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National Grid ESO Stability Market: Stage II – WP2

14th March 2023

FIRST DISCUSSION OF WP2 REMAINING QUESTIONS

Today AFRY will be addressing Work Package 2 questions

WP	 <p>WP1: Key Design Questions</p>	 <p>WP2: Further Eligibility and Contract Design Questions</p>	 <p>WP3: Procurement Strategy</p>
	Exam Questions	<p><i>TO involvement:</i></p> <ul style="list-style-type: none"> What are the key considerations for treatment of the TO assets? What is the role of the TO in the LT market?¹ <p><i>Eligibility rules:</i></p> <ul style="list-style-type: none"> Can existing capability enter the LT market?¹ How do we enforce the selective eligibility for the ST market? Open to all providers? Are there unintended consequences?¹ 	<p><i>Further analysis on network assets:</i></p> <ul style="list-style-type: none"> How is depreciation of TO assets assessed in a competitive market? What are the participation routes and business cases for OFTOs and Interconnectors? What are the eligibility rules for expired RAB assets? <p><i>Contract structure:</i></p> <ul style="list-style-type: none"> How long should LT market contracts be?² What contract resolution should we choose for the ST market?² What provision should be made for contract extensions?² Should we have a utilisation payment for the services in the LT and/or ST markets?² <p><i>Selective characteristics:</i></p> <ul style="list-style-type: none"> How do we define incremental investment?

1. Moved from WP2 to WP1; 2. Moved from WP1 to WP2 3. Not part of original scope | TO: Transmission Owner; LT: Long-Term; ST: Short-Term;

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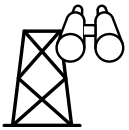


Remaining question on contract structure and selective characteristics criteria still to be addressed within WP2

WP2

Topics

Exam Questions



1. Further analysis on network assets



1.a How is depreciation of TO assets assessed in a competitive market?



1.b What are the participation routes and business cases for OFTOs and Interconnectors?



1.c What are the eligibility rules for expired RAB assets?



2. Contract structure



2.a How long should LT market contracts be?



2.b What contract resolution should we choose for the ST market?



2.c What provisions may be made for contract extensions (e.g., once pathfinders or SM contracts are finished, do these assets re-enter the competitive markets?)



2.d Should we have a utilisation payment for the services in the LT and/or ST markets?



3. Selective characteristics



3.a How do we define incremental investment, incremental capabilities and existing capabilities?












Will be discussed first, as it will influence recommendations for the other remaining questions

Focus of this meeting!

TO: Transmission Owner; OFTO: Offshore Transmission Owner; RAB: Regulated Asset Based; LT: Long-Term; ST: Short-Term; SM: Stability Market

Stability Market envisages LT contracts only for new build plants (and possibly refurbished), while existing ones would access to MT/ST frames

