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be recorded

Electricity System Operator

Enduring Auction Capability

23 May 2023

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EAC – What is it?

EAC – What is it?

- The Enduring Auction Capability (EAC) is designed to deliver **co-optimised procurement for our day-ahead Frequency Response and Reserve products**.
- It is envisioned that this method of procurement will allow us to meet our needs in the most efficient way, while enabling providers to participate in multiple markets.
- The EAC Platform will be both **extendable** and **scalable** to future products and services whilst delivering a multitude of benefits.

Enduring Auction Capability (EAC)

The RIIO-2 Business Plan committed ESO to delivering **co-optimised procurement of day-ahead Response and Reserve services**, which would be **scalable** and **extendable** to new services and products



During 2022-23 a consortium of three firms will support ESO deliver the EAC.



The EAC is expected to deliver the following benefits:



Better user experience

- Fewer manual, duplicated processes.
- Increased use of technology to facilitate bidding
- Consistent / standardised user experience



Closer to real-time procurement

- Increased market liquidity & participation
- Increased technology variation (e.g. renewables & demand flexibility)



Consistent procurement route

- Single route to market, replacing interim solutions
- Enhanced transparency of our procurement activities
- Lower costs to move between services
- Reduced duplication of resource for bidding



Connected and co-optimised auctions for ancillary services

- Efficient markets due to clearer price signals (increased algorithm efficiency)
- Easy access across multiple markets
- Greater diversity in bidding strategies (e.g. curtailable bids)
- Compatibility with downstream systems (e.g. settlement)






Long-term benefits

- Improved levels of flexibility and configurability to adapt to changes in service procurement
- Accessible to new / future service providers










Market Design Overview

Auction Overview

	Services Auctioned	<ul style="list-style-type: none">• The EAC is used for the clearing of capacity (availability) for the following services:<ul style="list-style-type: none">○ Frequency Response Services: Dynamic Containment (DC), Dynamic Moderation (DM), and Dynamic Regulation (DR).○ Reserve Services: Quick Reserve (QR), Slow Reserve (SR).• For every service, there are 2 product directions.<ul style="list-style-type: none">○ Low (L) and High (H) Products for <u>Response Services</u> (resulting in DRL and DRH, DML and DMH, DCL and DCH).○ Positive (P) and Negative (N) Products for <u>Reserve Services</u> (resulting in PQR and NQR, PSR and NSR).
	Auction Frequency	<ul style="list-style-type: none">• Frequency Response and Reserve Services will be procured in a single, simultaneous day-ahead auction held <u>daily</u>.
	Auction Design	<ul style="list-style-type: none">• Auction type: Closed double-sided auction.• Objective function: Maximisation of social welfare.• Pricing: Uniform clearing price per product for each service window.• Locational granularity: GB synchronous area.• Overholding allowed (cleared quantity may exceed ESO bid quantity).

New Market Design and Clearing Algorithm

	Single market for response and reserve	Frequency Response services (DC, DM, DR) and the new Reserve services (Quick Reserve, Slow Reserve) will be procured simultaneously in a single, pay-as-clear auction
	Co-optimisation	The auction clearing algorithm will be able to select between alternative provider offers and alternate ESO requirements to better optimise the overall market clearing
	Splitting	Participants may offer to delivery more than one Frequency Response service (DC, DM, DR) simultaneously from the same market unit
	New sell order design	Compared to the current market for frequency response, new sell order features are enabled to facilitate co-optimisation and other market features
	New clearing algorithm	Our strategic partner, N-SIDE, is developing a new, bespoke market clearing algorithm to enable the new market features
	Negative prices	Provider offer prices, ESO bid prices, and market clearing prices may be less than zero, to enable providers to offer to pay the ESO for offering an ancillary service
	Overholding	The auction clearing algorithm may clear a quantity of service in excess of ESO requirements if this better optimises the market

Curtaibility

Non-curtable order

An order which can only be fully accepted or fully rejected (i.e., the full offered volume must be taken, or the order rejected).

