



Strawman design options - Reactive Power market

8th December 2021

AFRY | NGESO

Agenda

1. Market design process
2. Scene setting
3. Market objectives
4. Building blocks
5. Strawman options
6. Next steps

5
7
9
14
17
33

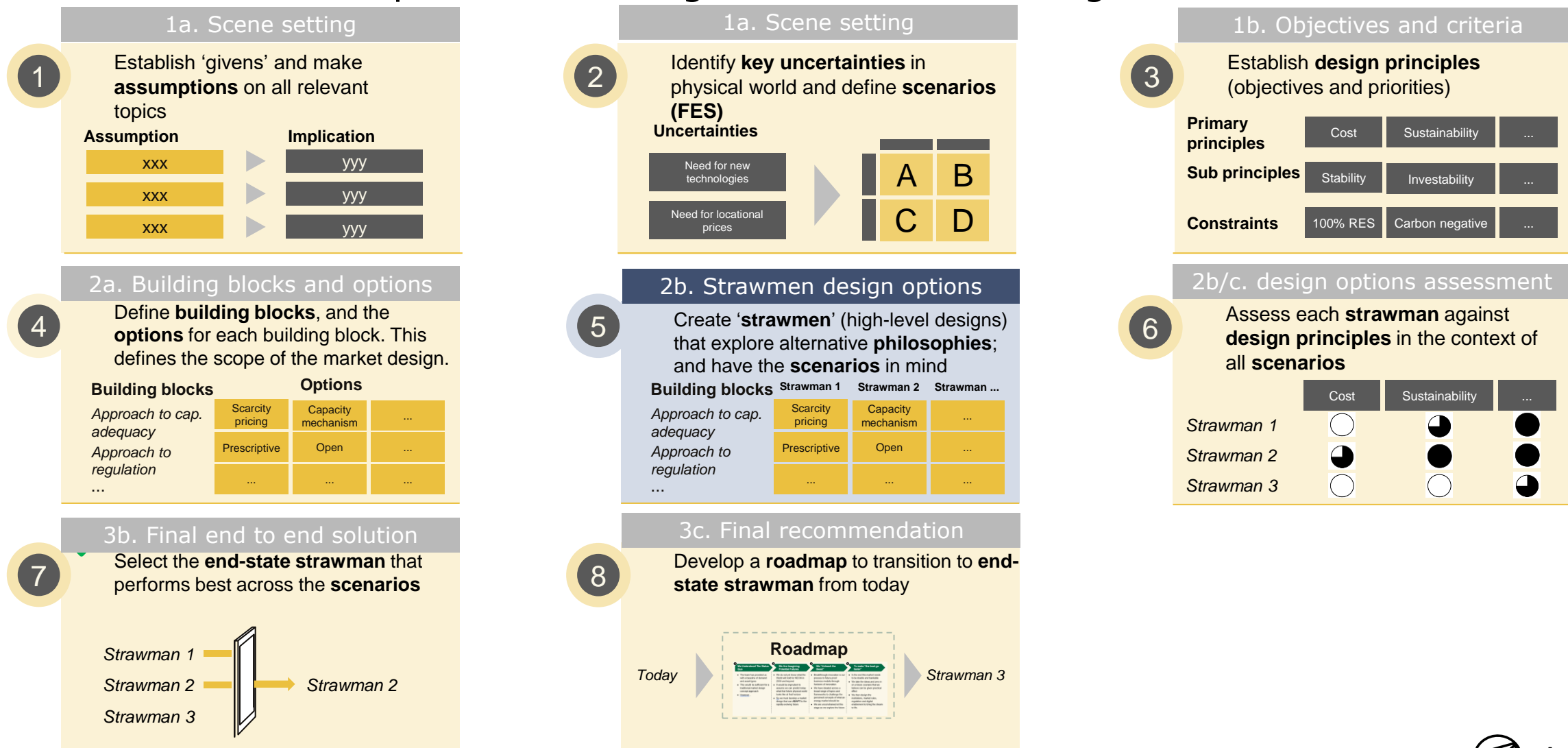


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1. Market design process	5
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Process to develop and select high level market design



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System security and uncertain future economics are driving the case for change in the provision of reactive power services



Tools obliged to provide reactive power are disappearing

Retiral of old plant providing services under the ORPS arrangements, in particular coal and in the future gas and nuclear



Shifting economics of different technologies means new generators are not replacing 'like-for-like'

Rapid increases in embedded generation and a shift towards intermittent technologies with complex characteristics and commercial arrangements potentially not bound by traditional arrangements and/or located far from system needs



Demand for reactive power services are increasing

Changes to network topology, offtake at GSP to DNO networks (due to embedded generation), and consumer behaviour



Spend on reactive power is increasing

Accessing providers is becoming increasingly expensive as traditional ORPS providers are being driven 'out of merit' by new technologies, requiring synchronisation to access



No enduring arrangements to drive technical innovation

No route to market for some solutions or insufficient economic incentives to stimulate innovation

System security could be threatened without action

New reactive power providers will need to emerge to ensure voltage performance in the future.

