Frequency Response Reform: Market Insights and Procurement Webinar

The webinar will start shortly.
Please make sure you are on mute and your camera is turned off.
Please note that the webinar will be recorded.

nationalgridESO

Agenda

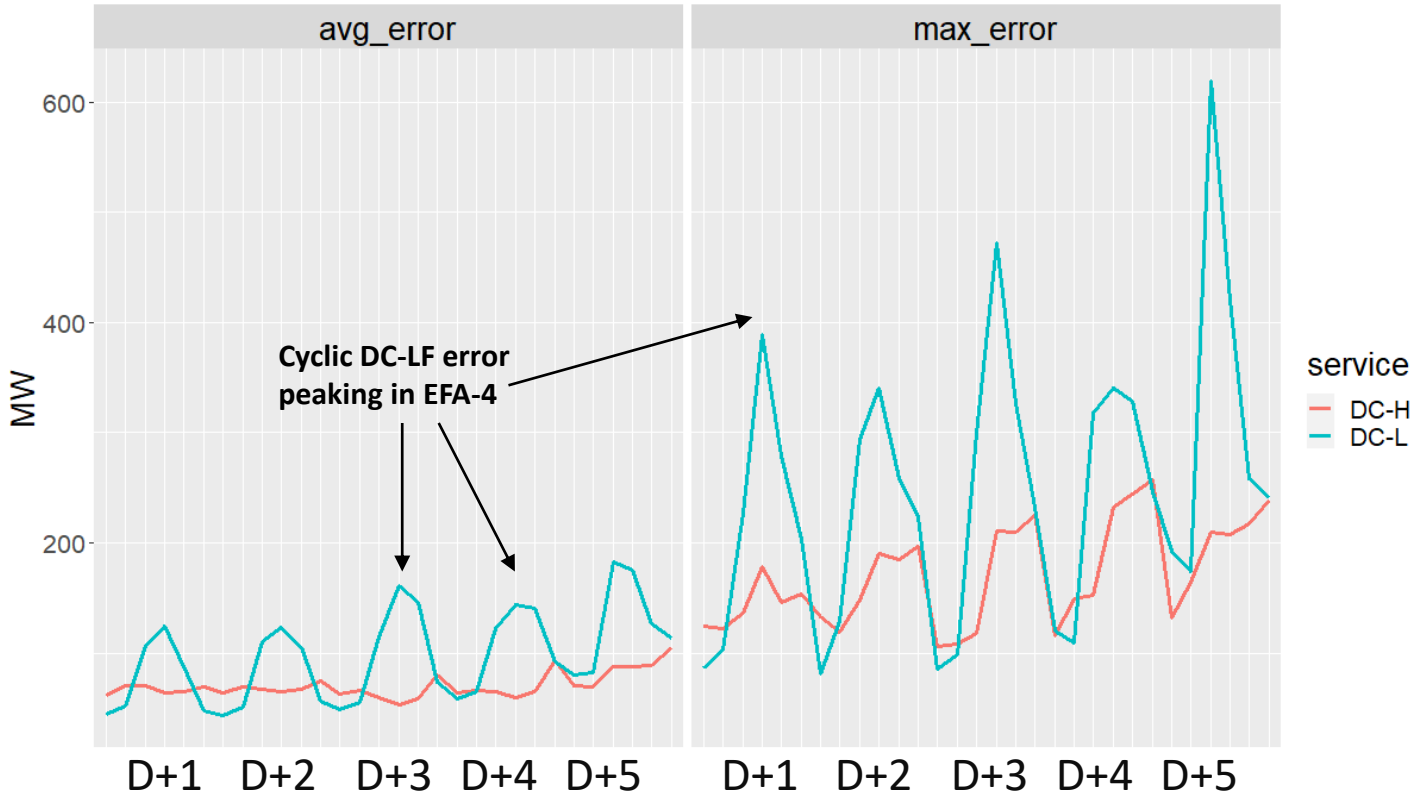
- DC Forecasting Deep Dive (Paddy McNabb)
- Response Buy Curve Methodology (Pete Underhill)
- Simulation exercise results and output of provider interviews (Sherry Li)
- Transparency Update (Neil Morgans)
- Q&A (compere - Sam Hill)

Please post any questions within the Teams meeting chat or email to box.AncillaryAssessment@nationalgrideso.com