Curtable order

An order which may be partially accepted (i.e., accepted for a smaller volume than the full offered quantity).

Consider a single Parent Order

A Parent Order is non-curtable. It must either be:

fully accepted

Parent

or

fully rejected

Parent

Linking: Parent and Child Blocks

Parent order

An non-curtable order whose acceptance is a pre-condition to acceptance of one or more other (child) orders in that Basket. A parent order may not have any linked child orders.

Child order

An order that can only be accepted if another order to which it is linked, the “parent order” is also accepted (i.e., the parent order can be accepted alone or the parent and child orders can be accepted together, but the child order cannot be accepted alone).

Order structure in EAC

Unit ID	Order ID	Order Type	DCL	Price
UNIT_001	P1	Parent	10	1.00
UNIT_001	C1	Child	10	2.00



Linking: Parent and Child Blocks

Consider a pair of parent-child orders

A parent order is non-curtable. It must either be fully rejected or fully accepted.

Order structure in EAC

Unit ID	Order ID	Order Type	DCL	Price
UNIT_001	P1	Parent	10	1.00
UNIT_001	C1	Child	10	2.00

The parent order is fully rejected.

P **Child** A child order cannot be accepted if its parent order is rejected.

The parent order is fully accepted.

P **Child** A child order may be fully rejected.

P **Child** A child order may be partially accepted.

P **Child** A child order may be fully accepted.



Splitting

Splitting

A unit has the opportunity (but not the obligation) to be accepted for different products in the same service window.

Splitting is allowed:

- between **all frequency response products** (i.e., amongst any combination of DCL, DCH, DML, DMH, DRL, and DRH)
- between **Quick Reserve** product (PQR and NQR)
- and between **Slow Reserve** products (PSR and NSR)

Splitting Matrix		DC		DM		DR		QR		SR	
		DCL	DCH	DML	DMH	DRL	DRH	PQR	NQR	PSR	NSR
DC	DCL	NA	Y	Y	Y	Y	Y	N	N	N	N
	DCH	Y	NA	Y	Y	Y	Y	N	N	N	N
DM	DML	Y	Y	NA	Y	Y	Y	N	N	N	N
	DMH	Y	Y	Y	NA	Y	Y	N	N	N	N
DR	DRL	Y	Y	Y	Y	NA	Y	N	N	N	N
	DRH	Y	Y	Y	Y	Y	NA	N	N	N	N
QR	PQR	N	N	N	N	N	N	NA	Y	N	N
	NQR	N	N	N	N	N	N	Y	NA	N	N
SR	PSR	N	N	N	N	N	N	N	N	NA	Y
	NSR	N	N	N	N	N	N	N	N	Y	NA



Co-optimisation

Co-optimisation

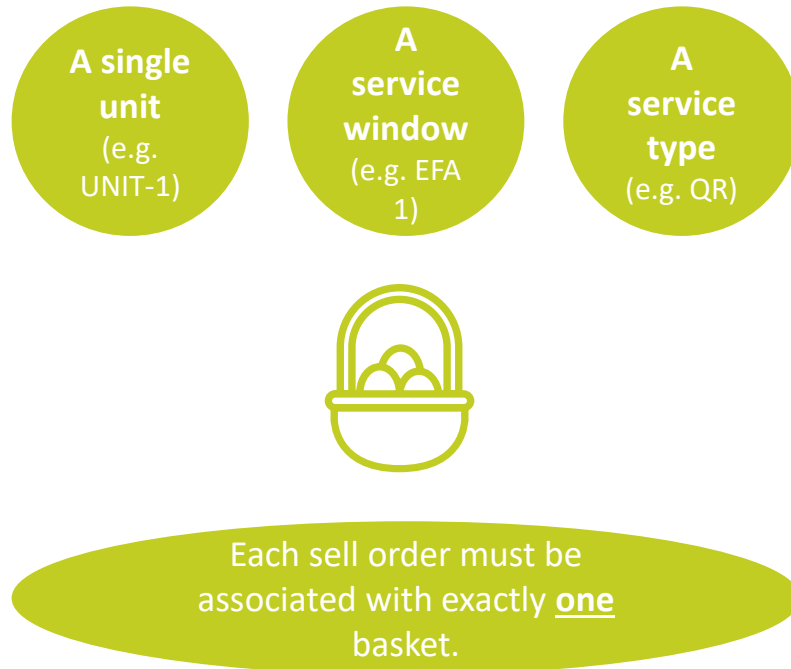
When a unit has capability to provide more than one of the services, the provider may wish to place multiple, alternative offers in the auction and let the auction clearing algorithm allocate the unit to the service that will clear the market most efficiently (i.e., best maximise market welfare, subject to the constraints). In contrast, without co-optimisation the provider has to choose in advance which of the various services to offer into the auction.