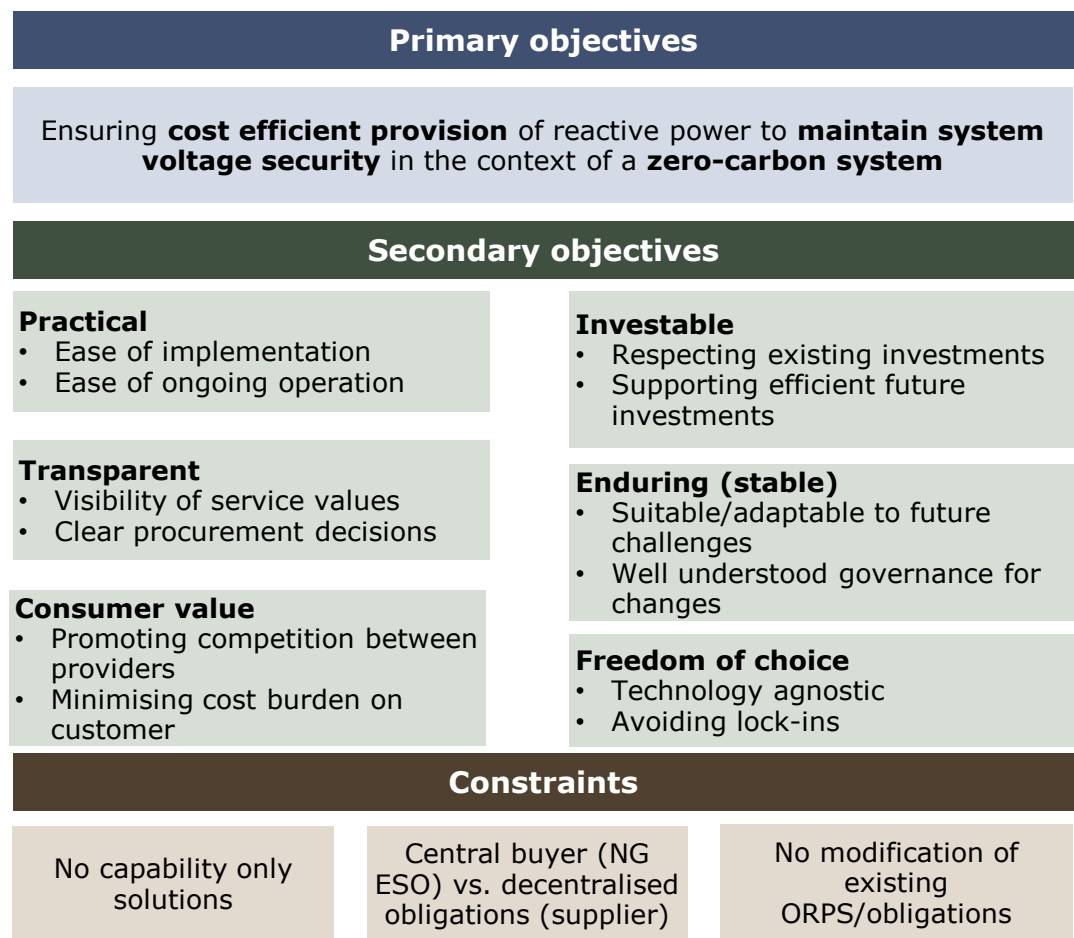
In practice ESO and TO arrangements are relatively robust, current arrangements can theoretically facilitate the transition (e.g. building grid assets) but there is potential to increase efficiency in service provision.

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Market objectives create a framework for evaluation of market design performance based on desired outcomes



Note that a similar proposal has been presented to NGESO's stability market project

Why do we need objectives?

- The market design process should be focussed on desirable outcomes – what do we want the market to actually do?
- Objectives allow us to make our intentions for the market mechanism clear.




How do we choose objectives?

- Primary objectives outline the overall desired end-state ignoring difficult questions on the physical realities.
- Secondary objectives allow us to set the context, the key questions are:
 - what do we believe the market will need to achieve primary objectives?
 - Is there anything that doesn't define ultimate success, but is important enough to be considered in the process?

What are the implications for preferred solutions?

- Objectives give us a framework to evaluate performance of proposed options, adding structure to an inherently nebulous process.
 - *Evaluating key choices against an established framework allows us to identify and capture areas of uncertainty where they exist.*
- We can move to identify our desired solution, generally a solution that best meets the objectives – however the relative weighting of importance is subjective.




The primary objectives of the market design set a framework to determine success

Primary objective	Explanation & rationale
 Cost efficient provision	<ul style="list-style-type: none"> – Cost efficiency refers to the overall economic efficiency of the system¹ in this context, reducing the spend required to meet reactive power constraints on the network relative to the baseline. – In recent years costs for managing voltages on the network have increased substantially and is one of the key drivers to exploring reform options today. – Any future arrangements need to establish the framework to deliver a benefit with respect to current voltage management practices.
 Maintain voltage security	<ul style="list-style-type: none"> – The ESO is intending to procure service to comply with licence obligations to ensure a safe and reliable supply of electricity throughout the network. – This is the ultimate purpose of the market, and will be delivered through procuring a suite of reactive power products which will give the ESO the tools needed to manage the system voltage. – Whilst this is the ultimate goal, ignoring other key objectives does not constitute 'success' as solutions delivered may not provide enduring security in an evolving energy landscape.
 Zero carbon compatible	<ul style="list-style-type: none"> – National Grid ESO has committed to be able to run the system with net-zero carbon emissions in any given period should the market deliver that solution (by 2025). – With the evolving system, it would be a fallacy to design market arrangements which cannot accommodate technologies capable of delivering against this commitment. – In the context of reactive power, this means ensuring arrangements are able to cater for scalable zero-carbon solutions for providing reactive power services.

Notes: ¹It does not explicitly address which parties reap the benefits of reduced cost (i.e. the impact on producer and consumer surplus), however in the context of electricity supply it is often implied that reduced costs lead to greater consumer benefits, we have added a secondary objective to make this point explicit.




SECONDARY OBJECTIVES

Secondary objectives help to enable primary objectives, and address other key themes that don't preclude market success

Secondary objective	Explanation & rationale
 Consumer value	<ul style="list-style-type: none">– Whilst economic efficiency should be the ultimate goal of a market mechanism the distribution of value that a market is able to realise through increased efficiency is an important consideration.– The solution should promote competition between all providers (and their preferred solutions) to ensure economic potential is realised and ultimately deliver value for money for consumers.
 Transparent	<ul style="list-style-type: none">– Transparency is needed for a market to function effectively, the absence of sufficient information on which to make commercial decisions could lead to inefficient outcomes.– In the context of a reactive power market with a single buyer, there is a need to communicate needs in a way that allows market participants to understand their costs of service provision to the greatest degree possible.– Without sufficient transparency additional risk is placed on the sellers which will feed through into their bidding behaviour.
 Investible	<ul style="list-style-type: none">– The market should give investors sufficient clarity for them to recognise and manage their risks.– Risks should be borne by the party most suitably equipped to bear them, undue unknowns should not be placed on providers unless there is sufficient reward to justify these risks.– Incentives should not just target investment as a whole, but focus on rewarding the right investments to improve overall system efficiency .

