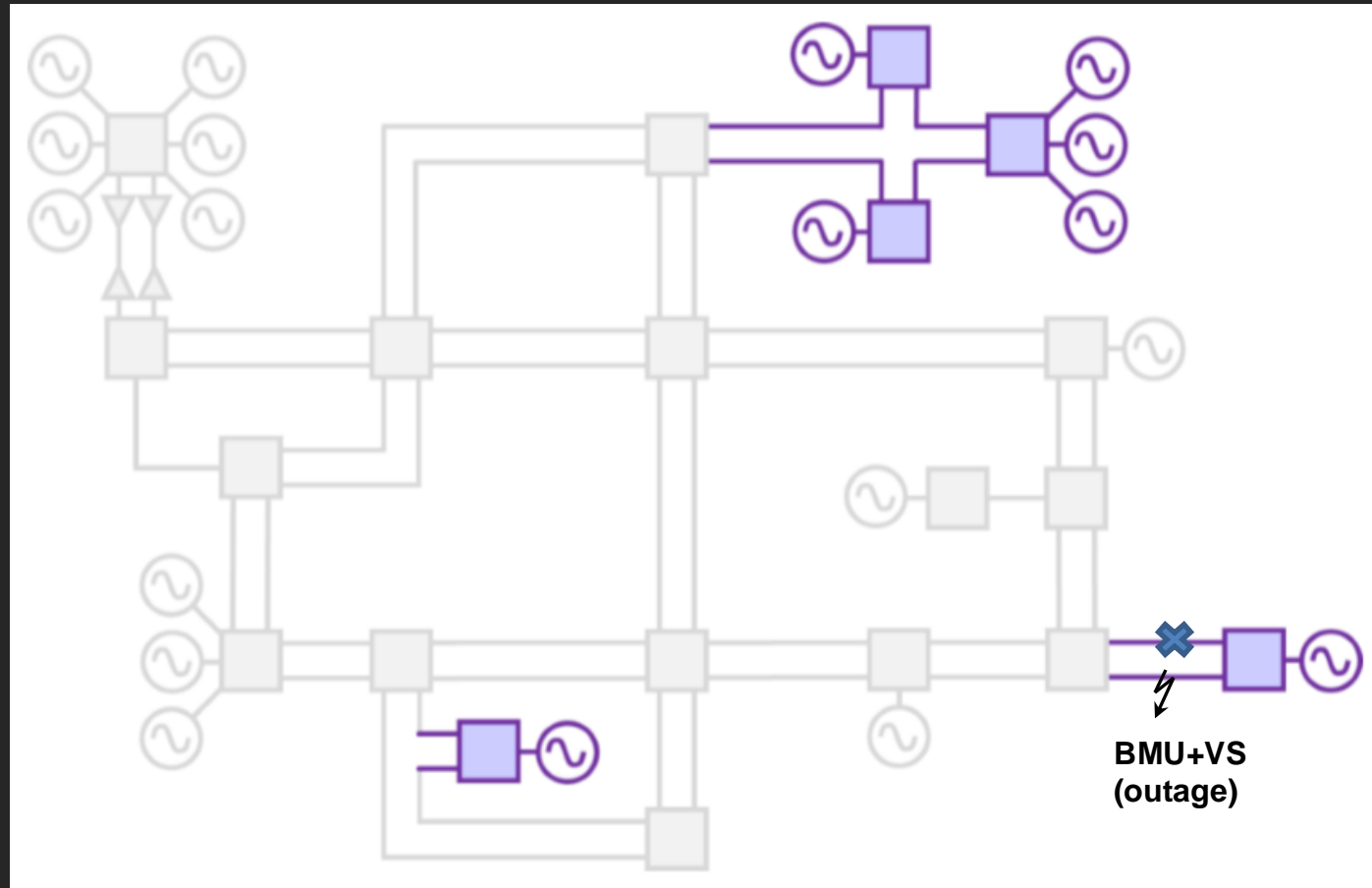
Assessment of frequency impact is broken down based on:

- Controls for managing high frequency (50.5Hz) are considered separately from low frequency impacts (48.8Hz, 49.2Hz and 49.5Hz)
- System Operator Guidelines (SOGL) states that the maximum frequency deviations in GB shall be 0.8Hz. The assessment considers the low frequency impacts in two steps:
  - the risk of a frequency deviation exceeding 49.2Hz, and the equivalent risk of frequency reaching 48.8Hz, then;
  - the risk of a frequency deviation exceeding 49.5Hz, and the additional cost that would be required to apply additional control over and above those needed for 49.2Hz

