Dispatch ‘Case for Change’ Workshop Pre-read

8th March 2024

ESO

Introduction

- We are concerned that the current GB Dispatch Mechanism design, including the Balancing Mechanism, is not working as intended.
- ESO is now supporting DESNZ' REMA Programme by leading the 'Dispatch' workstream. This includes options for reform to the Balancing Mechanism.

Objectives for the workshop:

1. Get your feedback on whether you agree with the challenges identified, and whether we have missed anything
2. Capture the impact of these challenges on market stakeholders

Next Steps following the workshop

Case for Change

- We will publish slides and a summary of the discussion to our Net Zero Market Reform website
- Integrate workshop feedback into final report on ‘Case for Change’

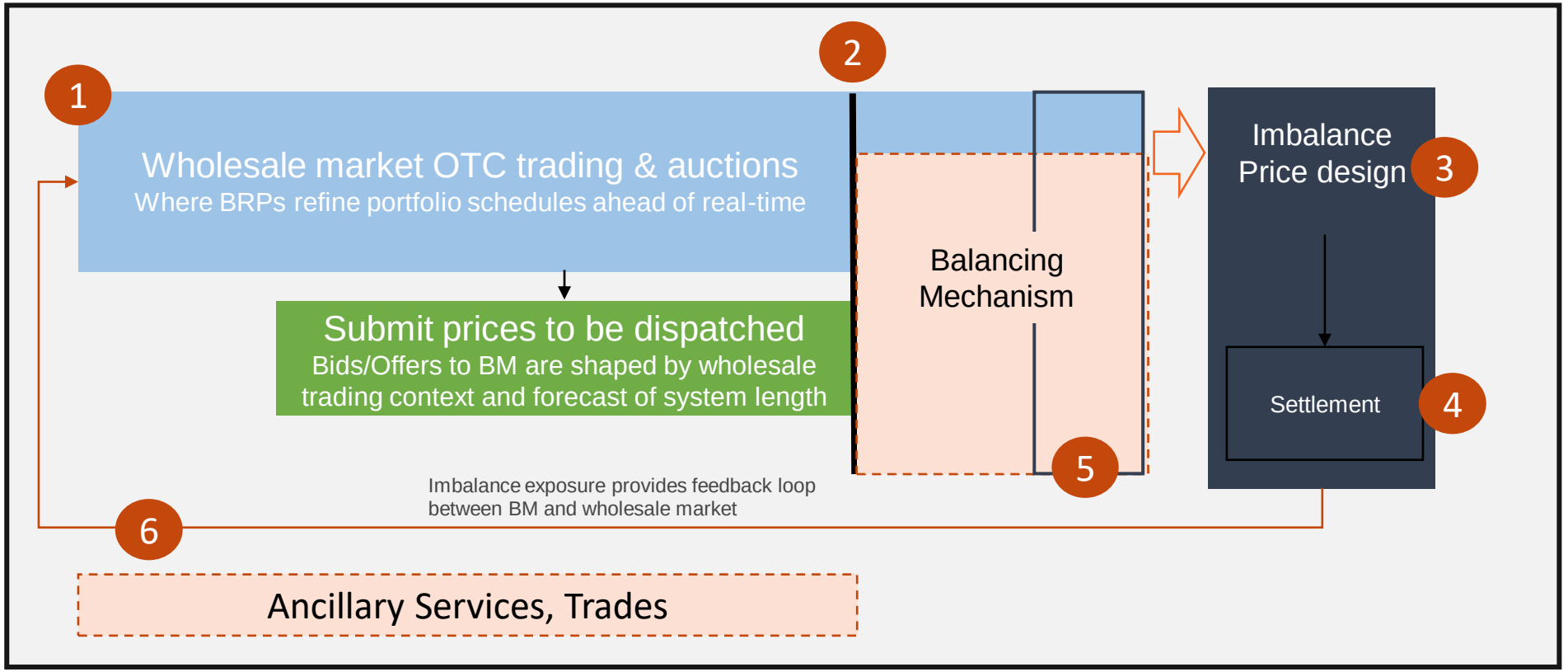
Options for Reform

1. **Industry idea generation:** Following the workshop, we will welcome organisations sending us their proposals for how the issues raised can best be addressed
2. **ESO option sharing:** We plan to run a follow-up workshop outlining the spectrum of options we have identified to address the issues raised, **likely in May**

Scope of this work

GB Dispatch Design includes multiple interlocking features governed by different parties, and sets ESO up to be a residual balancer

1. Design of spot markets
2. Timing of Gate Closure
3. Balancing Market or Mechanism
4. How is imbalance exposure allocated (i.e profiled or case based settlement)
5. Settlement Period Length
6. Speed of feedback loop



Portfolio owners | Consumers (bills) | SO | Balancing Mechanism Participants

Why are we exploring the Case for Change?