SKELETON OF STABILITY MARKET DESIGN

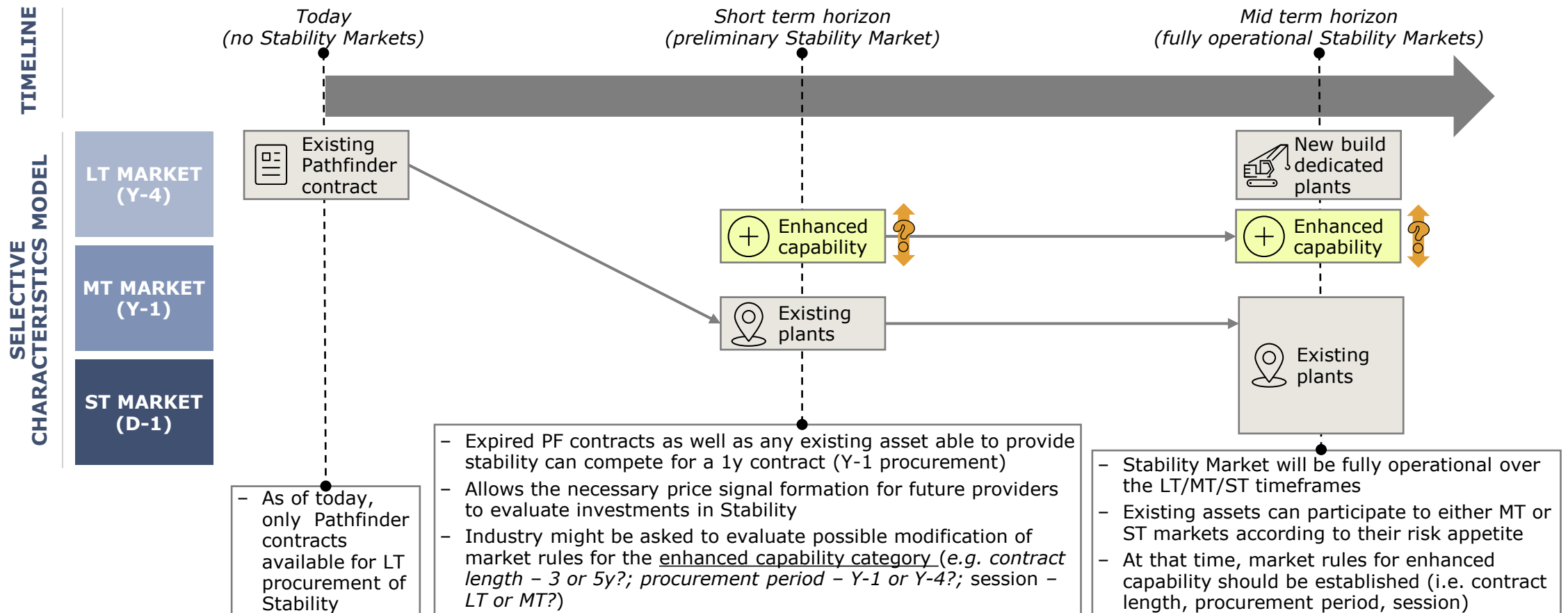
		Long Term (Y-4)	Mid Term (Y-1)	Short Term (D-1)	
 Purpose		<ul style="list-style-type: none"> - Procure capacity in advance (LT), to fulfil share of total requirements for Stability otherwise likely not to be met at delivery time - Allow financing of new build capacity (and enhanced capability¹, TBD) through LT contracts 	<ul style="list-style-type: none"> - Procure capacity in advance (MT), to adjust LT procurement in case necessary - Allow MT financing of any existing capability able to provide stability (e.g. expired PF contracts, enhanced capability¹) 	<ul style="list-style-type: none"> - Procure capacity to fulfil residual of total requirements for Stability closer to real time (ST) - Allow remuneration of marginal costs for providing Stability at 0MW (proving a change in behaviour) 	
 Timeline	Procurement lead time	- Y-4	- Y-1	- D-1	
	Contract duration	- 10+ y (TBD) (3y or 5y for enhanced capability ¹ , TBD)	- 1 y (3y or 5y for enhanced capability ¹ , TBD)	- Service windows	
 Product	Contract type	- Baseload availability	- Baseload availability	- 4 h (EFA blocks)	
	Contract obligations	- e.g. 90% availability	- e.g. 90% availability	- 100% availability	
 Pricing	Payment type	<i>Availability payment</i> - £/h	<i>Availability payment</i> - £/h	<i>Availability payment</i> - N.a.	<i>Delivery payment</i> - £/MW.s/h (TBC)
	Price mechanism	- Pay-as-bid	- Pay-as-bid (TBC)	- Pay-as-bid	- Pay-as-clear (TBC)
 Eligibility		 Incremental investment		 Incremental/  existing capability	
		 New build dedicated plants	 Enhanced capability ¹	 Existing plants	

1. Existing assets with additional investments to provide incremental Stability | PF: Pathfinder; SP: Settlement Period; LT: Long-Term; MT: Mid-Term; ST: Short-Term

Preliminary market for existing plants (including refurbished) would provide the necessary price signals for the future Stability Market

ILLUSTRATIVE

EVOLUTION OF SELECTIVE CHARACTERISTIC MODEL



PF: Pathfinder; LT: Long-Term; MT: Mid-Term; ST: Short-Term

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QUESTION 3A: OUTCOMES FROM WP2 ON ELIGIBILITY QUESTIONS




During WP 1, selective payment criteria have been recommended, while selective characteristics required further considerations in WP 2

OUTCOMES FROM WP 1

SELECTION CRITERIA FOR STABILITY

Selective characteristics

Selection criteria are defined by provider status:







-  **Incremental investment (in LT market):**
 - All new build plants
 - Significant investment in existing plants to enable or enhance stability provision (TBD)
-  **Incremental capability (in MT and ST markets):**
 - Existing capacity e.g. expired Pathfinders
 - Minor investment in existing plants to enable or enhance stability provision (TBD)
-  **Existing capability (in ST market):** all other providers not in the first two categories

Selective characteristics take primacy over selective payment

Preliminary – further consideration and final recommendation provided in the next slides

Selective payment

According to their status, providers will be selected for payment within ST market if they fulfil:

-  **Technical conditions to deliver the service at the relevant time:** operationally, unit needs to have necessary configuration/activation to provide the stability service
-  **D-1 indication of intention to meet condition to deliver the service:** eligibility to ST¹ for:
 -  Synchron. gen. capable of providing 0MW² service. If offering FPN>0MW, they would forego stability revenues
 -  Non synchron. generation/storage units
 -  Synchron. 0MW units (e.g. synchronous condenser)
-  **ST market preferable procurement route compared to other intraday alternatives:** e.g., evaluate possibility to procure through BM if cheaper











*If compliant with the above criteria (and selective characteristics), units can be procured under complementary **procurement strategies** in all market timeframes:*



1. Model 3.b 'Option to forego payment'; 2. e.g. equipped with clutch, which intend to operate at 0MW unless otherwise instructed | BM: Balancing Market; ST: Short-Term; MT: Mid-Term; LT: Long-Term

QUESTION 3A: GENERAL SELECTIVE CHARACTERISTICS RULES

Enhanced capability will be recommended to participate to either LT or MT markets (TBD), being eligible for intermediate LT-MT contract periods