Dynamic Containment Forecasting Deep Dive

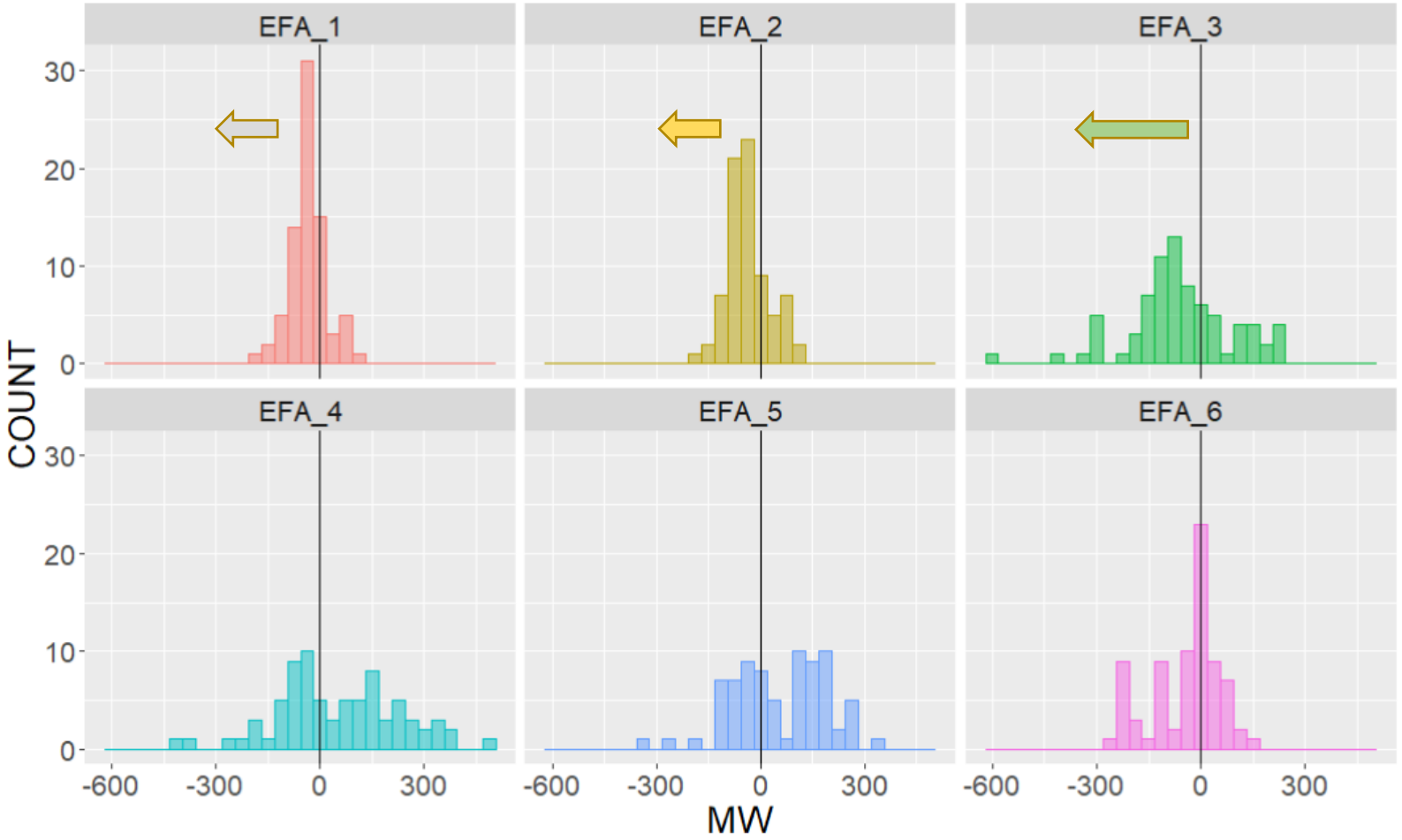
Paddy McNabb

Average/Max error



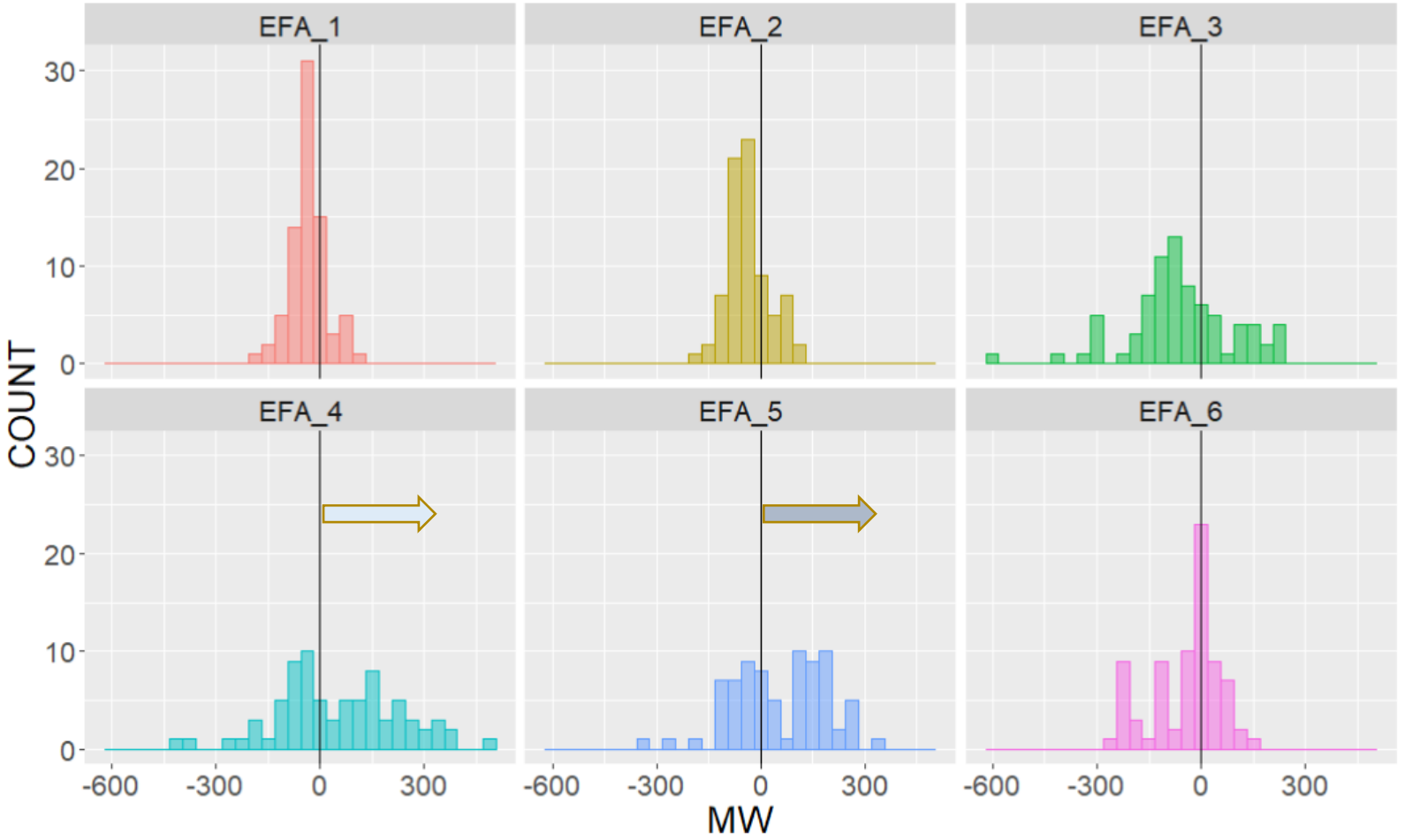
- Cyclic error in DC-L increasing across EFA4-6
- Increase in average error across time horizon
- DC-L has larger error due to RoCoF sensitivity (vs. DC-H)

Absolute error



Systematic under-forecast in EFA 1-3

Absolute error



EFA_1
EFA_2
EFA_3
EFA_4
EFA_5
EFA_6

Systematic over-forecast in EFA 4-5

Summary

- Larger error in DC-L vs. DC-H due to RoCoF considerations for infeed losses
- Cyclic pattern with peak errors in EFA 4-5 due to inertia forecasting error and RoCoF loss
- General decrease in accuracy over longer forecast horizons
- Phase 2 investigating improving inertia forecasting

