# National Grid ESO Stability Market: Stage II – WP1-2

9th January 2023

FINALISATION OF WP1 AND FIRST DISCUSSION OF WP2 QUESTIONS

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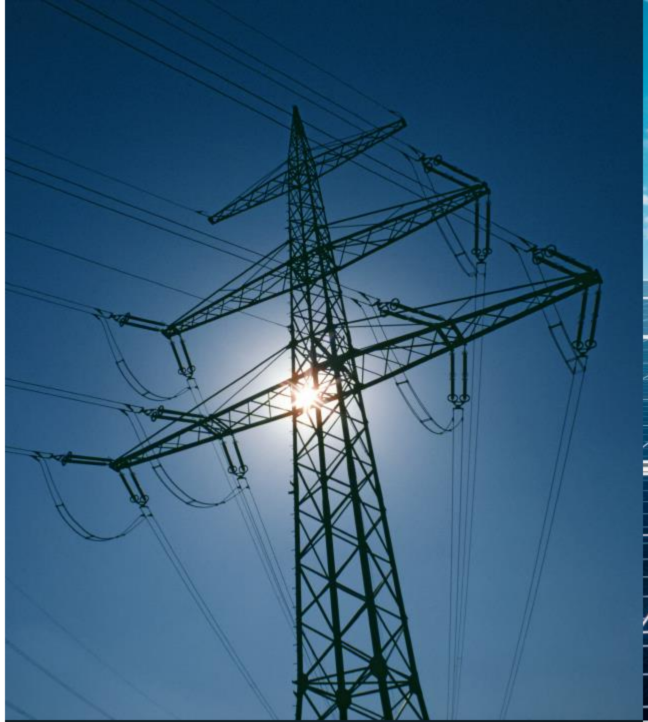
# Agenda






# From WP1 we will discuss possible selective payment models for the ST market

WP1

| Topics | Exam Questions | |
|---|---|---|
| **1. TOs' involvement** | *1.a What are the key considerations for treatment of the TO assets?* | *1.b What is the role of the TO in the LT market?* |
| **2. Eligibility rules** | *2.a Can existing capability enter the LT market?* | **Focus of this meeting** *2.b How do we enforce the selective eligibility for the ST market? Open to all providers? Are there unintended consequences?* |

TO: Transmission Owner; LT: Long-Term; ST: Short-Term; WP: Work Package



**Legend** *Answered* *To be finalised*

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# From WP2 we will discuss possible approaches to assess the depreciation of TO assets and participation of OFTOs/ICs and expired RAB assets

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?* | | | |

**Focus of this meeting**

From WP1 - not addressed yet

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



**Legend** ~ *To be finalised* ⊗ *Pending*

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# Agenda



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# Outcomes from project Phase 1 and feedback from the industry suggested to investigate and evaluate possible selective payment approaches for ST

## Outcomes from Phase 1

- AFRY modelling carried out during Project Phase 1 suggested significant extra costs if stability products are procured on a 'gross' basis, rather than using more selective eligibility criteria which compensates only plants willing to change their behaviour
- Hence, we opted to pursue a selective payment approach in order to avoid windfall gains for existing plants and to minimise costs for consumers whilst sending the appropriate signals to incentivise valuable service provision

## Feedback from the industry

- Results from Phase 1 did not provide conclusive indications on which plants are expected to make windfall gains
- Hence, during the last Expert Group session[1], AFRY and ESO presented several selection payment methods, based on D-1 indications, from which ESO can determine whether a unit is changing its behaviour or is anyway intended to provide stability not only as a by-product of its generation
- Such methodology will have to limit windfall gains, ensure technology neutrality, and be simple to understand and implement

## Proposal and appraisal of selection models

- Following the first Expert Group session, additional selection models have been investigated, each of them approaching the issue from different angles
- The most feasible models have been filtered and final recommendations provided

1. Held on 20th September 2022 | ST: Short-Term

# The selection of units eligible for stability payment can be undertaken through different working models…

| Core models | Sub models | Approaches for indication of intention: *Synch. generation units* | Approaches for indication of intention: *Synch. 0 MW, non-synch.[1] generation/storage units* |
|---|---|---|---|
| **1. 'D-1 indication by ESO/units'** | 1.a 'ESO forecast' | Based on D-1 ESO forecasts, exclusion of units that would anyway generate and so provide stability as by-product | No indication needed - always eligible as assumed to not otherwise offer stability unless contracted |
| | 1.b 'PN/self-declaration by unit' | Selection of only units providing PN=0 (or through self-declaration that unit does not intend to generate) | |
| **2. 'Segmented eligibility'** | | Exclusion of 'baseload' units, defined by ESO as e.g. those with a historical pattern of synchronised operating hours higher than e.g. 80% in the relevant season | No indication needed - always eligible as assumed to not otherwise offer stability unless contracted |
| **3. 'Focus on 0MW synch. gen.'** | 3.a 'Commitment to submit FPN=0MW' | Eligibility restricted to units with capability to provide 0MW service (e.g. equipped with clutch) and committed to offer FPN=0MW[2] | No indication needed - always eligible as assumed to not otherwise offer stability unless contracted |
| | 3.b 'Option to forego payment' | Eligibility restricted to units with capability to provide 0MW service (e.g. equipped with clutch). In case units offer FPN>0MW, they are forced to forego stability revenues[2] | |
| | 3.c 'No need to forego payment' | As per model 1.b (PN=0 or self-declaration), but units do not forego stability payment if they end up providing energy in the ID market | |
| | 3.d 'Gross procurement' | Gross procurement of resources, but payment for stability restricted only to those units offering FPN=0 (e.g. being equipped with clutch)[2] | |

1. Equipped with grid-forming; 2. Exception if instructed by ESO to generate | PN: Physical Notification; FPN: Final Physical Notification; ID: Intraday; ST: Short-Term

*2.b How do we enforce the selective eligibility for the ST market? Open to all providers? Are there unintended consequences?*

***2. Eligibility rules***



# …of which the potentially feasible options have been further investigated

| Core models | Sub models | Relevant considerations and feasibility of models |
|---|---|---|
| **1. 'D-1 indication by ESO/units'** | 1.a 'ESO forecast' | – According to ESO control room, too complex to forecast synch. gen. plants expected to anyway generate on a unit-by-unit basis<br>– ESO forecast might be seen by providers as not transparent and methodology questionable - not comfortable position for ESO |
| | 1.b 'PN/self-declaration by unit' | – Improved model compared to 1.a as eligibility is self-determined by units and not by specific ESO forecast<br>– PN/self-declaration might be open to gaming, making it complex to determine units anyway intended to generate |
| **2. 'Segmented eligibility'** | | – In principle, if applied on a single-unit basis, the model could avoid discrimination based on technology<br>– Identification of 'baseload' plants considers historical behaviours[1] and need to be updated periodically<br>– 'Baseload' definition[2], does not fully prevent from having units making windfall gains |
| **3. 'Focus on 0MW synch. gen.'** | 3.a 'Commitment to submit FPN=0MW' | – Commitment not to sell energy for synch. units (FPN=0)[3]<br>– Participation rules excludes most out-of-merit CCGTs (i.e. the intended target for the ST market)<br>– Model sterilises contracted capacity from ID trading |
| | 3.b 'Option to forego payment' | – Provides higher flexibility to synch. units to choose between stability or ID markets, compared to model 3.a<br>– Synch. units provide more inertia when generating[4]: why should they be excluded from payment if FPN>0MW?<br>– Opportunity cost of foregoing the stability payment might distort ID market |
| | 3.c 'No need to forego payment' | – Leads to less distortions in ID market compared to 3.b<br>– However, this model might open to gaming and not be efficient as units will receive both stability and ID payments when generating (FPN>0) |
| | 3.d 'Gross procurement' | – No reasons for generators who intend to produce energy to participate in the ST market, as they do not see risk of over-procurement<br>– Effectively payment is still restricted to units providing 0MW and non-synch. generation so not better than models 3.a and 3.b |

1. e.g. previous 5 years; 2. e.g. 80% of annual h in the relevant season; 3. Unless otherwise instructed by ESO; 4. Rather than in clutched mode. Issue addressable if units can keep the stability payment if instructed by ESO to generate | PN: Physical Notification; ST: Short-Term; ID: Intraday; BM: Balancing Market; FPN: Final Physical Notification; CCGT: Combined-Cycle Gas Turbine



***Legend*** *Feasible* *Not feasible* *Not in scope (non/partial market option)*

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2.b How do we enforce the selective eligibility for the ST market? Open to all providers? Are there unintended consequences?

**2. Eligibility rules**

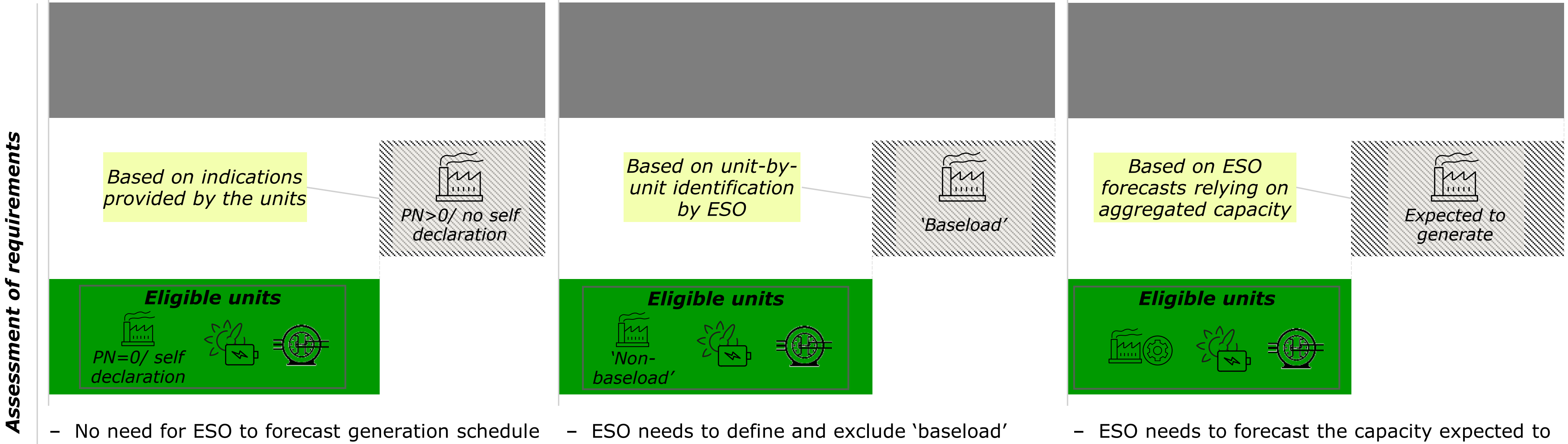


# Model 3.b still necessitates ESO to forecast net requirements, while models 1.b and 2 rely on indications provided by units or historical evaluations