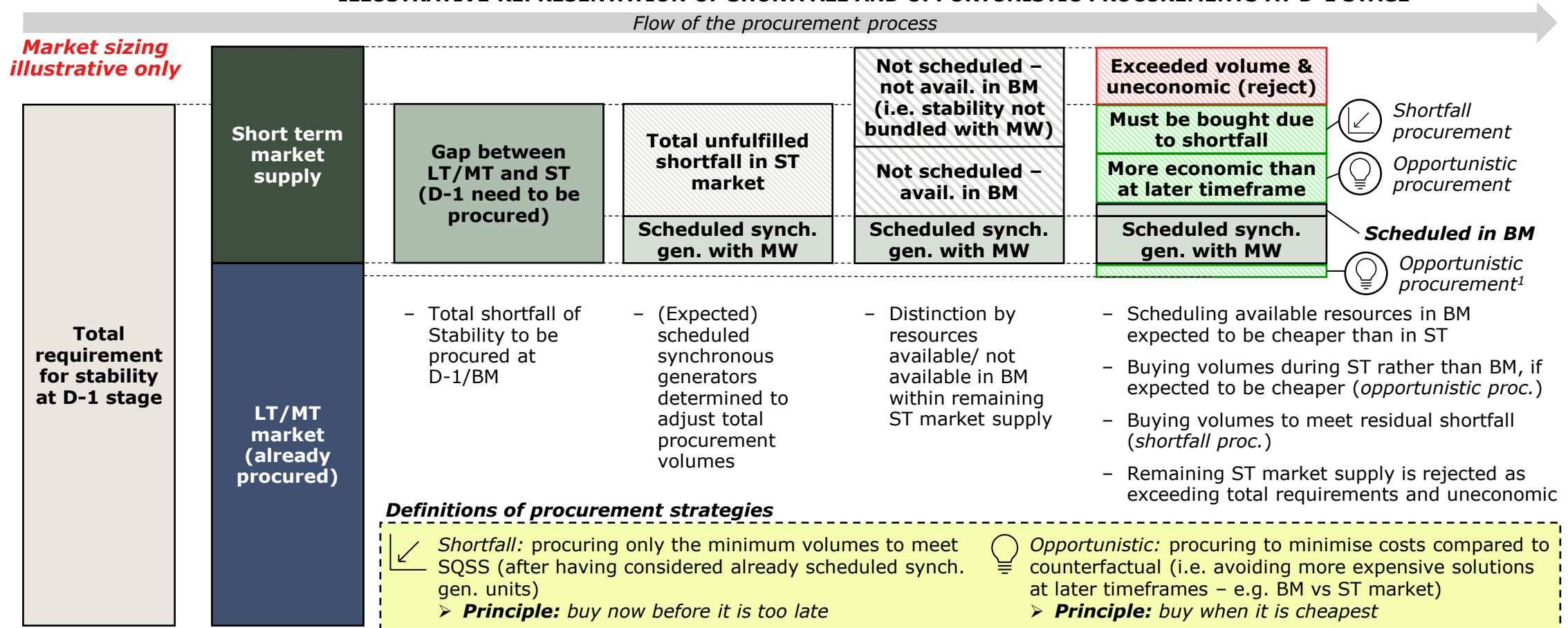
 Selective characteristics	POSSIBLE PARTICIPATION MODEL FOR ADDITIONAL INVESTMENTS			
	Long Term (Y-4)	<i>Time requirements for additional investments⁴ still unknown. First application of MT market would provide more evidences</i>	Mid Term (Y-1)	Short Term (D-1)
	 Incremental investment	 Incremental capability	 Incremental/ existing capability	
 <i>Market participants¹</i>	 New build dedicated plants	 Enhanced capability	 Existing plants	
 <i>Conditions for eligibility</i>	<ul style="list-style-type: none"> - New assets with capability to provide stability - Only dedicated synch. 0MW, storage and non-synch. gen. units eligible - Must meet availability requirements 	<ul style="list-style-type: none"> - Existing assets undertaking additional investments to provide incremental stability 	<ul style="list-style-type: none"> - Existing assets able to provide stability (e.g. expired PF contracts, enhanced capability), which meet overall eligibility conditions (<i>below</i>) 	
 <i>Contract lengths</i>	10+ years (TBD)	3+ years (TBD)	1 year	4h - EFA blocks

1. e.g. with clutch | PF: Pathfinder

QUESTION 3A: SHORTFALL VS OPPORTUNISTIC PROCUREMENT

Opportunistic procurement would allow procurement at D-1 if expected to be cheaper than BM, while shortfall procurement will fulfil the residual need

ILLUSTRATIVE REPRESENTATION OF SHORTFALL AND OPPORTUNISTIC PROCUREMENTS AT D-1 STAGE



LT: Long-Term; MT: Mid-Term; ST: Short-Term; BM: Balancing Market; SQSS: Security and Quality of Supply Standard
 Notes: ¹Opportunistic based on delivery price – some short term providers may be accepted if/when cheaper than delivery from long term procured capacity

QUESTION 3A: FEEDBACK FROM INDUSTRY

Open questions for which feedback from the industry is required



FEEDBACK FROM INDUSTRY

1. To what extent do you agree with the selective characteristics outlined for the LT, MT and ST markets?

⊕ *Enhanced capabilities*

2. What kind of refurbishments and enhancements are possible?

3. What is the preferable procurement lead time (e.g. Y-1, Y-4, other) for plant requiring major investment?

Considering e.g. technical timing to refurbish existing plants and the magnitude of the investment (any information you can share would be appreciated)

4. What is preferable contract duration (e.g. 3y, 5y) for major refurbishment? Considering e.g, magnitude of the investment, typical financing mechanisms, lifetime of the additional components

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QUESTION 2A: DESIGN OPTIONS

Options for LT contract length range from following PF methodology to having longer contract lengths based on ESO evaluation of future needs



Outcomes from WP2 – EQ 1.a: How is depreciation of TO assets assessed in a competitive market?

