Study on Cross-Border Balancing Market Design

Presentation to stakeholders

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nationalgridESO

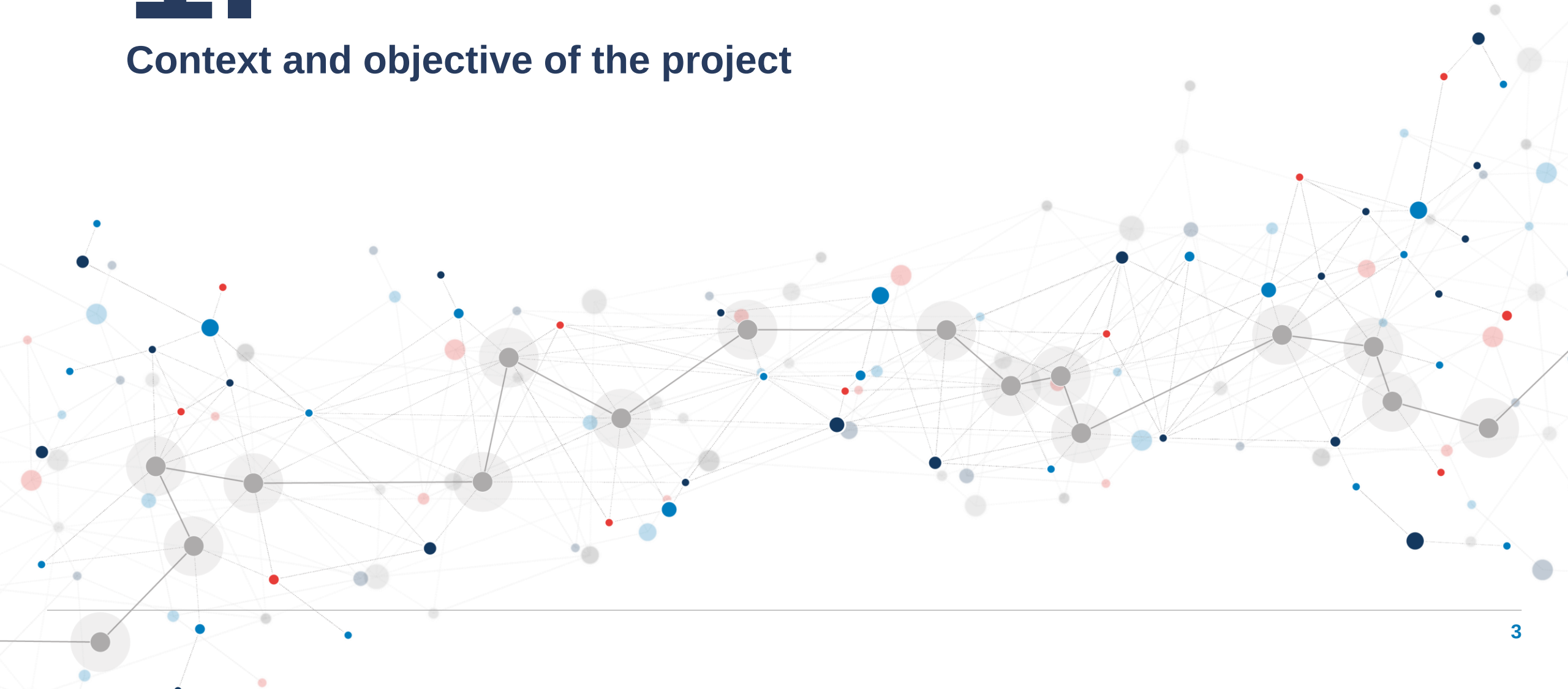
FTI CONSULTING COMPASS LEXECON ENERGY

Outline of the presentation

1	Context and objective of the project	13:00-13:10
2	Approach and identification of CBB options	13:10-13:25
3	Presentation of the results – Base case	13:25-13:40
?	Q&A session	13:40-14:00
4	Presentation of the results – Sensitivities	14:00-14:15
5	Multicriteria assessment and recommendations	14:15-14:35
?	Q&A session	14:35-15:00

1.

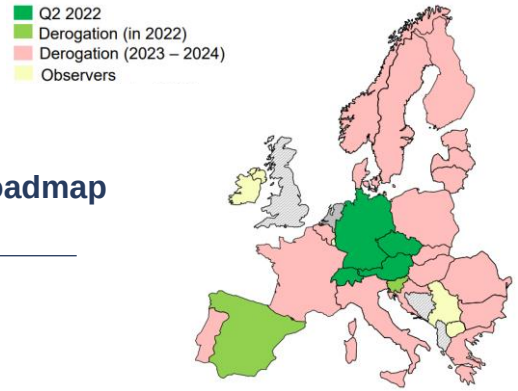
Context and objective of the project



Context of the study

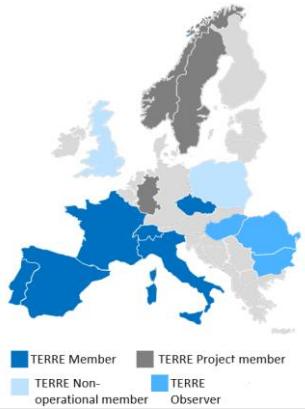
Following the Brexit, the EU-UK Trade and Cooperation Agreement foresees a new procedure to enable exchange of balancing products between the UK and the EU

MARI Platform



MARI Accession Roadmap (December 2021)

TERRE Platform



TERRE members (April 2021)

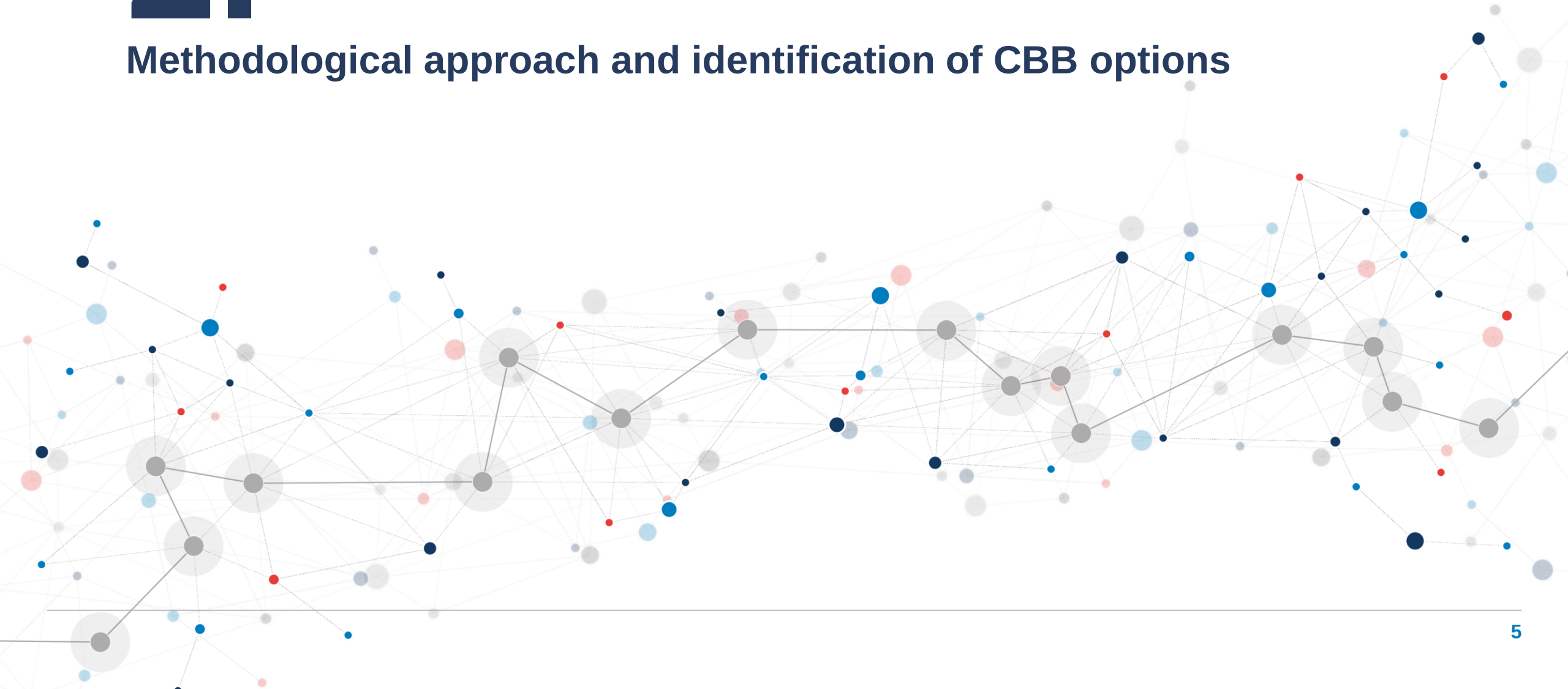
- Due to the Brexit, **UK can no longer participate in the EU internal market** for energy, and in particular in cross-border balancing platforms such as TERRE and MARI.
- The EU-UK Trade and Cooperation Agreement requires to develop a procedure for cross-border exchange of energy balancing between ESO and EU TSOs, via the interconnectors.
- The implementation of a **new UK market for balancing** raises a number of issues:
  - Interaction between the UK and EU markets
  - **Competition between the different balancing markets and exchange platforms** (liquidity, distortions in the allocation of resources);
  - **Interactions with the intraday market**, incentivizing the actors to be balanced;
  - No harmonisation of mFRR and RR products between countries (e.g. **many countries connected to UK do not have RR**);
  - Timeline for auctions, activation, delivery;
  - IT development;
  - Consistency with wholesale electricity market reform, notably nodal pricing.

NGESO mandated Compass Lexecon to carry out the modelling and a cost benefit analysis (CBA) of potential cross-border balancing solutions under a range of plausible scenarios.

The study was conducted in 2022/early 2023. Results were delivered **early 2023.**

2.