SECONDARY OBJECTIVES

Secondary objectives help to enable primary objectives, and address other key themes that don't preclude market success

Secondary objective	Explanation & rationale
 Practical	<ul style="list-style-type: none">– Any market arrangements must be practical from both a buyer and sellers perspective, sharing of the burden of responsibility for dealing with unknowns (allocation of risk and corresponding rewards).– The solution itself must be deliverable from the ESO perspective, unnecessary complexity can lead to additional administrative cost burdens which can offset some benefits of implementation
 Enduring (stable)	<ul style="list-style-type: none">– The market design should be sufficiently stable for market participants to avoid unnecessary administrative burden and associated costs.– Give providers confidence in the new market arrangements that participation is meaningful and sufficiently valuable to incentivise ongoing participation (ultimately helping to promote liquidity).
 Freedom of choice	<ul style="list-style-type: none">– Freedom of choice for providers in terms of the technologies they wish to employ to participate in the market.– Freedom of choice for providers to make commercial decisions and trade off between different value streams if price signals are of sufficient magnitude and justified.– Freedom for the ESO to change arrangements should the market fail to deliver in line with other objectives and needs (e.g. tightening rules to prevent anti-competitive behaviour).

Agenda

- | | |
|--------------------------|----|
| 1. Market design process | 5 |
| 2. Scene setting | 7 |
| 3. Market objectives | 9 |
| 4. Building blocks | 14 |
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We have created 10 building blocks, each with different options. These defines the scope of the market design options (strawmen)



Timeframe

Short term vs. long term market



Contract types

Contract alternatives with different delivery obligations



Eligibility

Categorises participants eligible for payment



Pricing mechanism

How services are remunerated



Product Linking

Cover linking between leading; lagging; & dynamic products



Frequency of procurement

Defines how frequently the market is run



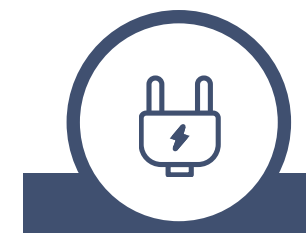
Locational requirement

Method for defining local requirements



Provider location

Defines how effectiveness factors are assessed



Availability requirement

Minimum availability requirement during the contract period



Regulatory back-stop

Principles for how to apply price caps

We have defined three products, capturing different procurement requirements

Static leading
(absorption)

Static lagging
(injection)

Dynamic



Need for absorption and injection will be different at different times, and some of this variation can be forecasted based on seasonal, weekly and daily requirement profiles. For example, you might require absorption overnight, but injection during day-peak periods. The market should seek to procure both requirements at least cost.



Enabling selling bi-directional services is captured by the building block 'product linking'

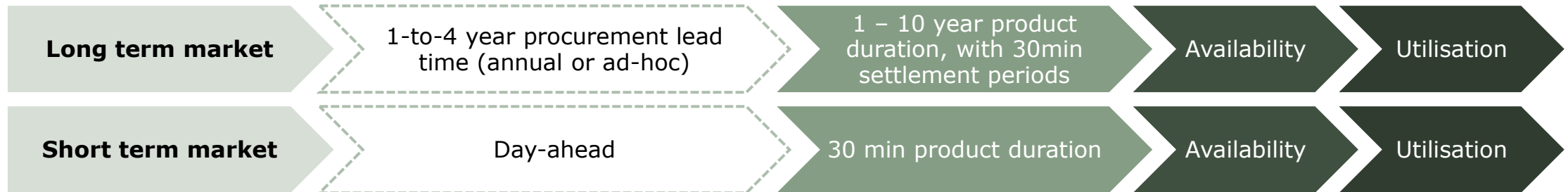
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1. Market design process	5
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TIMEFRAME

Long-term and short-term markets set the premises for the other building blocks. Main common characteristics are displayed below.