- Treatment of TO assets depreciation has opened the question on LT contract length
- The analysis has short-listed 3 feasible depreciation models:
 1. *'The Pathfinder evaluation'*: total cost of TO counterfactual depreciated over tender period (no RV)¹
 3. *'Fixed residual value for TOs'*: ESO assumes a RV, based on expected need/capability of TO assets to provide services after the tender period¹
 6. *'Pathfinder, but longer contracts'*: Same as 'The Pathfinder approach', but assessment considers longer tender period²

Possible design options

- Based on the short-listed models, three possible design options for LT contract length have been evaluated:
 1. *'The Pathfinder evaluation'*: contract length remains as per current Pathfinder (i.e. 10y)
 3. *'Fixed residual value for TOs'*: contract length to be decided (e.g. 10, 15, 20y) based on ESO estimation of future service needs, which will determine the length of contract extensions as well
 6. *'Pathfinder, but longer contracts'*: longer contracts compared to current Pathfinder (e.g. 15, 20 years)

Initial consideration

- Depreciation Model 3 seems to be complicated to approach. ESO would need data from TOs currently able to forecast Stability requirements only on a 10 years basis. Plus, ESO would be making an estimate on future needs >10 years, which could have a significant impact on the market outcomes
- Contract length depends also on technology lifetime and financing mechanisms, so feedback from industry is important. During Phase 1, industry expressed preference for 10y contracts

1. Commercial providers may (implicitly) consider a RV within their contract price; 2. e.g. 20 years vs. current 10 years of Pathfinder | TO: Transmission Owner; RV: Residual Value

QUESTION 2A: FEEDBACK FROM INDUSTRY

Open questions for which feedback from the industry is required

FEEDBACK FROM INDUSTRY

1. Are there any limitations in terms of contracts being too long (e.g. 15, 20 years) in the LT market?
2. What is the preference in terms of LT contract duration? What are the relevant underlying criteria (e.g. technical lifetime of the asset, length of financing period)?

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QUESTION 2B: APPROACH

Recommendation of EFA block (4h) resolution for ST has been based on criteria of low level of overholding and consistency with other ST products



Outcomes from Stability Phase 1

- Recommendations from Phase 1 have suggested the application of either Settlement period or EFA blocks for ST product resolution, based on the (split) feedback from Industry, the nature of the requirements and the characteristics of the providers

Possible design options

- Possible design options have been considered for ST product resolution:
 - a) ½h
 - b) 1h
 - c) 4h
 - d) 12h (day/night)
 - e) 24h (baseload)

AFRY assessment

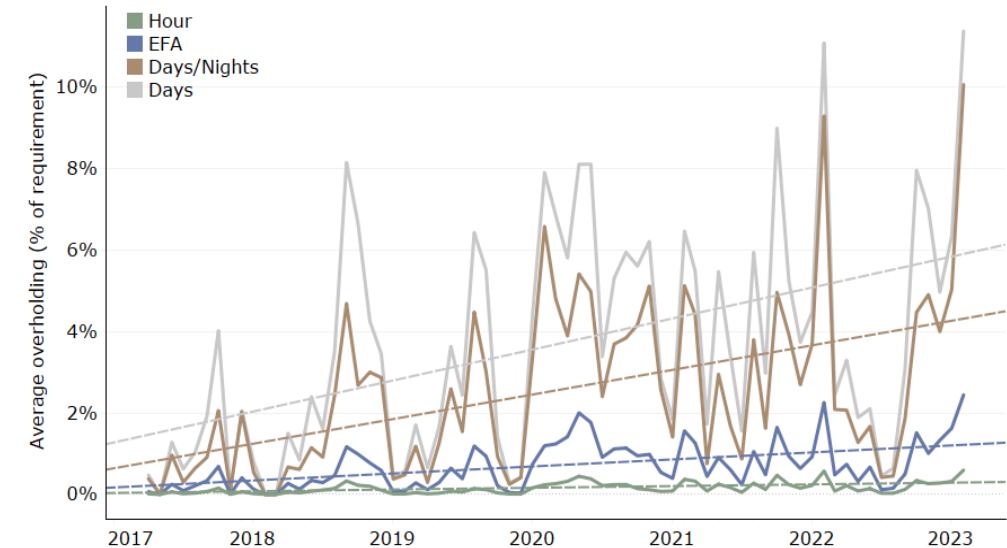
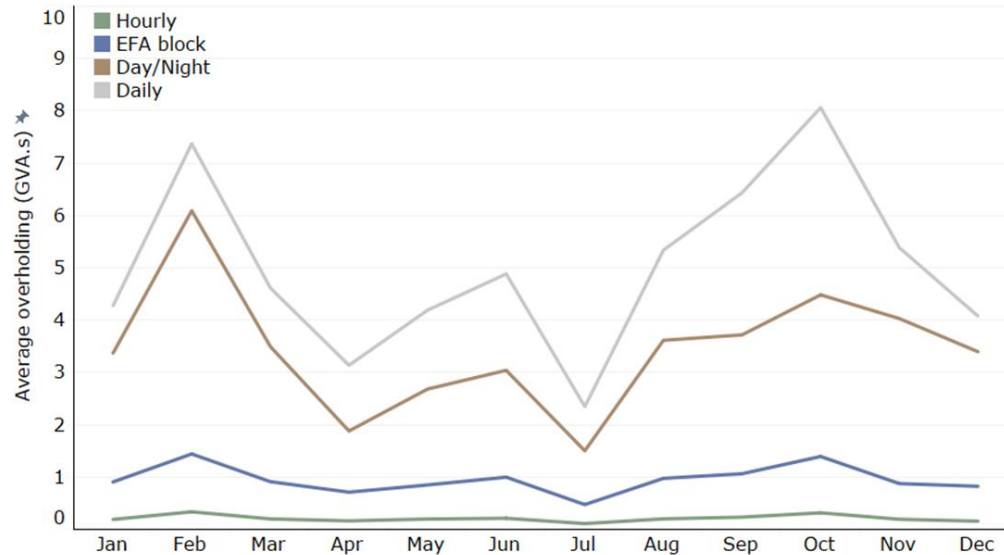
- The following criteria have been considered to evaluate the most suitable design option:
 1. Acceptable degree of overholding¹
 2. Consistency with other existing ST products
- The analysis have been performed based on 2017-2022 historical data (SP granularity) on inertia requirements and procurements
- EFA blocks (4h) is the recommended resolution for ST, having evaluated an acceptable level of overholding, practicality and the consistency with other existing ST products
- Cost assessment of the different procurements could not be performed, due to lack of historical inertia price data at SP granularity