DC/DR/DM Buy Curve Methodology

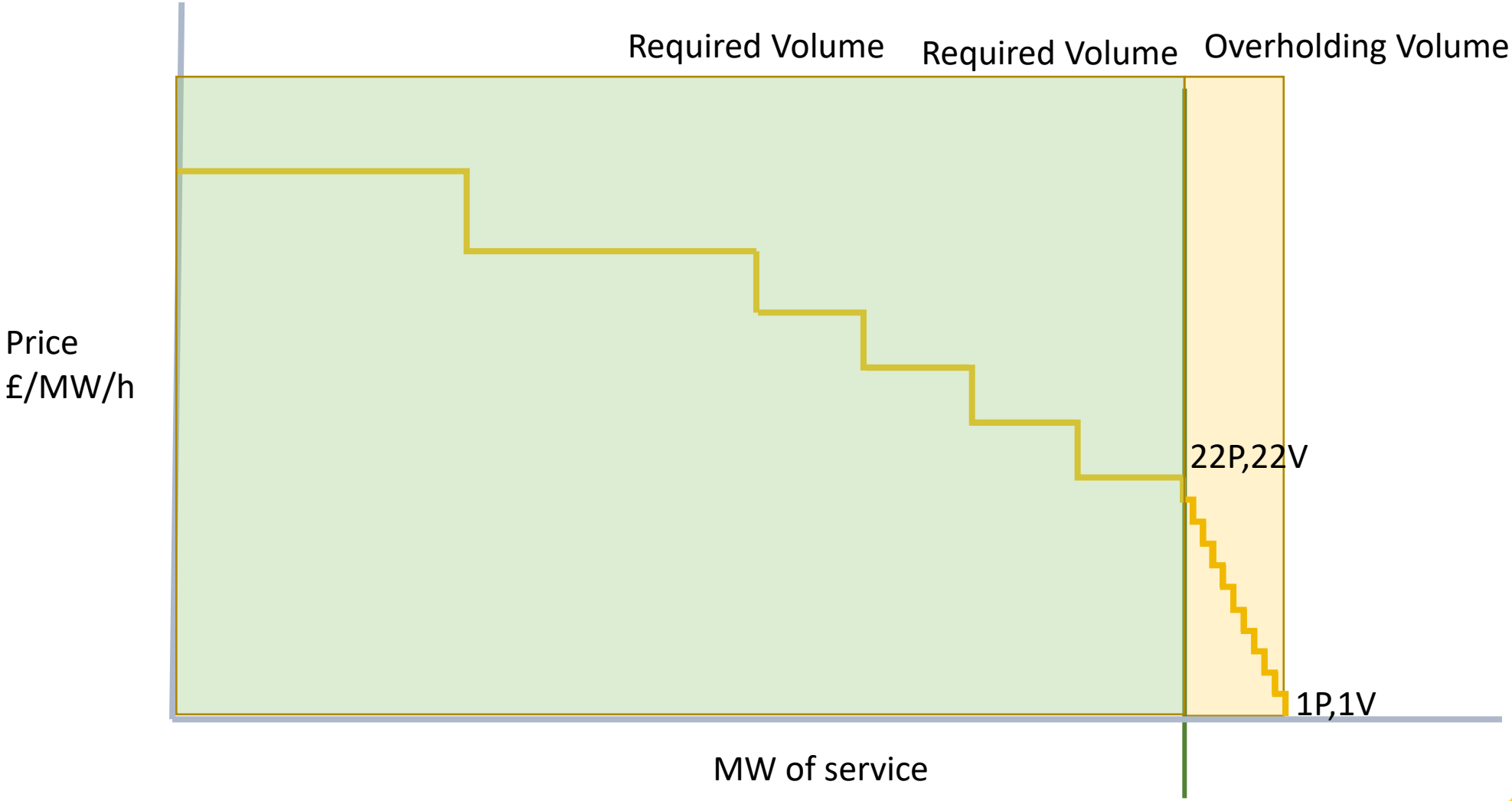
Pete Underhill

Daily Response Auction Buy orders

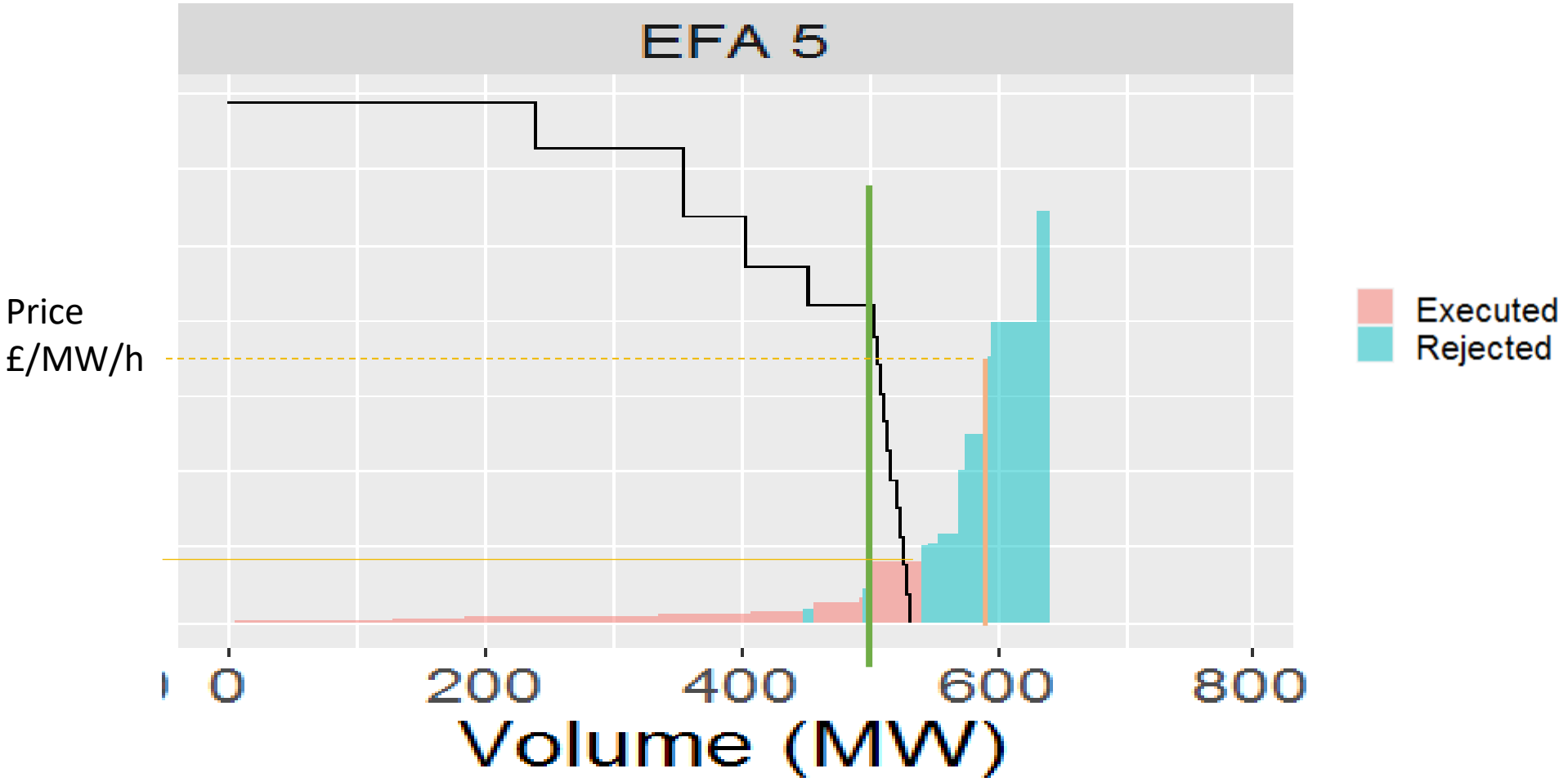
- Buy Order changes and how to interpret the new buy order
- How we value the services and forecast the alternative costs