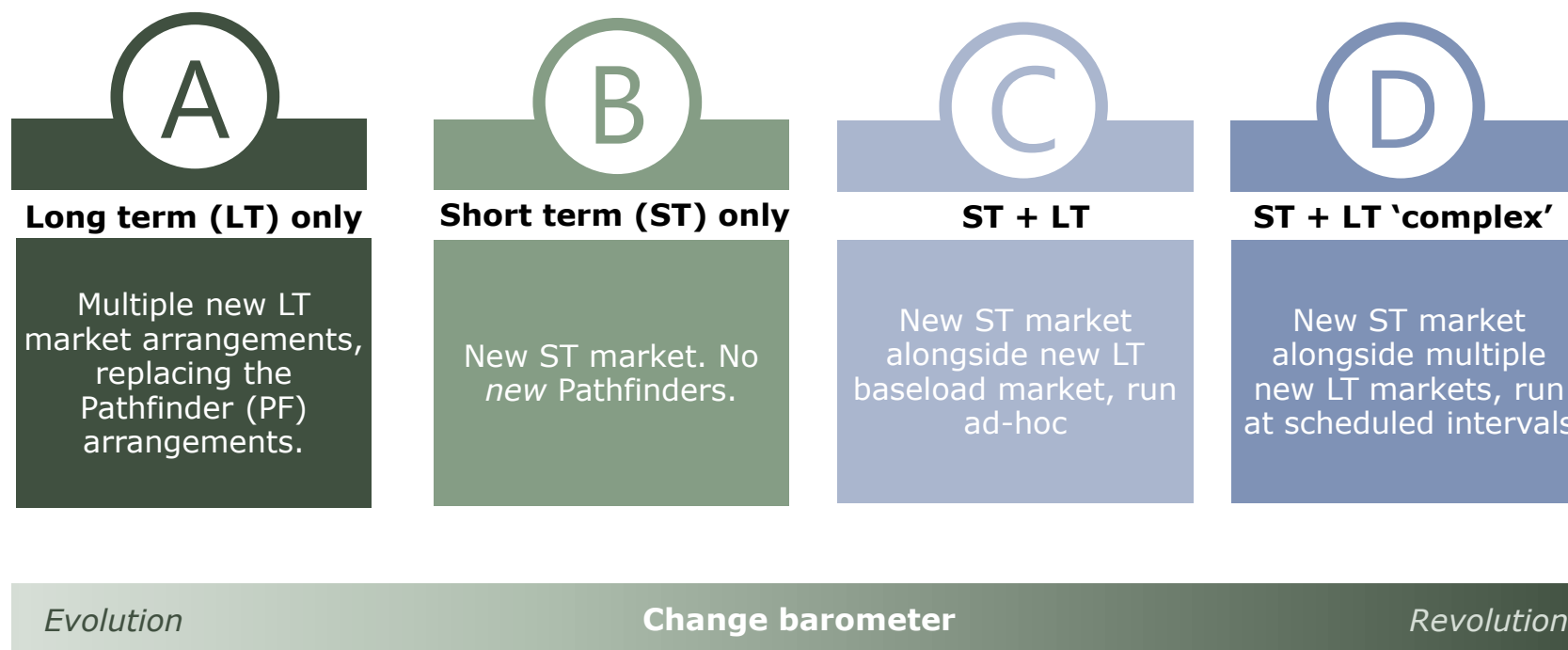
CONTRACT TYPES

Within the market timeframes we have outlined different contract types, each targeted at different needs and provider segments

			Description	Objective	Targeted segment
 Long-term	Shaped	Firm baseload	<ul style="list-style-type: none"> – Provider commits to firm availability with a high expectation of reliability throughout the contract period – Product duration e.g. 10 year baseload 	<ul style="list-style-type: none"> – Meet baseload need that <i>can</i> be forecast 	<ul style="list-style-type: none"> – Firm capacity with lowest cost of providing availability
		Firm fixed shape products	<ul style="list-style-type: none"> – Provider commits to firm availability with a high expectation of reliability throughout the contract period – Product duration e.g. seasonal or daily-peak 	<ul style="list-style-type: none"> – Meet shaped (peak) needs that <i>can</i> be forecast 	<ul style="list-style-type: none"> – Firm capacity with medium cost of providing availability
		Conditional products	<ul style="list-style-type: none"> – Committed under certain predefined conditions – E.g. when wind is blowing 	<ul style="list-style-type: none"> – Meet needs that correlates with types of variable production 	<ul style="list-style-type: none"> – Firm capacity with material cost of providing availability, which NGESO would prefer not to use baseload
		NGESO 'call options'	<ul style="list-style-type: none"> – Provider commits to availability on demand by NGESO throughout the product duration, at contracted qty and price – Provider paid only when ESO calls for availability 	<ul style="list-style-type: none"> – Meet peak needs that <i>cannot</i> be forecast 	<ul style="list-style-type: none"> – Firm capacity with high cost of providing availability, which NGESO would prefer to call only when needed
	Non-firm	Non-firm provider 'put option'	<ul style="list-style-type: none"> – Non-firm contract for availability. Provider has an option to sell its availability [day-ahead] at contracted qty and price – Provider paid only when announcing availability – <i>Requires a short-term mechanism that guarantees a payment for the volumes which the provider can (and like to) make available through a non-firm contract</i> 	<ul style="list-style-type: none"> – Incentivise incremental investment increasing overall capacity that <i>cannot</i> be forecast 	<ul style="list-style-type: none"> – Variable RES providers able to evaluate incremental investment
 Short-term		Short term (firm)	<ul style="list-style-type: none"> – Firm contracts with short procurement lead time [day-ahead] – Product duration at low granularity [e.g. 30min] 	<ul style="list-style-type: none"> – Meet short term needs, accurately, in any direction 	<ul style="list-style-type: none"> – Firm capacity with lowest cost of providing availability – Rout to market for variable RES providers – <i>Technologies switching business models on a daily basis</i>



STRAWMAN OPTIONS

4 broad design (strawman) options created based on combination of long and short timeframe; existing arrangements; and the different contract types



The combinations of timeframe and contract types outlined below. All options accommodate existing Pathfinders with Balancing Mechanism as backstop



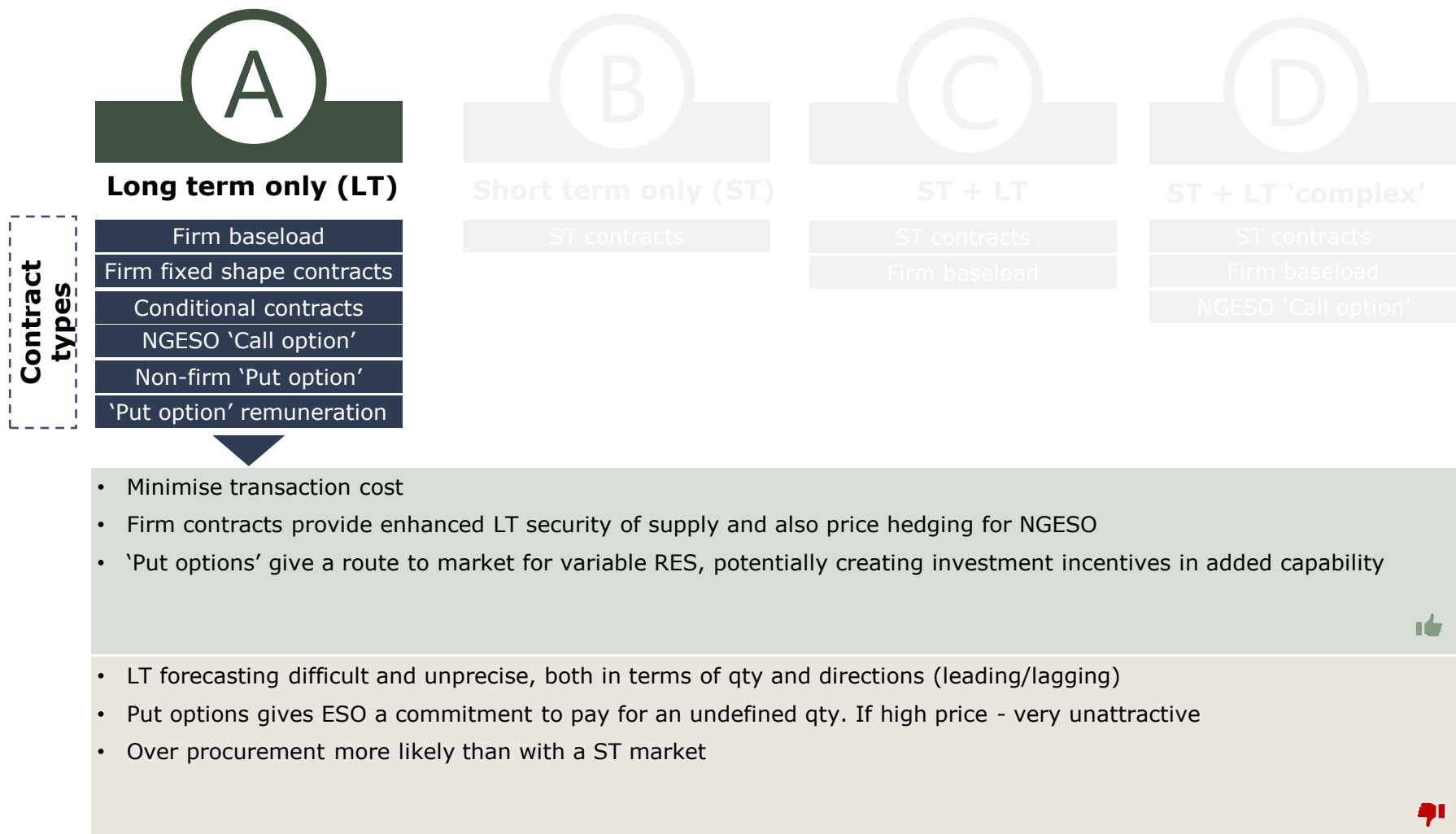
 Long-term (timeframe)	Existing PF 1,2,3	✓	✓	✓	✓
	Future PFs (ad hoc) Baseload/firm	✗	✗	✓ (?)	✗
	Firm baseload	✓	✗	✗ (?)	✓
	Firm shape products (Fixed shape products, conditional & 'Call options')	✓	✗	✗	✓
	Non-firm provider 'Put options'	✓	✗	✗	✗
 Short-term (timeframe)	ST market	✗	✓	✓	✓
	ST market requirement	✗	Gross* (net of existing PF contracts)	Shortfall	Shortfall
	BM and other ad hoc balancing services	(✓)	(✓)	(✓)	(✓)