ILLUSTRATIVE

## FORECAST REQUIREMENT PROCESS

| 1.b 'PN/self-declaration by unit' | 2. 'Segmented eligibility' | 3.b 'Option to forego payment' |
|---|---|---|




**1.b 'PN/self-declaration by unit'**

- No need for ESO to forecast generation schedule on D-1 basis (for the purpose of determining eligibility) as the eligibility criteria rely on PN/self declaration information provided by the units, which are also used to assess the net requirements

**2. 'Segmented eligibility'**

- ESO needs to define and exclude 'baseload' units to determine net requirements
- Excluded capacity depends on the definition of 'baseload' plants provided by ESO
- All other units are eligible, and forecasts requirement is net only of baseload generation

**3.b 'Option to forego payment'**

- ESO needs to forecast the capacity expected to generate to determine the net requirements
- Only 0 MW capable synch. units and (all) non-synch. units[1] are ultimately eligible
- ESO must take a view on synch. generation contribution to understand net requirements

1. Equipped with grid forming | PN: Physical Notification



# Based on the combination of efficiency, competition level and applicability criteria, 3.b might be the preferred model of the assessed options

**COMPARISON OF SHORTLISTED OPTIONS**

| *Criteria of comparison* | 1.b 'PN/self-declaration by unit' | 2. 'Segmented eligibility' | 3.b 'Option to forego payment' (Preferred model) |
|---|---|---|---|
| **Efficiency** - minimising costs for consumers | Low<br>– D-1 indication system opens for opportunities of gaming by units<br>– This risks to incentivise participants to submit inaccurate PNs (i.e. PN=0, when they intend to generate, to access revenues from stability) | Medium<br>– The definition of 'baseload' units (e.g. those generating > 80% of annual h in the relevant season) will not fully prevent other 'non baseload' (e.g. CCGTs) units from having the potential to make windfall gains | Medium/High<br>– Reduce the amount of units potentially making windfall gains (i.e. by not rewarding synch. units without clutches)<br>– However, it might create distortions in ID market, as cost opportunity from stability ST market might reduce participation of units in ID |
| **Competition level** - opening to wide range of players | High<br>– Market potentially open to all type of technologies | Low<br>– Implicitly discriminates by technologies, based on level of generation | Medium/High<br>– Market excludes participation of synch. units without clutches (effectively, existing synch. plants)<br>– Option to increase competition in ST: allowing synch. units to finance clutches through LT/MT contracts and cover variable costs through ST market |
| **Simplicity** - ease of implementation | High<br>– Based on information provided by units (i.e. PN/self-declaration) | High<br>– Easy to implement as model relies on historical data | Medium/High<br>– Based on information provided by units (i.e. FPN)<br>– However, FPN verification process[1] and settlement add an additional level of complexity for ESO |

1. i.e. Checking those units with FPN>0 and forcing them to forego the payment | PN: Physical notification; FPN: Final Physical Notification; LT: Long-Term; MT: Mid-Term; ST: Short-Term; ID: Intra-Day; CCGT: Combined-Cycle Gas Turbine



**Legend** *Level:* *High* *Medium* *Low* Preferred model

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# An appropriate signal is required to accelerate the uptake of grid-forming capability: this may be a mandatory obligation on non-synchronous plant to install capability for stability services, dispatched via a market mechanism

- Synchronous generators naturally have the inherent capability to offer and provide stability services to the grid.
- Traditionally, non-synchronous generators are grid-following and do not inherently provide stability.
- However, the development of Grid-Forming (GFM) convertors offers the potential for non-synchronous generators to provide stability services.

- There are few examples of stability-capable non-synchronous assets in operation currently, so there needs to be a stronger signal to encourage this equipment to be installed.
- This signal could be provided via a market mechanism (e.g. a long-term market), through code obligations to install the appropriate capability or other avenues.
- The direction on this will have an impact on the ST stability market.

ENTSO-E has recently published their intentions to explore this topic via the Requirements for Generators 2.0 consultation. We expect they will strongly consider the case for mandatory service capability with dispatch via a market mechanism.

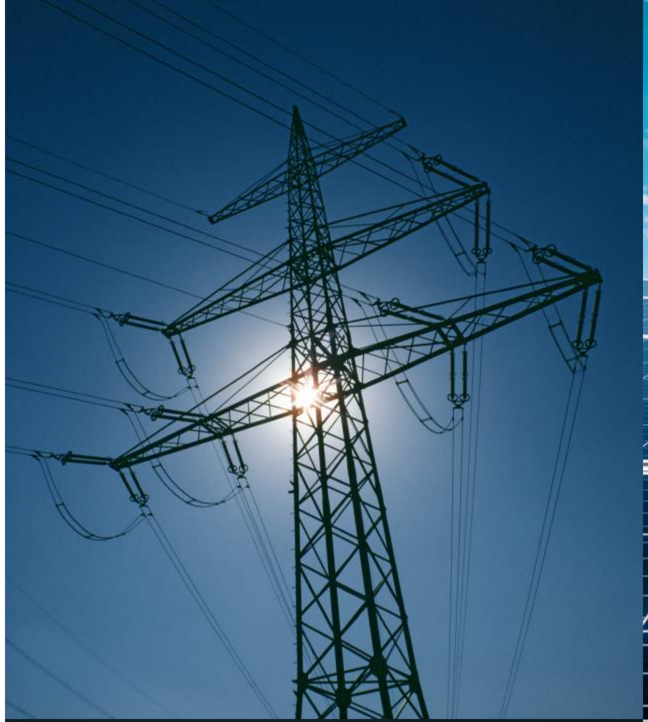
Other jurisdictions (e.g. Australian Energy Market) also have alternative approaches to delivering stability-capable assets from non-synchronous technologies which we are observing.

- ESO does not have a formal position on this at the moment but it is a key topic to explore alongside industry to understand the merits and drawbacks of utilising mandatory code obligations to accelerate the growth of stability-capable assets.
- This will be discussed further outside the scope of this phase of the Stability Market Design NIA project but we wanted to highlight it here as a point of note.

GFM: Grid-Forming; ST: Short-Term

# Agenda





# Agenda



# The Pathfinder methodology risks overpricing the TO counterfactual by assuming the full cost of the TO asset over the tender period

## TO counterfactuals

TO's submission

*Capital costs:* m£, Nominal money

**1. Annuities calculation:** constant amount of nominal revenues to recover costs in 40y at interest rate equal to TO WACC

**2. Depreciation:** annuities are depreciated following Treasury Green Book guidelines – DF=3.5% for the first years 0-30, DF=3.0% afterwards

Assessment ESO

**Illustrative example**

Capital costs: 10m£, WACC: 2.93%, Asset life: 40y → Annuity: 428k£/y

| Year | DF | DR | Annuity | Present value (PV) |
|---|---|---|---|---|
| 0 | 3.5% | 100.0% | 428k£ | 428k£ |
| … | … | … | … | … |
| 10 | 3.5% | 70.9% | 428k£ | 303k£ |
| … | … | … | … | … |
| 31 | 3.0% | 34.6% | 428k£ | 148k£ |
| … | … | … | … | … |
| 39 | 3.0% | 27.3% | 428k£ | 117k£ |

Hp: TO asset connected at Year 0 → Total PV = $\sum_{y=0}^{39} PV_y$ = 9.5 m£

### RECAP POINTS

- In WP1 and EG1 we recommended that the counterfactual regime should be the enduring approach
- We want to ensure a level playing field between commercial providers and TO assets to account for the fact that commercial providers could bid in some residual value as part of their submission

### CONSIDERATIONS ON CURRENT COUNTERFACTUAL METHODOLOGY

- Total costs are fully depreciated over the tender period, far shorter than the economic/technical lifetime of the TO asset
- This approach does not account for future capabilities of TO assets and the need for grid services beyond the tender period
- As commercial providers likely consider a residual value within their offers, TO assets are disadvantaged, at a cost to the consumer
- The discounted annuities after the tender period make up approximately 60% of the total Present Value (assuming 10y tender period)

Source: National Grid ESO | 1. Likely applying a DF higher than the one indicated by the Treasury Green Book (i.e. 3.5%) | TO: Transmission Owner; WACC: Weighted Average Cost of Capital; DF: Discount Factor; DR: Discount Rate; RV: Residual Value; PV: Present Value Hp: Hypothesis; RAB: Regulated Asset Base

POSSIBLE DEPRECIATION MODELS: HIGH LEVEL DESCRIPTION

# We have examined different models to compare the TO counterfactual against commercial offers to try and improve on the Pathfinder approach

| | Models | Description: TO counterfactual | Description: Commercial providers | |
|---|---|---|---|---|
| *The Pathfinder assessment methodology can be improved…* | **1. '*The Pathfinder evaluation*'** | – The total cost of TO counterfactual is depreciated over the tender period, without accounting for any RV after that | – Commercial providers may (implicitly) consider a residual value within their contract price | |
| *…ESO could assume a RV for the TO counterfactual…* | **2. '*Asset lifetime*'** | – TO assets assumed to be useful (i.e. in service, and needed by ESO) over the entire economic lifetime. The residual value is proportional to the residual lifetime after the tender period[1] | – Commercial providers may (implicitly) consider a residual value within their contract price | *Already investi-gated by ESO* |
| | **3. '*Fixed residual value for TOs*'** | – ESO assumes a residual value, based on expected need/capability of TO assets to provide services[2] after the tender period, which is used to markdown the TO counterfactual | – Commercial providers may (implicitly) consider a residual value within their contract price | |
| *…or adjust the commercial offer so depreciation is assessed over a more equal period of time.* | **4. '*Offered residual value*'** | – The total cost of TO counterfactual is depreciated over the tender period, without accounting for any RV after that | – Alongside contract price, comm. prov. offer and compete for a residual value as well. ESO has option/obligation (TBC) to trigger asset auction or extend the contract by the RV | *New models proposed* |
| | **5. '*Forced zero residual value*'** | – The total cost of TO counterfactual is depreciated over the tender period, without accounting for any RV after that | – ESO has option/obligation (TBC) to trigger asset auction or extend the contract to cover marginal cost only - commercial providers forced to assume zero residual value within their offers | |
| | **6. '*Pathfinder, but longer contracts*'** | – Same as '*The Pathfinder approach*', but assessment considers longer tender period (e.g. 20 years vs. current 10 years of Pathfinder) | – Same as '*The Pathfinder approach*', but assessment and contracts consider longer tender period (e.g. 20 years vs. current 10 years of Pathfinder) | |