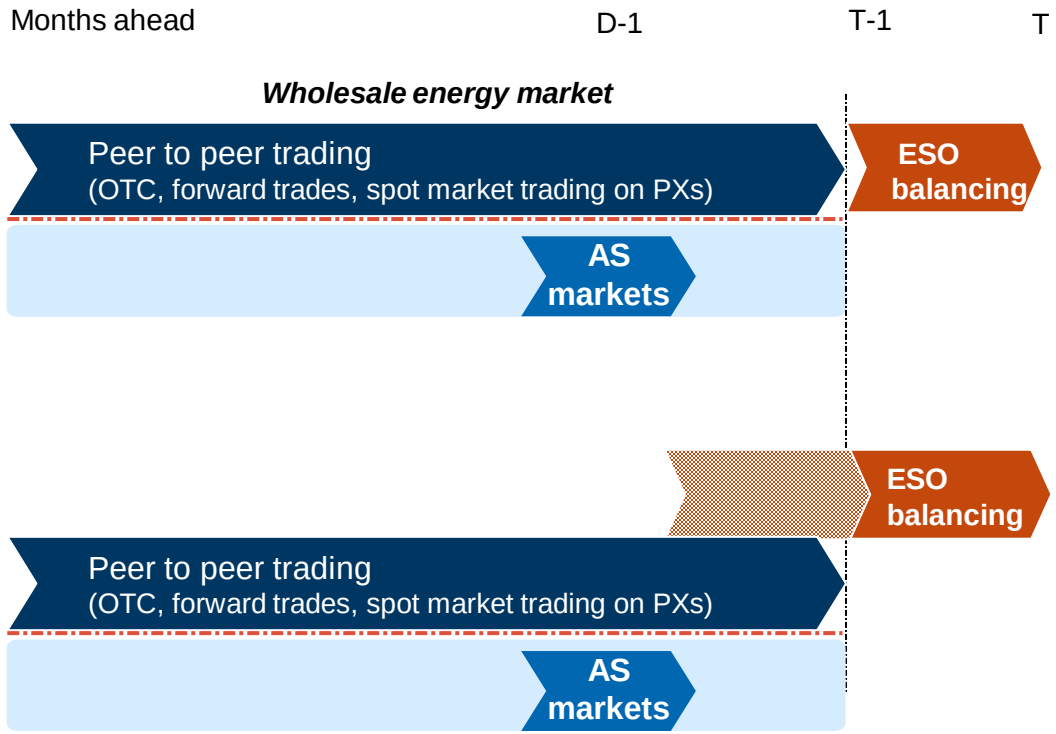
As operating the system becomes more challenging, we are concerned that ESO is becoming a ‘Central Scheduler’, contrary to its intended role