Methodological approach and identification of CBB options



Overview of the methodology

Criteria	Assessment
Economic efficiency	
Economic welfare	The new mechanism should bring a positive net social welfare at the European level and at the UK level. The social welfare captures the better allocation of available resources.
Impact on overall market signals	Balancing services should not reduce the incentive for stakeholders to be balanced in intraday. The new mechanism should not distort the efficient functioning of interconnectors.
Impact on liquidity and competition	Liquidity and competition is the different markets are essential to ensure efficient price formation.
Security of supply	
Security of supply	The SOs should have access to sufficient resources in order to stay balanced in very short timeframes.
Operational complexity	
Operational impact	A new mechanism would have an impact on the way of functioning and likely the cost for developing a new platform.
Robustness to changes	The potential changes to the UK and EU electricity markets shouldn't induce considerable adaptation costs.
Acceptability	
Distribution of costs and benefits for stakeholders	The split between UK and EU BRPs/BSPs/consumers may require some compensation.
Acceptability for neighbouring countries / TSOs	This acceptability could depend on benefits, operational difficulties and historic relationship with UK.
Required changes in the regulatory framework	Specific references in EU guidelines and the TCA may require some adaptations.
Contribution to the energy transition (CO_2 emissions)	

1 **Definition of the criteria for a cross-border balancing market**

2 **Identification and pre-screening of the options:**
- Identification of the main options
- Pre-screening of the different options

3 **Balancing market modelling set-up:**
- Setting-up and calibration of the model
- Definition of the market fundamentals
- Parametrisation of the cross-border balancing options

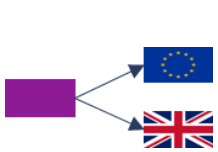
4 **Modelling and Cost-Benefit Analysis:**
- Modelling and Cost-Benefit Analysis of base case
- Modelling of Cost-Benefit Analysis of sensitivities (6)

5 **Multicriteria assessment and recommendations:**
- Multi-criteria analysis
- Ranking of the options and recommendations

We have defined with NGESO a list of criteria to apply in a multi-criteria assessment methodology

Criteria
Economic efficiency
Economic welfare
Impact on overall market signals
Impact on liquidity and competition
Security of supply
Security of supply
Operational complexity
Operational impact
Robustness to changes
Acceptability
Distribution of costs and benefits for stakeholders
Acceptability for neighbouring countries / TSOs
Required changes in the regulatory framework
Contribution to the energy transition (CO_2 emissions)

We have identified several high level options for Cross-Border Balancing



1 A market before TERRE/MARI

- Activation in the UK CBB platform before having to submit bids for TERRE/MARI.
- Bids retained in the UK CB market cannot participate in the TERRE/MARI platforms.

2 Parallel markets – BSP choice

- BSPs choose to participate in the UK CBB or local platforms operating in parallel.
- Bids submitted on a market cannot participate in the other market.

3 Parallel markets – TSO allocation

- EU SOs and NGESO choose to offer/demand balancing between UK CBB or local platforms operating in parallel.
- TSOs have the possibility to reallocate the local bids depending on their anticipations.

4 Indirect participation to EU platform

- NGESO aggregates the UK bids/offers/needs and allocate them across the different frontiers.
- The resulting exchanges are allocated to the EU platforms for a unique clearing phase.

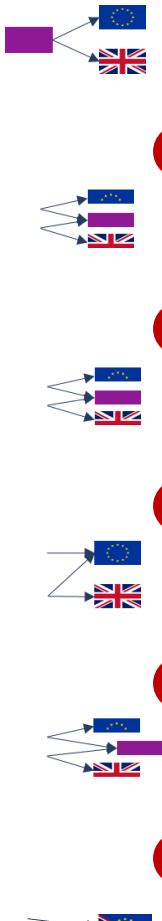
5 TSO directly nominate IC

- SOs directly exchange balancing products with each other. They may share bids of different characteristics and activate those which respond to their needs at minimum costs.
- If the SO-SO request is accepted, the SO can either wait for next auction to rebalance, either activate local resources (if legally/contractually possible).

6 "Volume-coupling"-like

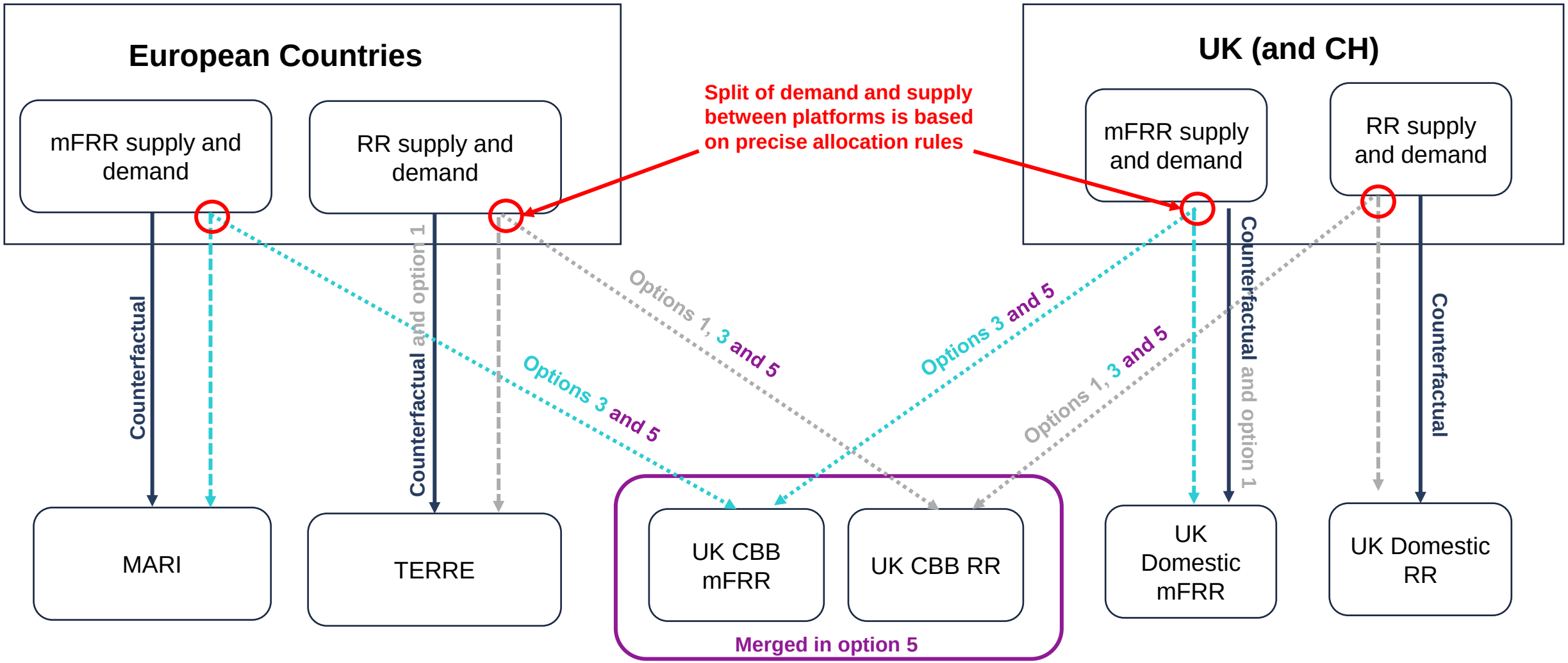
- The UK platform simulates the EU platforms' clearing at the UK+EU level and optimises exchanges between UK and EU.
- The resulting exchanges are allocated to the EU platforms for a second clearing phase.

Based on a pre-screening of options, we have narrowed down with NGESO options to be modelled considering trade-off between welfare and complexity



		Keep for modelling?	
1	A market before TERRE/MARI	▪ Gains might be limited, but the implementation might be easier, especially in before TERRE. ▪ The difference of activation time could have an impact on other products, notably intra-day.	✓
2	Parallel markets – BSP choice	▪ Induces a split of liquidity that may raise efficiency and potentially SoS concerns. ▪ May face legal issues.	✗ Due to difficulties to define BSPs' strategies, likely to lead to similar modelling results to option 3 although expected to be less efficient
3	Parallel markets – TSO allocation	▪ Induces a split of liquidity that may raise efficiency concerns. SOs' control may reduce them though. ▪ May face legal issues.	✓
4	Indirect participation in EU platform	▪ Efficiency highly depends on ability of the ESO to allocate bids/offers in adequate bidding zones. ▪ Reciprocity and legality could be questioned.	✗ Very complicated to model, many uncertainties on allocation rules between bidding zones
5	TSO directly nominate IC	▪ Efficiency highly depends on ability of the SOs to exchange information at timeframes different from usual markets. Could potentially be limited. ▪ Operational complexity can be important.	✓
6	"Volume-coupling"-like	▪ Likely most efficient, but complex, solution. ▪ Requires tight cooperation and data exchanges to work well. ▪ Day-ahead volume coupling faced implementation hurdles.	✗ Inefficiency compared to a perfect coupling situation is difficult to model

Illustration of the methodology used to model the options



Note: -In the counterfactual and the options, trades between countries of the platforms are limited by the interconnection capacity available after the Day-Ahead market.

- In option 1, as the UK CBB platform is before TERRE, it allows to replace the supply not selected in the UK CBB in TERRE and to have nuclear bids.

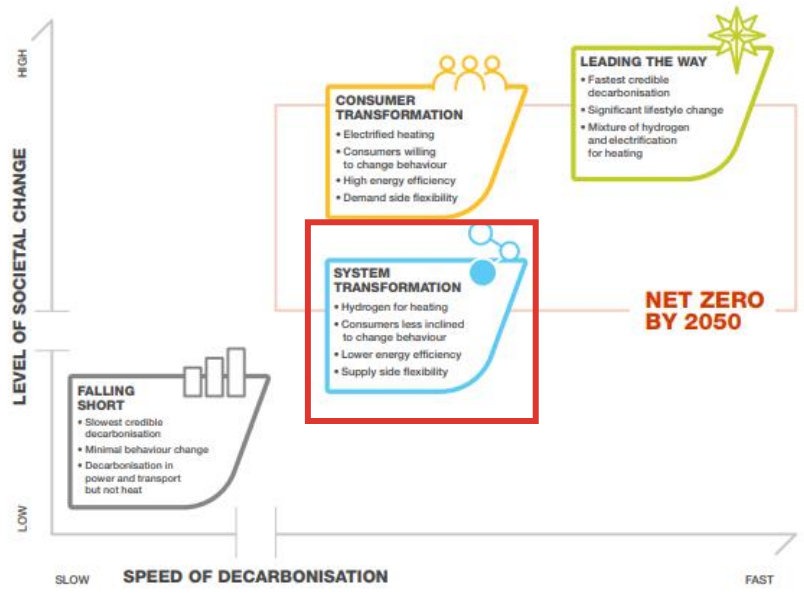
We use a Net Zero scenario across Europe as the market fundamentals in our study

We use the following scenario for market fundamentals:

- FES 22 scenario 'System Transformation' – "ST" for UK demand, capacity and interconnections
- TYNDP 22 scenario 'Global Ambition' – "GA" for the rest of Europe (demand and capacity)
- TYNDP 22 scenario "CBA Reference Grid" for the rest of Europe (interconnections)
- WEO 22 scenario 'Announced Pledges' for commodity prices.