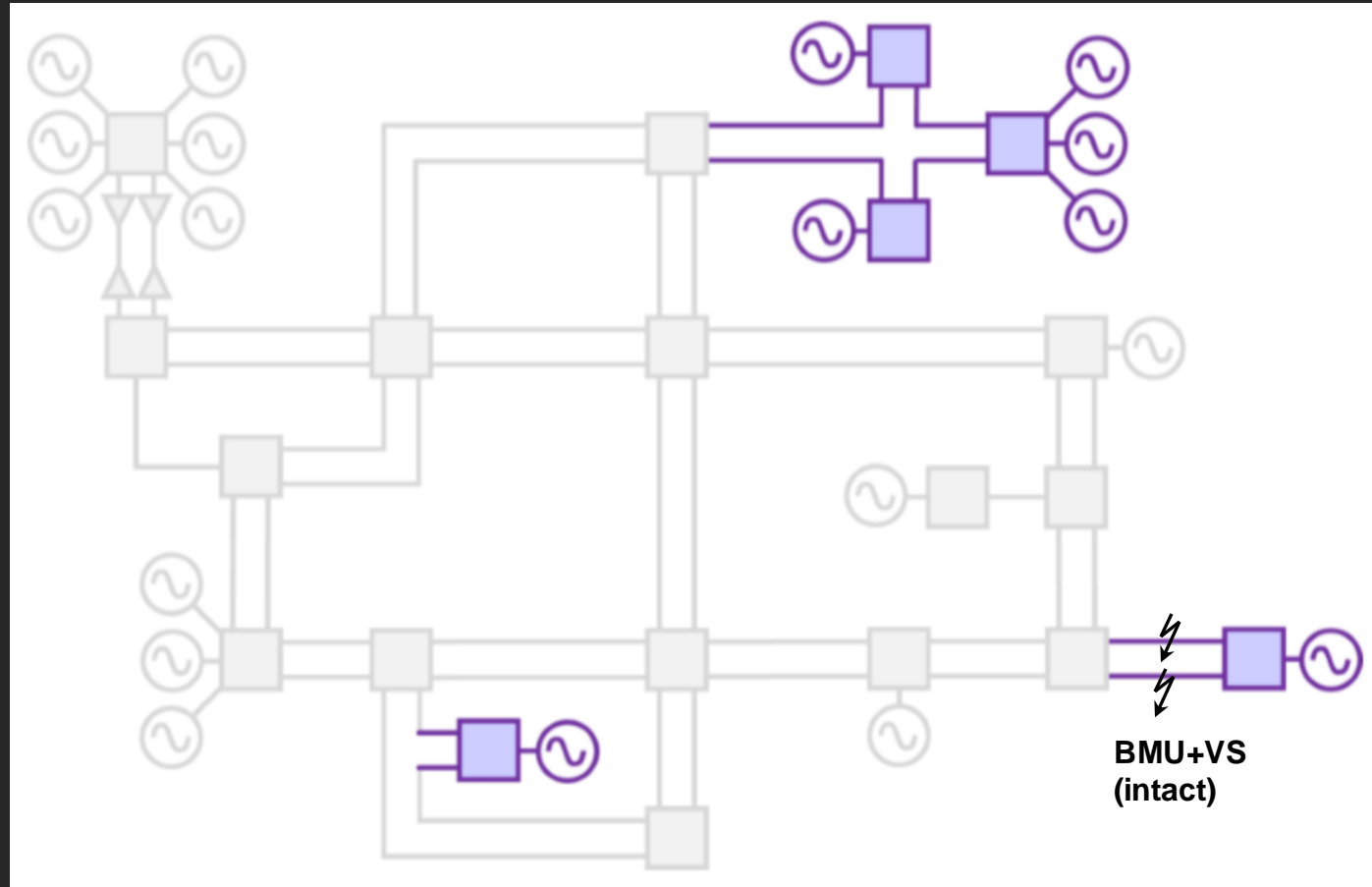
# Proposal 2: event categories (BMU-only)



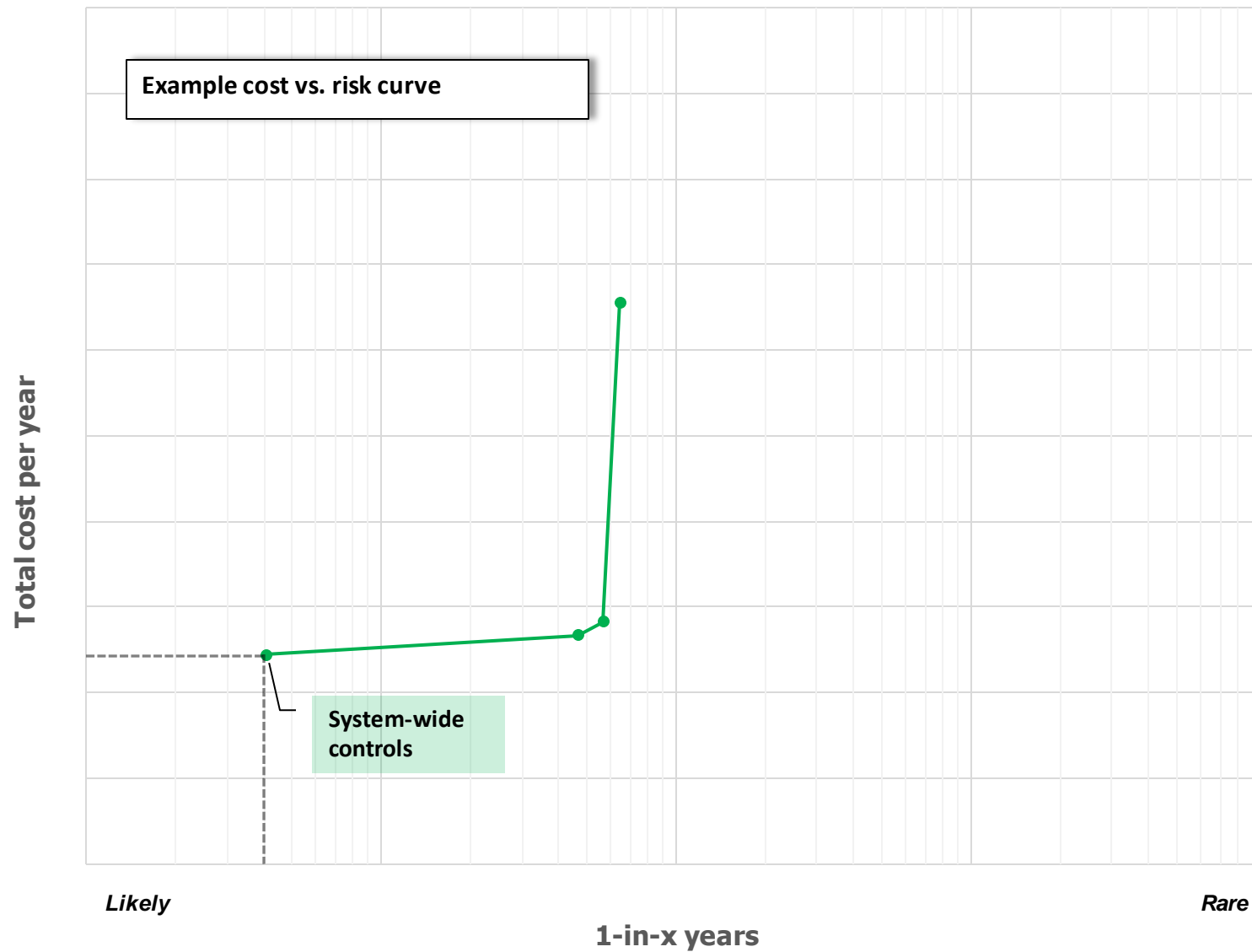
# Proposal 2: event categories (BMU+VS Outage)