- Co-optimisation reduces risk for market participants while increasing overall market liquidity and reducing procurement costs.
- The new market design for frequency response and reserve implements co-optimisation by two different auction features: **“mutually-exclusive baskets”** and **“substitutable families”**.

Basket (1/2)

In EAC, co-optimisation is implemented by using mutually exclusive *baskets*.

Sell orders are grouped together into baskets.



Baskets are used to model mutual exclusivity between sets of orders. Any two baskets are mutually exclusive if they are defined on the same service window (or on service windows that overlap in any time period).

Scenario 1

EFA 1 B1	EFA 1 B2	EFA 1 B3
-------------	-------------	-------------

- B1, B2, and B3 are mutually exclusive to each other.

Scenario 2

EFA 5 B4	EFA 5a B5	EFA 5a B6

- B4, B5, and B6 are mutually exclusive to each other.

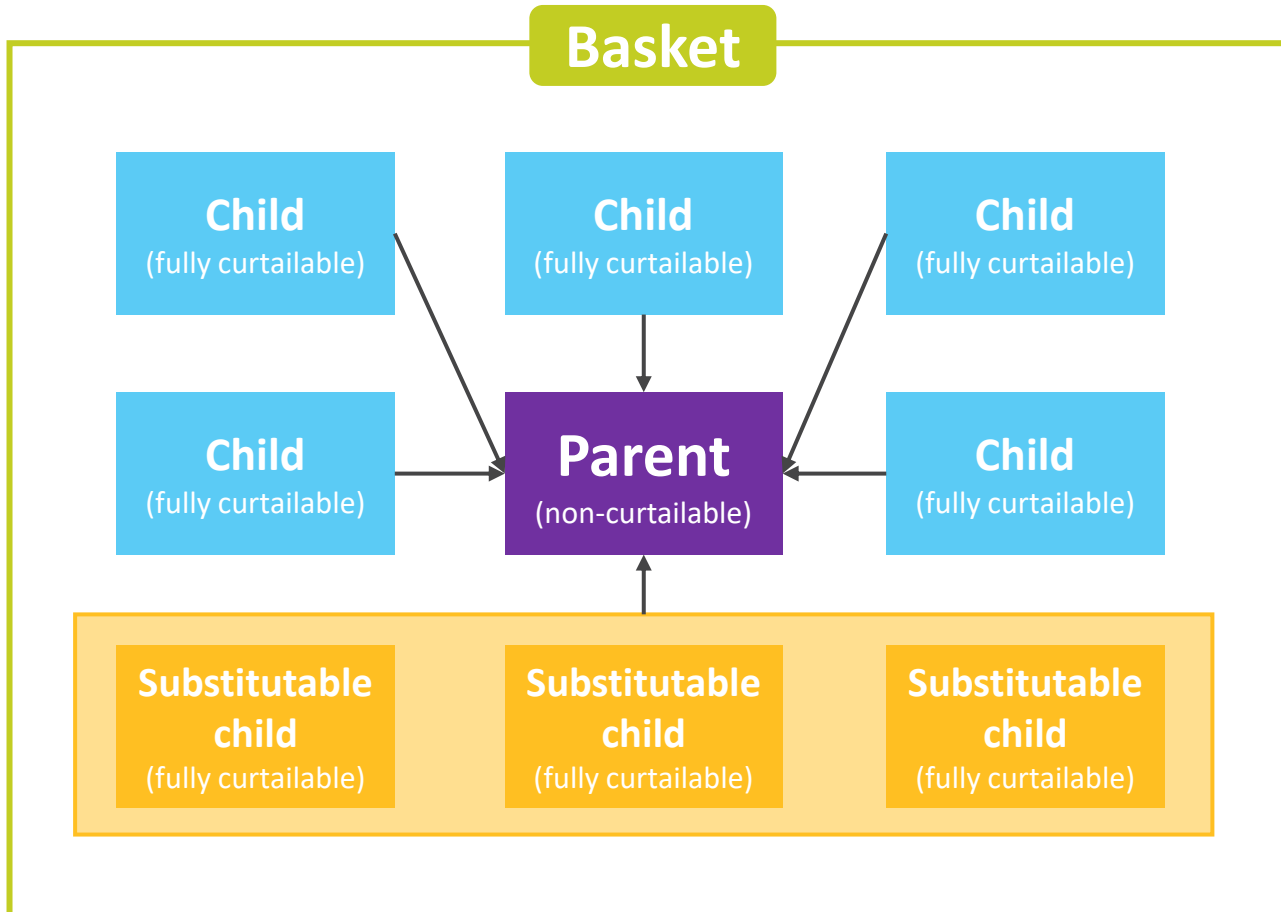
Scenario 3

EFA 1 B7	
	EFA 2 B8

- B7 and B8 are not mutually exclusive to each other.

Basket (2/2)

In EAC, co-optimisation is implemented by using mutually exclusive *baskets*.



***Note:** Although a basket is defined only on a single service window, it may be “looped” to any other non-concurrent basket(s). This feature allows participants to build up offers that are defined over longer periods of time. Two or more baskets that are looped together are a “looped family”.

A basket must contain...

- exactly 1 **Parent** Order.

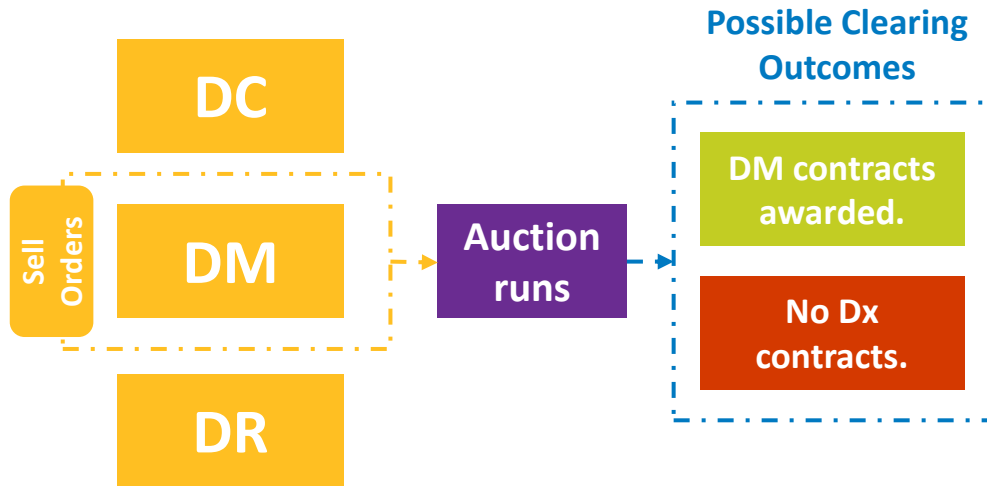


A basket may contain...

- at most 10 **Child** Order.
- at most 10 **Substitutable Child** Order.