This ensure a consistent scenario across Europe reflecting countries commitment to reach net zero emissions in 2050.

FES 22 "System Transformation"



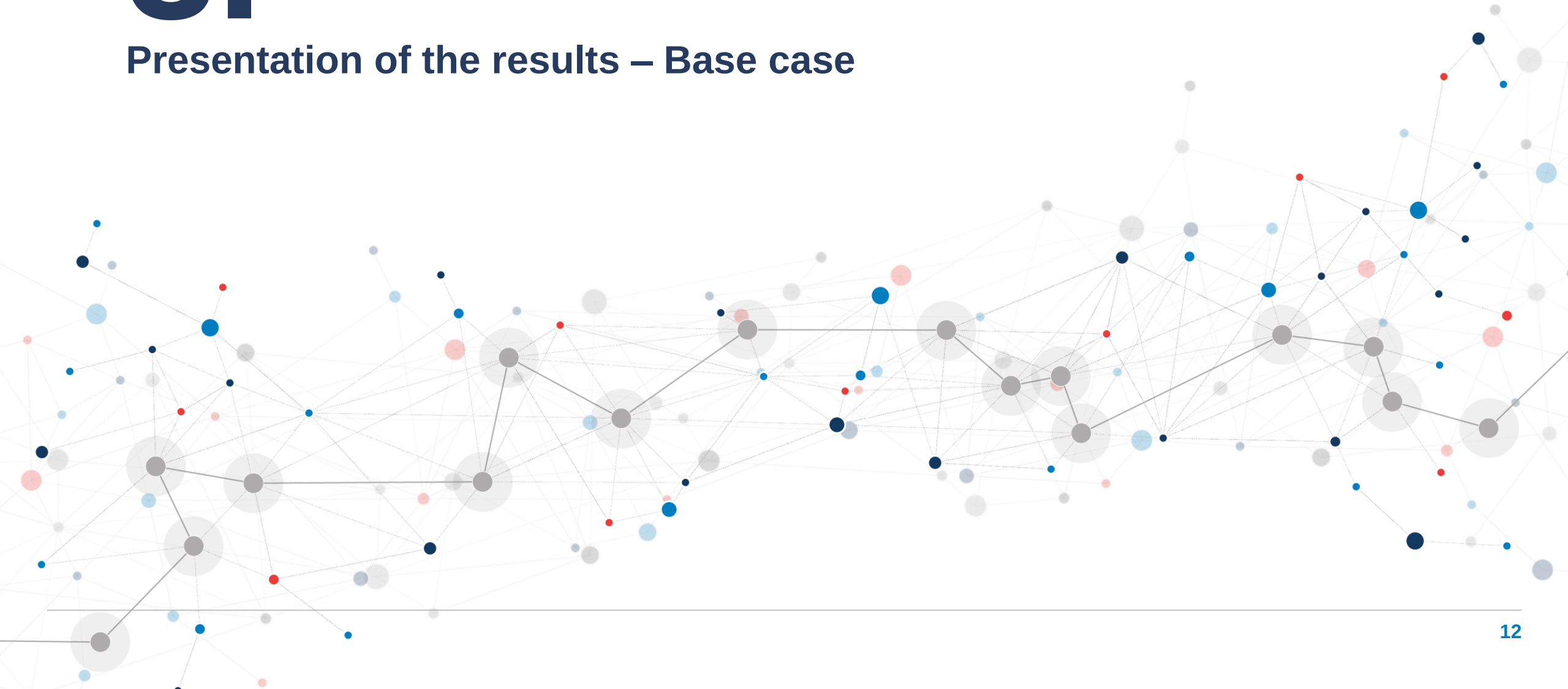
TYNDP 22 "Global Ambition"

	Distributed Energy Higher European autonomy with renewable and decentralised focus	Global Ambition Global economy with centralised low carbon and RES options
Green Transition	At least a 55 % reduction in 2030, climate neutral in 2050	
Driving force of the energy transition	Transition initiated at a local/national level (prosumers)	Transition initiated at a European/international level
	Aims for EU energy autonomy through maximisation of RES and smart sector integration (P2G/I.)	High EU RES development supplemented with low carbon energy and imports
Energy intensity	Reduced energy demand through circularity and better energy consumption behaviour	Energy demand also declines, but priority is given to decarbonisation of energy supply
	Digitalisation driven by prosumer and variable RES management	Digitalisation and automation reinforce competitiveness of EU business
Technologies	Focus of decentralised technologies (PV, batteries, etc.) and smart charging	Focus on large scale technologies (offshore wind, large storage)
	Focus on electric heat pumps and district heating	Focus on hybrid heating technology
	Higher share of EV, with e-liquids and biofuels supplementing for heavy transport	Wide range of technologies across mobility sectors (electricity, hydrogen and biofuels)
	Minimal CCS and nuclear	Integration of nuclear and CCS

Figure 2: Storylines for the two COP21 scenarios

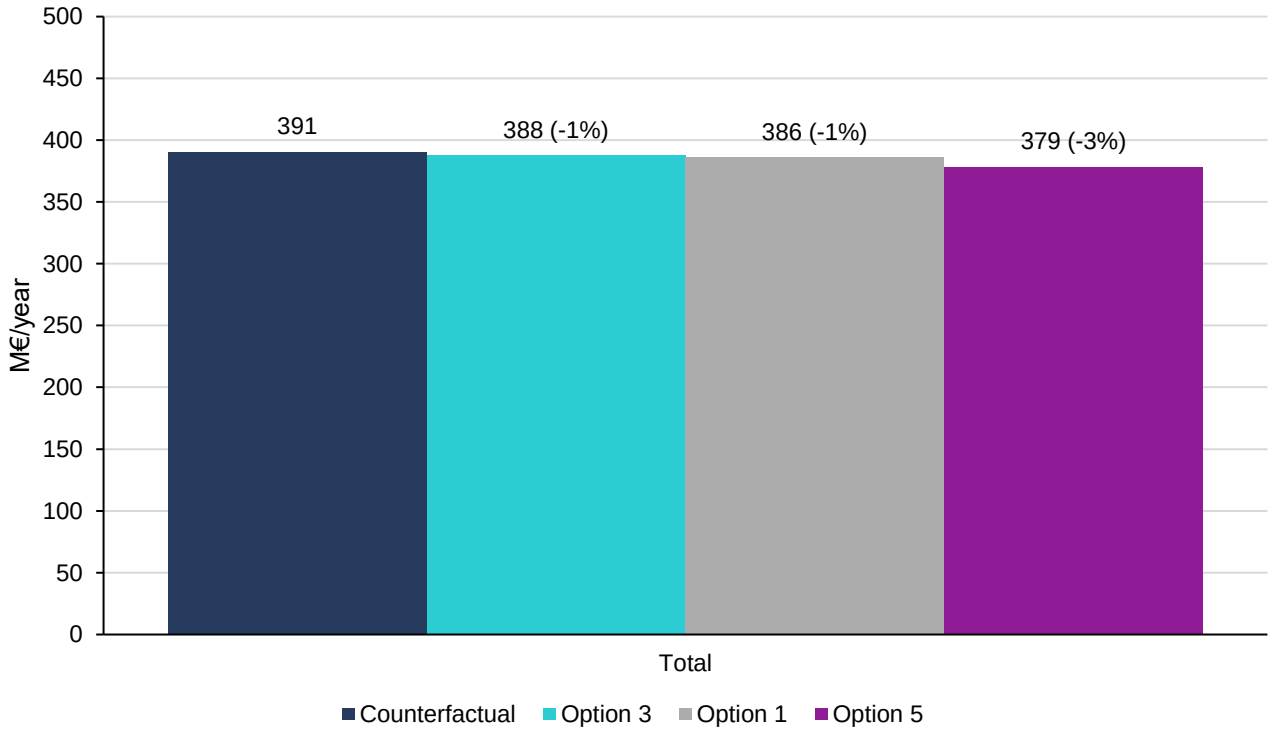
3.