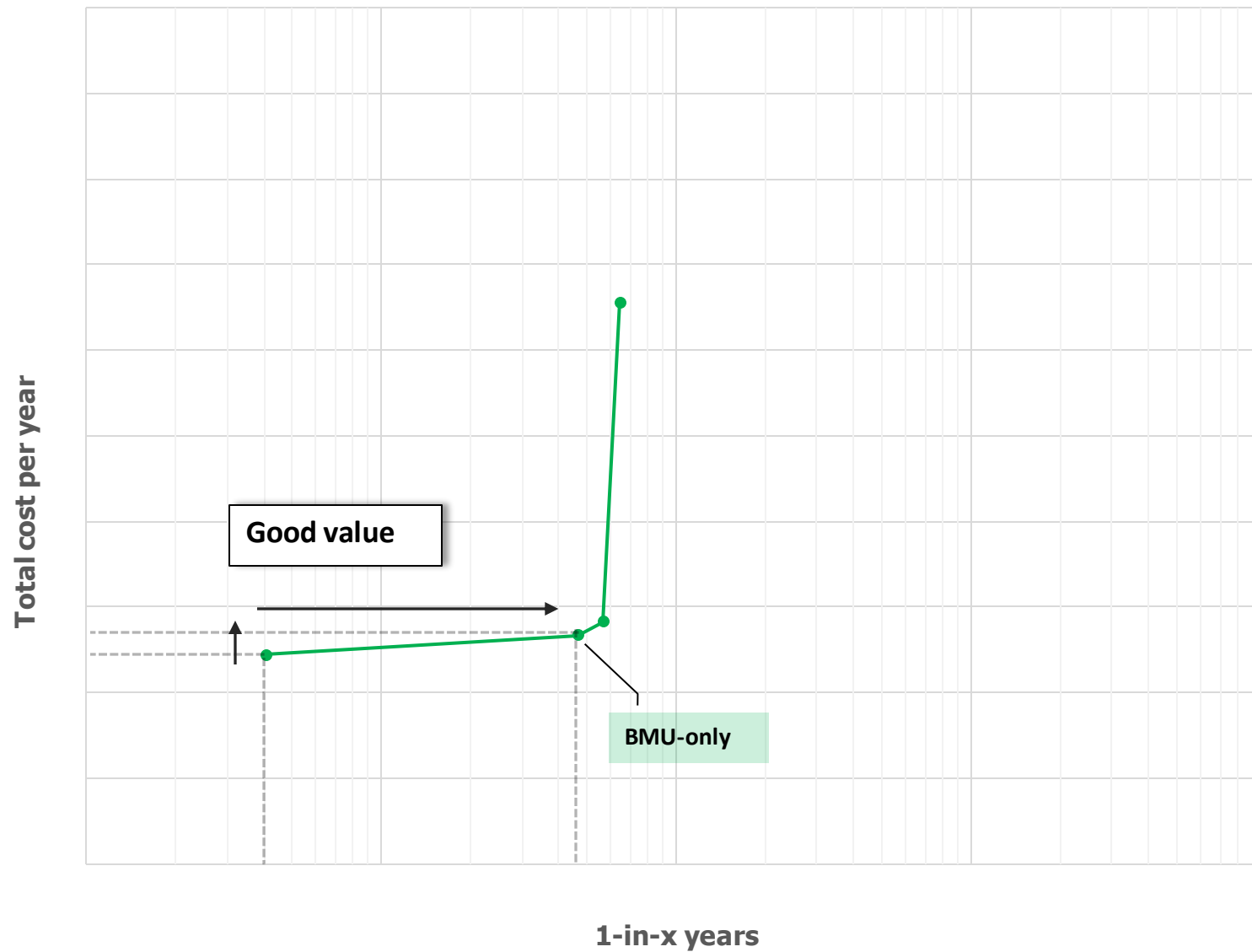
# Proposal 2: event categories (BMU+VS Intact)