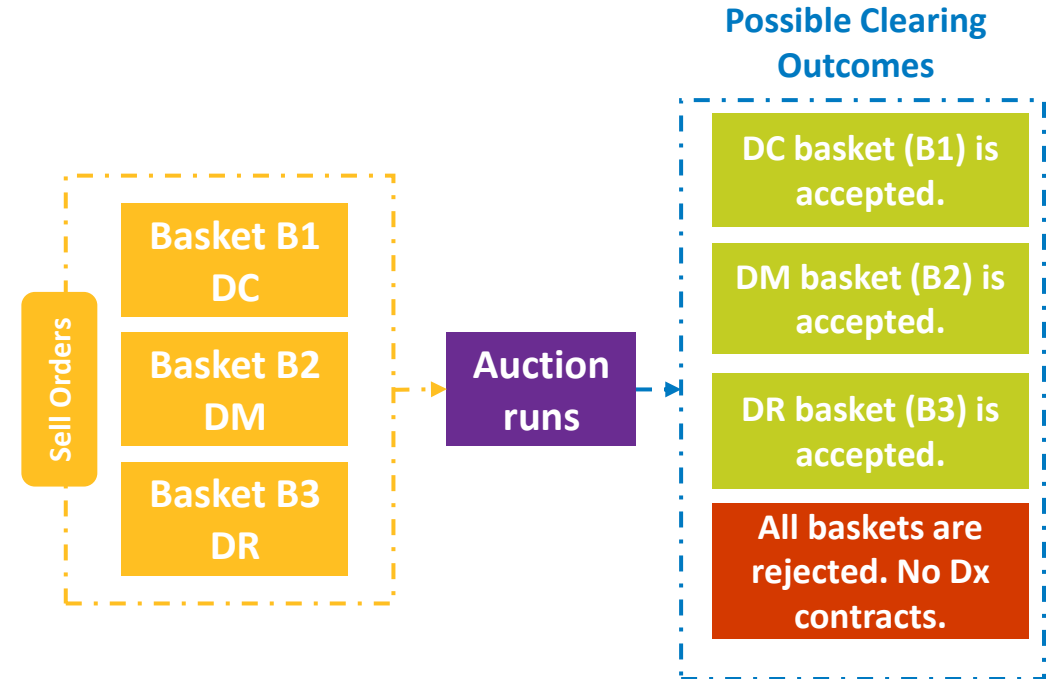
Co-optimisation with Mutually Exclusive Baskets

Current frequency response auctions



Currently only one service (i.e., either DC, DM, or DR) can be offered into the auction. The provider has to choose in advance which of the various services to offer into the auction.

EAC auction (with co-optimisation)



When a unit has the capability of providing more than one of the services, the provider can offer each service in a different basket. These baskets are mutually exclusive to each other, hence at most one basket will be selected. The auction clearing algorithm allocates the unit to the service that will clear the market most efficiently.

A simple example of co-optimisation with baskets

Scenario

A 20MW unit wants to participate in the response markets. Its marginal cost of providing each service is as follows:

- **DCL:** £2/MW/h, up to 20MW
- **DML:** £5/MW/h, up to 20MW
- **DRL:** £10/MW/h, up to 10MW

Order features

- ✓ Non-curtable orders
- ✓ Mutually exclusive baskets

Basket ID	EFA	Order ID	Order Type	DCL	DML	DRL	Price
B1	1	P1	Parent	20			2.00
B2	1	P2	Parent		20		5.00
B3	1	P3	Parent			10	10.00

Notes

- We introduce the idea of baskets as one way to represent co-optimised offers
- Baskets group one or more orders together
- Baskets defined on the same service window are mutually-exclusive: at most, one of them can be accepted.

Possible clearing outcomes in EAC

Possible Outcome	Accepted Basket	Executed Volume			Minimum Revenue (£/h)	Minimum Revenue in £/MW/h
		DCL	DML	DRL		
1	NA	0	0	0	0.00	0.00
2	B1	20			40.00	2.00
3	B2		20		100.00	5.00
4	B3			10	100.00	10.00





UI Demonstration - NSIDE



API Specification

API Information

- The EAC platform was designed with the intention to have sell orders submitted via an API.
- API integrations improve automation processes, making tasks that are currently manual easier thanks to connected applications.
- NGENSO have conducted some market provider feedback on the use of API's and the majority of providers are in favour of having an API upload function available
- In addition to this, providers will also be able to extract their own results via an API call from the EAC platform
- The API spec is available to view using this link:
<https://eac-sandbox.ngeso.validation.n-side.com/docs/market-participant/api/graphql/reference/>
- We plan to have a sandbox environment available to test the API's from July 2023.