1. e.g. considering a lifetime of 40y and a tender period of 10y (LT contract length), 25% of costs will be included in the counterfactual, while remaining 75% in the residual value; 2. Stability and other ancillary services | TO: Transmission Owner; RV: Residual Value

# ESO desires to investigate Model 3, which would ideally increase competition (benefitting the consumers), but requires to calculate a RV for TO assets

| Models | | Consumers | | NG ESO | | Transmission Operators | | Commercial providers |
|---|---|---|---|---|---|---|---|---|
| **1. 'The Pathfinder evaluation'** (shortlisted) | Negative | – Comm. solutions might be awarded even when not the cheapest (as compared with lifetime cost of TO solution) | Positive | – No RV to be calculated<br>– No view on costs for services after tender period | Negative | – Full depreciation of TO assets in the counterfactual represent a disadvantage for TOs | Positive | – Low competitive pressure form TO counterfactual gives commercial providers a competitive advantage |
| **2. 'Asset lifetime'** | Negative | – Counterfactual likely too low as assumes TO assets valuable for entire life[2] – consumers bear the cost/risk of this assumption | Positive | – Simple approach to calculate RV<br>– No view on costs for services after tender period | Positive | – Constant depreciation makes TO assets more competitive | Negative | – Extremely high competitive pressure from the TO counterfactual |
| **3. 'Fixed residual value for TOs'** (shortlisted; Option to further investigate according to ESO) | Positive | – Competitive pressure set by RV would reduce costs<br>– Consumers bear risk of RV to reflect situation after tender period | Balanced pros/cons | – Complex to calculate RV based on expectation of grid services in the future | Positive | – RV makes TO assets more competitive | Balanced pros/cons | – Higher competitive pressure from TO counterfactual<br>– No change of pricing strategy compared to Pathfinder |
| **4. 'Offered residual value'** | Positive | – Possibility to hedge costs through ESO option/obligation<br>– Cap of gains of comm. prov.<br>– No severe front payments within tender period | Balanced pros/cons | – No RV to be calculated<br>– Administrative burden to extract RV at contract expiry | Positive | – Commercial offer assessed on the same timeline of the counterfactual | Balanced pros/cons | – Higher competitive pressure from TO counterfactual<br>– More complex tendering process |
| **5. 'Forced zero residual value'** | Balanced pros/cons | – Avoids windfall gains<br>– Consumers bear whole contract costs in tender period | Balanced pros/cons | – No RV to be calculated<br>– Administrative burden to extract RV at contract expiry | Positive | – Commercial offer assessed on the same timeline of the counterfactual | Balanced pros/cons | – Higher competitive pressure from TO counterfactual<br>– Free from risks after contract expiry, but no chances to extract extra value from asset[3] |
| **6. 'Pathfinder, but longer contracts'** (shortlisted) | Balanced pros/cons | – Lower risk of windfall gains in case of contract renewal, but at the same time higher risk to pay for stranded assets in future | Balanced pros/cons | – Lower administrative burden as resources are contracted for longer time[4]<br>– Complex to forecast need for services for longer periods | Positive | – Commercial offer assessed on timeline closer to the counterfactual's compared to model 1 | Balanced pros/cons | – Lower commercial risks with longer contract<br>– Higher competitive pressure from the TO count. Compared to model 1 |

1. Effectively loosing the regulated WACC advantage; 2. Which realistically may not be the case; 3. As ESO would likely auction the asset in case perceives any value left; 4. Less need to extend contracts after tender period | TO: Transmission Owner; RV: Residual Value; mgmt.: management



***Legend*** *Overall impact:* *Positive* *Balanced pros/cons* *Negative* *Shortlisted models*

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POSSIBLE DEPRECIATION MODELS: DEEP DIVE OF MODEL 3

# The depreciation model needs to ensure target objectives such as fairness of the appraisal, matching expense with use of service and payment efficiency

## TARGET OBJECTIVES OF THE DEPRECIATION MODEL

### FAIR APPRAISAL BETWEEN TO AND COMMERCIAL ASSETS

- TO counterfactual and commercial bids have to reflect costs related to the same timeframe (i.e. the tender period)
- Assuming assets to be needed even after the tender period, TOs and commercial providers would have to consider a RV, reflecting the period of time between the end of tender and usefulness periods

### CUSTOMERS PAYING WHEN RECEIVING THE SERVICE

- Costs for stability, and other services after the tender period, should be paid by consumers over the periods when such services are actually required by the system (and provided by assets)
- This would apply only on commercial assets (which recover their costs during the contract period), as TO asset will anyway have to recover their costs over the RAB period (45 years), regardless of length of tender period

### COMMERCIAL ASSETS NOT OVERPAID/UNDERPAID

- Tender and usefulness periods have to be assumed by ESO so that commercial assets do not get paid multiple times or underpaid
- Wrong forecasts of usefulness might occur in:
  - Real usefulness period longer than forecasted – contract extensions pay windfall gains to the previously contracted commercial providers
  - Real usefulness period shorter than forecasted – results in missing money for commercial providers

TO: Transmission Owner; RV: Residual Value; RAB: Regulated Asset Base

# Due to the timeframe misalignment between the RAB and tender period, the counterfactual calculation needs to consider a RV for the TO capital costs

## TO counterfactuals

| Cost components | Assessment timeframe | Compatibility with tender period timeframe |
|---|---|---|
| Capital costs | RAB period | Not compatible – RAB likely longer than tender period |
| O&M costs | Tender period | Compatible |
| Energy consumption | Tender period | Compatible |

***Legend*** *Compatible* *Not compatible*

## POSSIBLE PARAMETERS TO CALCUALATE THE RESIDUAL VALUE

### Asset technical life

Representing the expected **residual capability** of the asset to provide services after the tender period, based on:

- *Technology type* – average lifetime of the single technologies (e.g. synchronous condensers, HVDC cables)
- *Utilisation rate* – reflecting how the use for stability services impact asset total lifetime

### Asset usefulness

Representing the expected **residual need** for the asset to provide services after the tender period, based on:

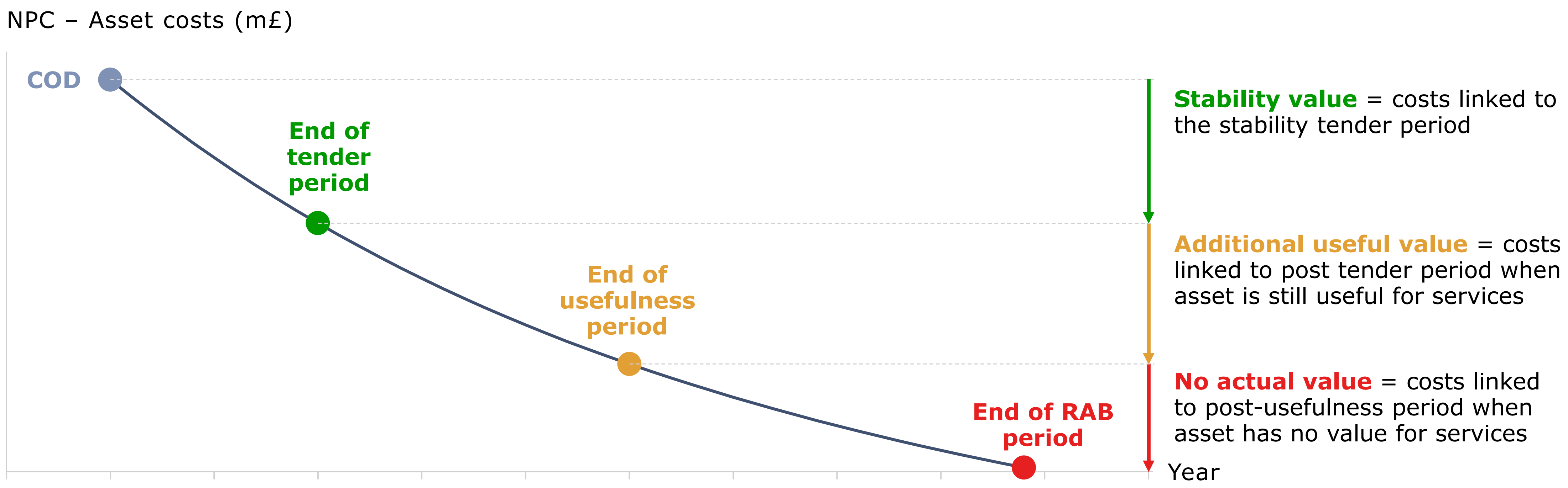
- *Service requirement* – based on ESO forecasts on local need for services (taking into account possible differences in required assets' availability compared to stability[1])
- *Portability of the asset* – possibility to reinstall the asset in different site in case services are needed elsewhere

1. In case need for services after tender period requires plants to be available more/less hours compared to Stability market, RV calculation will take into account the n. of years and the rate of usage (availability) required to the asset after the tender period| RV: Residual Value; TO: Transmission Owner; O&M: Operations and Maintenance; RAB: Regulated Asset Base

# The proposed methodology for Model 3 calculates the RV on the basis of the forecast of future asset usefulness and the choice of contract length

ILLUSTRATIVE

**POSSIBLE ASSESSMENT OF ASSET'S COSTS TO DETERMINE COUNTERFACTUAL AND RESIDUAL VALUE**




**Counterfactual** = '**Stability value**' + '**No actual value**' → Sum of asset's value during stability provision and when the asset is not needed by the system anymore

**Residual value** = '**Additional useful value**' → Residual value of the asset, reflecting its usefulness for services after the tender period

HYP: assuming asset technical life longer than asset usefulness, WACC=2.93% and discount factor equal to 3.5% for the first 30 years and 3.0% afterwards | COD: Commissioning Operation Date; RAB: Regulated Asset Base; NPC: Net Present Costs