DC buy order pre- April 22

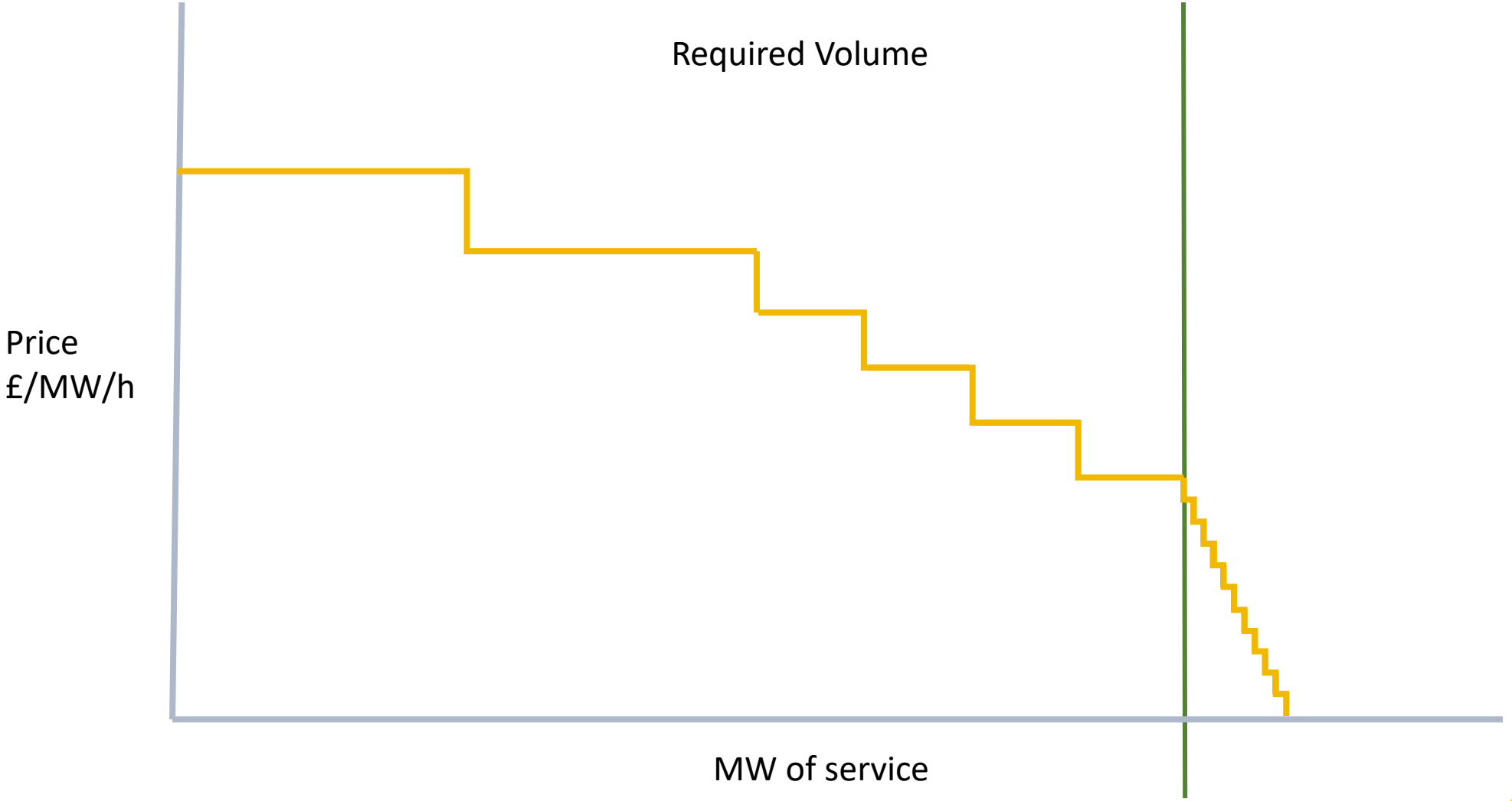
Current response buy orders



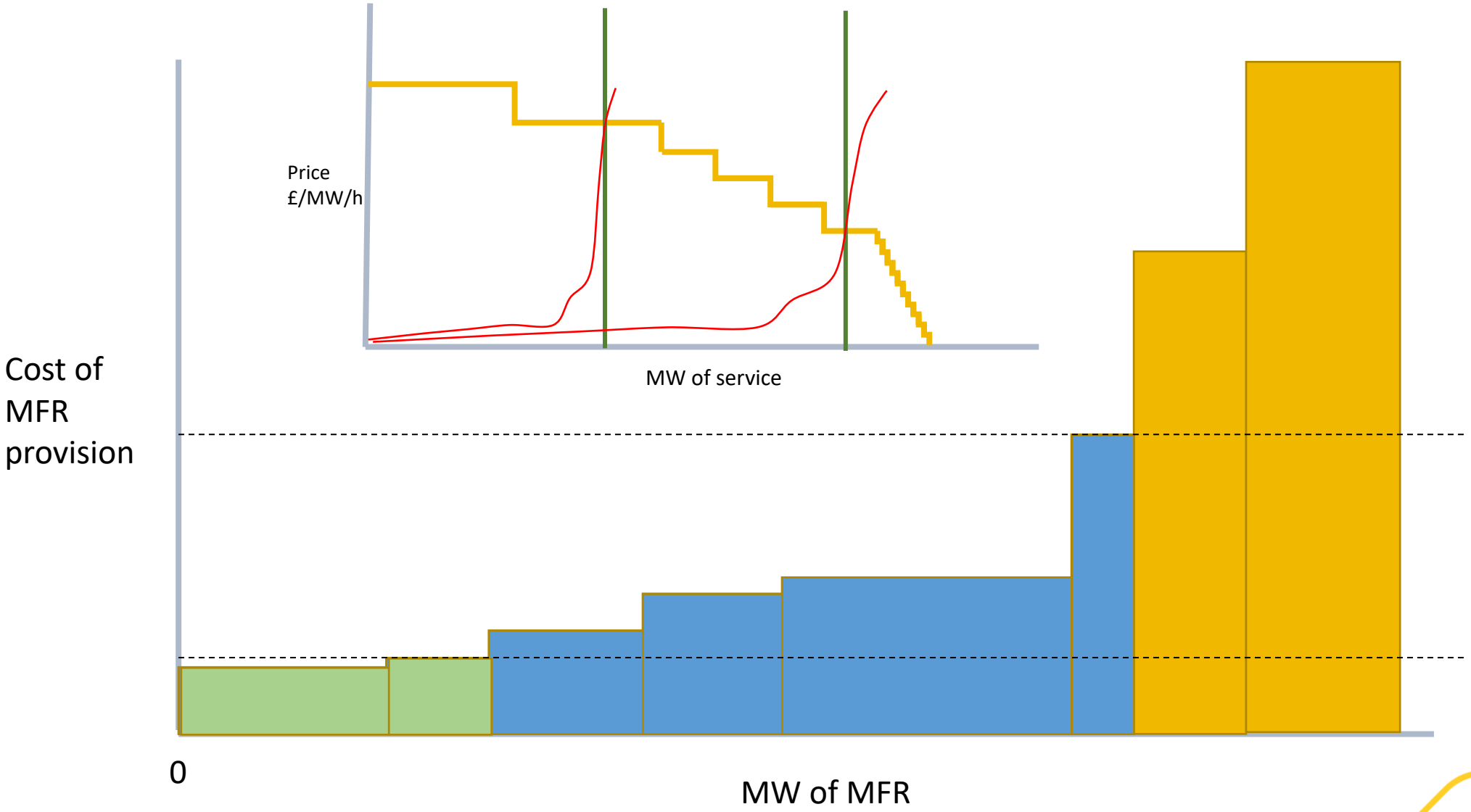
Overholding in practice



Current response buy orders



Price stacks



Service price caps and alternative costs

- For day ahead optimisation the alternative costs focus on procuring the shortfall in requirments from alternative response providers. This is predominantly MFR.
- The cost of procuring MFR contains four components:
  - Response Holding costs.
    - dependent on size of requirement, units available and their holding prices
  - Positioning costs.
    - dependent on size of requirement, market dispatch and BM prices
  - Reserve for response costs
    - dependent on size of requirement, market dispatch and BM prices
  - Response energy costs
    - dependent on units armed, energy price and frequency
- For the daily buy orders, we forecast each of these components on a per EFA block basis, using short term historic trends and forward price data. These forecasts are used to calculate the price caps for each service.