Market Trials High Level Plan

Market Trials Plan

The purpose of the mock auction is to facilitate the incorporation of a new auction platform, the integration with internal NGENSO systems (SMP) and familiarise market providers with how a co-optimised and stacked auction of the frequency response products will work.

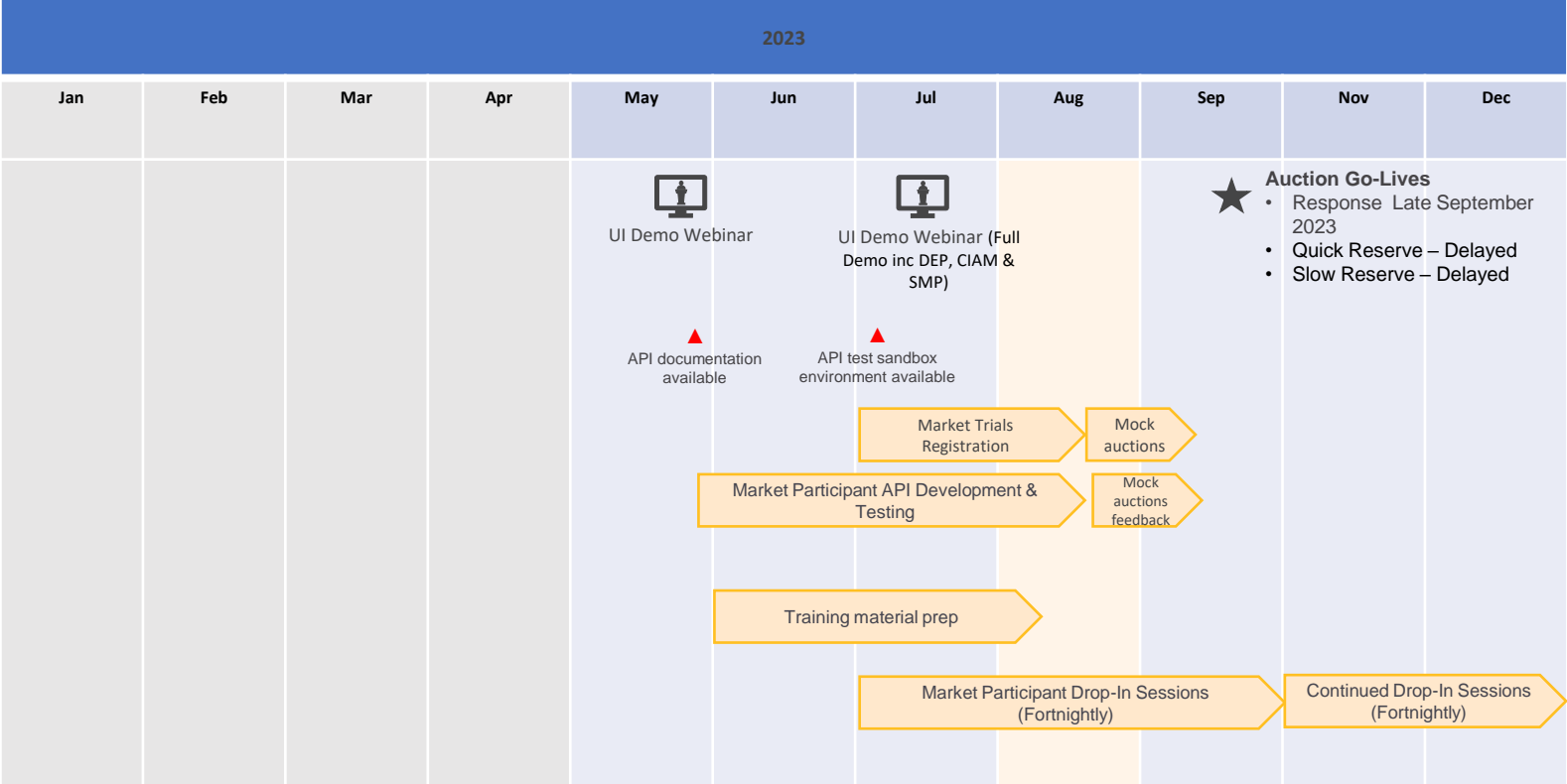
- 3 mock auction runs will be undertaken (1 per week) from the end August until mid September 2023.
- A mock auction guidance document will be provided nearer the time to providers that register their interest to take part in the mock auction.