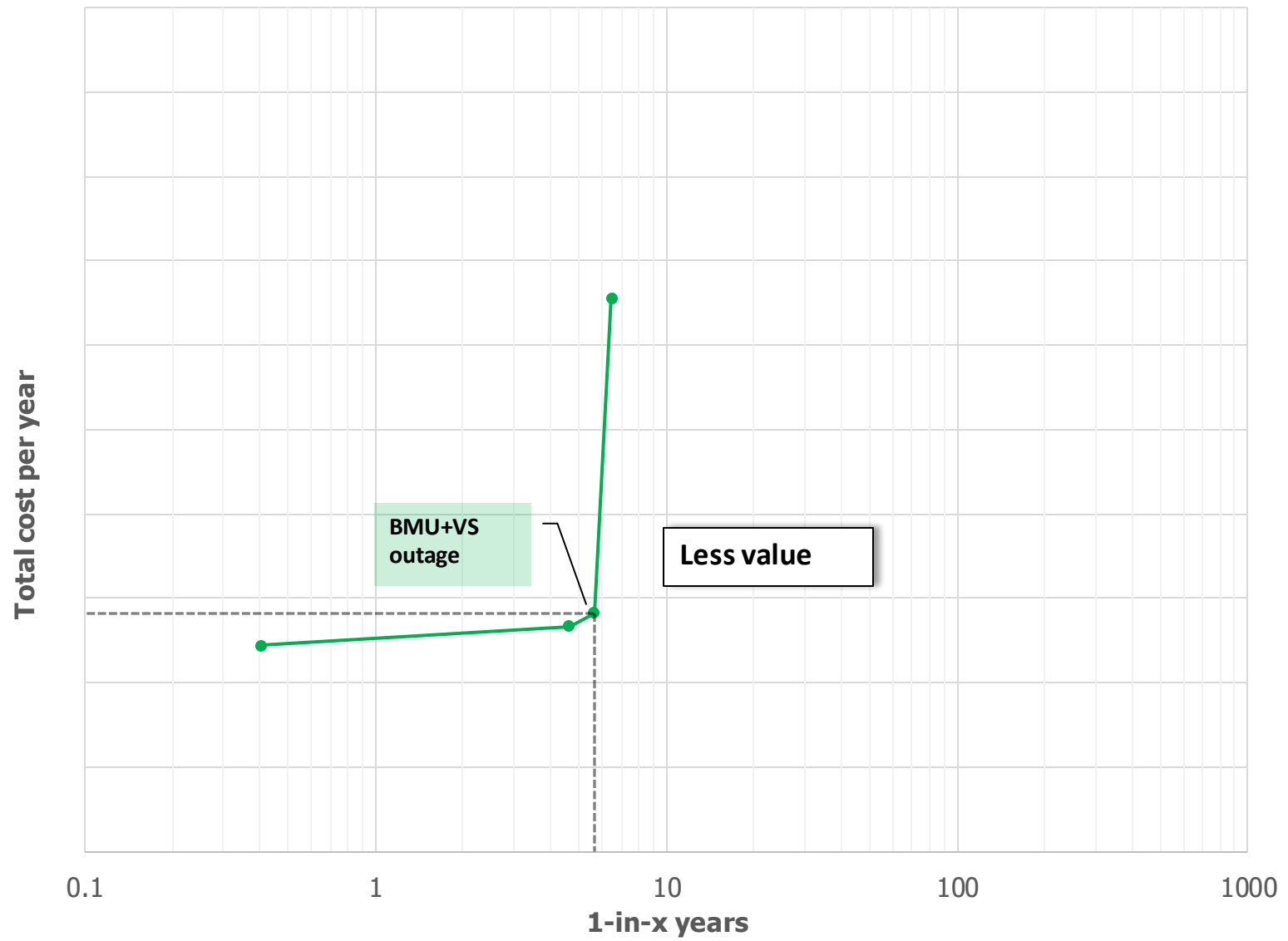
# Proposal 2: system-wide controls



# Proposal 2: BMU-only controls

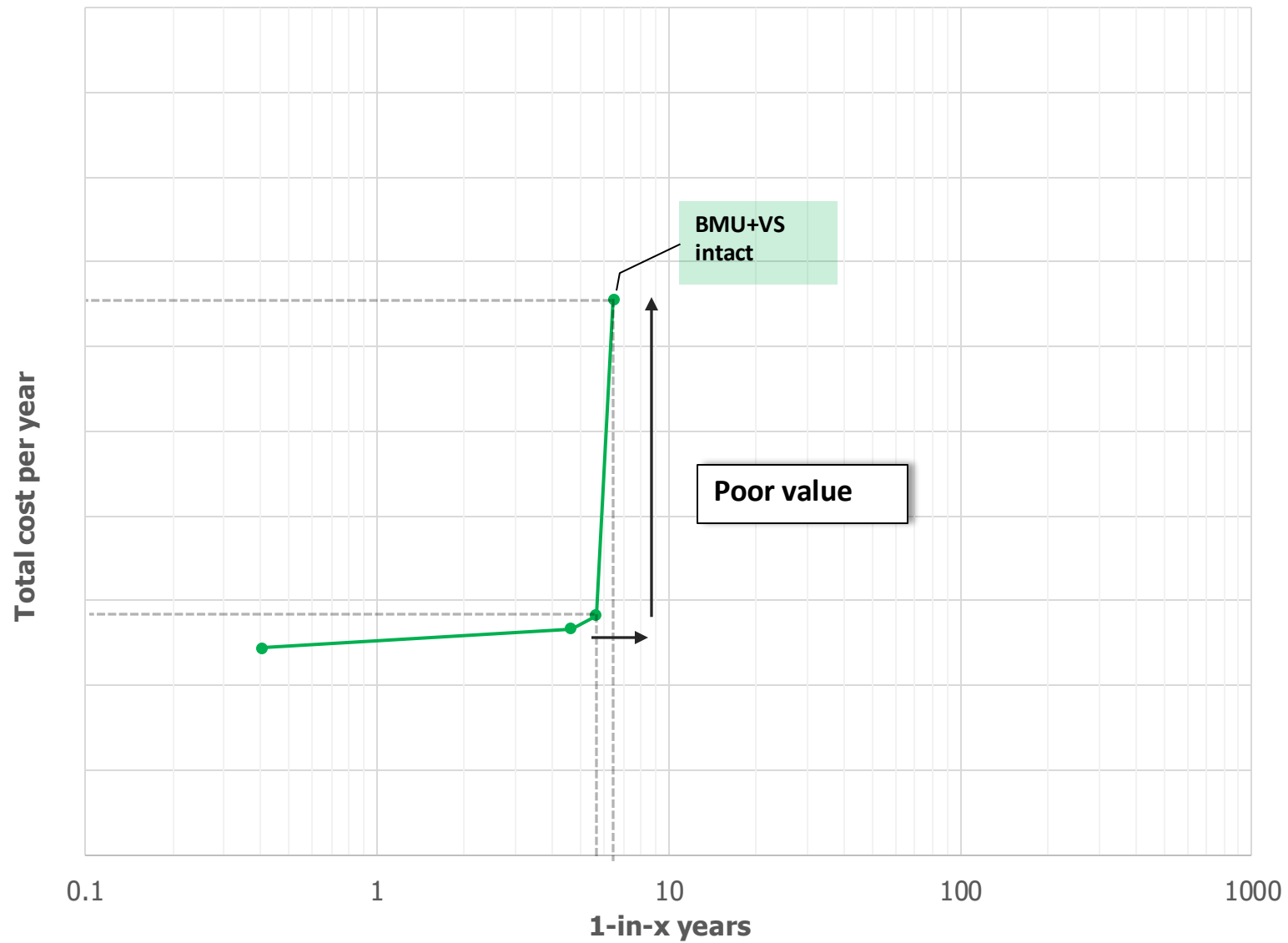


# Proposal 2: BMU-VS controls

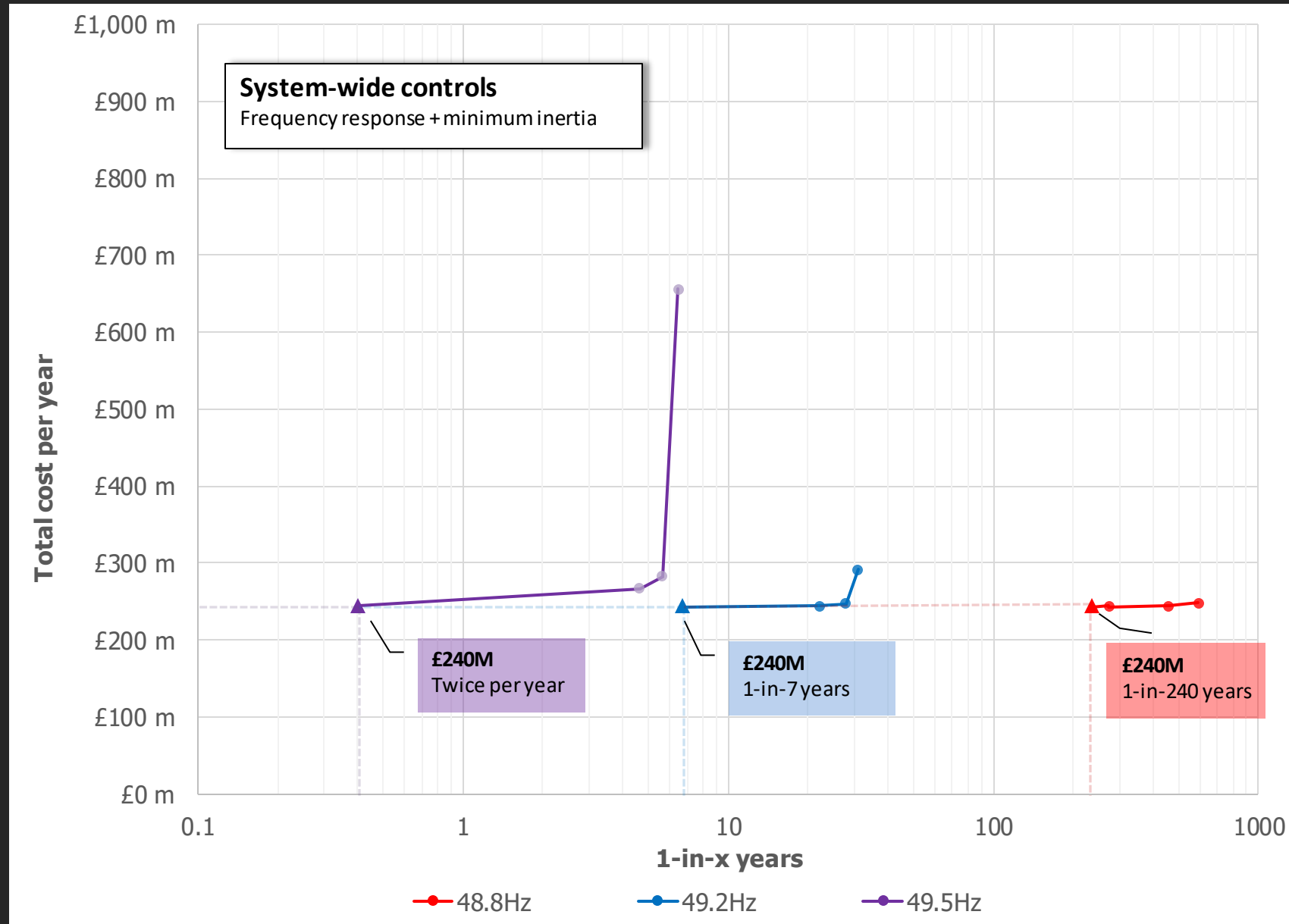




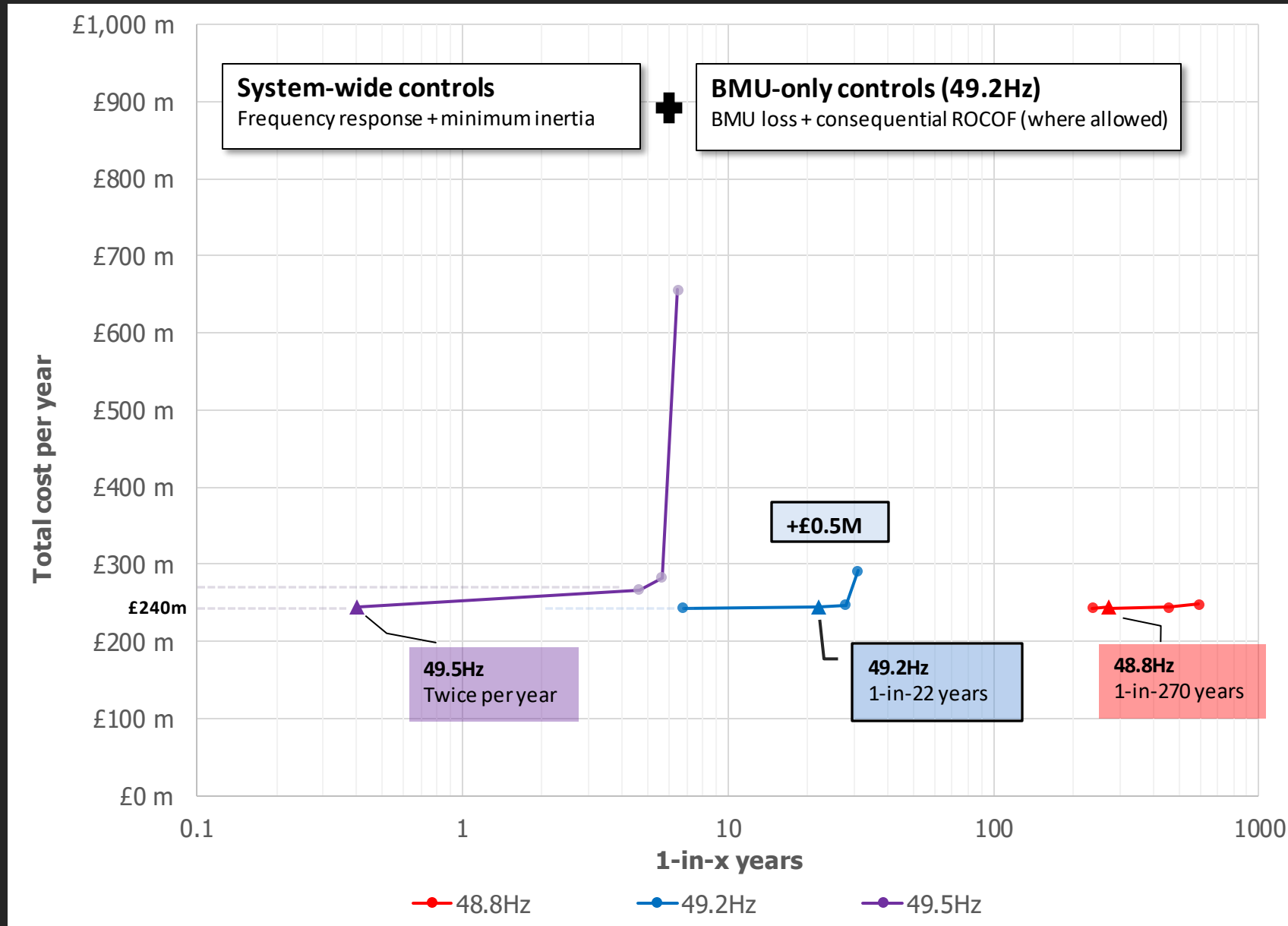
# Proposal 2: BMU-VS controls



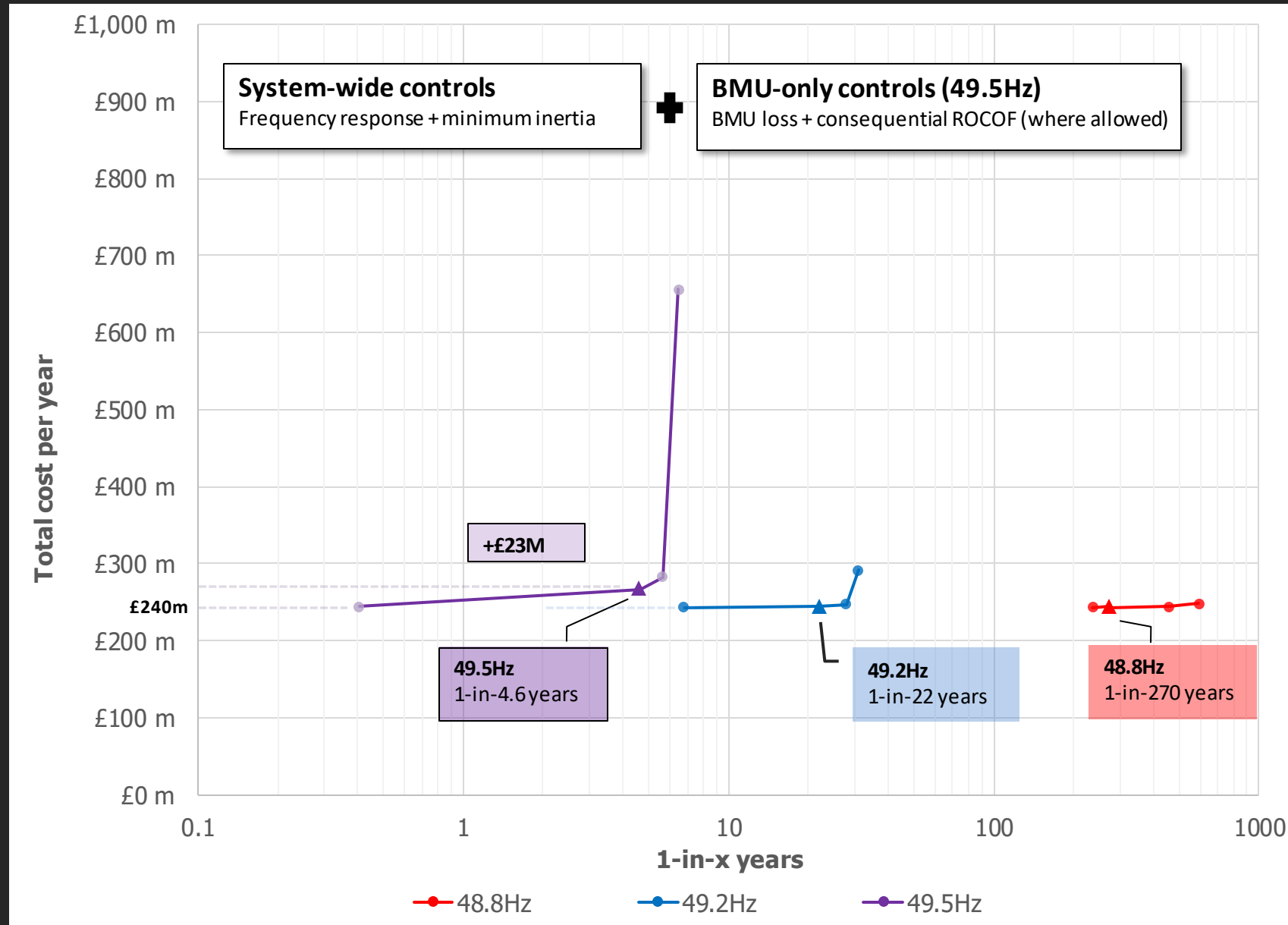
# Proposal 2: system-wide controls



# Proposal 2: BMU-only controls (49.2Hz)



# Proposal 2: BMU-only controls (49.5Hz)



# Proposal 2: individual loss risk controls

Impact levels 48.8, 49.2, 49.5 and 50.5Hz

Remaining risks and costs after applying (1) system-wide controls, (2) BMU-only, (3) BMU+VS outage, (4) BMU+VS intact:

49.2Hz & 48.8Hz

Event category	Cost to mitigate (per year)	Cumulative cost (per year)	Remaining risk 49.2Hz	Remaining risk 48.8Hz