1. Difference between profile requirements and actual profile supply | ST: Short-Term; SP: Settlement Period

QUESTION 2B: ANALYSIS RESULTS

1h and 4h blocks would provide relatively low overholding compared to higher resolutions, considering also their historical trends

Comparison of overholding for different ether blocks



Volume

- Large difference in avg. overholding between Day&Night/ Daily and Hourly/EFA block
- Low overholding in EFA and Hourly blocks, with EFA overholding only slightly higher than that of hourly

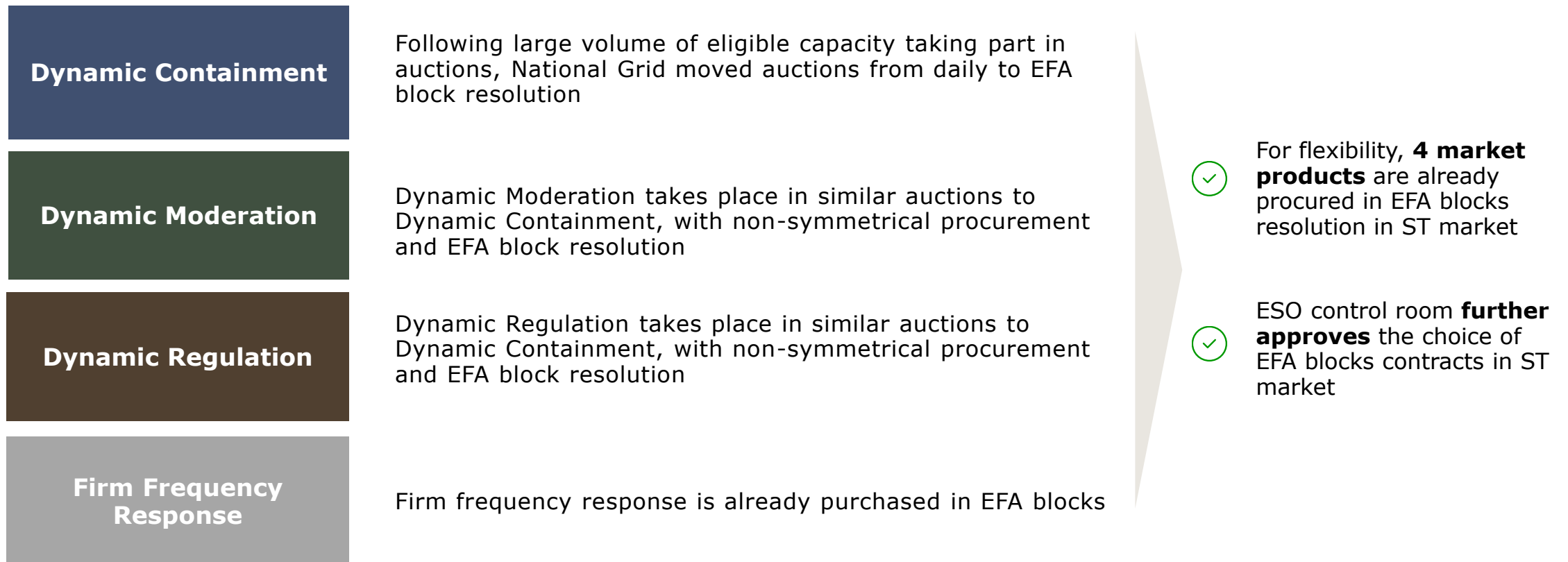
Volatility and rate of change

- Greater overholding volatility in Day/Night and Daily blocks
- Accelerating overholding requirement in Day&Night/Daily blocks over time, while slower increase in EFA and Hourly. This indicates a lower future requirement for overholding for EFA/Hourly