Theoretical GB market design

The GB market was designed assuming the ESO only intervenes at the last minute

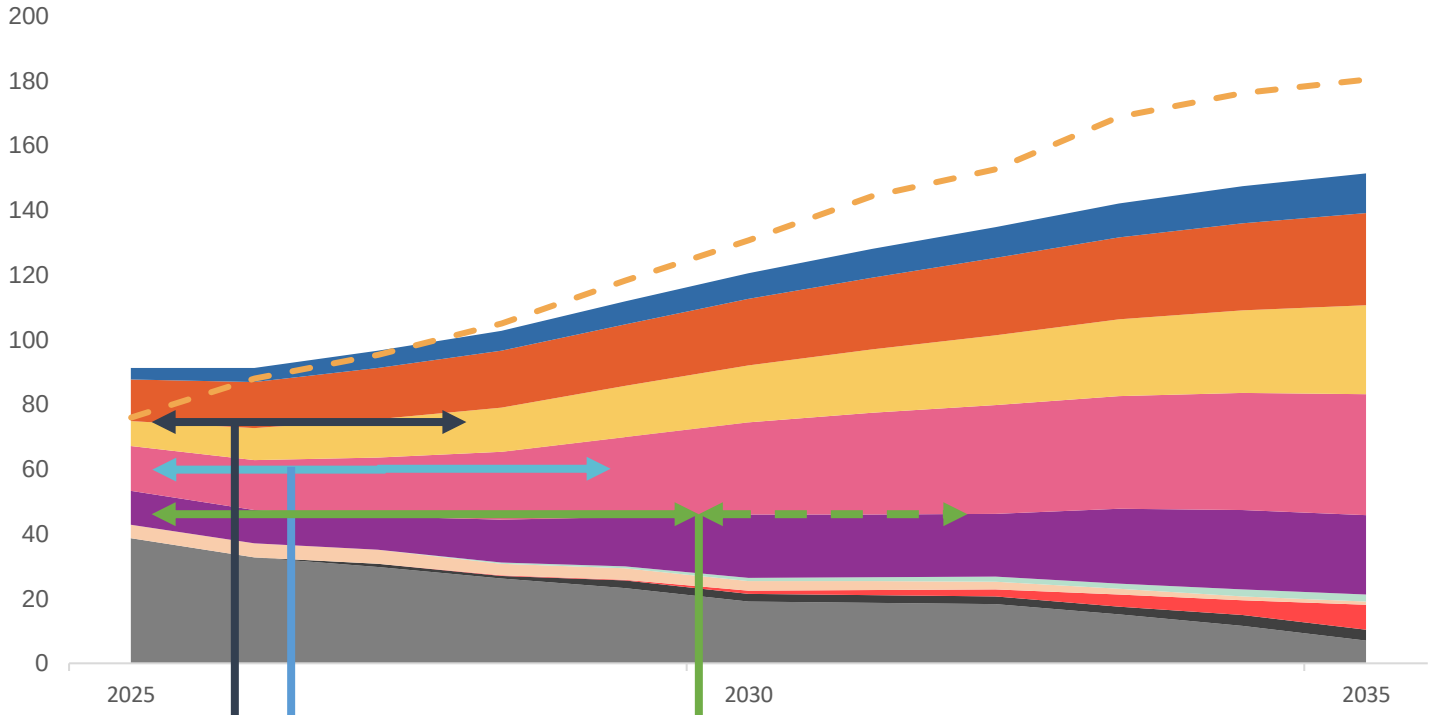
De facto GB market operation

As optimising the system becomes harder, ESO is overlapping with the wholesale market, creating confusing price signals



The growing overlap between ESO redispatch and wholesale market trading can create conflicting price signals and impact overall transparency

How does this work fit with other ESO programmes?



Key:

- Electrolysis
- DSR
- V2G
- Storage
- Interconnectors
- BECCS
- Biomass
- Hydrogen
- Gas CCUS
- Gas
- Renewables

Wholesale market design and implementation

Wholesale market implementation complete depending on design

Flexibility Strategy — Low/non regrets reforms to promote the growth of zero carbon flexibility

REMA — Enduring electricity market arrangements to support net zero system in 2035

Balancing Programme — Development of the Open Balancing Platform

Market Reforms

Systems development

Note: Year ranges represent illustrative implementation dates

ESO scheduling and dispatch

A case for change

AFRY MANAGEMENT CONSULTING

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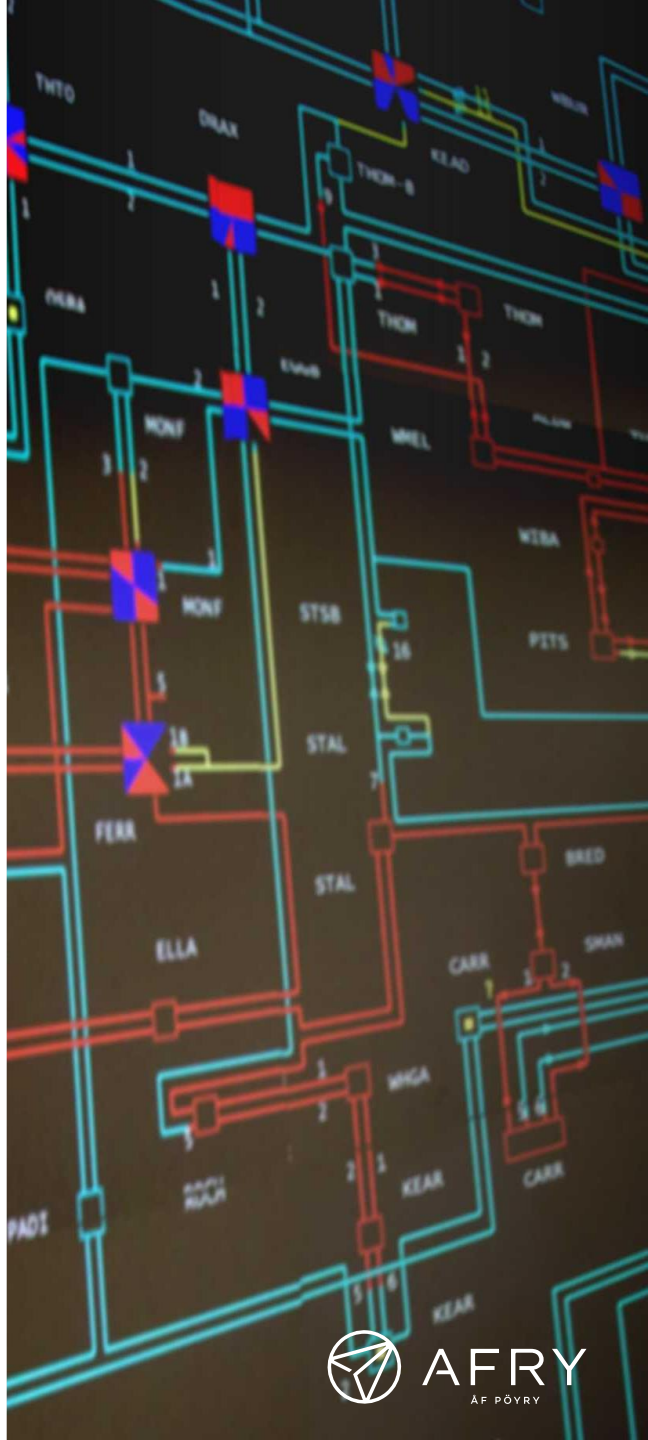
3. Conclusions 52