STRAWMAN OPTIONS

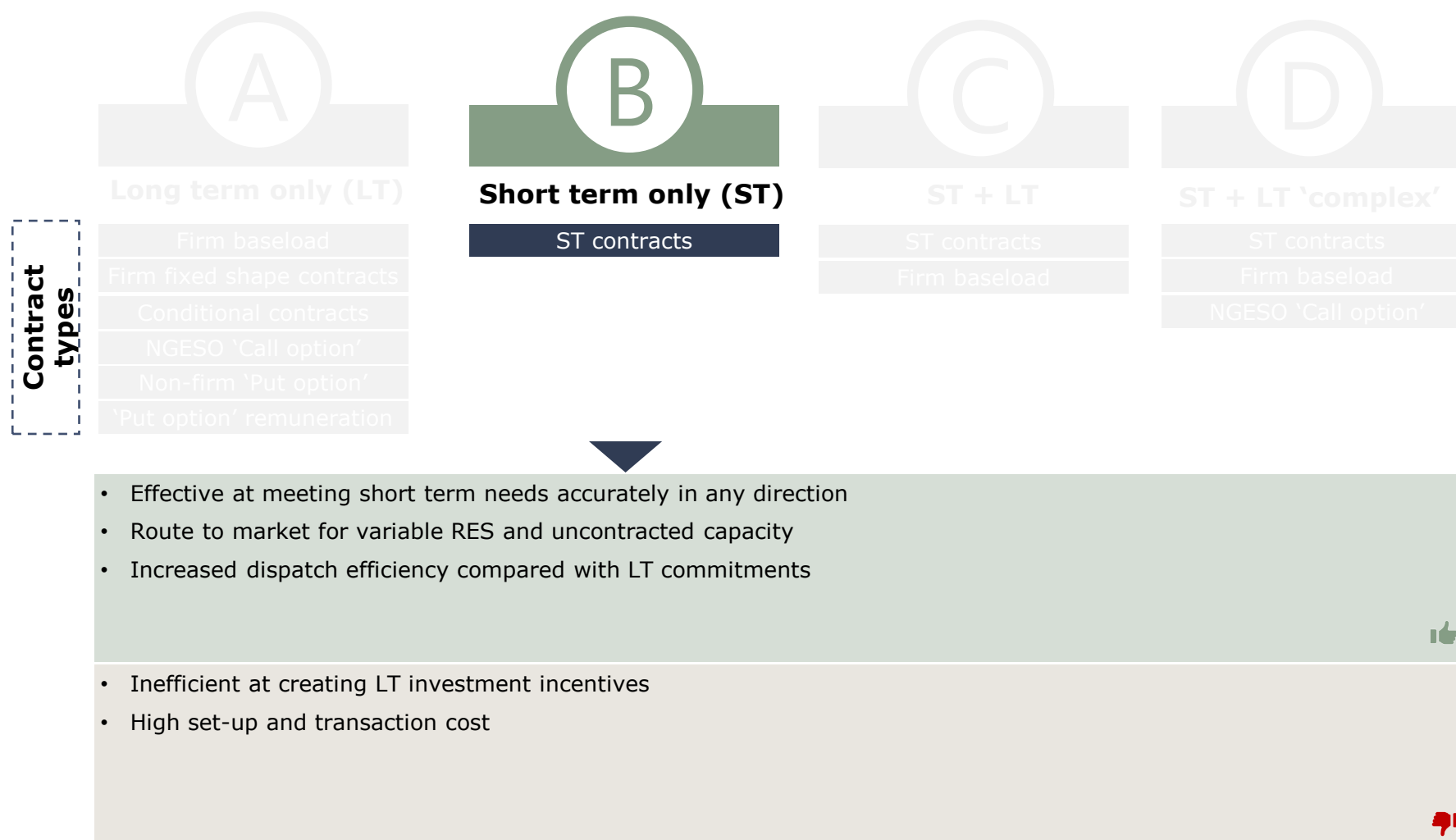
The options have different conditions providers need to meet be eligible for participation