QUESTION 2B: FINAL CONSIDERATIONS

EFA blocks (4h) would be the recommended ST resolution for Stability, considering practicality and the coherency with other existing ST products

ST PRODUCTS PROCURED BY NATIONAL GRID



ST: Short-Term

QUESTION 2B: FEEDBACK FROM INDUSTRY

Open questions for which feedback from the industry is required

FEEDBACK FROM INDUSTRY

1. Any criticalities to highlight with regard to using EFA blocks (4h) for ST procurement (e.g. inconsistency with other services offered by the Stability technologies)?
2. Which other products would you be looking to stack Stability provision with in the ST market, so we can evaluate the contract structure in those?

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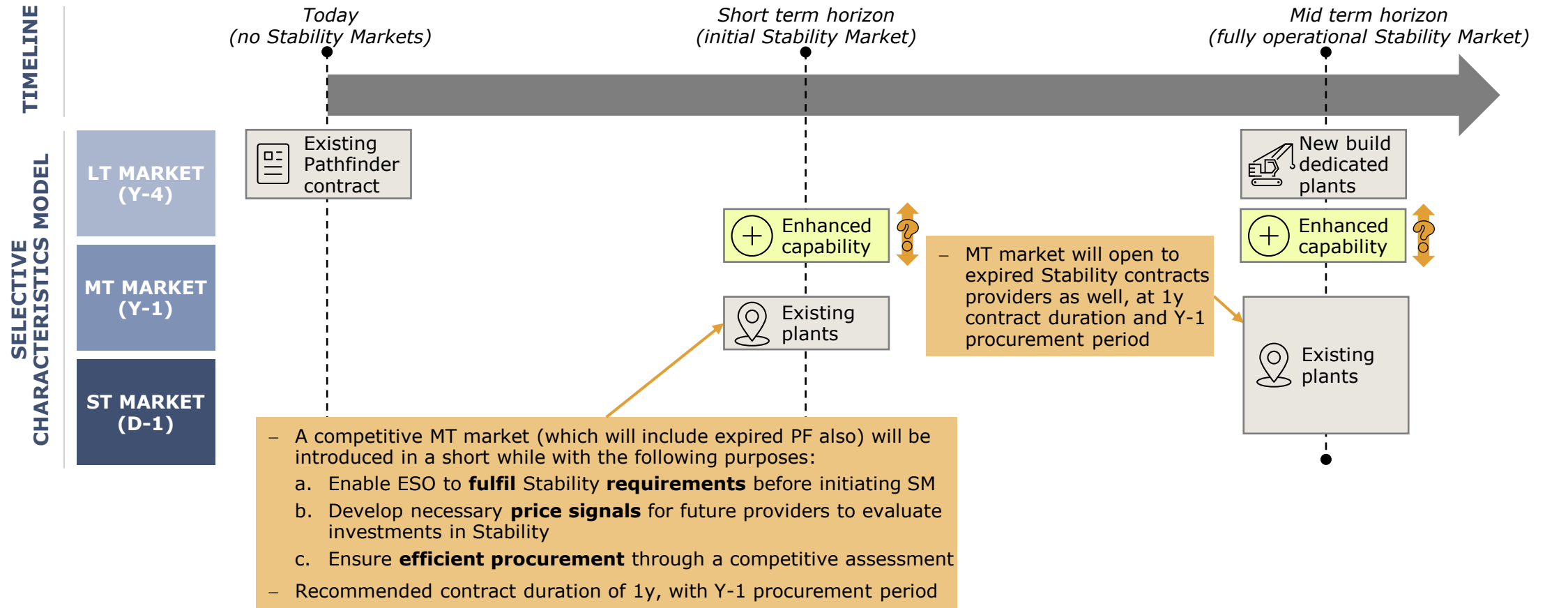


QUESTION 2C: FINAL RECCOMMENDATIONS FOR EXPIRED CONTRACTS

Expired PF and Stability contracts could be renewed within the MT market, with prices set through a competitive assessment

ILLUSTRATIVE

EVOLUTION OF SELECTIVE CHARACTERISTIC MODEL



LT: Long-Term; MT: Mid-Term; ST: Short-Term; PF: Pathfinder; SM: Stability Market

QUESTION 2C: FEEDBACK FROM INDUSTRY

Open questions for which feedback from the industry is required

FEEDBACK FROM INDUSTRY

1. Do you note any issues on the recommended option for renewing expired contracts – e.g. once Stability Pathfinders or enduring Stability Market contracts expire?