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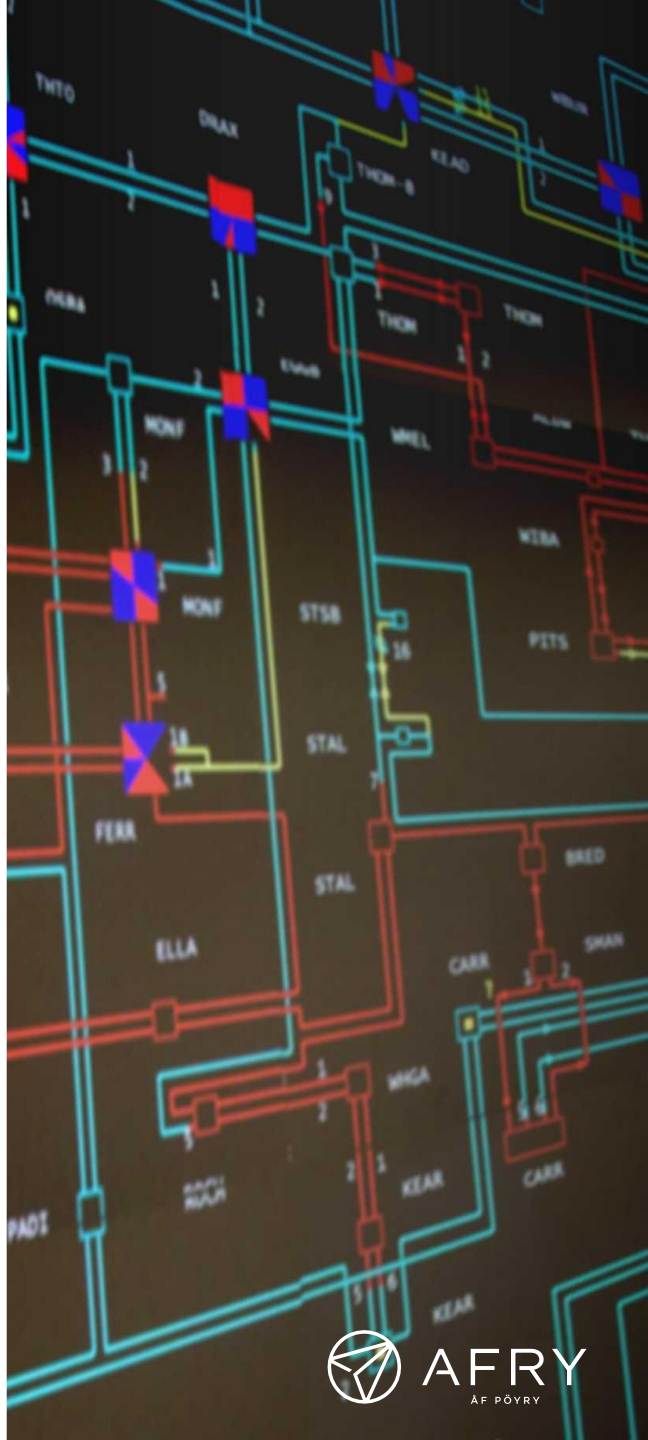

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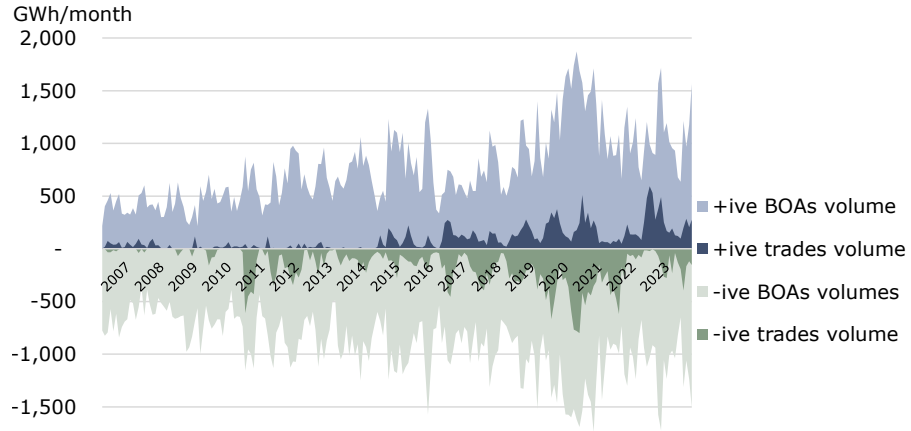
A lot has changed since the introduction of NETA

ESO is increasingly acting as a central scheduler in a market environment designed for a residual balancer