Presentation of the results – Base case



Cross-border balancing options not based on the participation of GB in EU platforms have a limited impact on social welfare (limited cost reduction)

Activation cost – Different Options – Average 2030-2040 - Base Case

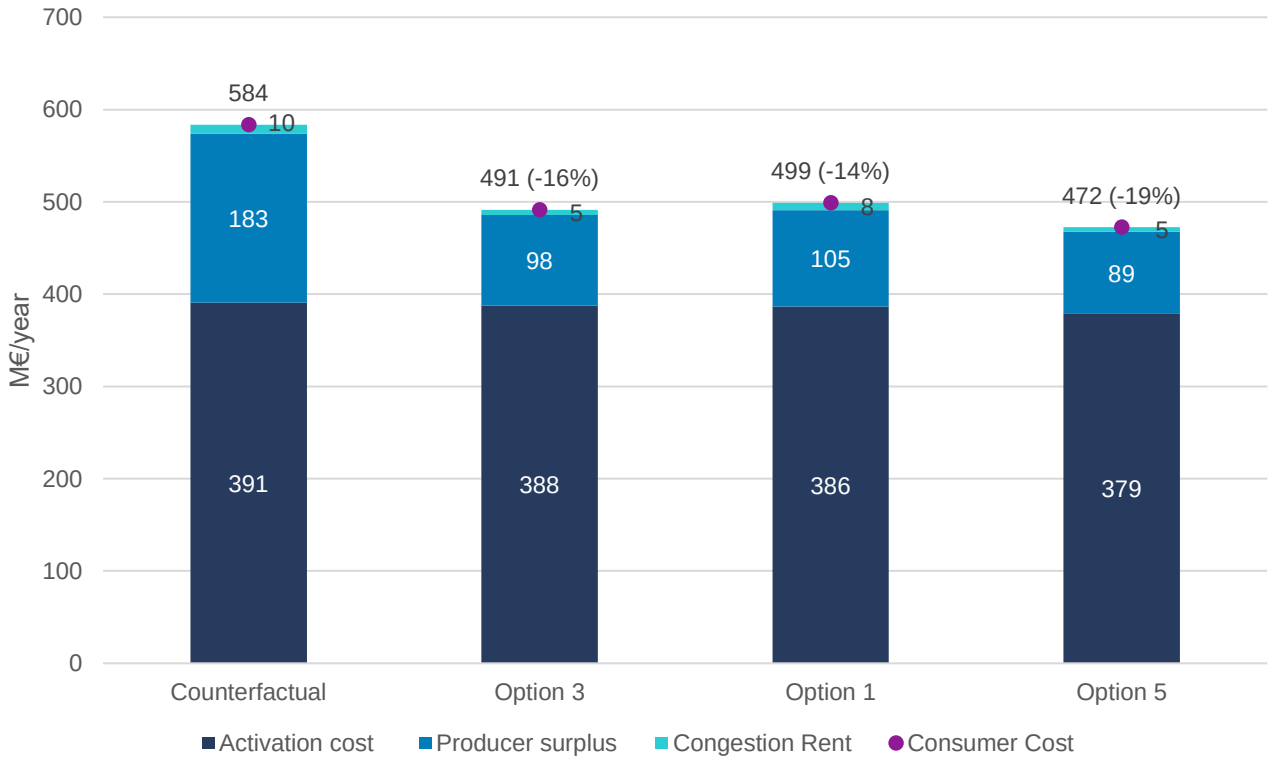


Activation cost is the sum of the activation costs of power plants over all modelled countries. The difference of activation costs between counterfactual and options represents the gain made by the platforms.

- In the base case, **activation costs are around 400M€. Cross-border balancing options not based on the participation of GB in EU platforms lead to a reduction of balancing activation costs of 1% to 3% between the counterfactual and the options over the period**.
- Benefits are limited by the **sharing strategy implemented in practice** by TSOs, but no learning effect is taken into account.
- But…
  - **Risk of overestimation** due to merging of balancing offer and demand (option 5) beyond potentially technically feasible
  - **Implementation issues and risk of market inefficiency** due to anticipated gate closure
  - Assumption on the **ability to share supply on EU side** as EU TSOs participating in TERRE / MARI have a legal obligation to place all their supply on these platforms.

Cross-border balancing options reduce consumer costs, mainly due to the breakdown of demand obtained through the platforms

Consumer cost – Different Options – Average 2030-2040 – Base Case

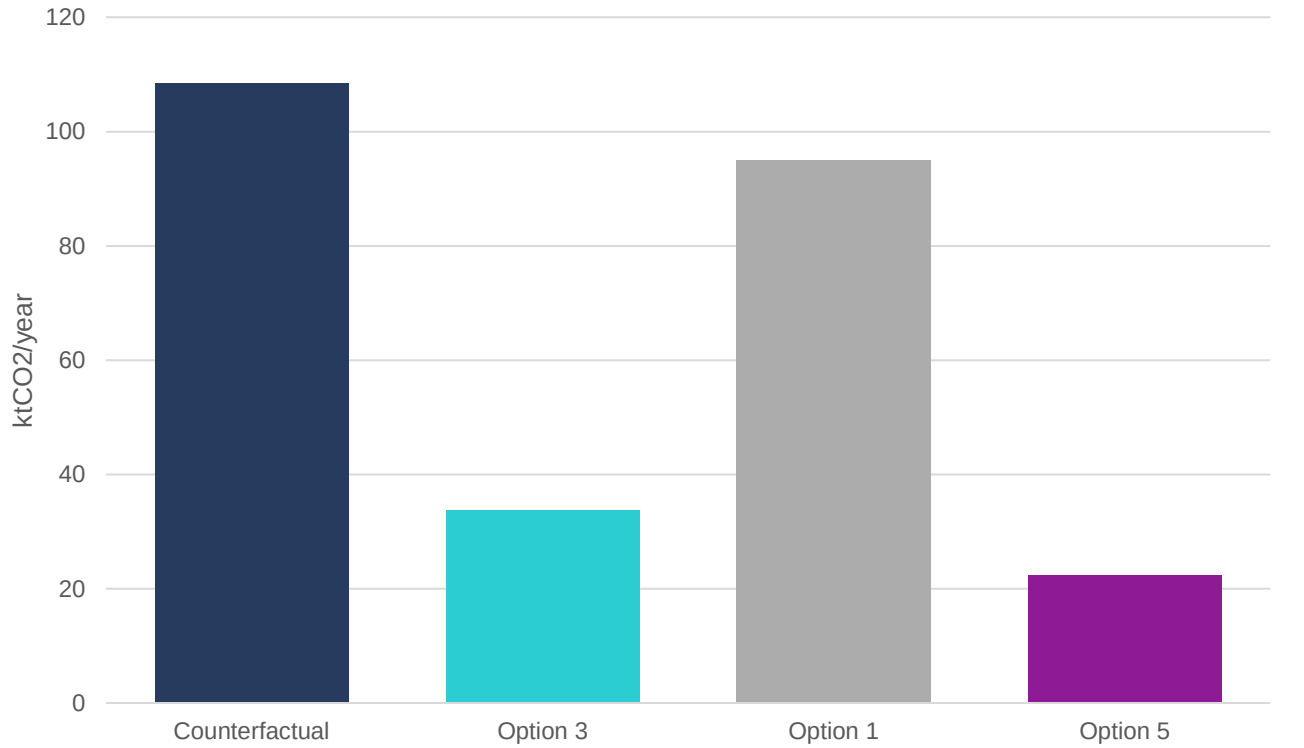


Consumer cost represents the cost paid by the final consumer (represented by the TSO in BMs), i.e. the load multiplied by the price paid for each of the countries modelled (deducted from revenues in downward mFRR and RR when the plants bought back their electricity)

- **Cross-border balancing options lead to a significant reduction** of consumer costs, because of **the rules for allocating demand between UK CBB and TERRE / MARI platforms and to price formation.**
  - The **reduction of demand in EU platforms** and UK domestic markets together with the sharing of the less expensive offers on these platforms lead to a price reduction in these platforms, applied to large volume.
  - This **reduction in prices in these platforms largely exceeds the similar or higher prices observed on the UK CBB platform**.
- **Option 5 seems to offer the greatest reduction in consumer costs**, but this is subject to the same limitations as regards the technical possibility of merging merit orders of two different products.

Cross-border balancing options allow for a reduction in CO2 emissions, albeit moderate when compared to the emissions of the power system

CO2 Emissions – Different Options – Average 2030-2040 – Base Case



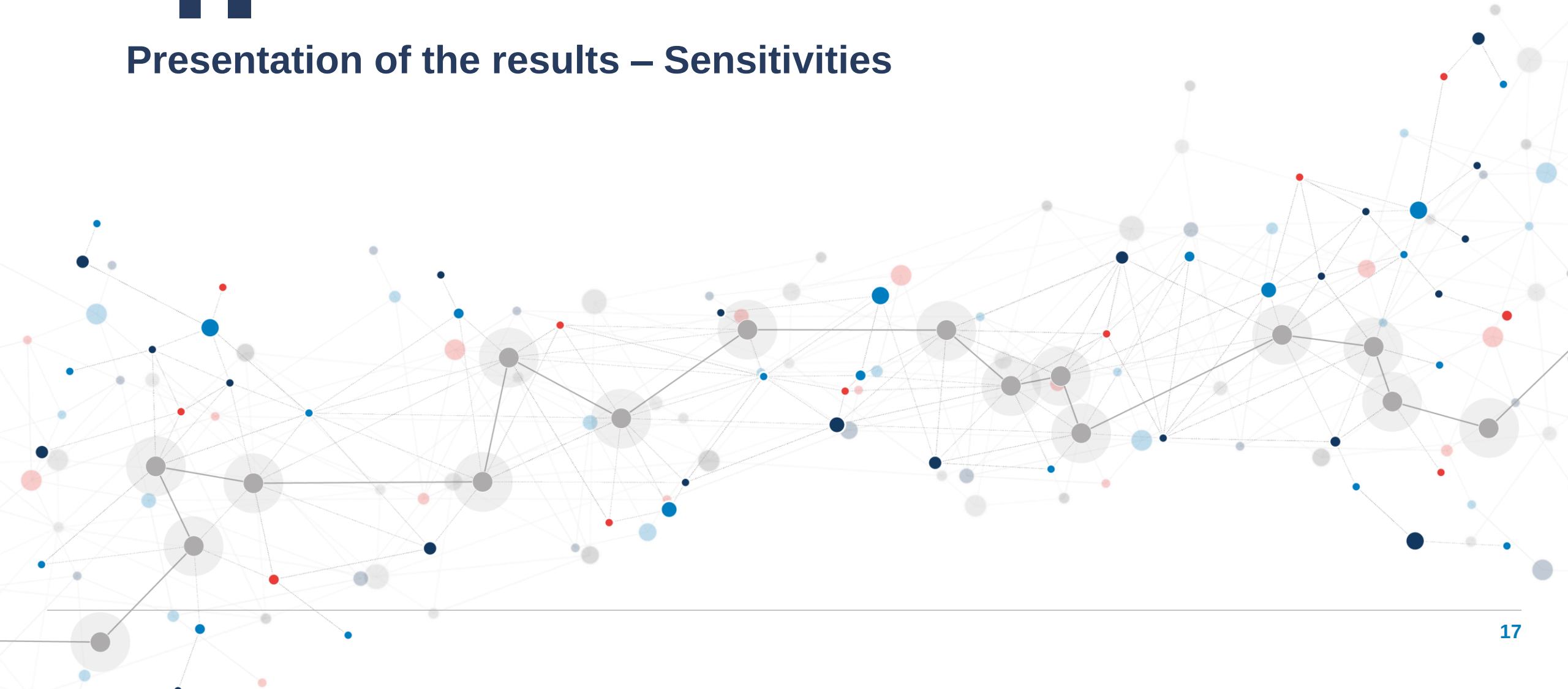
The values presented correspond to the CO2 emissions from thermal power plants activated during upward activation minus the reduction in CO2 emissions from thermal power plants activated during downward activation.