# Further analysis of future needs would provide information to forecast the usefulness period

ILLUSTRATIVE

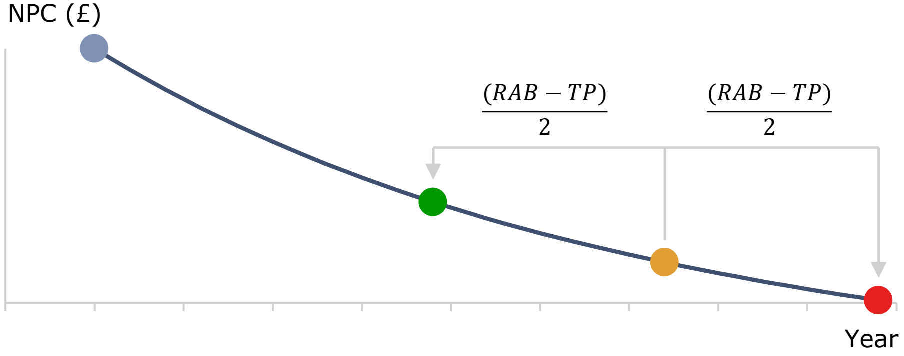
**Assets useful in the long period**

***RV possibly set by ESO***

*Determination of usefulness and tender periods*

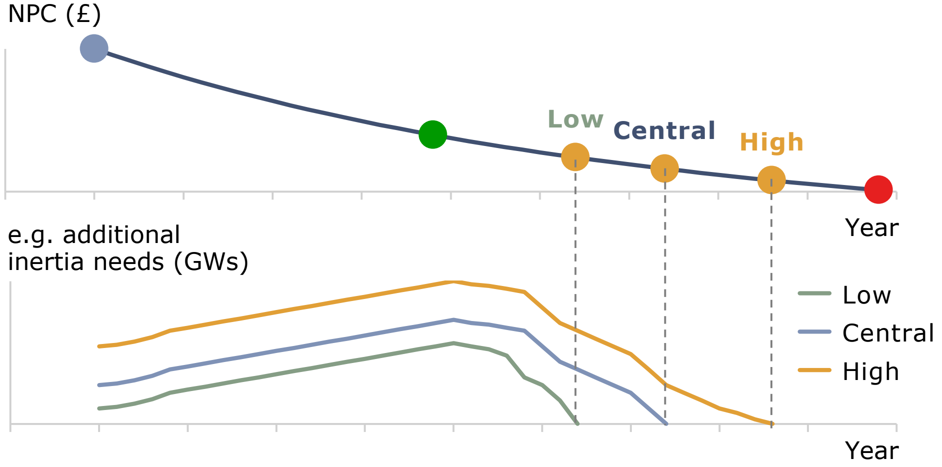
POSSIBLE OPTIONS

a) 'Simple approach'




- Usefulness period is estimated to be in between the end of tender (estimation of reasonable need for stability, enough to support bankability of the commercial projects) and RAB periods (rough estimation of technical lifetime of the TO assets)
- This simple methodology assumes that setting the end of usefulness period right in between the end of tender and RAB periods statistically provides highest accuracy

b) 'Refined approach'




- Usefulness periods are determined through estimation of stability needs (inertia in this example) based on different scenario assumptions (e.g. High, Central, Low views)
- This more complex methodology would require additional analysis by ESO and would also provide strong signals to the market. This exposes ESO and commercial providers to high risks if ESO assumptions and, as a result bidding strategies, end up to be incorrect

NPC: Net Present Costs; RV: Residual Value; UP: Usefulness Period; TP: Tender Period; RAB: Regulated Asset Base; TO: Transmission Owner



***Legend*** *COD* *End of tender period* *End of usefulness period* *End of RAB period*

# The (potential) adoption of Model 3 would require additional effort by ESO to determine the usefulness period

**SUMMARY OF FINAL CONSIDERATIONS ON MODEL 3**

**Reasons for further investigating Model 3**

- There is reasonable certainty that the period of need is longer than 10 years
- ESO is better placed than commercial providers to estimate future need and value
- This has driven the choice of Model 3 (where ESO calculates a RV for TO assets) expected to ensure the achievement of target objectives[1] of the Stability market

**Elements affecting the calculation of the RV**

- The methodology for calculating the counterfactual needs to consider only the portion of capital costs linked to the tender period
- The RV, to be deducted from the counterfactual, determined by both the expected technical lifetime and period of time when the asset is expected to be useful

**Possible approach to calculate the RV**

- Approach requires scenario analysis to determine future system needs and value
- Potential future mandating of services (e.g. grid forming) will influence future value
- To determine the RV, apply a depreciation model[2] which is based on the timeframe between the end of tender and usefulness periods, or (directly) the future values

**Possible methodologies to determine the usefulness period**

- The major complexities in the proposed approach relate to the methodology (and transparency) of the estimation by ESO of the usefulness period
- The usefulness period could be determined through a simple[3] or a more detailed[4] approach. The latter potentially provides more accurate indications, but it is affected by high uncertainty and exposes ESO and comm. prov. to higher risks

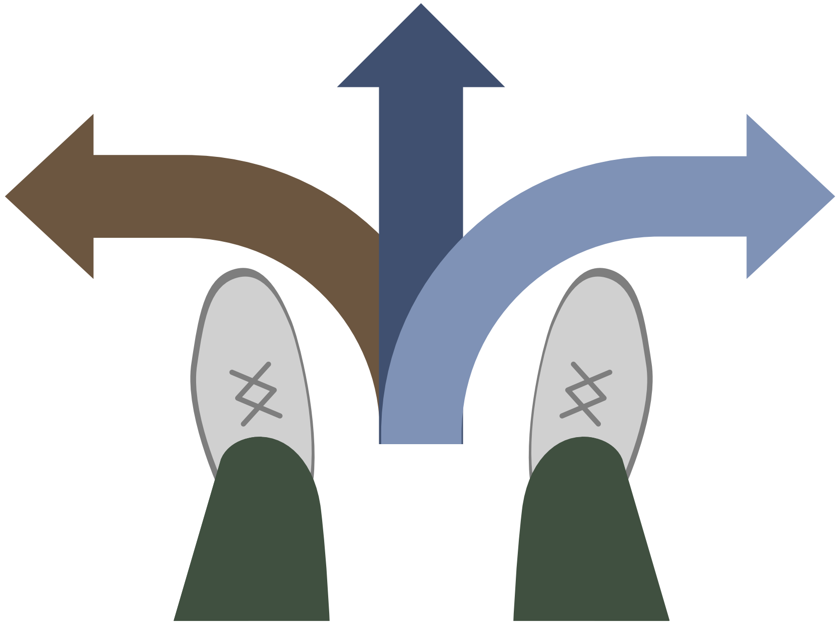
1. Fair appraisal between to and commercial assets, customers paying when receiving the service, commercial assets not overpaid/underpaid; 2.Assuming asset tech. life longer than asset usefulness, TO WACC and a discount factor equal to 3.5% for the first 30 years and 3.0% afterwards; 3. Usefulness period estimated to be in between the end of tender and RAB periods; 4. Usefulness periods determined through estimation of stability needs, based on different scenario assumptions |TO: Transmission Owner; RV: Residual value

SHORTLIST OF MODELS FOR DEPRECIATION OF TO ASSETS

# The estimation of future requirements makes Model 3 and Model 6 viable alternatives to the pathfinder evaluation approach

**1. *'The Pathfinder evaluation'***

- Model currently in use for Pathfinder, with 10 years contract duration
- Counterfactual might be overpriced (as does not consider the residual value of TO asset after tender period)
- However, a competitive ST market after the tender period could provide fair remuneration to commercial providers, in alternative to contracts extensions, avoiding paying for them multiple times



**3. *'Fixed residual value for TOs'***

ESO assumes a RV for TO counterfactual after tender period through:

- Simple approach: RV reflects usefulness period of TO asset, assumed as the mid-point between tender and RAB period
- Refined approach: based on ESO modelling, assuming different degrees of asset usefulness under scenarios of future stability requirements

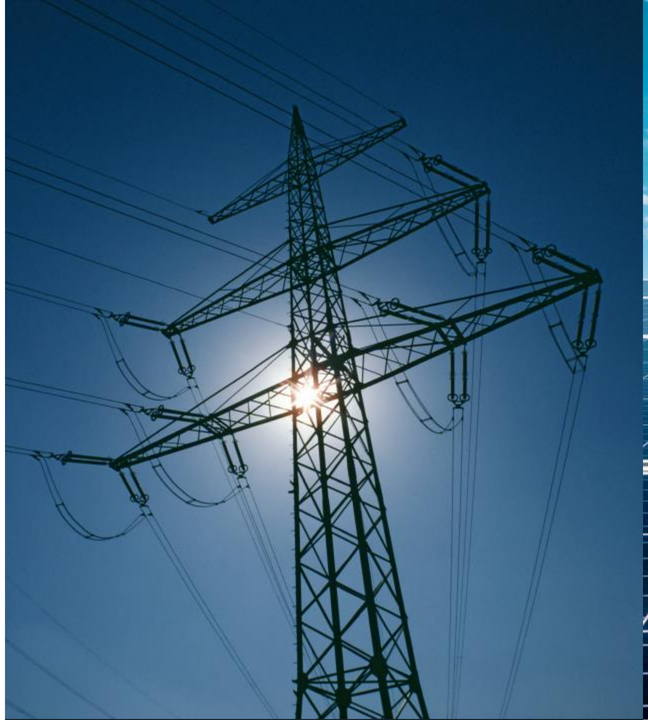
**6. *'Pathfinder, but longer contracts'***

- Applies Pathfinder model but envisages longer contract duration (e.g. 20 years)
- This to be more aligned with the usefulness period, expected to be longer than 10 years, but complex to estimate
- Requires a compromise between granting possibly too short contracts, risking to pay for assets multiple times if asset remains useful after tender period, and the risk of over-burdening future customers by offering contracts longer than then actual usefulness period

TO: Transmission Owner; ST: Short-Term; RV: Residual Value

# Agenda





# Involvement of OFTOs and ICs depends on their technical capability to provide stability and the resolution of possible regulatory/economic barriers

**KEY QUESTIONS ON THE PARTICIPATION OF OFTOs AND ICs WITHIN THE STABILITY MARKET**

## TECHNICAL ENABLERS

- *Are current OFTO/IC technical configurations able to provide stability services?*
- *In case not, what are the possible add-on components to allow service provision?*

## REGULATORY/ECONOMIC ENABLERS

- *Are there any regulatory and economic barriers affecting the participation of OFTOs and ICs in the stability market?*
- *What are possible regulatory and economic measures that could facilitate their participation?*

OFTO: Offshore Transmission Owner; IC: Interconnector

EQUIPMENT ENABLING STABILITIES FOR OFTOS/IC

# OFTOs and ICs are able to provide stability when equipped with specific kit, such as:

**Voltage Source Converters (VSC) with algorithm for stability provision**

VSCs are a type of converter made with transistors (usually IGBTs) that can be turned on/off by a control action, allowing converter-based technologies such as HVDC cables to deliver electricity and provide grid services. A VSC equipped with a Grid Forming control algorithm can allow a HVDC cable to provide inertia, short circuit levels and dynamic control to the grid. For inertia provision, a flywheel can be added to deliver additional energy required for the inertia service.