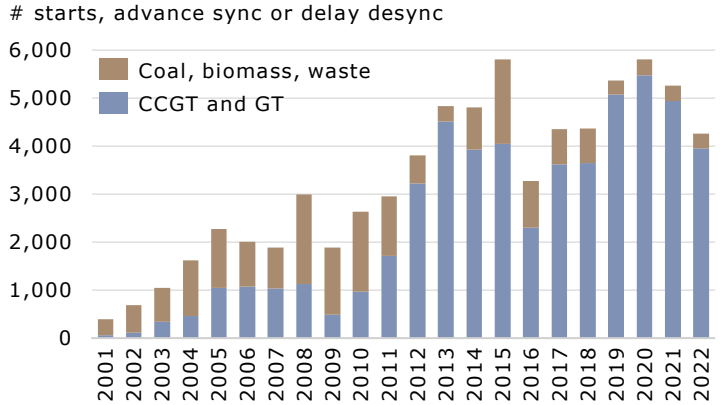
While the need for balancing actions grows, ESO faces an increasing level of uncertainty and variability, compounding the difficulty and the potential for inefficient decisions

There is a greater need for forward-looking decisions, and the BM was not designed to optimise over multiple timeframes or to deliver transparent forward-looking prices

MONTHLY BALANCING VOLUMES (BOAS AND TRADES), 2006-2023



NUMBER OF UNIT COMMITMENT DECISIONS THROUGH THE BM, 2001-2022



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There is a clear case for change of the ‘status quo’ as the underlying conditions have changed since NETA was introduced

What are the key limitations of the ‘status quo’ scheduling and dispatch regime?

1. **Incentives** — The energy markets do not provide scheduling incentives in line with system needs and operational requirements
2. **Visibility and access** — Incomplete ESO visibility of market outcomes and limited access to some resources impacts coherence between wholesale market and balancing
3. **Intertemporal issues** — The current dispatch mechanism does not facilitate effective optimisation of costs and unit constraints over time

In addition to network capacity challenges, the limitations of the current market design challenge system operation and can result in inefficient dispatch

		Reason for ESO actions			
		Energy balance	Network congestion	Reserve	Other system needs
Limitations of the current market design and processes	**Incentives**: The energy markets do not provide scheduling incentives in line with system needs and operational requirements				
	Visibility and access: Incomplete ESO visibility of market outcomes and limited access to some resources impacts coherence between wholesale market and balancing				
	Intertemporal issues: The current dispatch mechanism does not facilitate effective optimisation of costs and unit constraints over time				

While each aspect is potentially manageable individually, the combination of the three creates the current limitations of the scheduling and dispatch processes

Solving the underlying reasons for ESO action is another way to limit potential difficulties

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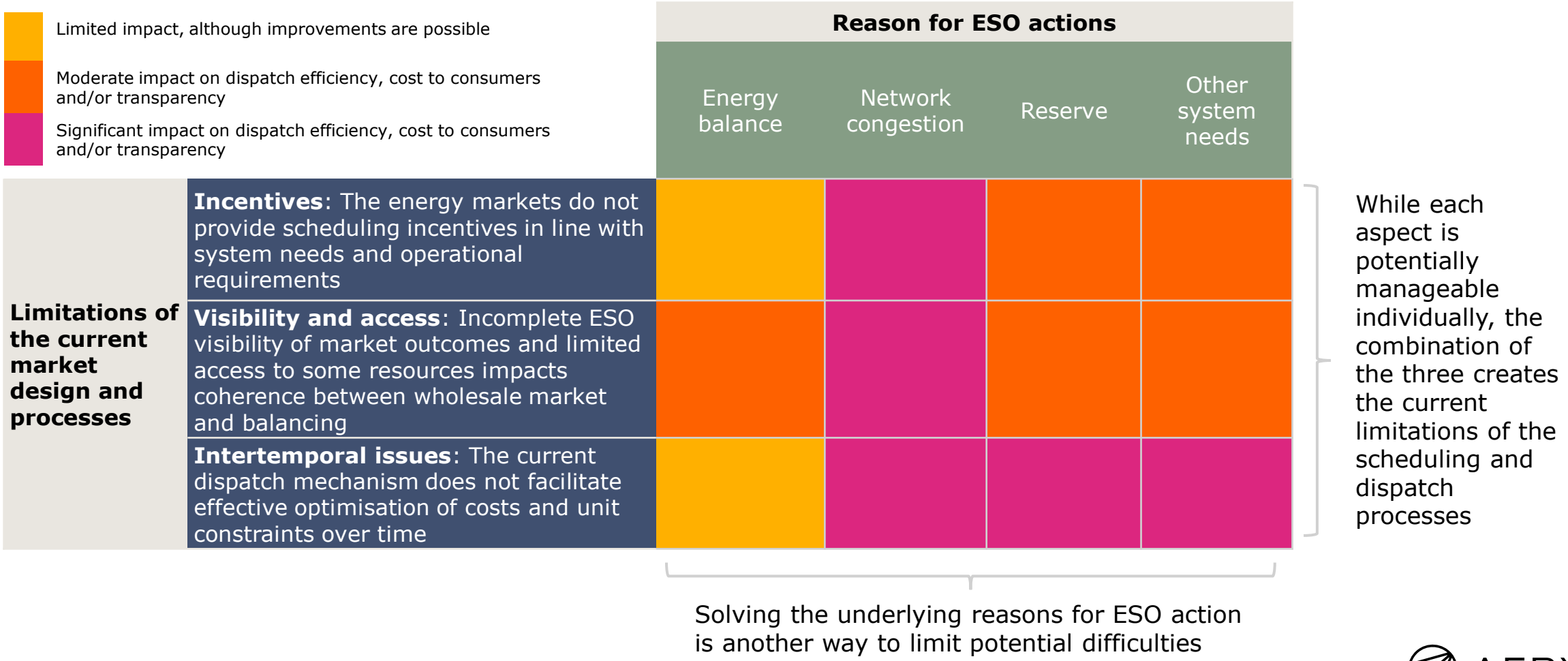
In addition to network capacity challenges, the limitations of the current market design challenge system operation and can result in inefficient dispatch