- **Cross-border balancing options lead to a significant reduction** of CO2 emissions in the base case and in all sensitivities.
- **Options 3 and 5 allow a significant reduction in CO2 emissions compared to the counterfactual** by allowing more decarbonised supply to be shared in upward mFRR and upward RR and more thermal supply to be shared in downward mFRR and downward RR.
- However, **CO2 emissions levels avoided by these options remain quite low when compared to the overall emissions of the power system, of the order of 200Mt in 2030 in our power dispatch model.**

Q&As

4.

Presentation of the results – Sensitivities

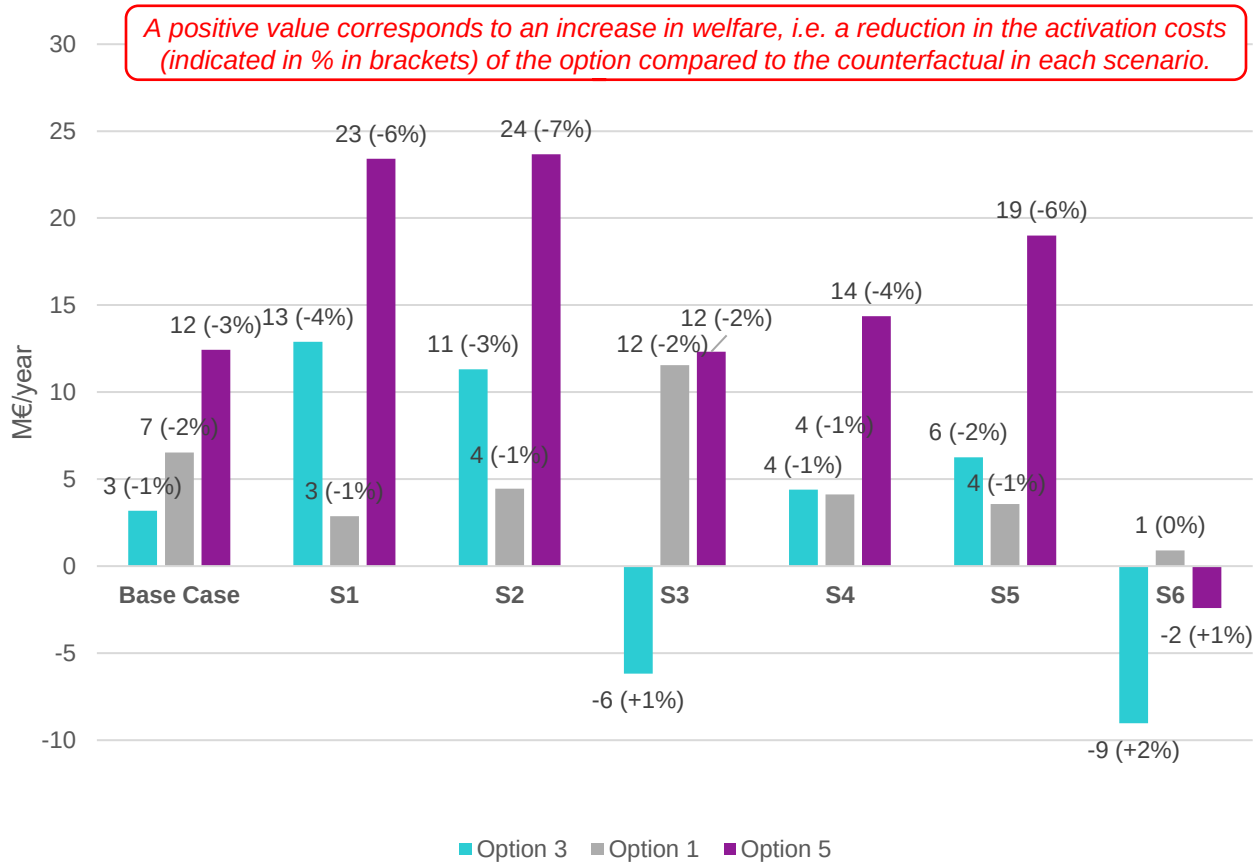


List of sensitivities to assess the uncertainties in these markets

1 Swapping Hydrogen out for Electrification of heating (GB)	▪ We consider a higher electrification of heating than in the base case (from 16 to 28 TWh) but a lower production of hydrogen by electrolysis (from 12 to 4 TWh). We use the values from the Consumer Transformation scenario (FES 22) instead of the System Transformation scenario (FES 22) in the base case.
2 UK interconnection capacity of 25GW from 2030	▪ We use an UK interconnection capacity of 25GW in 2030 instead of 13GW in the base case.
3 High gas prices in the long term	▪ Due to a gas shortage in Europe because of the war in Ukraine, gas prices will remain high in the long term (i.e. 75€/MWh in 2030 instead of 25€/MWh in the base case), with gas imports remaining low and relying mainly on LNG imports.
4 More renewables in European countries	▪ We consider more renewables in European countries: more offshore wind in Norway, more offshore wind in Sweden, more onshore wind and solar in Germany.
5 Increased involvement of new technologies	▪ We consider the involvement of new technologies to be twice as high in terms of proposed volumes as in the base case.
6 Share of balancing bids between domestic and cross-border platforms	▪ We consider a different share of balancing bids between domestic and cross-border platforms, placing 10% of bids on the UK CBB platform (rather than 30% in the base case) to represent a very constrained transmission network.

Compared to the counterfactual, options generally reduce the activation costs, but in rather small proportions (less than 7%) and sometimes even have a higher activation cost than the counterfactual

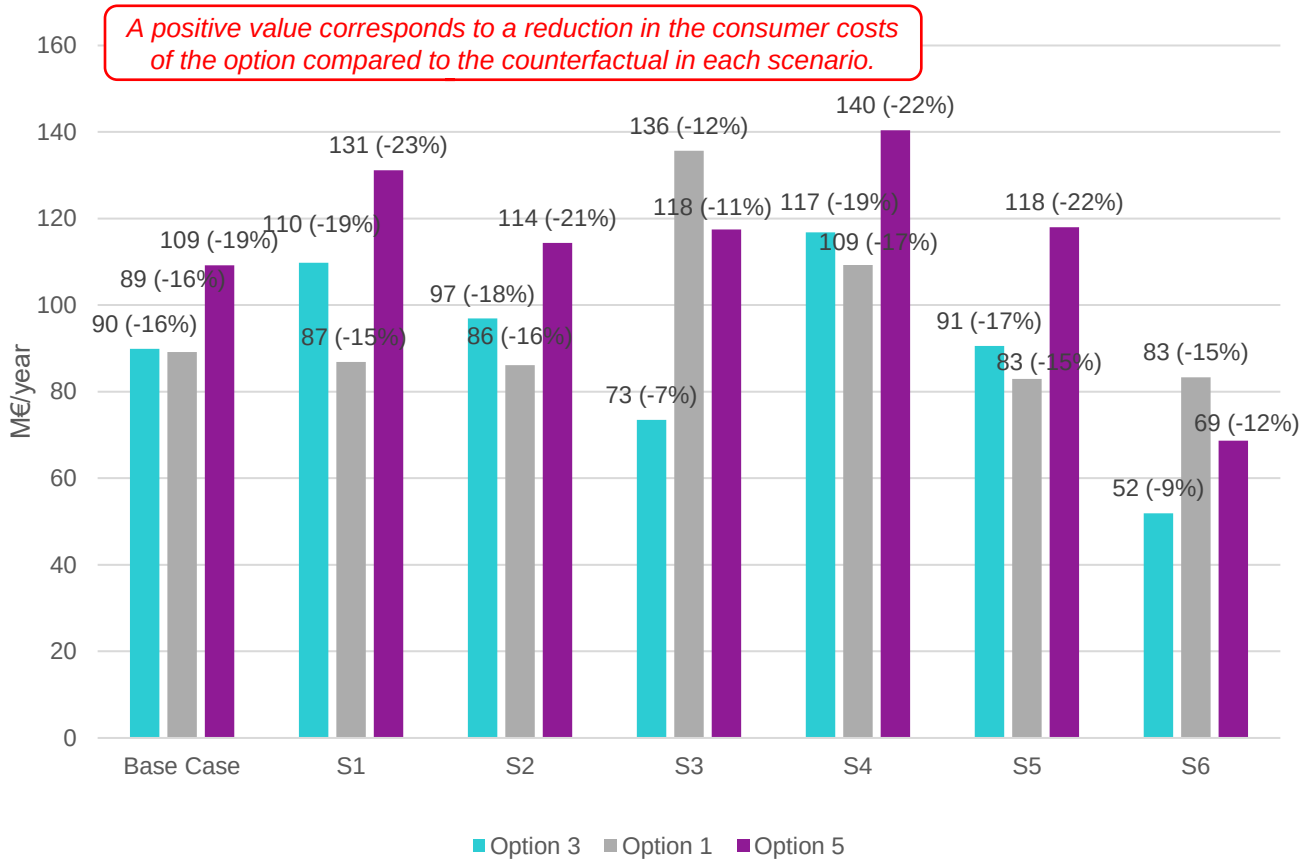
Additional welfare – Delta between Options and Counterfactual – 2030 – Base Case and Sensitivities 1 to 6 (S1 to S6)



- **Benefits of CBB tend to increase with higher interconnection (S2), higher heating electrification (S1) or higher participation of new technologies (S5).**
- **Option 5 seems to be the most economically efficient** of the options but **subject to significant risk of overestimation of gains**.
- **Option 1 also reduces activation costs** compared to the counterfactual, esp. when high gas prices (S3), but **raises major implementation issues and risk of market inefficiency**.
- Option 3 also reduces activation costs but to a lesser extent and not in all scenarios.
- In sensitivity 6, **a very constrained transmission** means a lower allocation of bids to the UK CBB platform resulting in **higher activation costs in options 3 and 5** than in the counterfactual.