**Synchronous Condensers (SC)**

A synchronous condenser (SC) is an AC-driven synchronous motor able to spin freely without load, providing stability services such as inertia, short circuit levels and dynamic voltage control to the electrical grid. A flywheel can be added to the SC to provide additional inertia provision.

**Storage (flywheels)**

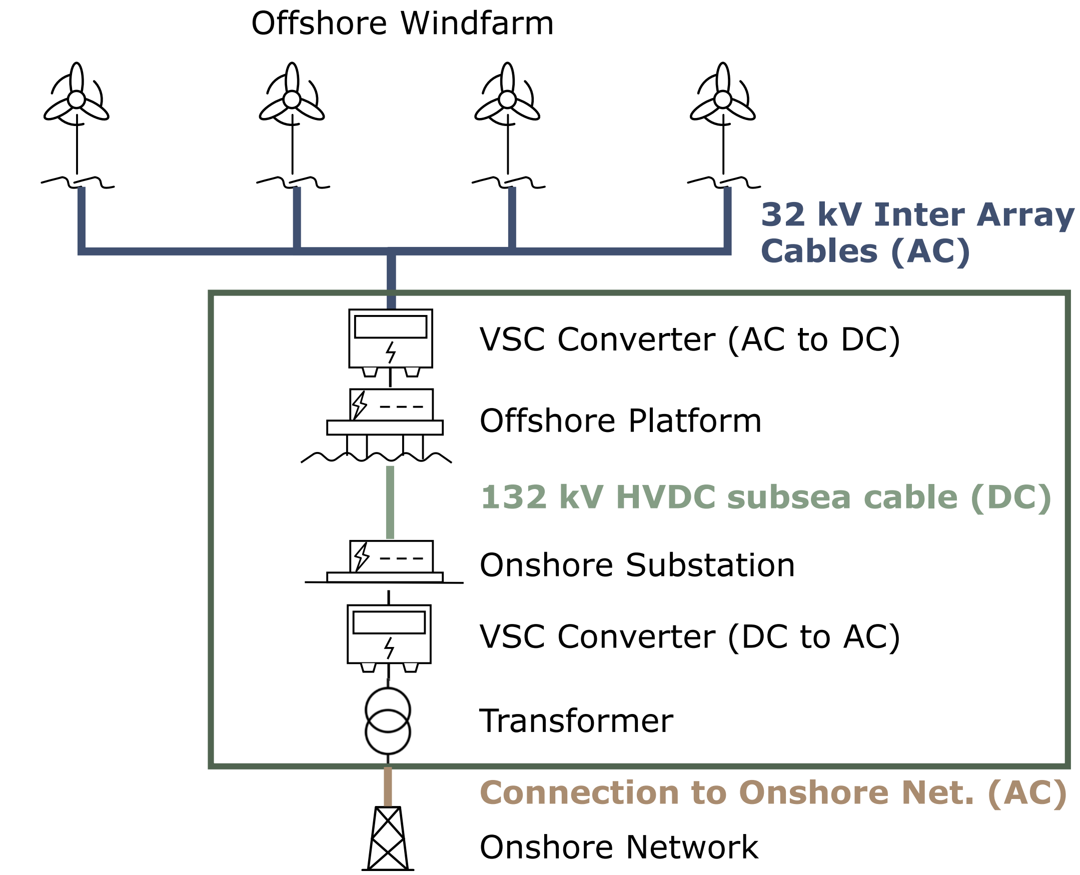
Flywheels are solid cylinders with large mass, spun at very high speed through a motor which converts electricity into kinetic energy. Kinetic energy can be released back to the system through the motor acting as a generator, converting flywheel spinning motion back into electricity. Flywheels can be used to release energy into the system, supporting inertia provision when coupled with VSCs or SCs.

OFTO: Offshore Transmission Owner; IC: Interconnector; HVDC: High-Voltage Direct Current; SCL: Short Circuit Levels; DVC: Dynamic Voltage Control; VSC: Voltage Source Converter; IGBT: Insulated-Gate Bipolar Transistor; SC: Synchronous Condenser

TYPICAL CONFIGURATIONS OF OFTOS

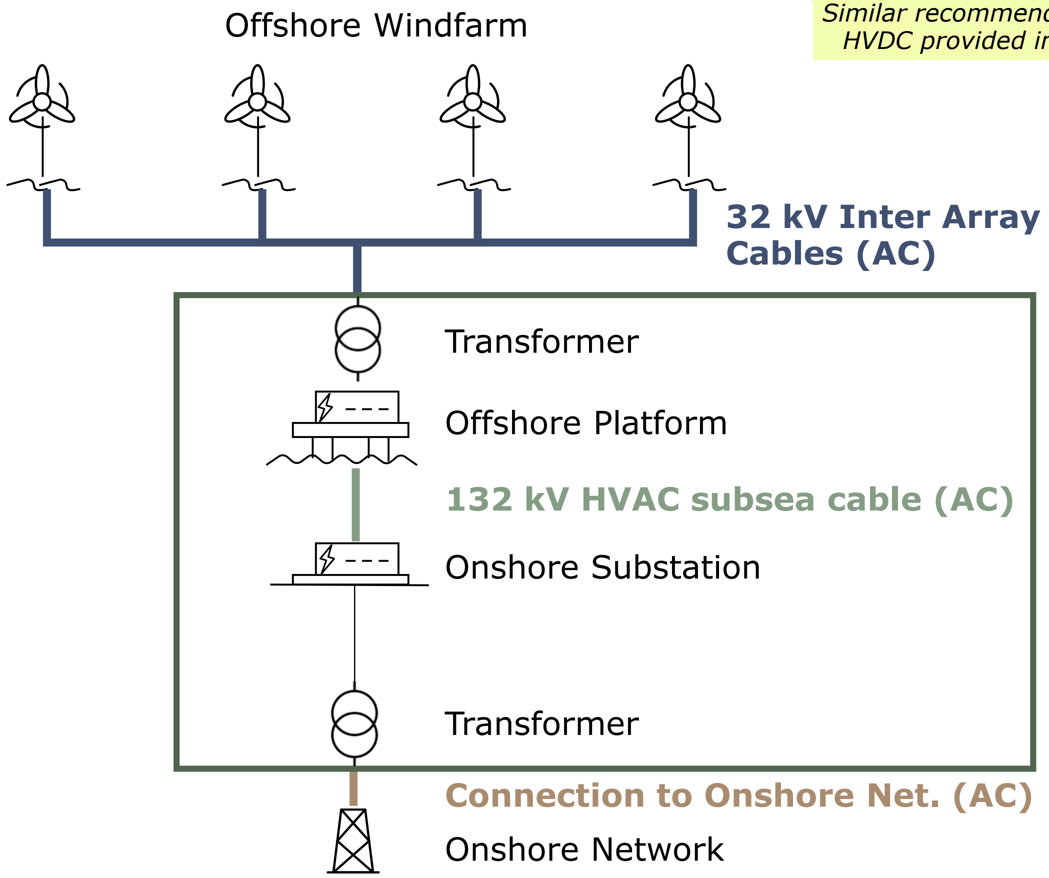
# Typical OFTOs utilise either AC or DC connections, depending mainly on length of subsea cable (DC typically for long distance applications)

**HVDC OFTO - SIMPLIFIED CONFIGURATION**




**HVAC OFTO - SIMPLIFIED CONFIGURATION**

*Technical recommendation provided in the next slides. Similar recommendation for HVDC provided in Annex*




OFTO: Offshore Transmission Owner; HVDC: High-Voltage Direct Current; HVAC: High-Voltage Alternating Current; DC: Direct Current; AC: Alternating Current; VSC: Voltage Source Converter



***Legend*** *Perimeter of OFTO's ownership*

POSSIBLE CONFIGURATIONS AND STABILITY PROVISION FOR HVAC OFTOS

# HVAC OFTOs would require to install a VSC (with dedicated algorithm for stability) or a synchronous condenser to provide stability

## HVAC OFTOs – POSSIBLE CONFIGURATIONS AND STABILITY PROVISION

| | Additional components[1] | Model description | Inertia – Frequency reg. | Inertia – Energy | SCL | DVC |
|---|---|---|---|---|---|---|
| | None (as-is model) | OFTO not equipped with VSC. Windfarm can provide stability if equipped with grid-forming converters | | | | |
| VSC/VSC+Storage | | OFTO equipped with a VSC converter and algorithm to provide stability. Also windfarm able to provide stability[2] | | | | |
| VSC/VSC+Storage | + | As per previous model, with the addition of a storage (flywheel) and related converter to enable the OFTO to provide energy for inertia | | | | |
| SC/SC+Storage | | OFTO equipped with a Synchronous Condenser, enabling it to provide stability. Also windfarm able to provide stability[2] | | / SC can provide inertia even without injecting energy | | |
| SC/SC+Storage | + | As per previous model, with the addition of a storage (flywheel) to enable the SC to provide extra inertia | | | | |

Entities providing stability services

1. Compared to as-is configuration described in previous slide; 2. If equipped with grid-forming converters | OFTO: Offshore Transmission Owner; HVAC: High-Voltage Alternating Current; SCL: Short Circuit Levels; DVC: Dynamic Voltage Control; VSC: Voltage Source Converter; SC: Synchronous Condenser