AFRY

What is less clear is what to change to …

There are two high-level approaches:

Giving market participants **better incentives** and better information to support system operation

This may include some or all of the following:

- shorter imbalance settlement intervals
- smaller zone size
- improved signals for ancillary services
- improved information sharing between market participants and ESO

Formalise ESO de facto role by giving **greater control earlier**

Effectively allowing ESO to coordinate unit commitment decisions and operation of energy-limited units, as well as within-day positions

Ongoing changes are expected to mitigate some specific manifestations of the issues

Recent or planned changes potentially mitigating identified issues

Incentives

- **Ongoing network capacity expansion**
- **Balancing Reserve will pre-contract some resources to provide reserve availability**
- **Half-hourly settlement**
- **Ofgem compliance engagement with storage regarding TCLC**

Visibility and access

- **GC117 proposal to reduce BMU threshold to 10MW**
- **Local constraint market (pilot for B6) will allow ESO access to more resources**

Intertemporal issues

- **Balancing reserve will reduce the need for pro-active scheduling actions in the BM**
- **Potential submission of data on energy limited units (within Gate Closure only)**
- **Ofgem inflexible offers licence condition**

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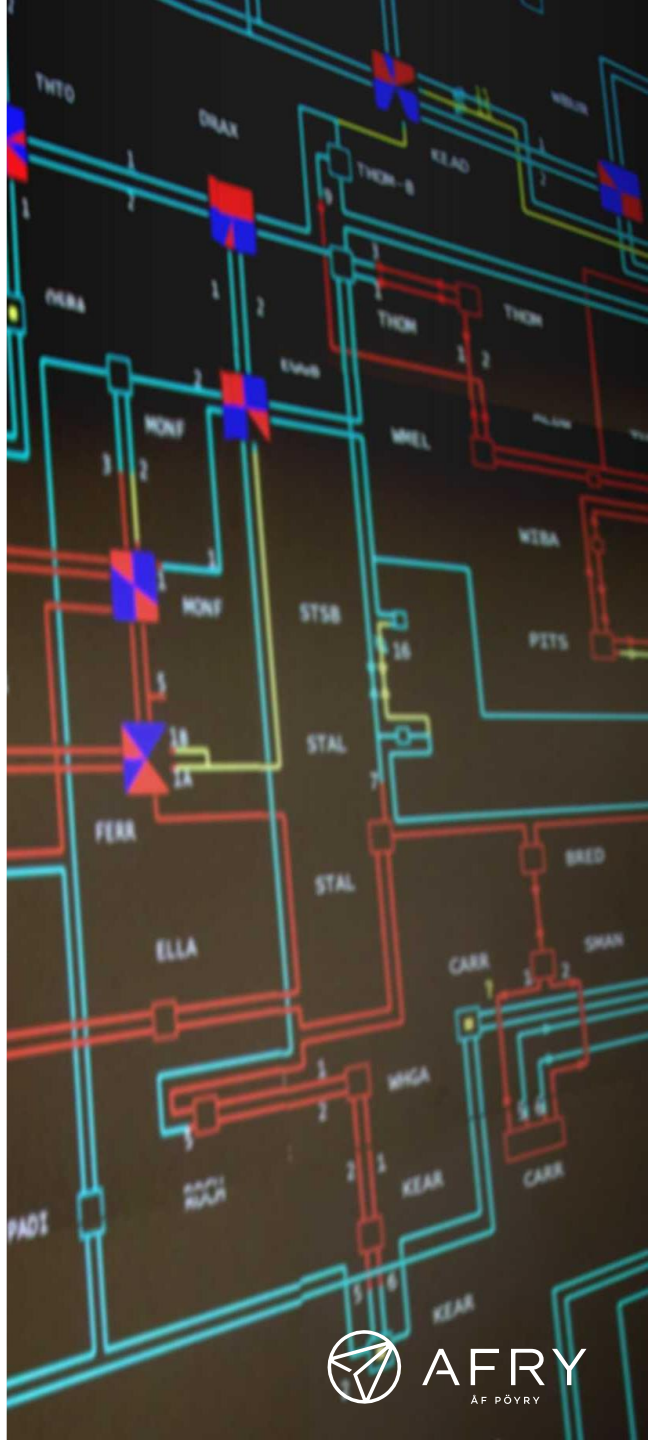