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QUESTION 2D: APPROACH

Outcomes from project Phase 1 and feedback from the industry suggested application of the utilisation payment just for LT/MT market units



Outcomes from Stability Phase 1

- Recommendations from Phase 1 have suggested application of availability and utilisation payment for the LT/MT market units, while only availability payment for ST
- Rationale was that LT market is likely to attract high-capex/low variable cost providers. Hence, there should be arrangements to manage their energy consumption costs. ST market is likely to attract high availability/variable cost or low availability/variable cost providers with high certainty over utilisation so no explicit UP needed
- On utilisation price for LT/MT, industry feedback was split over the application of imbalance or user defined utilisation prices



Possible design options

- Possible design options have been considered for the possible combinations of Availability and Utilisation Payments (*the latter called Delivery Payment from now on*) over the LT/MT and ST markets



AFRY assessment

- Feasibility of the proposed design options have been assessed under criteria of:
 1. Ease of evaluation
 2. Efficiency of dispatch
- A list of short-listed models have been proposed

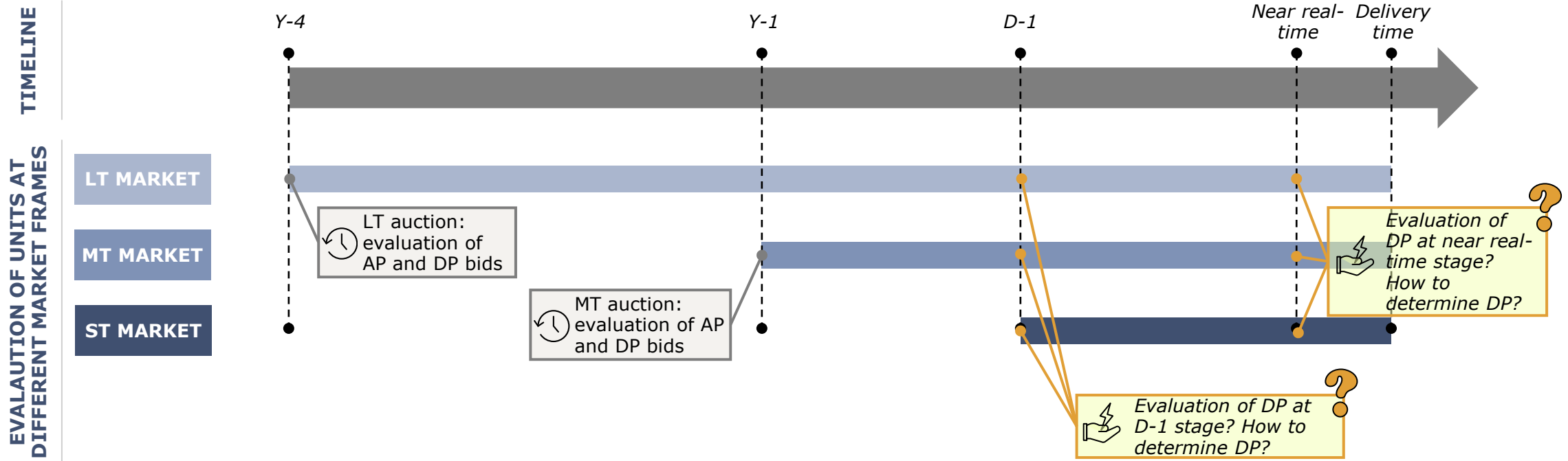
UP: Utilisation Payment; LT: Long-Term; MT: Mid-Term; ST: Short-Term

QUESTION 2D: TIMELINE ON EVALUATION OF UNITS WITHIN THE STABILITY MARKETS

To select the units effectively delivering stability, ESO will need to determine how (and if) a delivery payment will be defined and at what stage evaluated

ILLUSTRATIVE

EVALUATION OF UNITS WITHIN STABILITY MARKETS







Definitions of payment components

- Availability payment (AP):** offer for being 'active' and available to provide Stability at later timeframes. Embeds cost opportunity of not participating in other markets
- Delivery payment (DP):** offer for delivering Stability as instructed by the SO. Embeds marginal costs (e.g. energy consumptions) to deliver the service and possibly opportunity costs in case of ST contract

DP: Delivery Payment; AP: Availability Payment; SO: System Operator; LT: Long-Term; MT: Mid-Term; ST: Short-Term

QUESTION 2D: MODEL OPTIONS FOR PAYMENTS



Different models could be applied to determine the value of delivery (and availability) payment for LT, MT and ST markets

LT/ MT contract providers		ST contract providers			
Options	 Availability Payment (eval. Y-4: LT; Y-1:MT)	 Delivery Payment (eval. D-1: LT/MT)	Options	 Availability payment (eval. D-1: ST)	 Delivery Payment (eval. D-1: ST)
a Only AP (DP embedded)	- Bid for LT/MT availability	- Effectively, DP embedded in availability bids during LT/MT auctions	a Only DP (AP embedded)	- Effectively, AP embedded in delivery bids during ST auctions	- Bid for ST delivery (ideally reflecting both cost opportunity and energy costs)
b AP and fixed DP	- Bid for LT/MT availability	- Separate bid for ST delivery - DP fixed at the point of LT (MT) contract, at Y-4 (Y-1) stage	b AP and bid DP	- Bid for ST availability (ideally reflecting cost opportunity only)	- Separate bid at D-1 stage for ST delivery (ideally reflecting energy cost only)
c AP and indexed DP	- Bid for LT/MT availability	- DP calculated through a formula linked to the actual costs of unit to provide services (e.g. real-time cost of electricity if unit consumes energy to provide stability)	c AP and pass-through DP	- Bid for ST availability (ideally reflecting cost opportunity only)	- DP calculated through a formula linked to the actual costs of unit to provide services (e.g. real-time cost of electricity if unit consumes energy to provide stability)