Service Exchange rates

- Each of the 3 services offset MFR differently in different situations,
- As part of calculating the price cap per service we calculate an exchange rate between the service and MFR.
- For DR and DM these exchange rates are fixed whilst we learn and grow the service.
- For DC these exchange rates are dynamically calculated as part of the daily requirements process.

- The cost forecasts are then combined with these exchange rates to create the price caps for each service.

Provider Insight and Simulation Output

Sherry Li

Provider Insight & Market Simulation Study

Provider Engagement

- **16** out of 20 DC providers took part in our DC market review session

Topics

- Current market design
- Future market design
- Stacking
- Co-optimisation
- Availability payment

Market Simulation Study

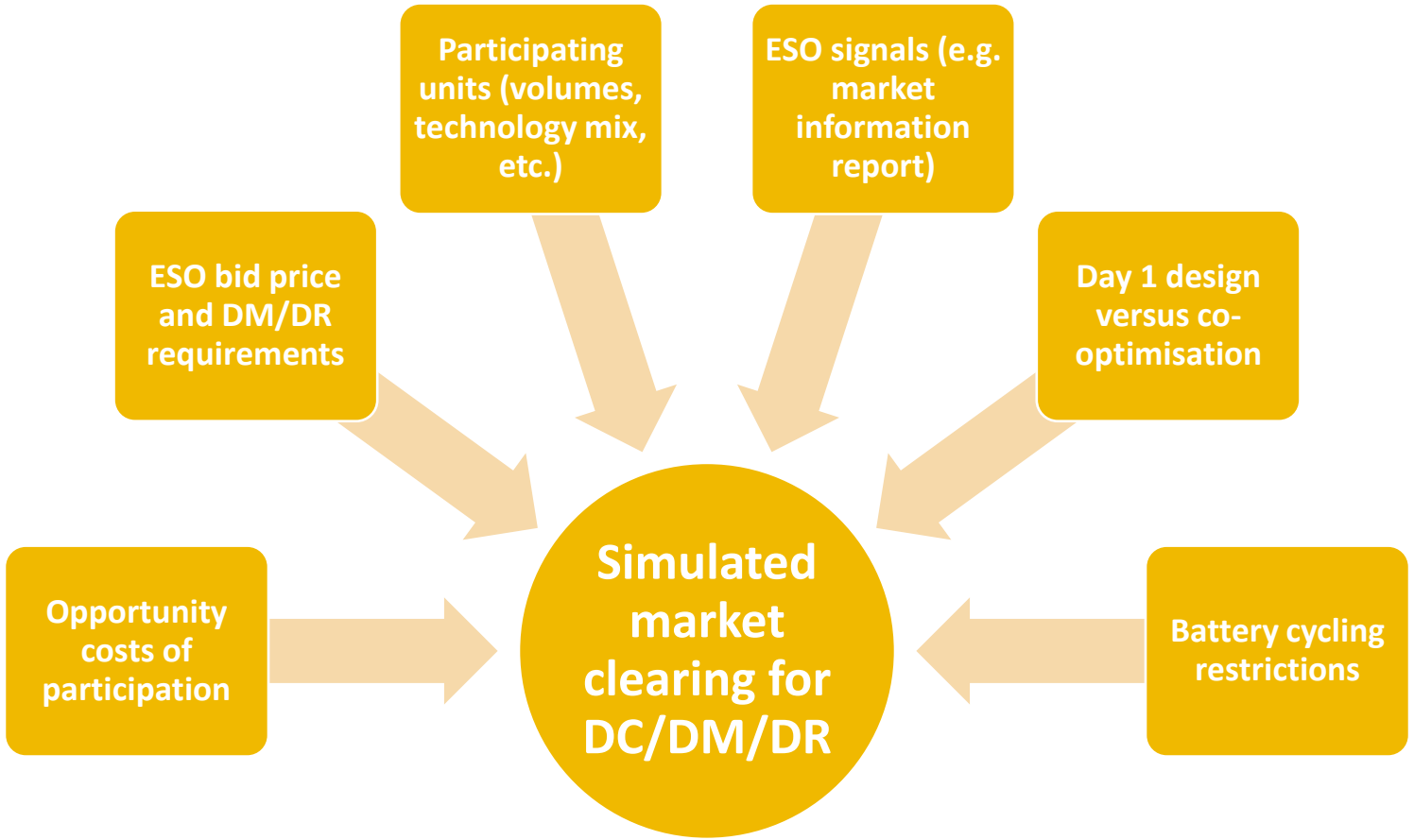
- This exercise simulated the new frequency response market for DC, DM, and DR with the objective to improve our understanding of participant behaviours and auction outcomes
  - Participant behaviour
  - ESO buy order and procurement strategy
  - Co-optimisation benefits
  - Incentives and signals

Participation

- **16** participants from **8** parties
- **11** offers received (considering that some participants want to act as one group, the actual response rate was 100%)

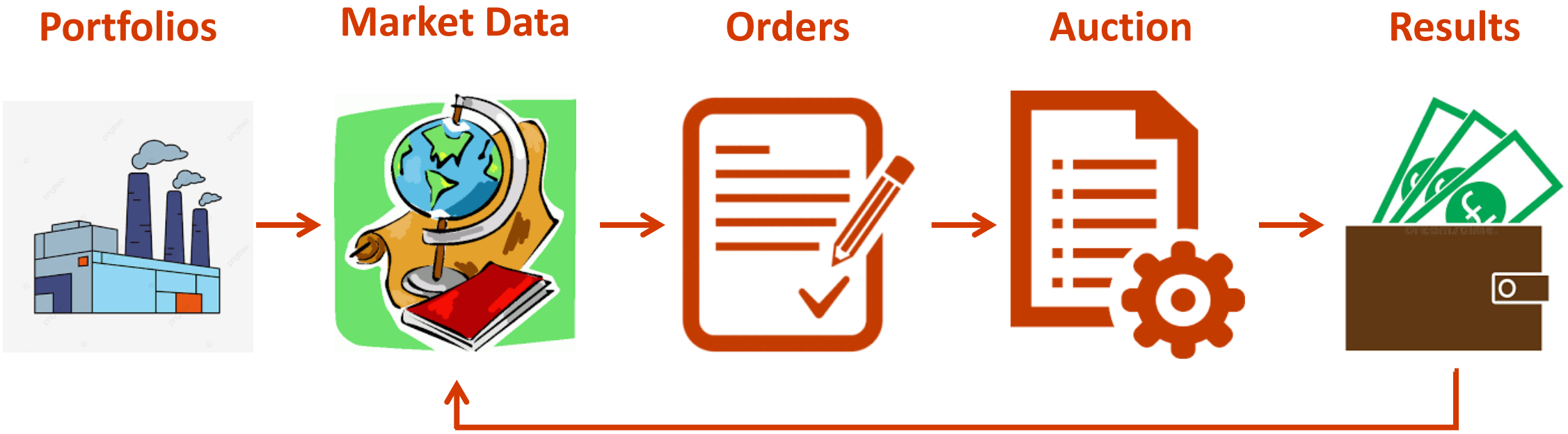
Market Simulation Study - Scope

Assumptions and design elements were changed to test the impact on market clearing outcomes