		<div> <div>A</div> <div>Long term only (LT)</div> </div>		<div> <div>B</div> <div>Short term only (ST)</div> </div>		<div> <div>C</div> <div>LT + ST</div> </div>		<div> <div>D</div> <div>LT 'complex' + ST</div> </div>	
Eligibility	<div> <div>⚡</div> </div>								
		Incremental				LT		ST	
		Opportunistic							
		Global							
Eligible		<div> <div>Incremental</div> <ul style="list-style-type: none"> New assets/providers (beyond ORPS) Existing providers with new capability (beyond ORPS) Existing providers with uncontracted existing capacity </div>		<div> <div>Opportunistic</div> <ul style="list-style-type: none"> In general, all providers are eligible. However, NGESO discretion for awarding contracts ESO buys (expected) shortfall plus the economically desirable – incl. ORPS if it is cheaper than alternatives¹ DSO + DER²: [TBD] </div>		<div> <div>Global (Gross)</div> <ul style="list-style-type: none"> In general, all providers are eligible. Limited NGESO discretion for awarding contracts This means it also includes ORPS providers within ORPS ranges ; ORPS providers outside of ORPS ranges; non-ORPS/uncontracted providers DSO + DER²: [TBD] </div>			
		<div> <div>Excluded</div> <ul style="list-style-type: none"> TO assets and LT contract holders New and existing ORPS providers within ORPS ranges </div>		<div> <div>Excluded</div> <ul style="list-style-type: none"> TO assets and LT contract holders Uneconomic ORPS providers more expensive than BM alternatives or ORPS utilisation price </div>		<div> <div>Excluded</div> <ul style="list-style-type: none"> TO assets and LT contract holders </div>			

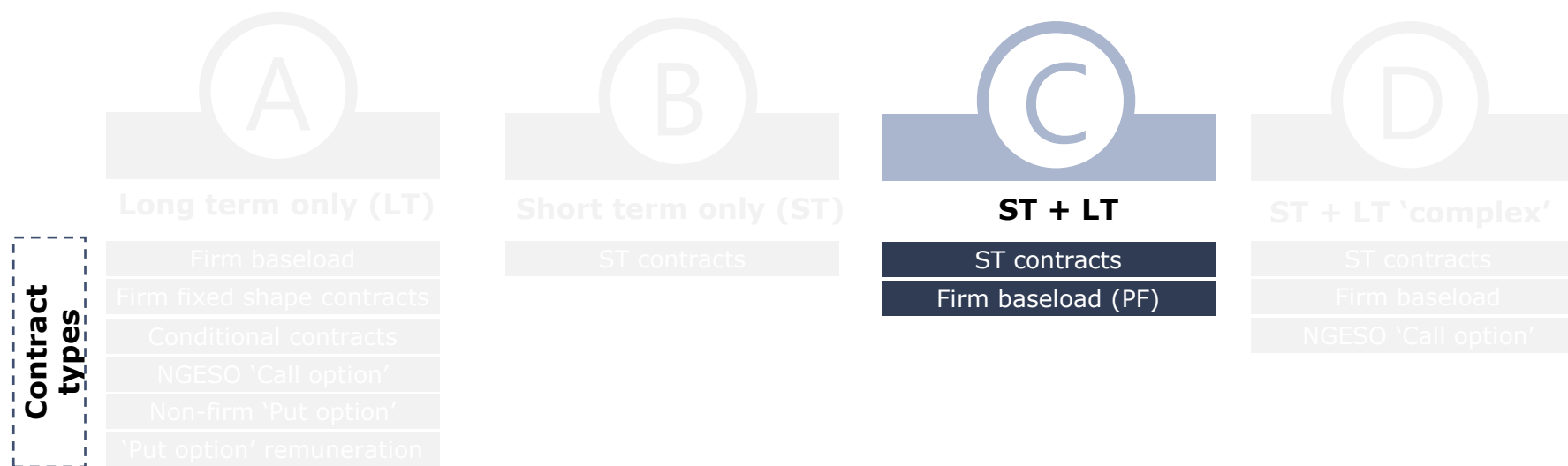
Replace pathfinders and provides multiple options for procuring reactive power long term, also providing a route to market for variable RES



'Short term only' depends on a strong confidence in future volumes and prices to incentivise new investments in the long term



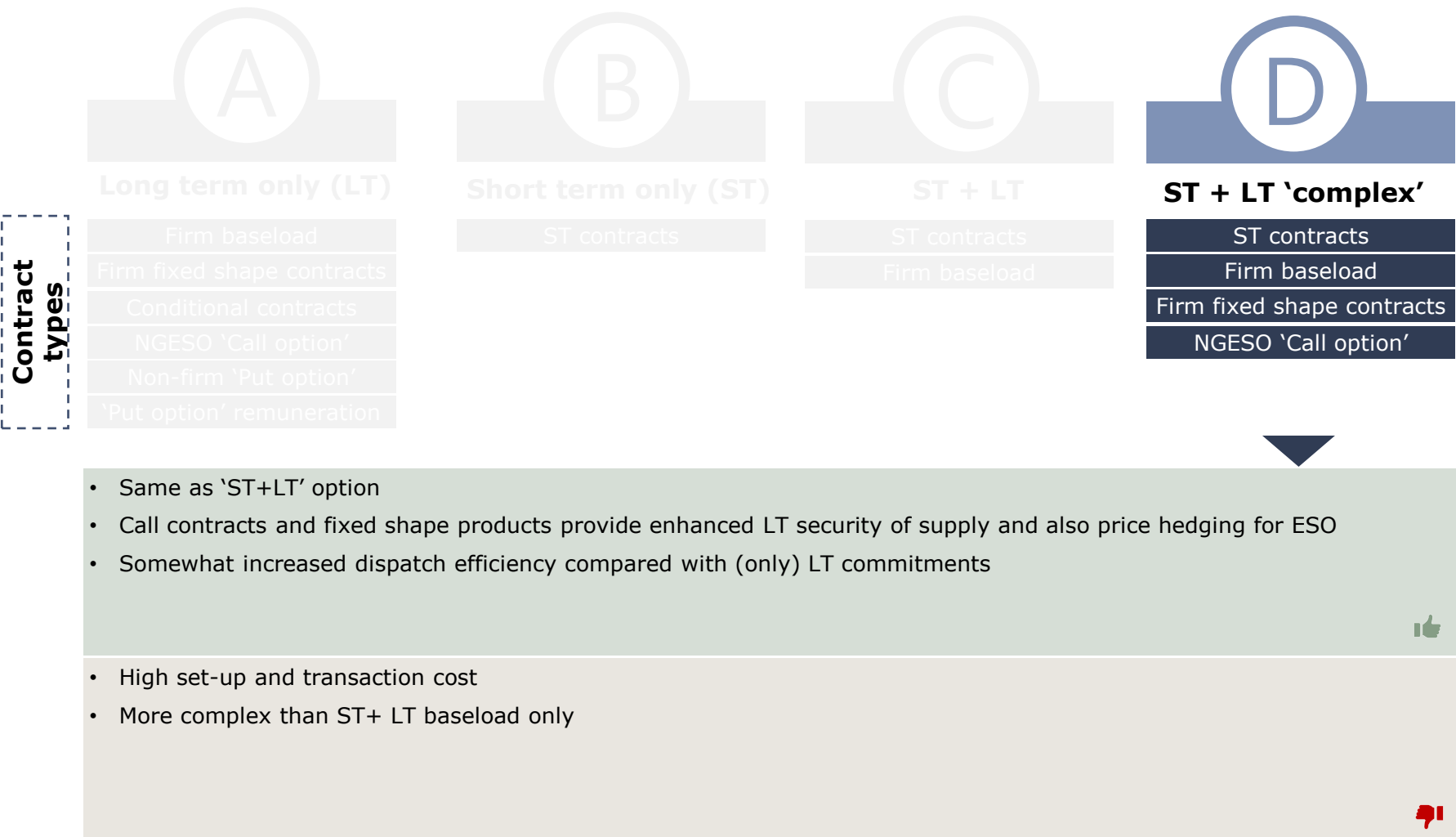
This option combines a new ST market with an ad-hoc LT market (similar to PF), bringing more focus on short term needs than today