Registration for Mock Auction:

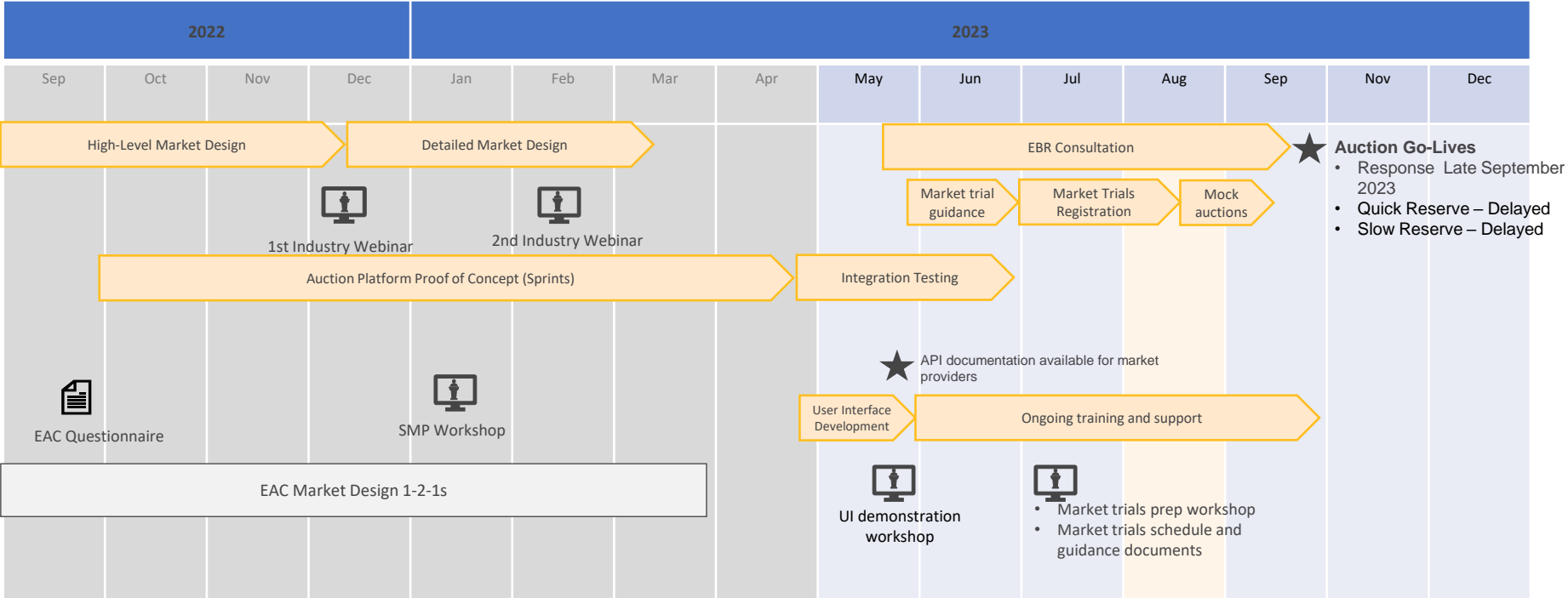
We invite you to email box.futureofbalancingservices@nationalgrideso.com by **17:00 Friday 30 June 2023** expressing your interest.

In your email, please use the subject title: **EAC Mock Auction - Agent/Applicant name - Expression of Interest.**

Market Trials Plan



EAC Delivery Roadmap



Q&A