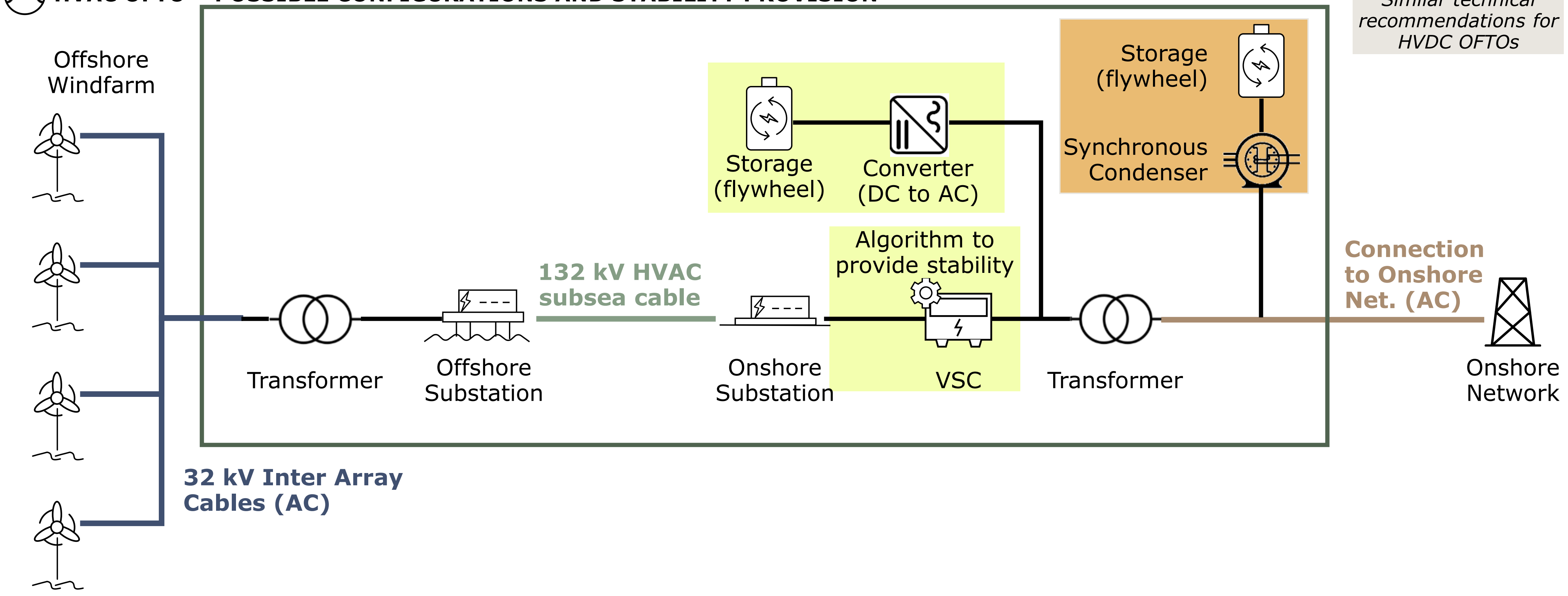
**Legend** OFTO | Offshore Windfarm | None | / Potentially provided by both | VSC with algorithm for stability | Synchronous Condenser | Storage (flywheel) and related converter

CONFIGURATION FOR HVDC OFTOS FOR STABILITY PROVISION

# Storage and synchronous condensers could be connected in parallel with AC OFTOs, with the VSC (with algorithm for stability) in series

**HVAC OFTO – POSSIBLE CONFIGURATIONS AND STABILITY PROVISION**

*Similar technical recommendations for HVDC OFTOs*




OFTO: Offshore Transmission Owner; HVDC: High-Voltage Direct Current; HVAC: High-Voltage Alternating Current; VSC: Voltage Source Converter; SC: Synchronous Converter



***Legend*** *Perimeter of OFTO's ownership* *Additional components for stability:* *Option VSC/VSC+Storage* *Option SC/SC+Storage*

EXISTING REGULATORY REGIMES FOR OFTOS

# OFTOs can be developed under either 'generator-led' or 'OFTO-led' approach, where the 'generator-led' is the only route followed to date

*Adopted by all OFTOs so far*

**EXISTING REGIME MODELS FOR OFTOs**

| | Generator-led | OFTO-led |
|---|---|---|
| **Responsibilities** | – The wind developer is responsible for constructing the offshore transmission system<br>– The OFTO is responsible for operating and maintaining the asset | – The OFTO is responsible for the construction, operation and maintenance of the asset |
| **Awarding process** | – Wind developer designs and constructs the offshore transmission system<br>– Ofgem initiates the competitive tender process, where offshore transmission assets are transferred from the wind developer to the OFTO and a licence is granted to the OFTO entities | – Two options:<br>– *Early OFTO Build*: once wind dev. obtains the connection offer, Ofgem initiates the competitive tender where OFTO bids its approach to aspects of preliminary works, consenting, design, procurement, financing, construction, operation, maintenance and decommissioning of transmission assets and costs associated with these activities<br>– *Late OFTO Build*: wind dev. undertakes preliminary works, consenting, and high-level design of the transmission assets. Ofgem then initiates the competitive tender where OFTO bids its approach to procurement, financing, construction, operation, maintenance and decommissioning of transmission assets and the costs associated with these activities |
| **Remuneration** | – Provided by NETSO and based on the Tender Revenue Stream (TRS), which is fixed (regulated) and guaranteed over a period of 25 years<br>– In case the wind developer requests the OFTO for an incremental investments (up to 20% of original investment costs) to install additional transmission capacity, the NETSO can increase the TRS to recover such incremental investment | |
| **Availability conditions** | – OFTOs are incentivized to maintain availability above 98% (upper revenue effect – up to +5% of annual revenues), while penalties are applied, in case availability reaches lower levels (lower revenue effect – up to -10% of annual revenues) | |

Source: Ofgem | OFTO: Offshore Transmission Owner; NETSO: National Electricity Transmission System Operator; TRS: Tender Revenue Stream

# Potential participation of OFTOs in stability provision raises several open points

| Topics | Areas | Considerations |
|---|---|---|
| 1. Overlap of OFTO and wind dev.'s operations | *Technical aspects* | – Both windfarms and OFTOs would be able to provide stability: which entity has priority to provide the service? Does the provision of stability by wind farm/OFTO have negative implications on the quality of their services (i.e. generating and injecting energy to the grid)? |
| 2. Recovery of investment for stability retrofit | *Regulatory framework* | – Current regulation allows OFTOs to invest up to 20% of original investment costs (when asked by wind developer) to increase transmission capacity in return for a revised (increased) TRS. Existing OFTOs not able to recover costs of investing in additional equipment (e.g. VSCs, SCs, flywheels) for stability service provision.<br>– Also, as the TRS is regulated, there is an open question on how stability revenues (e.g. ST) would be treated |
| 3. Incentives for wind farm to invest in stability | *Costs-benefits* | – Under the generator-led regime, there are no incentives for the wind developer (who builds and then sells the assets) to invest in equipment for stability to be installed in the OFTO.<br>– Adding stability service capabilities will increase project costs, which will initially be financed by the windfarm developer. Additional capital and financing costs will need to be appropriately reflected in the transfer value. |
| 4. Impact on OFTO's risk profile | *Costs-benefits* | – Main goal of OFTOs is to maintain the availability target in order to capture the contracted TRS.<br>– As per its business model, OFTO is considered a low risk business. The addition of stability service provision within OFTO's activities could increase its risks profile, potentially impacting TRS requirements. |
| 5. Impact of stability provision on wind developers | *Regulatory framework* | – In case the provision of stability services by the OFTO has impacts on the windfarm business model (e.g. alters generation to support inertia provision), this would require complementary commercial arrangements to define compensation for the wind developer. |
| 6. OFTOs owning storage | *Regulatory framework* | – As per the current regulatory framework, it is not clear if OFTOs are allowed to own storage assets to provide grid services. |
| 7. Applicability on MPI | *Technical aspects/*<br>*Reg. framework/*<br>*Costs-benefits* | – Specific case of Multi-Purposes Interconnectors (MPIs) have not been considered. Some of the considerations relevant for the stand-alone OFTOs and ICs[1] will be relevant. |

1. Illustrated in the IC's section | OFTO: Offshore Transmission Owner; HVAC: High-Voltage Alternating Current; TRS: Tender Revenue Stream; VSC: Voltage Source Converter; SC: Synchronous Condenser; NETSO: National Electricity Transmission System Operator; ST: Short-Term

POSSIBLE MEASURES TO FACILITATE OFTOS' CAPABILITIES FOR STABILITY

# Possible measures can be applied to allow OFTOs to provide stability. As an alternative, a third-party operator connected to the same bay could do it

***POSSIBLE MEASURES TO FACILITATE OFTOs' CAPABILITIES FOR STABILITY***

## New OFTOs

*Design*:

- Generator-led – wind developers mandated by Ofgem[1] to include stability equipment in the design of transmission assets. Alternatively, OFTOs should be allowed to install stability equipment once they have their licence.
- OFTO-led – OFTO allowed[2] by Ofgem to install stability equipment in the design of transmission assets

*Remuneration*: in case of incremental investment with LT contract in place, TRS should not cover the stability equipment expenditure already financed through LT market

*Permission to operate storage*: possible revision of role specification to allow OFTOs to operate storage only in case of provision of grid services

## Existing OFTOs

*Design:*

- Generator-led – wind developers and OFTOs would need to discuss the design of the additional stability equipment and how this will impacts the windfarm's daily operations
- OFTO-led – no existing OFTOs so far under this route

*Additional investment*: regulation will need to be revised to allow existing OFTOs to bear additional investment (for stability purposes) compared to the original plan

*Remuneration:* TRS might be revised in order to reflect the investment made by the OFTO for stability equipment (only in case existing TRS does not guarantee return of investment/operational costs related to stability provision)