Cross-border balancing options reduce the consumer costs compared to the counterfactual in all sensitivities, mainly due to the breakdown of demand obtained through the platforms

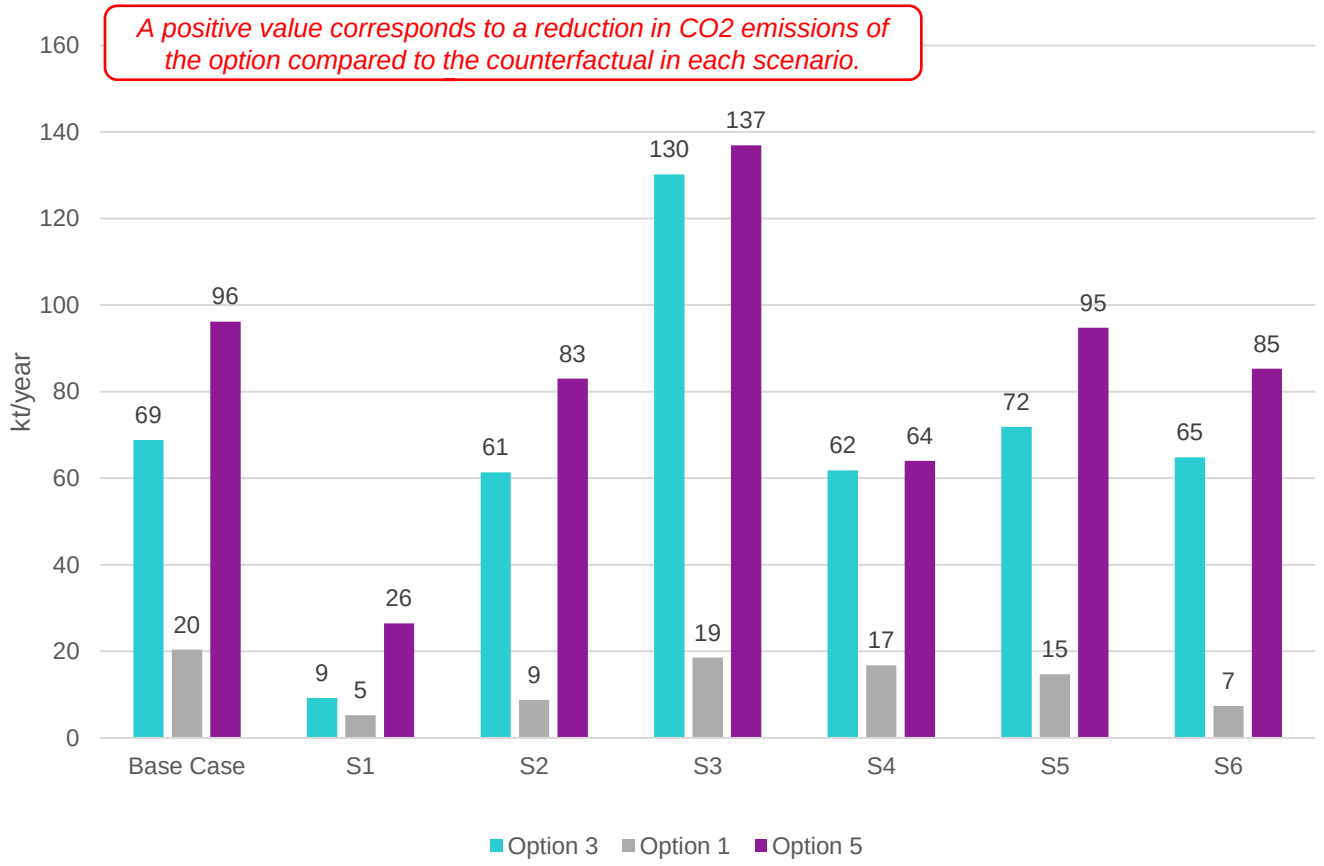
Consumer cost reduction – Delta between Options and Counterfactual – 2030 – Base Case and Sensitivities 1 to 6 (S1 to S6)



- **As in the base case, cross-border balancing options lead to a significant reduction** of consumer costs in all sensitivities, because of **the rules for allocating demand between UK CBB and TERRE / MARI platforms and to price formation.**
- **In most scenarios, option 5 seems to offer the greatest reduction in consumer costs**, but subject to the same limitations in the technical possibility of merging merit orders of two different products, as explained previously.

Cross-border balancing options allow for a reduction in CO2 emissions, albeit quite moderate when compared to the emissions of the overall power system

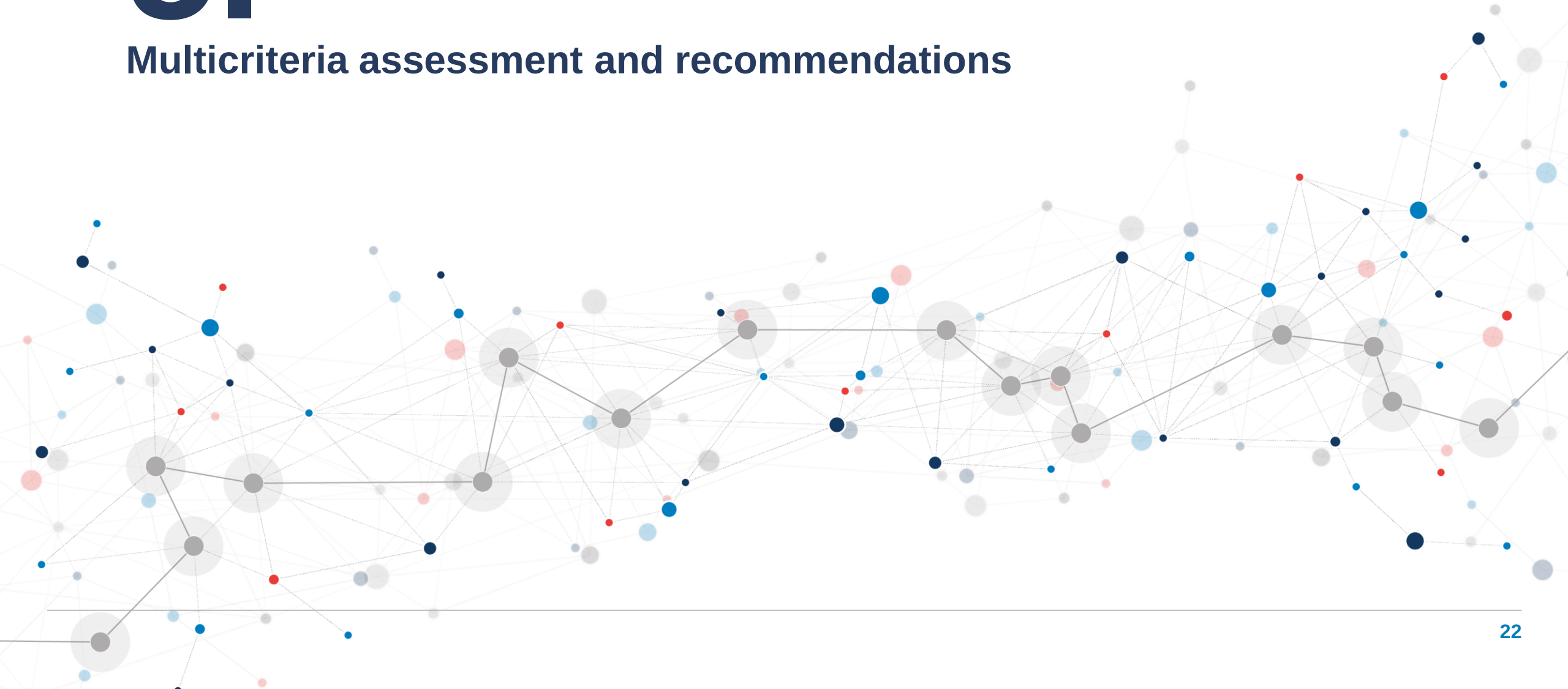
Reduction in CO2 emissions – Delta between Options and Counterfactual – 2030 – Base Case and Sensitivities 1 to 6 (S1 to S6)