System-Wide	£ 240m	£ 240m	1-in-7 years	1-in-240 years
<b>BMU-only</b>	<b>£ 0.5m</b>	<b>£ 241m</b>	<b>1-in-22 years</b>	<b>1-in-270 years*</b>
BMU+VS outage	£ 2.3m	£ 243.3m	1-in-28 years	1-in-460 years
BMU+VS intact	£ 44.3m	£ 287.6m	1-in-31 years	1-in-600 years

49.5Hz

Event category	Cost to mitigate (per year)	Cumulative cost (per year)	Remaining risk 49.5Hz
Start point	£ 240m	£ 240m	2 times per year
<b>BMU-only</b>	<b>£ 23m</b>	<b>£ 263m</b>	<b>1-in-4.6 years</b>
BMU+VS outage	£ 13m	£ 276m	1-in-5.6 years
BMU+VS intact	£ 330m	£ 606m	1-in-6.5 years

\*System would be secured operationally to 49.2Hz

50.5Hz

Event category	Cost to mitigate (per year)	Cumulative cost (per year)	Remaining risk 50.5Hz
Start point	£ 240m	£ 240m	1-in-3.6 years
<b>BMU-only</b>	<b>£ 3.8m</b>	<b>£ 243.8m</b>	<b>1-in-1,100 years</b>
BMU+VS outage	£ 2.1m	£ 245.9m	1-in-2,800 years
BMU+VS intact	£ 21.2m	£ 267.1m	n/a

\*The probability of a 1-in-270 year event happening in the next 10 years is  $p = \frac{10}{270} e^{\frac{-10}{270}} = 3.6\%$

# Proposal 2: individual loss risk controls

Without applying control to the 49.5Hz impact

	System-wide controls	plus BMU-only	plus BMU+VS outage	plus BMU+VS intact
Extra	n/a	£ 4m	£ 5m	£ 65m
Total	£ 240m	£ 244m	£ 249m	£ 314m
48.8Hz	1-in-240 years	1-in-270 years	1-in-460 years	1-in-600 years
49.2Hz	1-in-7 years	1-in-22 years	1-in-28 years	1-in-31 years
49.5Hz	2 times per year	2 times per year	2 times per year	2 times per year
50.5Hz	1-in-3.6 years	1-in-1,100 years	1-in-2,800 years	n/a

**Proposal 2a:** Don't apply individual loss risk controls to actively manage frequency deviations within 49.5Hz

**Proposal 2b:** Update current *Policy* to apply individual loss risk controls to **BMU-only** events to keep resulting frequency deviations within **49.2Hz and 50.5Hz**

Securing BMU-only events to 49.2Hz and 50.5Hz is good value for money, BMU+VS outage events are lower value for money, and the BMU+VS intact events are poor value for money

# Proposal 3: Dynamic Containment Low

The assessment compares two scenarios:

- 500MW of Dynamic Containment Low
- growing Dynamic Containment Low further with the anticipated MW pipeline

The anticipated pipeline reaches 500MW in May 2021 and 900MW in July 2021.