*Permission to operate storage:* as for new OFTOs

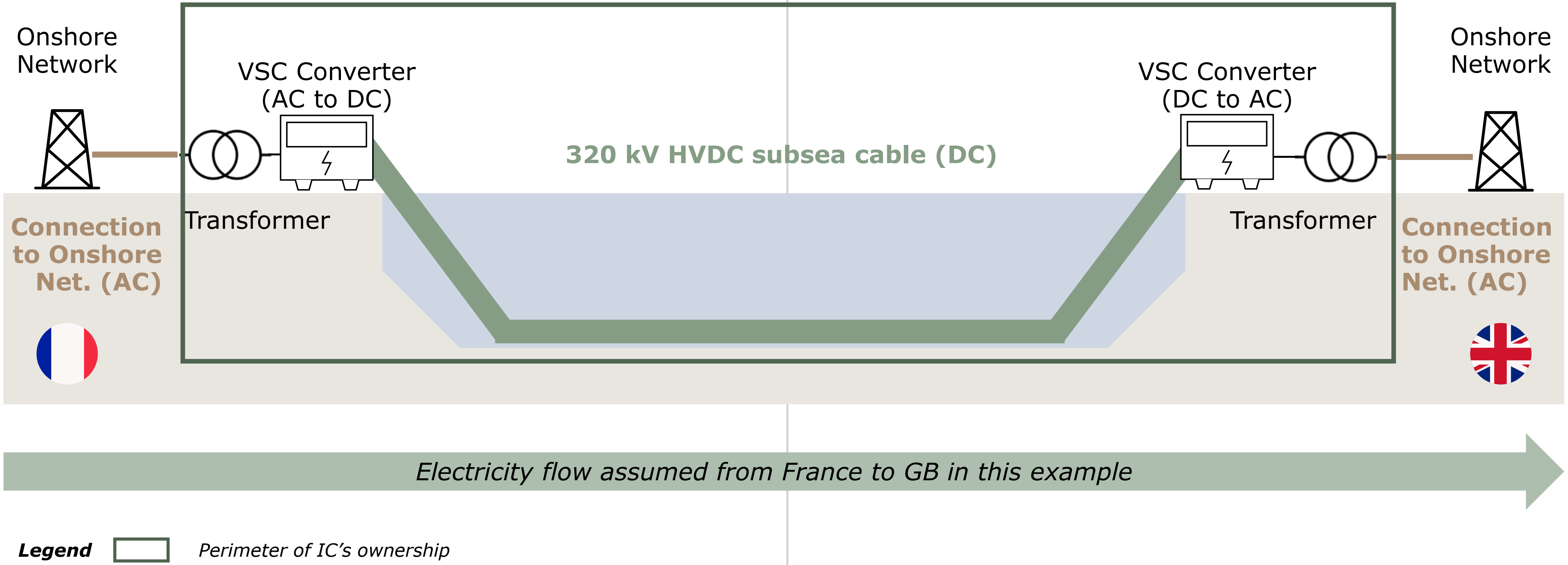
***Third-party provision*** (alternative to provision of stability by OFTOs): allows third-party providers to connect assets for stability (e.g. SC, storage) to the same connection bay of the OFTO, effectively operating as a separate commercial provider for stability[3]

1. In case Ofgem consider necessary the provision of stability in specific areas; 2. But not forced ; 3. Condition that stability operations must not interfere with the normal operation of the windfarm
| OFTO: Offshore Transmission Owner; TO: Transmission Owner; TRS: Tender Revenue Stream; VSC: Voltage Source Converter

TYPICAL CONFIGURATIONS OF INTERCONNECTORS

# Typical Interconnectors rely on DC cables, allowing flows of electricity between GB and other overseas countries

## HVDC INTERCONNECTORS - SIMPLIFIED CONFIGURATION




HVDC: High-Voltage Direct Current; IC: Interconnector; AC: Alternating Current; DC: Direct Current

POSSIBLE CONFIGURATIONS AND STABILITY PROVISION FOR HVDC IC

# IC would be able to provide stability by equipping VSC with a dedicated algorithm or through a synchronous condenser

## HVDC INTERCONNECTORS – POSSIBLE CONFIGURATIONS AND STABILITY PROVISION

| | Additional components[1] | Model description | Entities providing stability services: Inertia – *Frequency reg.* | Inertia – *Energy* | SCL | DVC |
|---|---|---|---|---|---|---|
| | None (as-is model) | Interconnector equipped with VSC but no algorithm to provide stability. Overseas generator might be able to provide stability | | | | |
| VSC/VSC+Storage | | VSC provided with an algorithm to deliver stability services. Also overseas generator could able to provide stability | | | | |
| VSC/VSC+Storage | + | As per previous model, with the addition of a storage (flywheel), and related converter, to enable the IC to provide energy for inertia | | | | |
| SC/SC+Storage | | IC equipped with a Synchronous Condenser, enabling it to provide stability. Also overseas generator could able to provide stability | | SC can provide inertia even without injecting energy | | |
| SC/SC+Storage | + | As per previous model, with the addition of a storage (flywheel) to enable the SC to provide extra inertia | | | | |

1. Compared to as-is configuration described in previous slide | IC: Interconnector; HVDC: High-Voltage Direct Current; SCL: Short Circuit Levels; DVC: Dynamic Voltage Control; VSC: Voltage Source Converter; SC: Synchronous Condenser



***Legend*** *Interconnector* | *Overseas generator* | *None* | *Potentially provided by both* | *VSC algorithm to provide stability* | *Synchronous Condenser* | *Storage (flywheel) and related converter*

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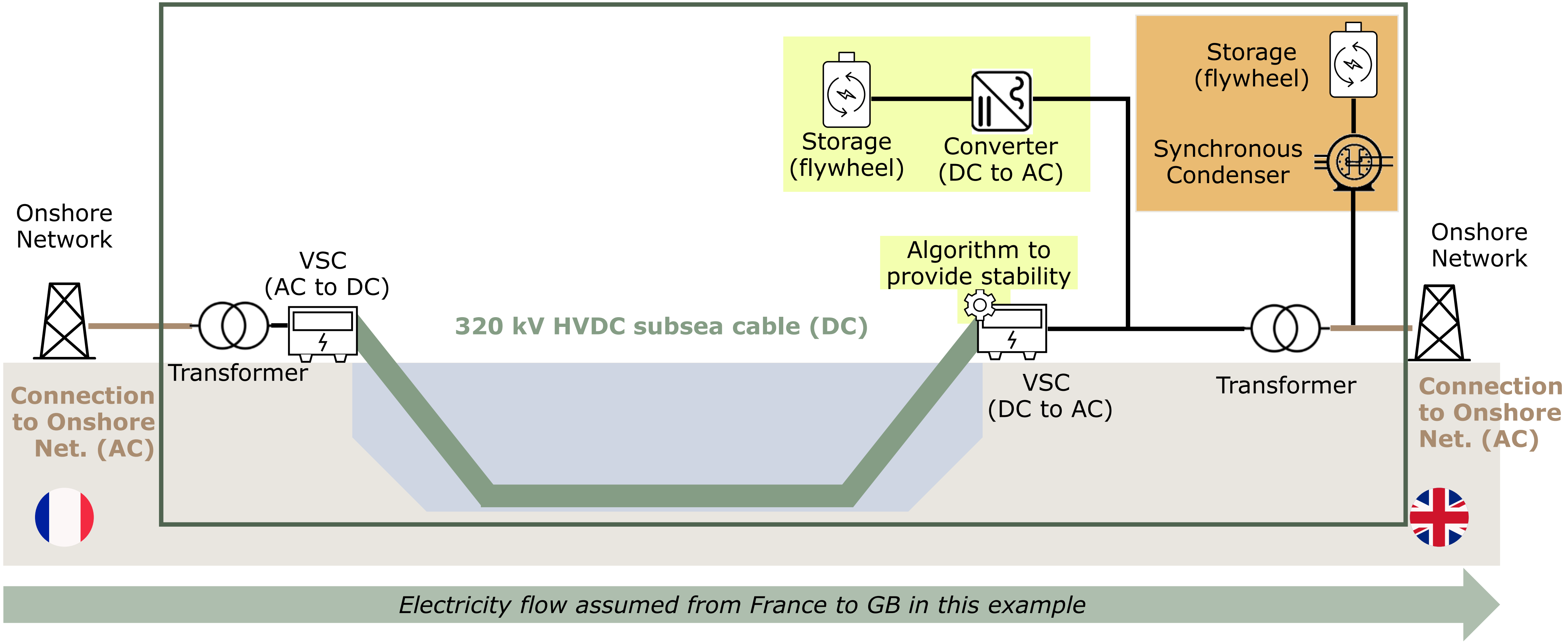
CONFIGURATION FOR HVDC OFTOS FOR STABILITY PROVISION

# Storage and synchronous condenser components could be connected in parallel with IC, while algorithm for stability is upgraded on existing VSC

**HVDC INTERCONNECTOR – POSSIBLE CONFIGURATIONS AND STABILITY PROVISION**




OFTO: Offshore Transmission Owner; HVDC: High-Voltage Direct Current; HVAC: High-Voltage Alternating Current; VSC: Voltage Source Converter; SC: Synchronous Converter



***Legend*** *Perimeter of IC's ownership* *Additional components for stability:* *Option VSC/VSC+Storage* *Option SC/SC+Storage*

CURRENT REGULATORY FRAMEWORK FOR INTERCONNECTORS

# Regulatory framework in GB allows interconnectors to operate as regulated, semi-regulated (Cap&Floor) or fully merchant assets

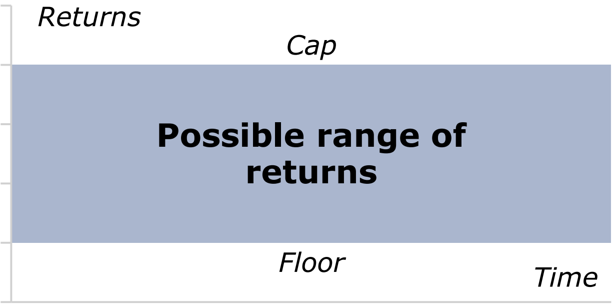
**EXISTING REGIME MODELS FOR INTERCONNECTORS**

**Revenue model**

## Regulated


- Interconnector asset is included in the Regulated Asset Based (regulated revenues)
- The revenue risks are socialized (on consumers)

## Cap&Floor




- Cap&Floor regime assures a minimum threshold of revenues to the IC (floor), under which the missing revenues to reach the floor will be paid by consumers
- If revenues go above an upped threshold (cap), the exceeding revenues beyond the cap will be returned to the consumers
- The revenue risks are partly socialized (on consumers) and partly borne by the IC owner

## Merchant


- Merchant regime does not provide regulatory underpin (no floor) and does not limit the operator's revenue capture (no cap)
- The operator has greater commercial freedom compared to the other regimes, but it will bear all the revenue risk