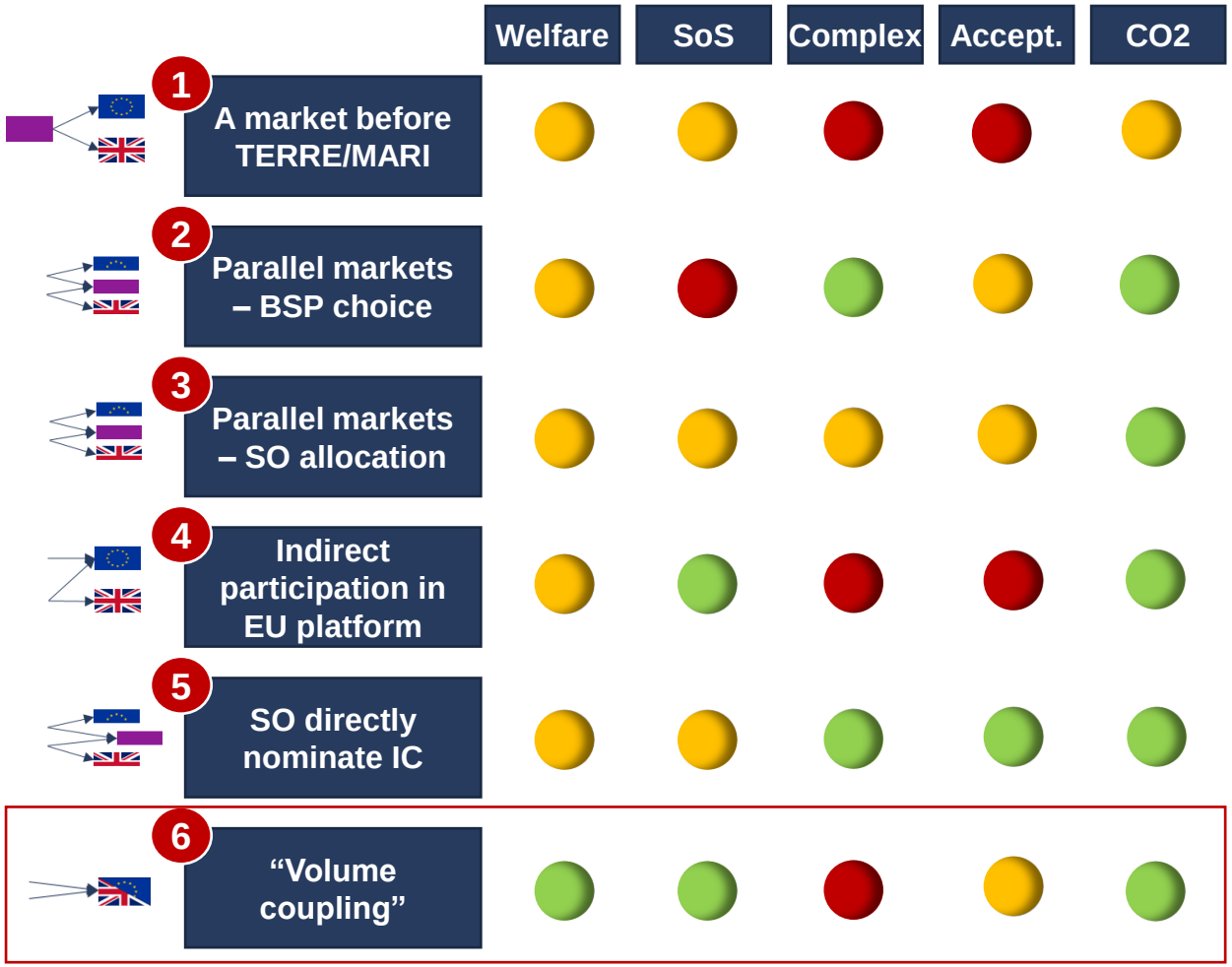
- **Cross-border balancing options lead to a reduction of CO2 emissions** in the base case and in all sensitivities.
- **Options 3 and 5 allow a significant reduction in CO2 emissions compared to the counterfactual** by allowing more decarbonised supply to be shared in upward mFRR and upward RR and more thermal supply to be shared in downward mFRR and downward RR.
- However, **CO2 emissions levels avoided by these options remain quite low when compared to the overall emissions of the power system** (c.200Mt in 2030 in our model).

5.

Multicriteria assessment and recommendations

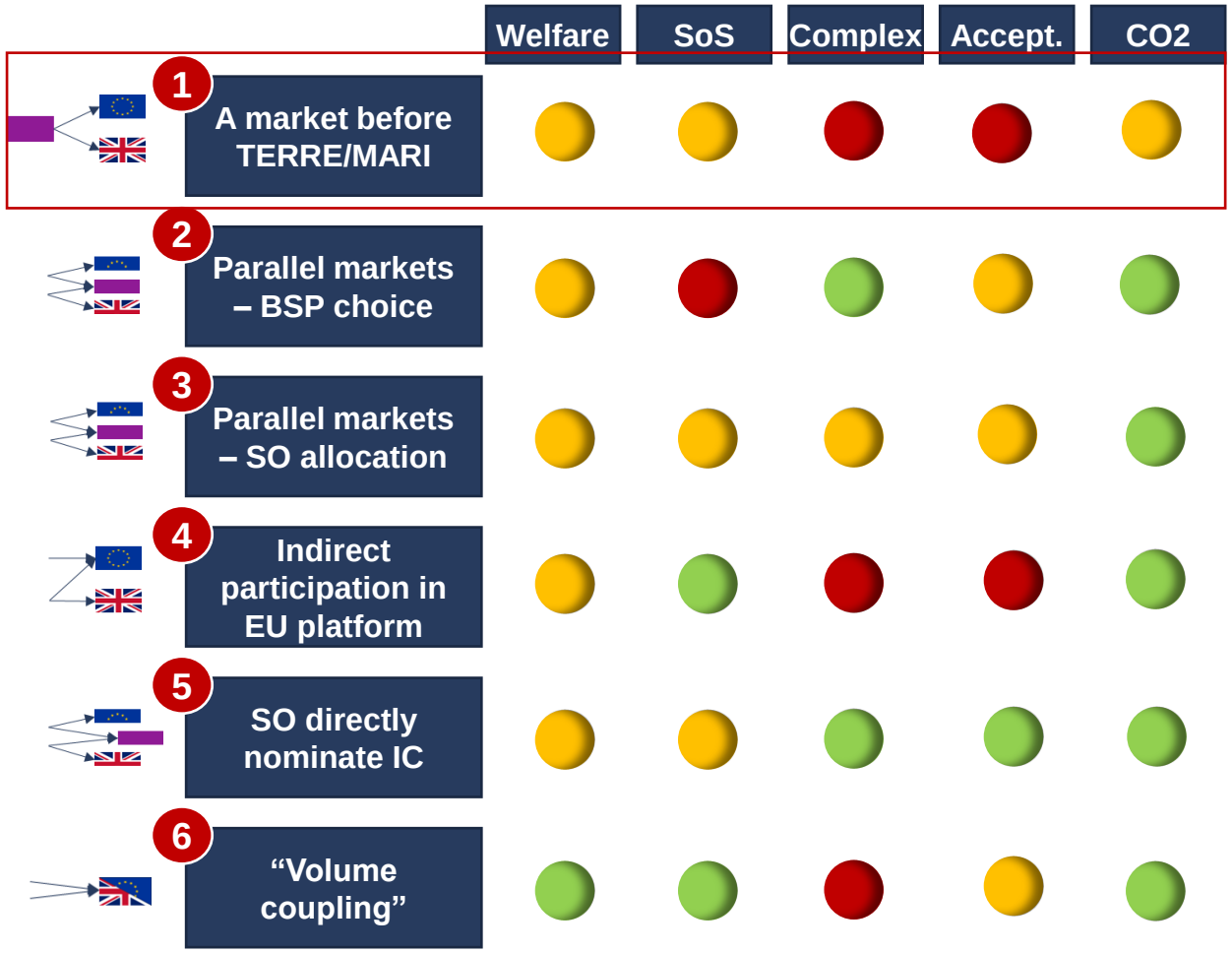


The different options imply a trade-off between welfare and complexity



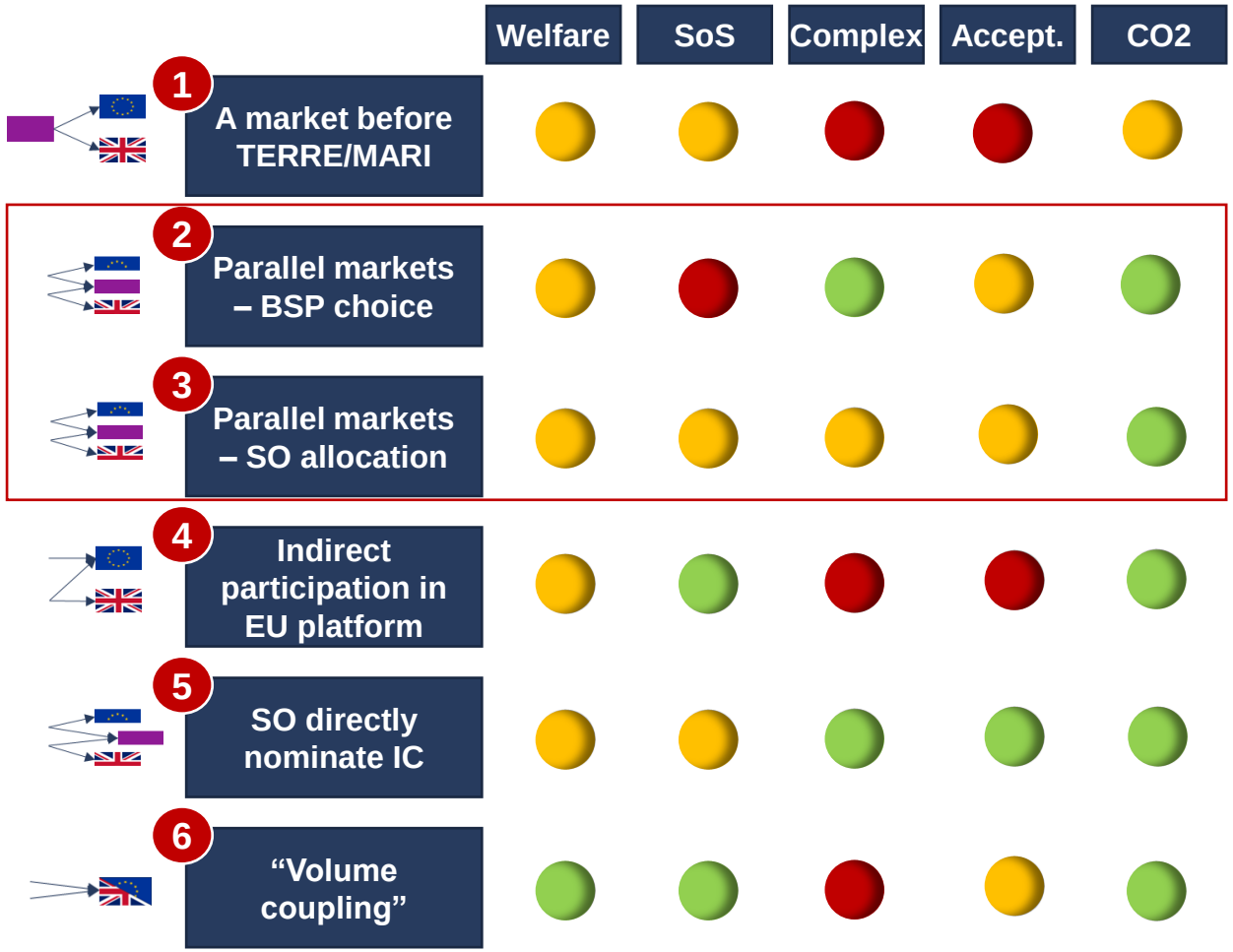
- **Option 6 - “Volume Coupling” would likely provide the highest welfare** – close to a full participation of UK to EU platforms – and increase security of supply, although its **operational complexity could be a barrier to its implementation**.