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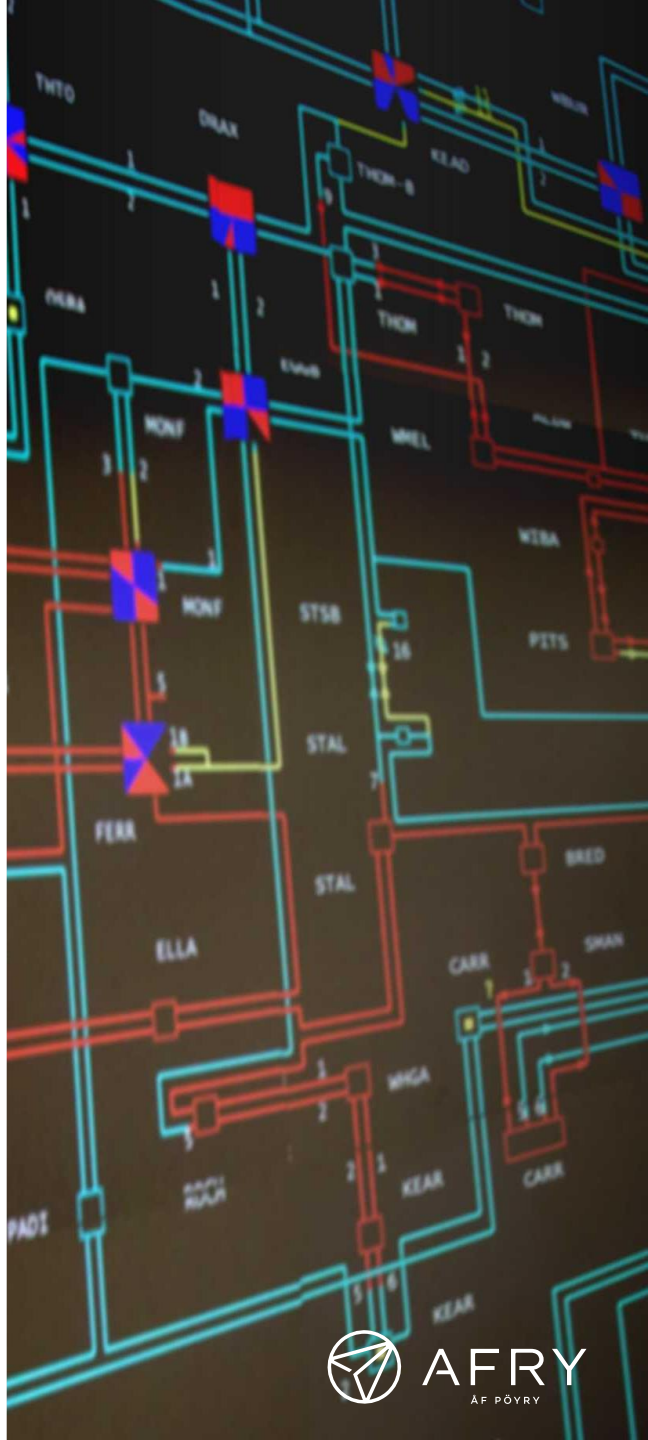
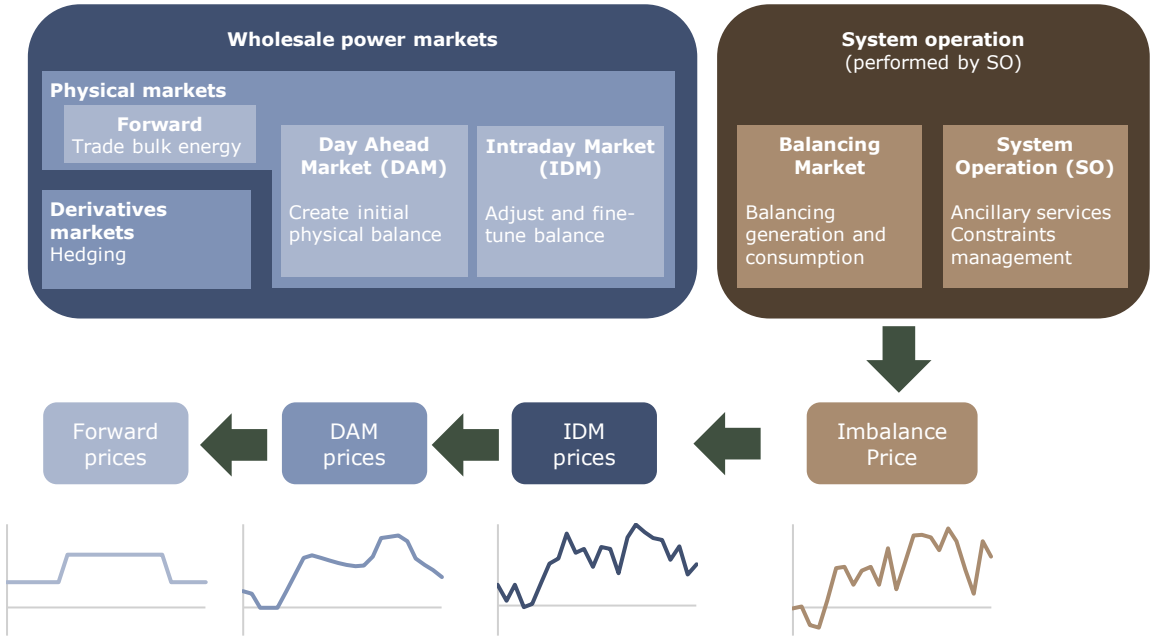