Scenario	DC at 500MW	DC Pipeline
System-wide controls cost	£ 220m	£ 240m
Individual loss risk controls cost	£ 8m	£ 4m
Total cost	£ 228m	£ 244m
Remaining risk: 48.8Hz	<b>1-in-63 years</b>	<b>1-in-270 years</b>
Remaining risk: 49.2Hz	<b>1-in-10 years</b>	<b>1-in-22 years</b>
Remaining risk: 49.5Hz	3 times per year	2 times per year
Remaining risk: 50.5Hz	1-in-1,100 years	1-in-1,100 years

Overall, growing the Dynamic Containment Low pipeline in 2021 represents good value for money.

# Proposal 4: Reduce Loss of Mains

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The assessment compares three scenarios:

- no changes to the LOM risk baseline for 2021
- a 50% reduction to the Vector Shift risk but no change to the ROCOF baseline for 2021
- a 50% reduction to the Vector Shift risk and a 50% reduction to the ROCOF risk for 2021

Scenario	Remaining capacity		
	100% Vector Shift 100% RoCoF	50% Vector Shift 100% RoCoF	50% Vector Shift 50% RoCoF
Remaining risk: 48.8Hz	1-in-270 years	1-in-400 years	1-in-16,000 years
Remaining risk: 49.2Hz	1-in-22 years	1-in-25 years	1-in-275 years
Remaining risk: 49.5Hz	2 times per year	2 times per year	1-in-1.4 years
Remaining risk: 50.5Hz	1-in-1,100 years	1-in-850 years	1-in-700 years

Note there will be an enduring requirement and cost of holding additional Dynamic Containment until a one-off change to relays are made.

1MW of Dynamic Containment Low costs around £150k per year. Whereas the average cost of changing 1MW of capacity under the ALoMCP has been under £2k as a one-off cost.

Consequential RoCoF and Vector Shift loss are a key driver of system risk. Continued delivery of the ALoMCP during 2021 for both RoCoF and Vector Shift provides a significant reduction in the low frequency 48.8Hz, 49.2Hz and 49.5Hz risks.



# FRCR All Recommendations

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## Proposal 1: minimum inertia

Continue with current *Policy*:

- Minimum inertia at 140GVA.s

## Proposal 2: individual loss risks

Continue with current *Policy*:

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Update current *Policy* to:

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## Proposal 3: Dynamic Containment Low

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## Proposal 4: ALoMCP

The ALoMCP should continue during 2021 for both RoCoF and Vector Shift

The proposals are made in line with the concept of value set out in the Methodology

# Wider considerations: stakeholder impacts

The recommendations have been made in line with the impact levels set out in the Methodology but the proposals have impacts beyond the direct cost risk components considered in the assessment:

Stakeholder	Impact
End consumers	Reduction in cost of frequency control at overall reduction in risk (Vs recent years)
Balancing market participants	Reduction in the scale of intervention the ESO must take in market dispatch through trades and Balancing Mechanism actions
Distributed Energy Resources (DER)	DER who have yet to change their Loss of Mains protection setting to comply with the latest standards will have an increase likelihood of their protection being activated due to events on the National Electricity Transmission System
Transmission Network Owners	As proposal 2 is to maintain current Policy, there should be no impact on the current Network Access Planning process.

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# How to respond?

1. Overall, do you agree that the FRCR represents appropriate development in determining the way that the ESO will balance cost and risk in maintaining security of supply while operating the system?
2. Do you agree that the FRCR has been prepared appropriately taking account of the requirements set out in the methodology?
3. To help structure comments, do you agree with and what is your feedback on the specific proposals in the FRCR?

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- The ALoMCP should continue during 2021 for both RoCoF and Vector Shift

5.Do you have any suggestions for further areas that can be addressed in future editions of the FRCR?

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**Fill in the proforma which is available on the [GSR027](#) web page which was also sent in the email notifying stakeholders of the consultation on 1 March 2021 as here:**

<http://subscribers.nationalgrid.co.uk/t/d-DCE22AD437FEDE2A2540EF23F30FEDED>

**Deadline is 12 March 2021 at 5pm**

**Any problems with this – please contact the Code Administrator at [box.SQSS@nationalgrideso.com](mailto:box.SQSS@nationalgrideso.com)**



# Q&A

Please ask any questions via Slido (code #W238) and we will try to answer as many as possible now.

<https://app.sli.do/event/nwj7p5jr>

A Q&A document will be shared on the website later this week.

**Slido: #W238**

# Further information

## Further information

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- The modification to the SQSS ([GSR027](#)) encompassing these changes was raised in April 2020. It was progressed by a workgroup going through two consultations and was approved by the SQSS panel in Oct 2020 for submission to Ofgem
- Ofgem's decision of 10 Dec 2020 was that SQSS modification GSR027 had a positive impact on the SQSS objectives and it was therefore approved
- The version of the SQSS with which licensees are required to comply needs to be updated by amending the relevant licence conditions. A consultation on this took place closing on 12 Jan and the changes are planned to be made on 1 April 2021
- It was noted in Ofgem's decision on GSR027 that the ESO's intent is now to develop the first versions of the methodology and FRCR following the process set out in GSR027 such that the FRCR is ready to submit to Ofgem for approval on 1 April 2021 as soon as the licence changes go live

### **Dynamic Containment**

- <https://www.nationalgrideso.com/industry-information/balancing-services/frequency-response-services/dynamic-containment>

### **Accelerated Loss of Mains Change Programme**

- <https://www.nationalgrideso.com/industry-information/accelerated-loss-mains-change-programme-alomcp>
- <https://www.energynetworks.org/industry-hub/engineering-and-technical-programmes/accelerated-loss-of-mains>