The different options imply a trade-off between welfare and complexity



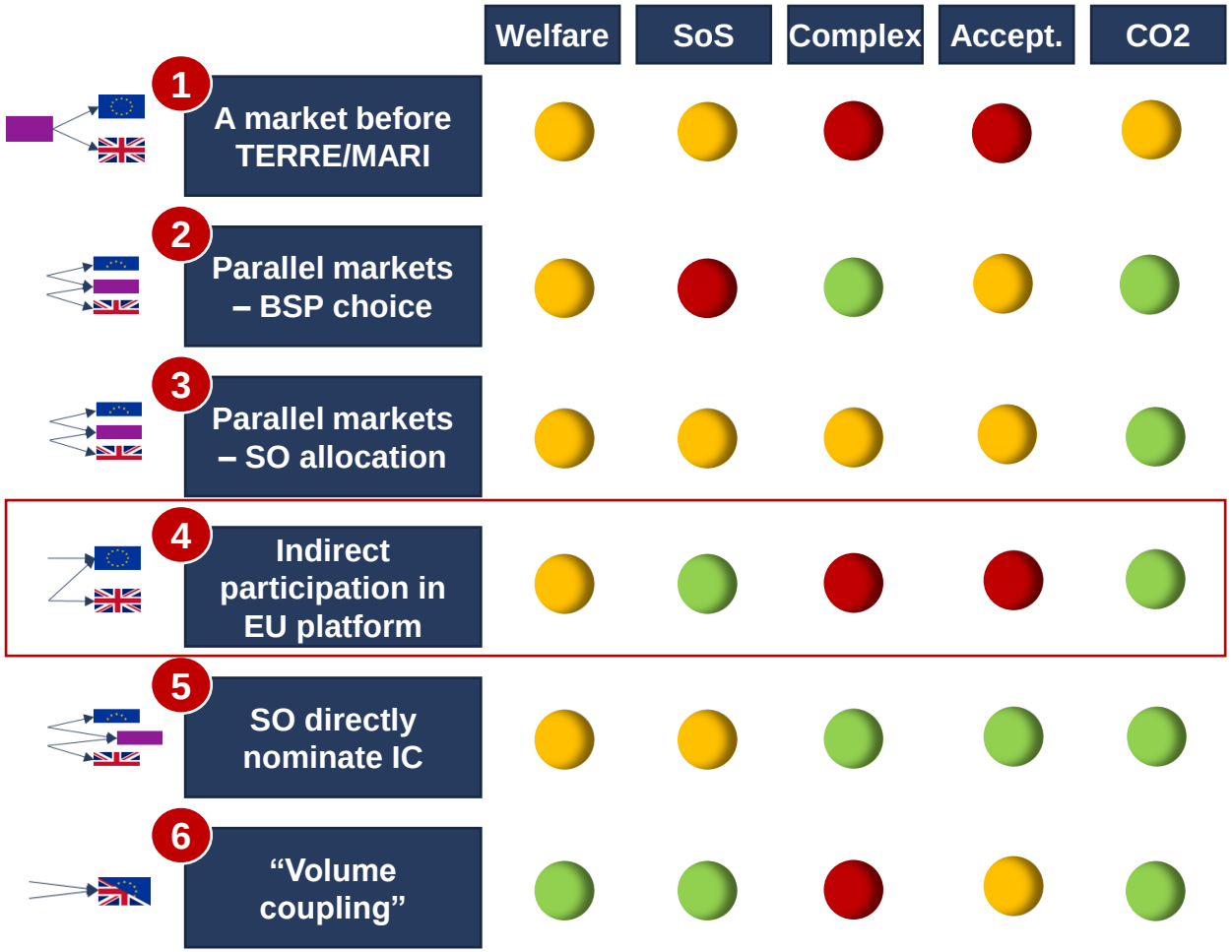
- On the other hand, other options would likely provide modest benefits, which will also greatly depend on how bids/offers will be split between domestic markets and the UK-EU CBB platform.
  - Option 1 would involve a limited number of countries, but may provide some benefits. **The main obstacle of this option is the operational implications**, as the ID GCT would need to be anticipated. This could be complex, detrimental to the overall efficiency of the market and unacceptable to many stakeholders, including TSOs.

The different options imply a trade-off between welfare and complexity



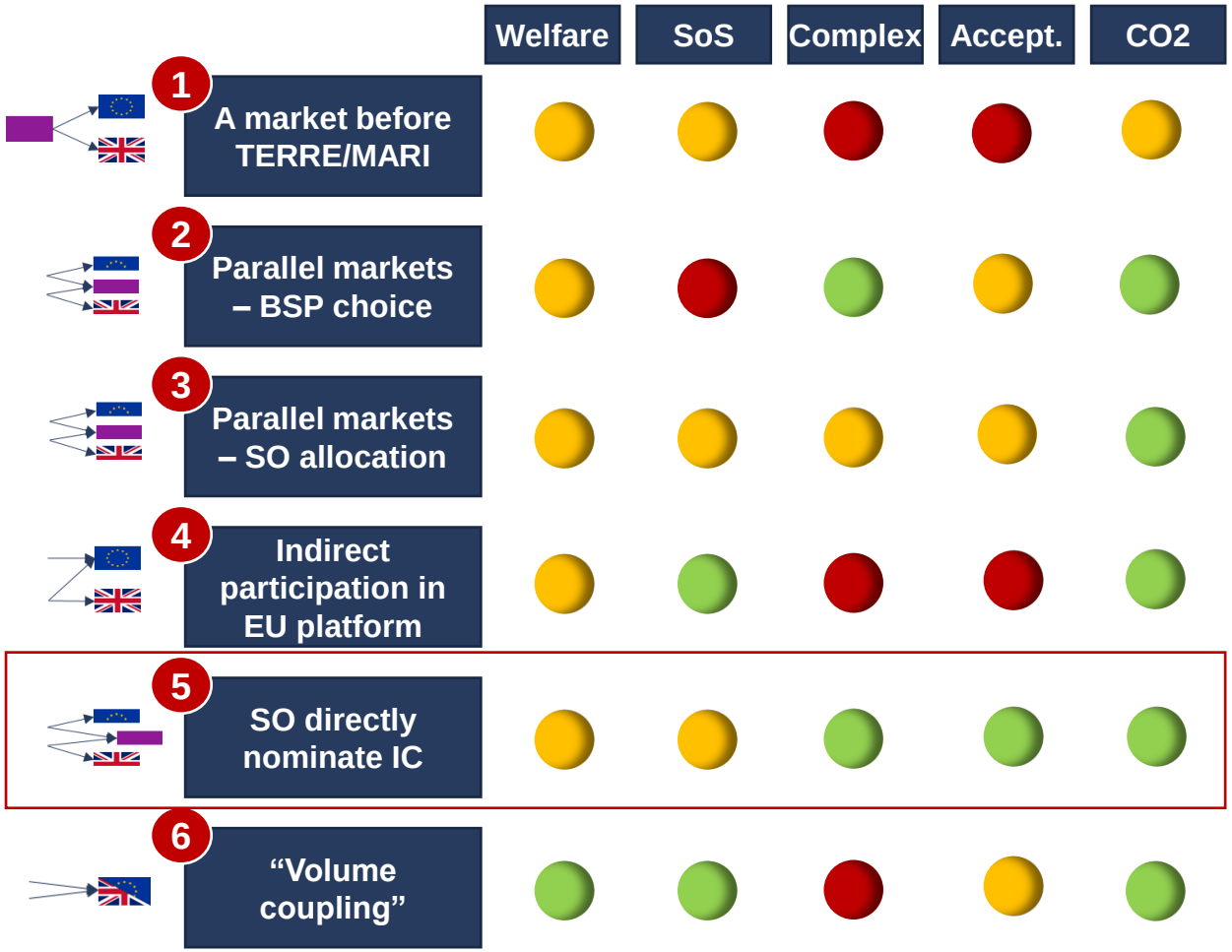
- On the other hand, other options would likely provide modest benefits, which will also greatly depend on how bids/offers will be split between domestic markets and the UK-EU CBB platform.
  - Options 2 and 3 **would require lower complexity, but our modelling has shown limited economic benefits** – about 3M€/year and could even be negative.
    - These benefits would be highly subject to the learning process of TSOs (and BSPs in option 2), which may desert the CBB or on the contrary optimise and coordinate their participation to improve results.
    - The legal possibility of sharing bids for EU parties would have to be confirmed as it seems contradictory to EU regulation.
    - Finally, option 2 leads to a loss of visibility and control on available resources, which could affect security of supply.

The different options imply a trade-off between welfare and complexity



- On the other hand, other options would likely provide modest benefits, which will also greatly depend on how bids/offers will be split between domestic markets and the UK-EU CBB platform.
  - **The benefits of option 4 are difficult to capture** as it depends on the ability to split net demand and offer amongst the different interconnectors. Moreover, beyond its complexity, **this option is likely to face legal barriers to the participation of a UK representative party in EU platforms and lack of acceptability** as it could be perceived as asymmetric and non-reciprocal.

The different options imply a trade-off between welfare and complexity



- On the other hand, other options would likely provide modest benefits, which will also greatly depend on how bids/offers will be split between domestic markets and the UK-EU CBB platform.
  - **Option 5 appears as a pragmatic approach** although its actual benefits depend on the actual use of the CBB platform by the TSOs. The modelling results are **likely overestimating the benefits** for a given participation strategy as it does not fully reflect the technical characteristics and needs. This may **lead to a situation of low benefits compared to high implementation costs**.

Key takeaways

1. All the options analysed present some drawbacks and/or **operational difficulties** and the **modelling of these options is complex** as it **strongly depends on how these options will be operationally used by the SOs** and to what extent they will share their supply and demands.

2. **The most promising options seem to be option 5** where TSOs voluntarily share balancing bids and offers and can request activations on an ad hoc basis and **possibly option 3** with parallel markets and where TSOs allocate supply and demand between the domestic/EU platforms and the UK CBB platforms.

3. Option 1 (a market before TERRE/MARI), option 4 (indirect participation in EU platform) and option 6 (Volume coupling) **present very significant complexities and depend heavily on the willingness of TSOs to engage in this integration work.**

Q&As

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