Market Simulation Study – High Level Process

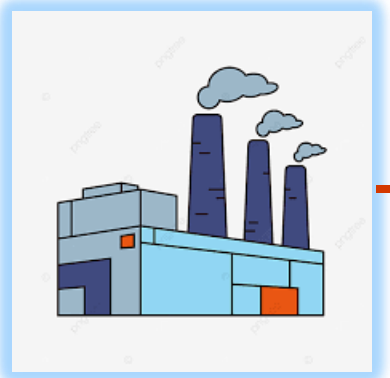
Internal simulation of auction clearing: matching of hypothetical participant sell orders and hypothetical ESO buy orders



Market Simulation Study – High Level Process

Internal simulation of auction clearing: matching of hypothetical participant sell orders and hypothetical ESO buy orders

Portfolios



Unit	Technology	Duration (minutes)	Cycling Limits	Capacity (MW)
u1	Battery	59	Yes	6
u2	Battery	59	Yes	35
u3	Battery	29	Yes	9
u4	Battery	59	Yes	4
u5	Battery	29	Yes	10
u6	Battery	59	Yes	50
u7	Battery	59	Yes	50
u8	Battery	59	Yes	25
u9	Battery	59	Yes	1
u10	Battery	59	Yes	1
u11	Battery	59	Yes	1
u12	Battery	59	Yes	1

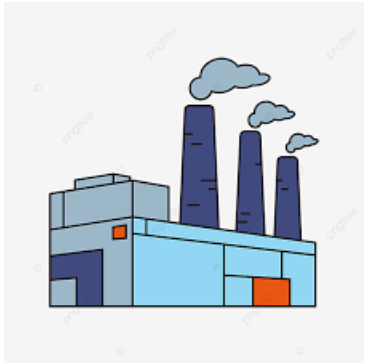
Auction

Results

Market Simulation Study – High Level Process

Internal simulation of auction clearing: matching of hypothetical participant sell orders and hypothetical ESO buy orders

Portfolios → **Market Data** → **Orders** → **Auction** → **Results**



Historical Buy Order

EFA Period 1	DCL	DCH	DML	DMH	DRL	DRH
Requirement (MW)	742	620	100	100	100	100
Bid Price (£/MW/h)	50.00	80.00	30.00	40.00	45.00	70.00

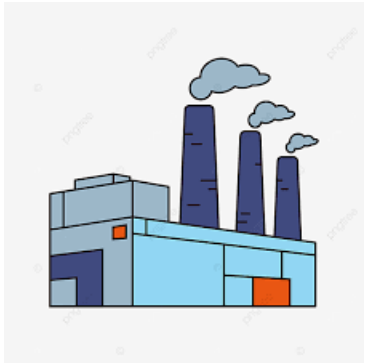
4 Day Rolling Forecast

	Requirement (MW)	
	EFA 1	EFA 5
DCL	635	758
DCH	608	417

Market Simulation Study – High Level Process

Internal simulation of auction clearing: matching of hypothetical participant sell orders and hypothetical ESO buy orders

Portfolios → **Market Data** → **Orders** → **Auction** → **Results**



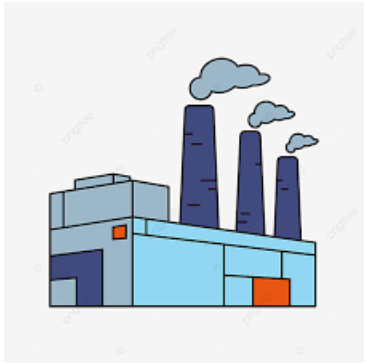
EFA 1	Volumes (integer only)						Prices (decimal, i.e., pounds and pence)						Looping (binary: 0 or 1)		
unit	DCL	DCH	DML	DMH	DRL	DRH	DCL	DCH	DML	DMH	DRL	DRH	DC	DM	DR
u5			4	4					14.12	0.01				1	

Participant | Unit Description | Non Cooptimised Offers | Cooptimised Offers

Market Simulation Study – High Level Process

Internal simulation of auction clearing: matching of hypothetical participant sell orders and hypothetical ESO buy orders

Portfolios



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Auction Feature	In house	HELENA
3 services: DC, DM, DR	Yes	Yes
LF and HF products for each service	Yes	Yes
LF and HF products can be “looped”	Yes	Yes
Pay-as-clear	Yes	Yes
Services are co-optimised	Yes	No
Non-curtailable orders	Yes	Yes
Curtailable orders	No	Yes
Multi-period blocks	No	Yes
Parent and child blocks	No	Yes
Linear (“stepped”) buy order curves	No	Yes
Overholding	No	No
Service stacking	No	No

Auction

Results

Market Simulation Study – High Level Process

Internal simulation of auction clearing: matching of hypothetical participant sell orders and hypothetical ESO buy orders

Portfolios

Market Data

ESO Buy Order						
	DCL	DCH	DML	DMH	DRL	DRH
ESO Volumes (MW)	700	400	100	100	100	100
ESO Bid Price (£/MW)	17.00	12.00	20.00	8.00	30.00	20.00

Auction Results - Co-optimised						
	DCL	DCH	DML	DMH	DRL	DRH
Cleared Volumes (MW)	471	400	100	100	100	99
Clearing Price (£/MW)	10.00	7.98	10.00	4.00	22.00	5.00
Total Procurement Cost £/h						11997.00
Average Procurement Cost £/MW/h						9.45

Auction Results - Non Co-optimised						
	DCL	DCH	DML	DMH	DRL	DRH
Cleared Volumes (MW)	337	304	100	91	93	100
Clearing Price (£/MW)	15.06	12.00	3.20	6.04	20.00	9.99
Total Procurement Cost £/h						12451.86
Average Procurement Cost £/MW/h						12.15

Results

Market Simulation Study - Results

We ran the auction with the following buy orders:

- Base case: Buy DC at forecast values, 80MW DM&DR
- Scenario 1: Buy 100MW DM&DR
- Scenario 2: Buy 50% DC requirement

Auction result – base case:

ESO Buy Order - EFA 1	DCL	DCH	DML	DMH	DRL	DRH
ESO Volumes (MW)	635	608	80	80	80	80
ESO Bid Price (£/MW)	50.00	80.00	30.00	40.00	45.00	70.00

Auction Results	Co-optimised EFA 1						Non Co-optimised EFA 1					
	DCL	DCH	DML	DMH	DRL	DRH	DCL	DCH	DML	DMH	DRL	DRH
Cleared Volumes (MW)	635	608	80	80	58	80	393	414	77	76	80	80
Clearing Price (£/MW)	17.99	17.99	20.00	20.00	44.99	1.29	49.99	79.99	2.15	2.25	0.65	1.05
Total Procured Volume (MW)						1541						1120
Total Procurement Cost (£/h)						28274.19						53234.48
Average Procurement Cost (£/MW/h)						18.35						47.53
Total Cost incl Unmet Requirement (£/h)						29264.19						81104.48
Average Cost incl Unmet Requirement (£/MW/h)						18.72						51.89