- Firm contracts provide enhanced LT security of supply and also price hedging for ESO
- ST as route to market for variable RES and uncontracted capacity
- Balance between LT market providing baseload and ST market meeting peak requirements – decreasing tendency for over procurement
- Somewhat increased dispatch efficiency compared with (only) LT commitments
- High set-up and transaction cost

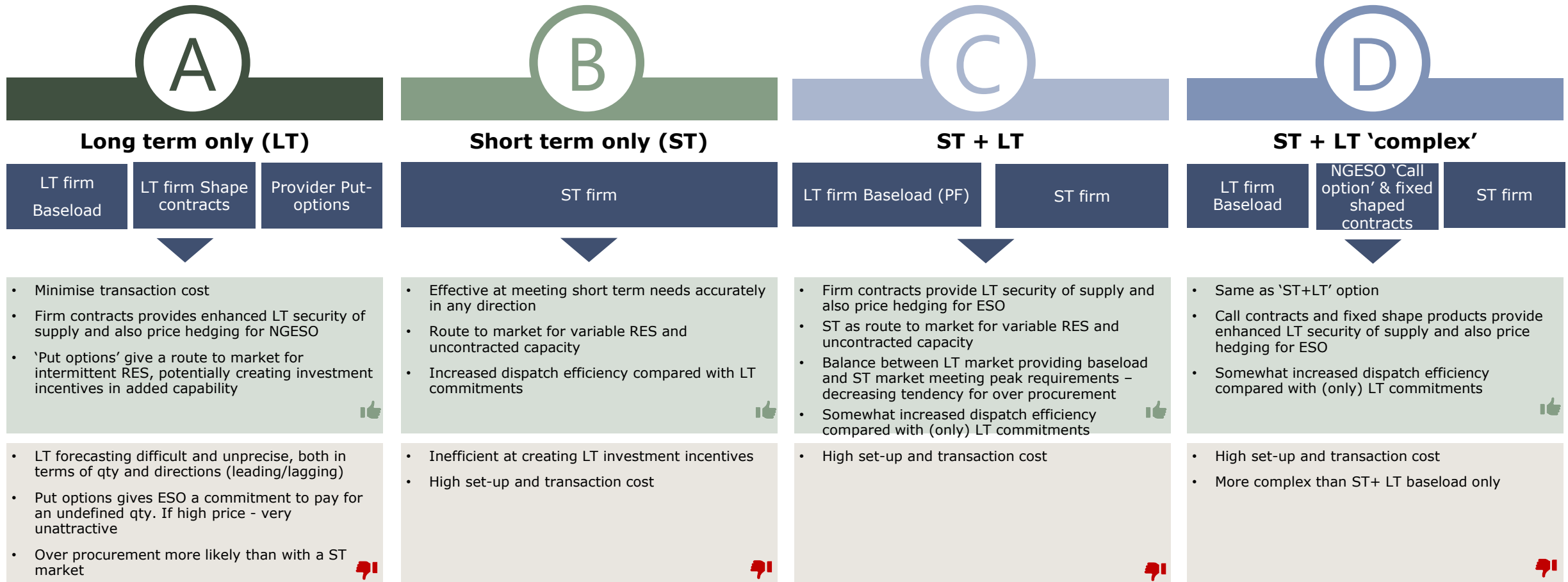


Introduces multiple annual LT procurement opportunities, in addition to a ST market



SUMMARY

'Long term only' and 'Short term only' markets meet different purposes and have obvious limitations. Hybrids are more complex/expensive to operate



On the next slides we have applied remaining essential building blocks to each of the options



Long term only (LT)

Pricing mechanism

Availability

- General: Pay-as-bid
- General: Payment £/MVar/SP
- 'Call options':
 - Additional option premium
 - Paid only when ESO calls for availability
- Non-firm: Paid only when provider announces availability [e.g. day-ahead]

Utilisation (TBD)

- Variant 1: No utilisation
- Variant 2: Utilisation (self-bid, Pay as Bid)
- Variant 3: Utilisation (ORPS or regulated)



Contracts types

Firm Baseload

- *Penalties: Non-payment, becoming more 'penal' below availability requirement*

Firm fixed shape products

- *Penalties: Non-payment, becoming more 'penal' below availability requirement*

Conditional products

- *Penalties: Non-payment, becoming more 'penal' below availability requirement*

NGESO 'Call option'