AP: Availability Payment; DP: Delivery Payment; ST: Short-Term; MT: Mid-Term; LT: Long-Term

QUESTION 2D: EVALUATION OF MODELS

Moving forward from Pathfinder approaches, a two-part bid for AP/DP is recommended to allow efficient dispatch and reduce risks for providers

LT/ MT contract providers	POSSIBLE SHORTLISTED MODELS FOR AP/DP OVER THE SHORT-TERM HORIZON (INITIAL STABILITY MARKET)		
	A. Pathfinder Phase 1	B. Pathfinder Phase 2-3	C. Future Stability Market Alternative
 Availability payment	- Single bid (£/SP) – reflecting AP only	- Single bid (£/SP) – reflecting both AP and DP	- Single bid (£/MW.s/h) – reflecting AP only
 Delivery payment	- As pass-through – energy costs calculated by ESO ex-post as: $\sum_h [\text{En. Cons. (kWh)} * \text{SBP}(\text{£/kWh})]_h$	- N.a. – energy costs assumed by comm. prov. (utilisation and energy prices during contract duration) and embedded in AP bids	Possible options i. Fixed DP: DP (£/MW.s/h) set at the point of contract (e.g. Y-1), paid when the asset is utilised throughout the contract duration (e.g. 1 year) ii. Indexed DP: same as 'option i.', but DP is then indexed (through a formula, e.g. day-ahead/intra-day) against variable(s) linked to energy consumptions (e.g. energy price, inflation) VARIANTS OF OPTIONS i., ii. Variable DP (capped): either 'option i.' or 'option ii.', but comm. prov. are free to bid a lower price (e.g. at D-1 stage, monthly, quarterly) than the fixed DP set at the point of contract – effectively fixed DP works as a cap for the lower bids offered by comm. prov.

SP: Settlement Period; AP: Availability Payment; DP: Delivery Payment; SBP: System Buy Price (Imbalance Price)

QUESTION 2D: FEEDBACK FROM INDUSTRY

Open questions for which feedback from the industry is required

FEEDBACK FROM INDUSTRY




1. Do you think the models presented for the LT & MT markets (Model C) are optimum?
2. Within the proposed Model C, would you be favourable to introduce a cap for the Delivery Payment, set at the point of contract? What type of indexation (e.g. imbalance price, energy costs) would be the most appropriate for adjusting such cap closer to real-time?
3. Would you instead prefer a fixed £/MW.s/h payment which encompasses both availability and utilisation (Model B – PF 2-3), or a variable utilisation payment (Model A – PF 1)?
4. Considering the technologies eligible, roughly what proportion of the overall investment in the LT/MT market equates to energy consumption costs?
5. Would you consider other models for the Delivery Payment?
6. Do you have any preferences between pay-as-bid and pay-as clear price mechanisms for the Delivery Payment (for all LT/MT/ST units)? What are the motivations behind?

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The next steps in the long run are to address the WP3 exam questions

WP	 <p>WP1: Key Design Questions</p>	 <p>WP2: Further Eligibility and Contract Design Questions</p>	 <p>WP3: Procurement Strategy</p>
	Exam Questions	<p><i>TO involvement:</i></p> <ul style="list-style-type: none"> What are the key considerations for treatment of the TO assets? What is the role of the TO in the LT market?¹ <p><i>Eligibility rules:</i></p> <ul style="list-style-type: none"> Can existing capability enter the LT market?¹ How do we enforce the selective eligibility for the ST market? Open to all providers? Are there unintended consequences?¹ 	<p><i>Further analysis on network assets:</i></p> <ul style="list-style-type: none"> How is depreciation of TO assets assessed in a competitive market? What are the participation routes and business cases for OFTOs and Interconnectors? What are the eligibility rules for expired RAB assets? <p><i>Contract structure:</i></p> <ul style="list-style-type: none"> How long should LT market contracts be?² What contract resolution should we choose for the ST market?² What provision should be made for contract extensions?² Should we have a utilisation payment for the services in the LT and/or ST markets?² <p><i>Selective characteristics:</i></p> <ul style="list-style-type: none"> How do we define incremental investment?

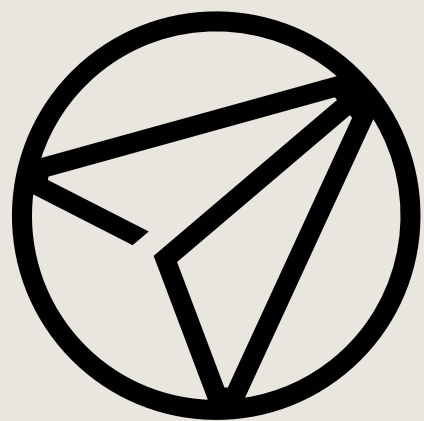
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NEXT STEPS

Next steps in the short run

1. AFRY will send a form to the Industry representatives to collect feedback on the topics presented today
2. AFRY will continue to engage with Industry in the next few weeks to address the topics covered in WP 3
3. A final webinar (covering the whole project material) would be arranged by first half of Q2 2023, target period for the project's finalisation





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