ESO Buy Order - EFA 5	DCL	DCH	DML	DMH	DRL	DRH
ESO Volumes (MW)	758	417	80	80	80	80
ESO Bid Price (£/MW)	100.00	70.00	40.00	12.00	60.00	50.00

Auction Results	Co-optimised EFA 5						Non Co-optimised EFA 5					
	DCL	DCH	DML	DMH	DRL	DRH	DCL	DCH	DML	DMH	DRL	DRH
Cleared Volumes (MW)	758	417	29	42	80	80	675	417	79	55	53	80
Clearing Price (£/MW)	40.00	12.99	39.99	11.99	44.00	9.09	99.99	65.00	19.00	3.76	30.00	12.00
Total Procured Volume (MW)						1406						1359
Total Procurement Cost (£/h)						41647.32						98856.05
Average Procurement Cost (£/MW/h)						29.62						72.74
Total Cost incl Unmet Requirement (£/h)						44143.32						109116.05
Average Cost incl Unmet Requirement (£/MW/h)						29.53						72.99

Summary:

- **Market Efficiency & Procurement Cost:** In comparison to non-cooptimised auction results, the co-optimised auction leads to lower clearing price and higher cleared volume. The improvement in market efficiency is more significant in auctions with low market liquidity.
- **Risk Reduction:** Offering DC/DM/DR in a non-cooptimised market has a higher risk of stranded capacity, i.e. that an asset will not be awarded a frequency response contract despite there being unfulfilled ESO requirements.
- **Bidding Strategy:** In the market simulation exercise, despite DR having a longer duration therefore being more suitable for longer duration batteries, participants targeted 2-hour batteries at DC because they expected DC to clear at higher prices.
- **Business Processes:** It is easier to offer co-optimised bids than the non co-optimised bids. Because participants do not need to choose a market to participate, they can offer all possible services and let the ESO choose.

Note: This is a one round simulation therefore is different from the repetitive EPEX auctions, the in-house algorithm used in this simulation study also lacks several features of the EPEX HELENA algorithm.

Market Simulation Study - Results

Auction result – Scenario 1 (Buy 100MW DM&DR)

- Buying more DM & DR does not shift the procured volume from DC to DM & DR.

ESO Buy Order - EFA 1	DCL	DCH	DML	DMH	DRL	DRH
ESO Volumes (MW)	635	608	100	100	100	100
ESO Bid Price (£/MW)	50.00	80.00	30.00	40.00	45.00	70.00

Auction Results	Co-optimised EFA 1						Non Co-optimised EFA 1					
	DCL	DCH	DML	DMH	DRL	DRH	DCL	DCH	DML	DMH	DRL	DRH
Cleared Volumes (MW)	635	608	100	83	64	100	393	414	99	89	100	100
Clearing Price (£/MW)	17.99	20.00	27.00	39.99	44.99	48.00	49.99	79.99	4.00	2.25	0.70	1.15
Total Procured Volume (MW)						1590						1195
Total Procurement Cost (£/h)						37282.18						53543.18
Average Procurement Cost (£/MW/h)						23.45						44.81
Total Cost incl Unmet Requirement (£/h)						39582.18						81633.18
Average Cost incl Unmet Requirement (£/MW/h)						24.09						49.69

ESO Buy Order - EFA 5	DCL	DCH	DML	DMH	DRL	DRH
ESO Volumes (MW)	758	417	100	100	100	100
ESO Bid Price (£/MW)	100.00	70.00	40.00	12.00	60.00	50.00

Auction Results	Co-optimised EFA 5						Non Co-optimised EFA 5					
	DCL	DCH	DML	DMH	DRL	DRH	DCL	DCH	DML	DMH	DRL	DRH
Cleared Volumes (MW)	758	417	14	36	98	100	675	417	99	49	53	100
Clearing Price (£/MW)	89.00	9.50	39.99	11.99	24.00	12.00	99.99	65.00	18.00	0.01	30.00	12.00
Total Procured Volume (MW)						1423						1393
Total Procurement Cost (£/h)						75967.00						99170.74
Average Procurement Cost (£/MW/h)						53.39						71.19
Total Cost incl Unmet Requirement (£/h)						80295.00						110942.74
Average Cost incl Unmet Requirement (£/MW/h)						50.98						70.44

Auction result – Scenario 2 (Buy 50% DC requirement)

- The improvement in market efficiency (e.g., reduction in clearing prices, increase in procured volumes) is less significant with high market liquidity.

ESO Buy Order - EFA 1	DCL	DCH	DML	DMH	DRL	DRH
ESO Volumes (MW)	318	304	80	80	80	80
ESO Bid Price (£/MW)	50.00	80.00	30.00	40.00	45.00	70.00

Auction Results	Co-optimised EFA 1						Non Co-optimised EFA 1					
	DCL	DCH	DML	DMH	DRL	DRH	DCL	DCH	DML	DMH	DRL	DRH
Cleared Volumes (MW)	318	304	80	80	80	80	318	304	77	76	80	80
Clearing Price (£/MW)	3.99	2.50	2.15	4.18	2.00	1.15	17.99	20.00	2.15	2.25	0.65	1.05
Total Procured Volume (MW)						942						935
Total Procurement Cost (£/h)						2787.22						12273.37
Average Procurement Cost (£/MW/h)						2.96						13.13
Total Cost incl Unmet Requirement (£/h)						2787.22						12523.37
Average Cost incl Unmet Requirement (£/MW/h)						2.96						13.29

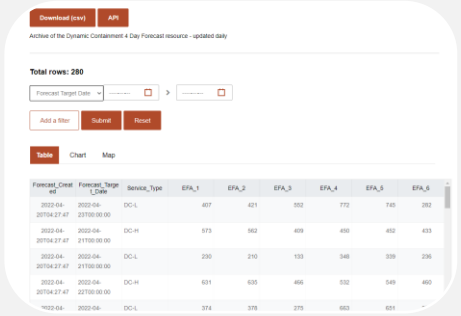
ESO Buy Order - EFA 5	DCL	DCH	DML	DMH	DRL	DRH
ESO Volumes (MW)	379	209	80	80	80	80
ESO Bid Price (£/MW)	100.00	70.00	40.00	12.00	60.00	50.00

Auction Results	Co-optimised EFA 5						Non Co-optimised EFA 5					
	DCL	DCH	DML	DMH	DRL	DRH	DCL	DCH	DML	DMH	DRL	DRH
Cleared Volumes (MW)	379	209	80	80	80	80	379	209	79	55	53	80
Clearing Price (£/MW)	22.99	9.50	8.99	5.45	20.00	3.50	20.00	10.00	19.00	3.76	30.00	12.00
Total Procured Volume (MW)						908						855
Total Procurement Cost (£/h)						13733.91						13927.80
Average Procurement Cost (£/MW/h)						15.13						16.29
Total Cost incl Unmet Requirement (£/h)						13733.91						15887.80
Average Cost incl Unmet Requirement (£/MW/h)						15.13						17.50