IC: Interconnector

REGULATORY/ECONOMIC CONSIDERATIONS FOR ICS

# Potential participation of ICs in stability provision raises several open points

| Topics | Areas | Considerations |
|---|---|---|
| 1. Limited incentives to capture additional value | _Costs-benefits_ | – Within overseas markets, ICs are generally treated as part of the onshore TSOs' regulated assets[1].<br>– As the revenue accruing to the connected country is likely to be regulated/fixed, there might be limited incentives for an IC to provide stability services as well. |
| 2. Implications on connected countries | _Regulatory framework_ | – Project costs/revenues are typically allocated between the two connected markets (often 50:50, but this is not necessarily the case). In case of additional costs to provide stability to GB, how will the counterparty regulator view this (in case of no/limited benefits to its market)? Should the counterparty regulator also be involved for regulatory approvals?<br>– Also, where service provision affects the connected market as well, there is need to consider energy/imbalance implications of service provision on either market. This implies the potential need for trilateral agreements between IC and foreign markets. |
| 3. Recovery of investment for stability retrofit | _Regulatory framework_ | – For existing ICs under regulated and cap & floor, in case of financing and installation of equipment for stability, the cap & floor thresholds would need to be revised to reflect extra costs for such equipment. At the moment, regulation does not specify how additional costs (e.g. for retrofitting) may be treated under regulated/cap & floor regimes. |
| 4. Impact of ICs on stability service requirement | _Technical aspects_ | – While ICs may be helpful as sources of stability provision, there is also the need to consider implications of installing additional ICs and of geographic clustering of ICs (e.g. south-east, east coast) on service requirements – do excess of ICs connected to a region of the grid increase needs for stability (e.g. local voltage issues).<br>– Consideration could be given to making stability capability mandatory for ICs, but the implications would need to be evaluated[2] |
| 5. Applicability on MPI | _Technical aspects/ Reg. framework/ Costs-benefits_ | – Specific case of Multi-Purposes Interconnectors (MPIs) have not been considered. Some of the considerations relevant for the stand-alone OFTOs[3] and ICs will be relevant. |

1. With the exception of Ireland, where a Cap&Floor regime is also in place; 2. Germany mandate GFM capability on NeuConnect whilst GB don't; 3. Illustrated in the OFTO's section | TSO: Transmission System Operator; IC: Interconnector; MPI: Multi-Purpose Interconnectors

POSSIBLE MEASURES TO FACILITATE IC CAPABILITIES FOR STABILITY

# Possible measures can be applied to enable IC provision, but required amendments may be considerable for existing cables

**POSSIBLE MEASURES TO FACILITATE ICs' CAPABILITIES FOR STABILITY**

## New ICs

*New agreement terms:* agreements between IC and the connected markets' entities need to include terms to enable the IC to provide stability in GB (e.g. split of revenues, management of imbalances)

→ Regulated, Cap&Floor, Merchant

*Treatment of additional components in costs assessments:* costs related to the additional stability-aimed equipment[1], need to be considered within the regulated costs assessment and covered within the e.g. cap-floor levels

→ Regulated, Cap&Floor

*Risk profile adjustments:* revenue potential of new ICs has to consider risks of provision of stability service and potential for lost revenues from other routes to market

→ Regulated, Cap&Floor, Merchant

## Existing ICs

*Revision of agreement terms:* existing agreements between IC and the connected markets' entities need to be revised to include additional/changes of terms to enable the IC to provide stability in GB (e.g. split of revenues, management of imbalances)

→ Regulated, Cap&Floor, Merchant

*Treatment of additional components in costs assessments:* not clear how additional CAPEX/OPEX (stability equipment in this case) are treated within cap & floor regime. In case not allowed, need to revise regulation to include these costs within the costs assessment

→ Regulated, Cap&Floor

*Risk profile adjustments:* revenue potential of ICs need to be revised considering risks of provision of stability service and lost revenues from other routes to market

→ Regulated, Cap&Floor, Merchant

***Third-party provision*** (alternative to provision of stability by ICs): allows third-party providers, similarly to what suggested for OFTOs

1. e.g. VSC algorithm, Synchronous Condenser, Storage (flywheel) | IC: Interconnector; VSC: Voltage Source Converters; OFTO: Offshore Transmission Owner



**Legend** *Application of measure according to regimes:* *Regulated* *Cap&Floor* *Merchant*

SUMMARY

# OFTOs and ICs can provide stability, but there are technical, regulatory and economical challenges to consider

**CONSIDERATIONS**

**Technical Enablers**

- Voltage source converters
- Synchronous condensers
- Storage

**Regulatory & Economic Enablers**

*OFTOs:*

- Overlap of OFTO and wind developer operations
- Recovery of investment for stability retrofit
- Incentives for wind farm to invest in stability
- Impact on OFTO’s risk profile
- Impact of stability provision on wind developers
- OFTOs owning storage
- Applicability on MPI

*ICs:*

- Limited incentives to capture additional value
- Implications on connected countries
- Recovery of investment for stability retrofit
- Impact of ICs on stability service requirement
- Applicability on MPI

**Possible Measures**

*OFTOs:*

- Consideration of requirements for stability equipment to be included in OFTO design
- Additional investment for existing OFTOs
- Ensuring consistency between the transfer / TRS revenue values and stability investment costs
- Consideration of permission to operate storage

*ICs:*

- New / revised agreement terms to enable the IC to provide stability in GB
- Costs of additional stability-aimed equipment considered within the regulated costs assessment
- Revenue potential considers the risks of providing a stability service and the potential for lost revenues from other routes to market

# Agenda



KEY ISSUES OF EXPIRED RAB ASSETS

# The possible involvement of expired RAB assets within the stability market raises several open points

**KEY QUESTIONS ON THE PARTICIPATION OF EXPIRED RAB ASSETS WITHIN THE STABILITY MARKET**

| | |
|---|---|
| **Treatment of TO assets after RAB period** | – How are TO assets treated once RAB is expired? Will they be decommissioned or will they be free to keep running? |
| **Technical life of RAB assets** | – Does the economic lifetime (i.e. RAB period of 45 years) of the TO assets differ from their actual technical life? |
| **TO obligations before/after RAB period** | – Are there any obligations for TOs to keep assets running within/after the RAB period? Are there any penalties if the asset stops functioning before the end of RAB? |
| **Cost recovery of expired RAB assets** | – How is cost recovery managed for expired RAB assets? |

TO: Transmission Owner; RAB: Regulated Asset Base

# ‘Expired RAB assets’ are not expected to be eligible for contractual payment via stability markets

**CONSIDERATION ON EXPIRED RAB ASSETS**

**Treatment of TO assets after RAB period**

- If TO assets are still functioning after the RAB period, and they are considered still useful for the system (e.g. to provide stability) and beneficial for consumers (cheaper than other alternatives), they are likely to continue to be employed until the end of their technical life

**Technical life of RAB assets**

- Technical lifetime of TO assets depends on technology (e.g. substation, synchronous condenser, cable etc.) and more in general on type of asset (e.g. software technical life expected to be way shorter than an overhead line)
- Technical life of each TO asset can differ from the 45 year depreciation period applied to the RAB

**TO obligations before/after RAB period**

- No obligations for TOs to keep specific assets running or penalties if they stop functioning after the RAB period. TOs’ activities are driven by specific performance targets[1] rather than by e.g. building new assets or keeping them functioning
- However, in case it is efficient and useful for the system, TOs might be requested to refurbish their assets if they stop functioning before the RAB period

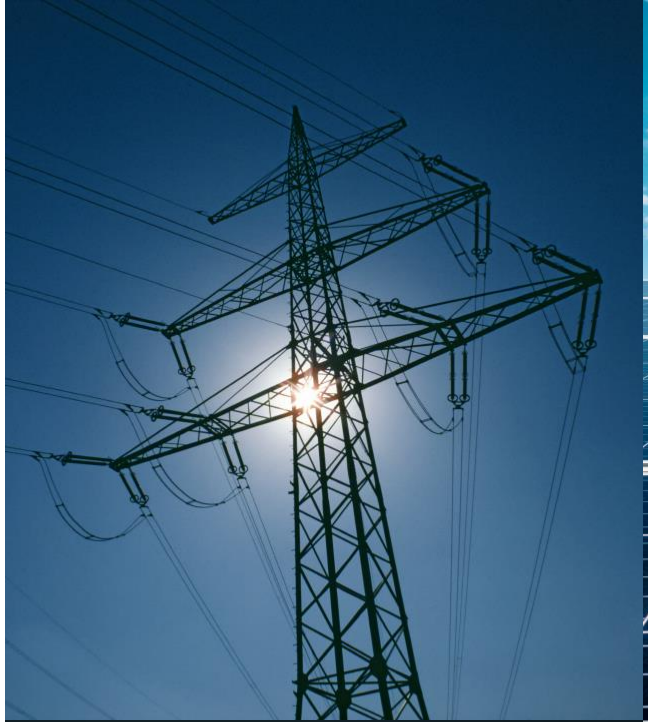
**Cost recovery of expired RAB assets**

- Expired RAB asset should be able to cover only future OPEX, as CAPEX should already be covered during the RAB period[2]
- *Remaining open question: in case of additional CAPEX expenditures after the RAB period, how these will be approved? By ESO/Ofgem or the TOs themselves?*

1. e.g. flowing electricity through transmission lines, maintaining security of the system; 2. In case no additional CAPEX needed after the RAB period | TO: Transmission Owner; RAB: Regulated Asset Base

# Agenda





# The next steps are to address the remaining WP2 exam questions, plus the WP3 exam questions

**WP**

**Exam Questions**

## WP1: Key Design Questions

*TO involvement:*

- What are the key considerations for treatment of the TO assets?
- What is the role of the TO in the LT market?[1]

*Eligibility rules:*

- 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]

## WP2: Further Eligibility and Contract Design Questions

*Further analysis on network assets:*

- 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?

*Contract structure:*

- 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]

*Selective characteristics:*

- How do we define incremental investment?

## WP3: Procurement Strategy

**3a: Procurement Design**

- What are the stacking rules for stability contracts?
- What arrangements could be employed to mitigate market power in ST market? Treatment of TO, price cap backstop, within procurement

**3b: Procurement Process**

**Led by ESO**

- Requirements Setting exam questions

**Led by AFRY**

- What strategy options can ESO pursue?
- Advantages of each procurement strategy?
- What are the risks, magnitude and mitigations for each procurement strategy?
- ESO's preferred strategy for procurement?

**Led by subconsultant**

- Principles for clearing the market?[3]

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;



**Legend** Covered today Upcoming

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