- *Penalties: Sharp 'penalty' price as this is a 'peak' requirement*

Non-firm provider 'Put-option'

- *Penalties: Non-payment*

General penalty principles: Contract termination for sustained non-performance

Frequency of procurement

National annually procurement



Product types

- Static leading
- Static lagging
- Dynamic



Product linking

Yes, between product types, with *no* obligation to provide bi-directional

Participants are allowed to submit orders with different leading and lagging quantity



Regulatory back-stop

TO owned asset solution depreciated over [10y horizon]



Locational requirement

- One or multiple reference node per region (TBD)



Provider location

- Effectiveness factor defined individually per asset (could also be zonal, TBD)
- Effectiveness factor adjusted to represent least cost solution
- Effectiveness factor fixed at point of contracting for the whole product duration

Availability requirement

Firm products: High [e.g. 95%]

Non-firm 'Put option': No commitment, just incentive based, until provider has declared availability. Then high [e.g. 95%]



Short term only (ST)

Pricing mechanism

£/MVar/SP availability payment
£/MVarh utilisation payment

- Availability and utilisation (two-part bid, pay as bid)



Contract types

ST

- Firm penalty for non-delivery of declared availability (beyond non-payment [strong fixed penalty agreed price * X or agreed price + X]).
- [Under pricing mechanism 'variant 3', repeat offenders may face the same consequences that ORPS providers are exposed to today (i.e. 20% payment for utilisation until reliability is proved through current processes)]

Products types

- Static leading
- Static lagging
- Dynamic



Locational requirement

- One or multiple reference node per zone/region (TBD)



Product linking

Yes, linking between product types, with *no* obligation to provide bi-directional

Participants are allowed to submit orders with different leading and lagging quantity



Provider location

- Effectiveness factor defined individually per asset (could also be zonal, TBD)
- Effectiveness factor adjusted to represent least cost solution
- Dynamic effectiveness – changing frequently, to reflect changes towards reference node

Frequency of procurement

National daily procurement for next day



Regulatory back-stop

Balancing mechanism, i.e. alternative BM cost



Availability requirement

- Self-declared availability (firm) per market time unit
- Failing to deliver declared availability/utilisation results in facing non-performance process

STRAWMAN OPTIONS



ST + LT

Pricing mechanism

LT:

- Availability only, with *no* utilisation payment
- Pay as bid
- £/MVar/SP availability payment

ST:

£/MVar/SP availability payment
£/MVarh utilisation payment

- Availability and utilisation (two part bid, pay-as-bid)



Contract types

Firm Baseload

- *Penalties: Non-payment, becoming more 'penal' below availability requirement*
- Contract termination for sustained non-performance

ST:

- Firm penalty for non-delivery of declared availability (beyond non-payment [strong fixed penalty agreed price * X or agreed price + X])

Products types

- Static leading
- Static lagging
- Dynamic



Locational requirement

One or multiple reference node per region (TBD)



Product linking

Yes, between product types, with *no* obligation to provide bi-directional

Participants are allowed to submit orders with different leading and lagging quantity



Provider location

- Effectiveness factor defined individually per asset (could also be zonal, TBD)
- Effectiveness factor adjusted to represent least cost solution
- **LT:** Effectiveness factor fixed at point of contracting for the whole product duration
- **ST:** Dynamic effectiveness – changing frequently, to reflect changes towards reference node

Frequency of procurement

LT: Regional procurement, ad-hoc

ST: National daily procurement for next day



Regulatory back-stop

- **LT:** TO owned asset solution depreciated over [10y] horizon
- **ST:** Balancing mechanism, i.e. alternative BM cost

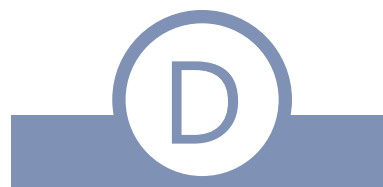


Availability requirement

- **LT:** High [e.g. 95%]
- **ST:** Self-declared availability (firm) per market time unit

Failing to deliver (declared) availability/utilisation results in facing non-performance process

STRAWMAN OPTIONS



ST + LT 'complex'

Pricing mechanism

LT:

- Availability only, with no utilisation payment
- Pay as bid
- £/MVar/SP availability payment
- 'Call options':
 - Additional option premium
 - Paid only when ESO calls for availability

ST:

£/MVar/SP availability payment
£/MVarh utilisation payment

- Availability and utilisation (two part bid, pay-as-bid)



Contract types

LT Firm Baseload

- *Penalties: Non-payment, becoming more 'penal' below availability requirement*

LT fixed shape

- *Penalties: Non-payment, becoming more 'penal' below availability requirement*

LT NGESO 'call options'

- *Penalties: Sharp 'penalty' price as this is a 'peak' requirement*

ST

- Penalties: Firm 'penalty' for non-delivery of declared availability (beyond non-payment [strong fixed penalty agreed price * X or agreed price + X])

General penalty principles: Contract termination for sustained non-performance

Frequency of procurement

LT: National annual procurement

ST: National daily procurement for next day



Products types

- Static leading
- Static lagging
- Dynamic



Product linking

Yes, between product types, with *no* obligation to provide bi-directional

Participants are allowed to submit orders with different leading and lagging quantity



Regulatory back-stop

- **LT:** TO owned asset solution depreciated over [10y] horizon
- **ST:** Balancing mechanism, i.e. alternative BM cost



Locational requirement

One or multiple reference node per region (TBD)



Provider location

- Effectiveness factor defined individually per asset (could also be zonal, TBD)
- Effectiveness factor adjusted to represent least cost solution
- **LT:** Effectiveness factor fixed at point of contracting for the whole product duration
- **ST:** Dynamic effectiveness – changing frequently, to reflect changes towards reference node

Availability requirement

- **LT:** High [e.g. 95%]
- **ST:** Self-declared availability (firm) per market time unit

Failing to deliver (declared) availability/utilisation results in facing non-performance process

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3. Market objectives	9
4. Building blocks	14
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NEXT STEPS

Once we have decided on the 4 strawman options, we will assess them against the market objectives and select one strawman that will be foundation for an e2e solution