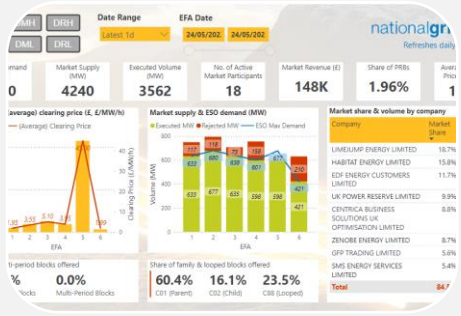
Transparency Update

Neil Morgans

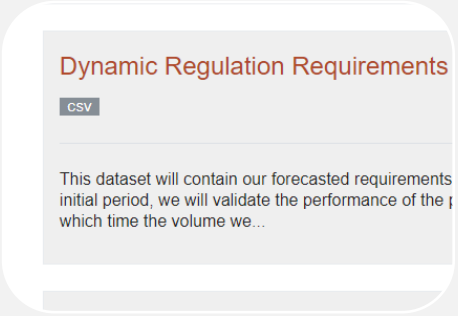
Transparency Update



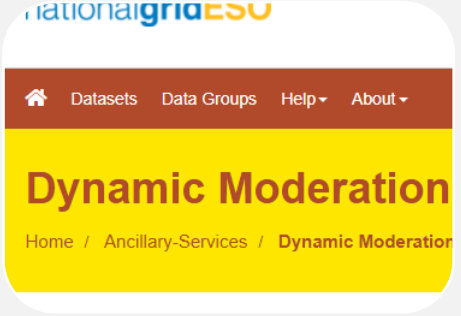
[DC Forecast + History]



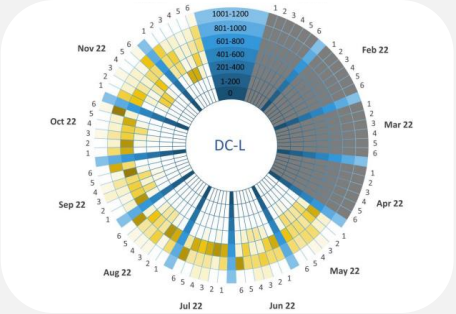
[Response Dashboard]



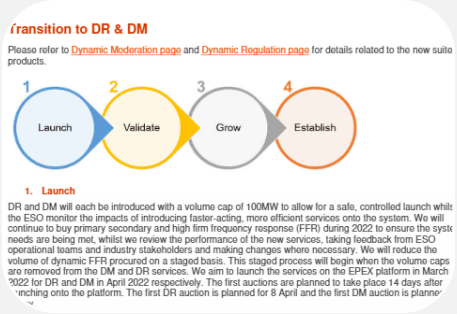
[DR Requirements]



[DM Requirements]



[2022 Indicative Requirements]



[Response Update Publication]

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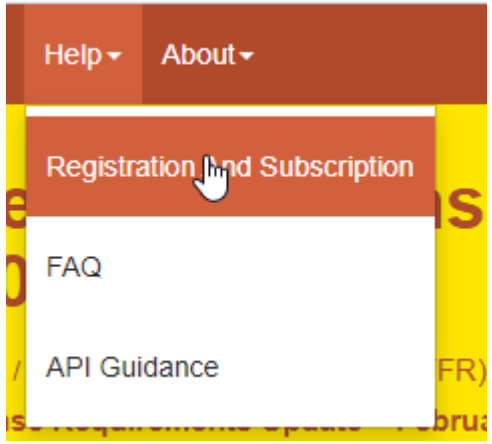
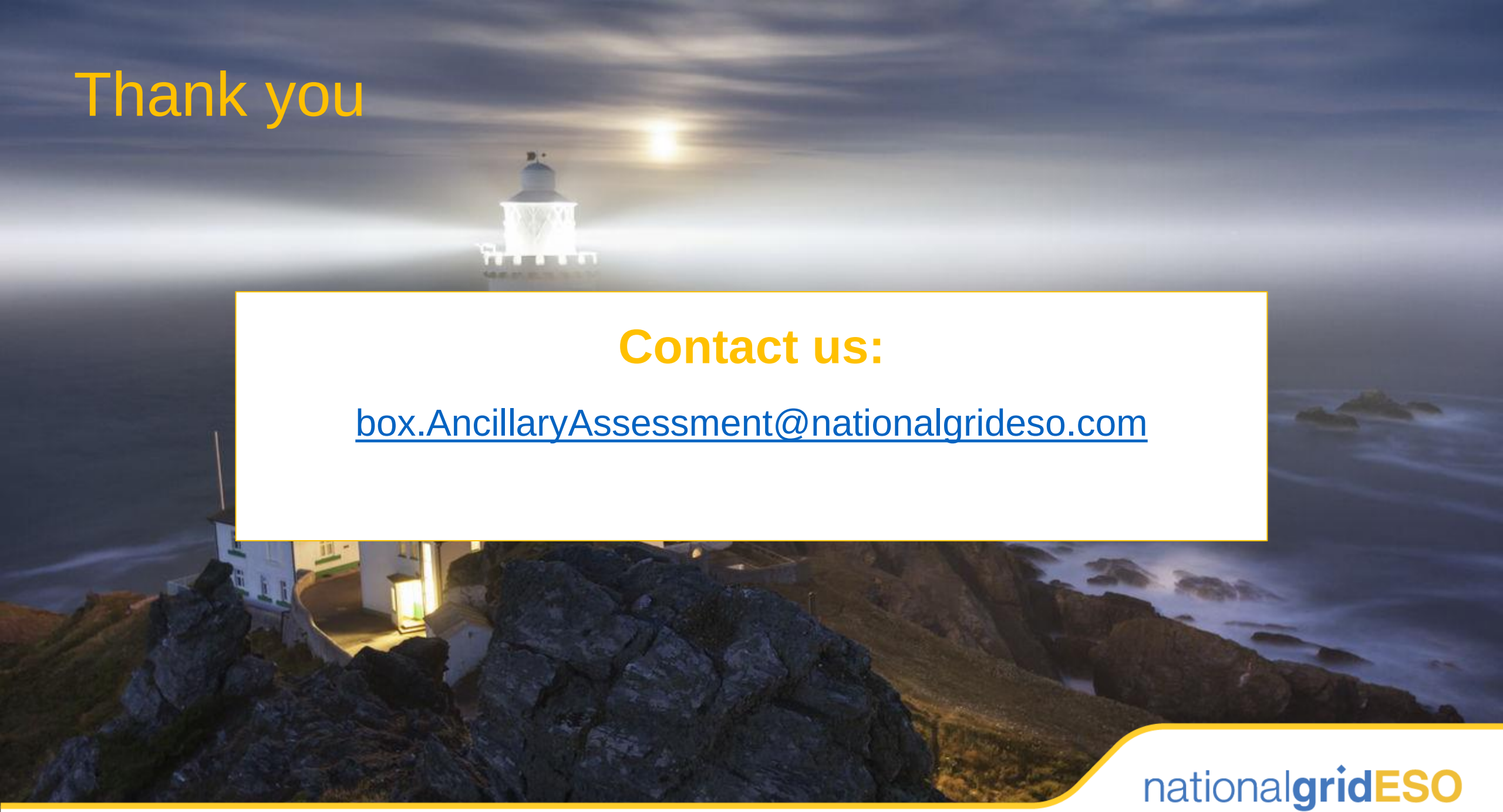
Data Portal: Registration and Subscription



https://data.nationalgrideso.com/registration-and-subscription

Thank you



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