Through the Imbalance Price, market participants are incentivised to balance their portfolio against their traded positions



Balance responsibility

- Market actors have balance responsibility and manage this through market trading and portfolio balancing
- There are no obligations for individual participants to balance their own positions, but collectively, the market is incentivised to support national supply and demand balance through exposure to the Imbalance Price
- Each participant may have individual imbalances, but these may net out, and the SO needs to deal with the overall system position

Role of markets in ensuring system balance

- Market participants may change their traded position until GC, locking in firm trades with known prices to manage exposure to the Imbalance Price
- There is no obligation for participants to be balanced (they are entitled to deliberately be long or short provided they submit accurate Physical Notifications for BMUs)
- Participants may continue to use non-BMU resources after GC for portfolio balancing or NIV chasing

Imbalance Price

- The Imbalance Price against which imbalances are settled is only known after the event

INCENTIVES

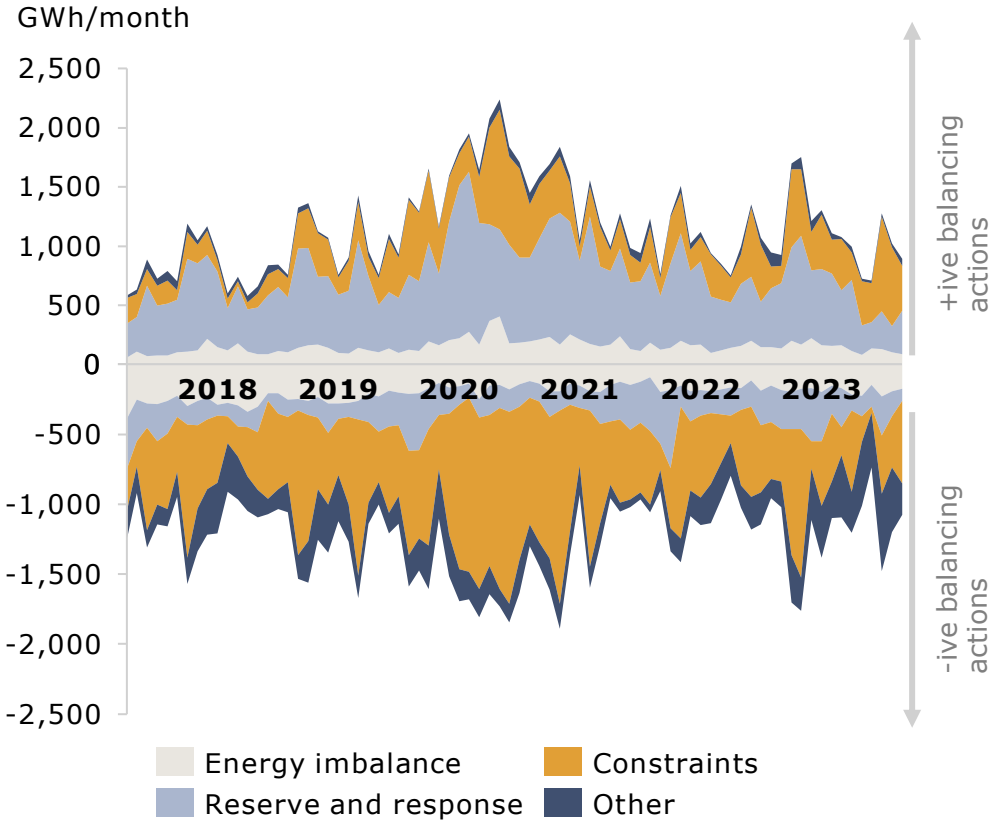
Energy markets don’t provide scheduling incentives in line with system needs and operational requirements

1. **‘Unconstrained’ market incentives:** Incentive provided by national Imbalance Price does not align with network constraints and other system needs
2. **‘National’ imbalance price:** Portfolio level balancing and national Imbalance Price lead to dispatch/NIV chasing in ‘wrong’ location
3. **Potential missing signals for real time reserve procurement:** Market is not incentivised to provide reserve capacity where and when needed

INCENTIVES

The volume of balancing actions for system constraints and reserve is now significantly greater than the volume of pure balancing energy actions

HISTORICAL MONTHLY BALANCING VOLUMES BY TYPE OF ACTION



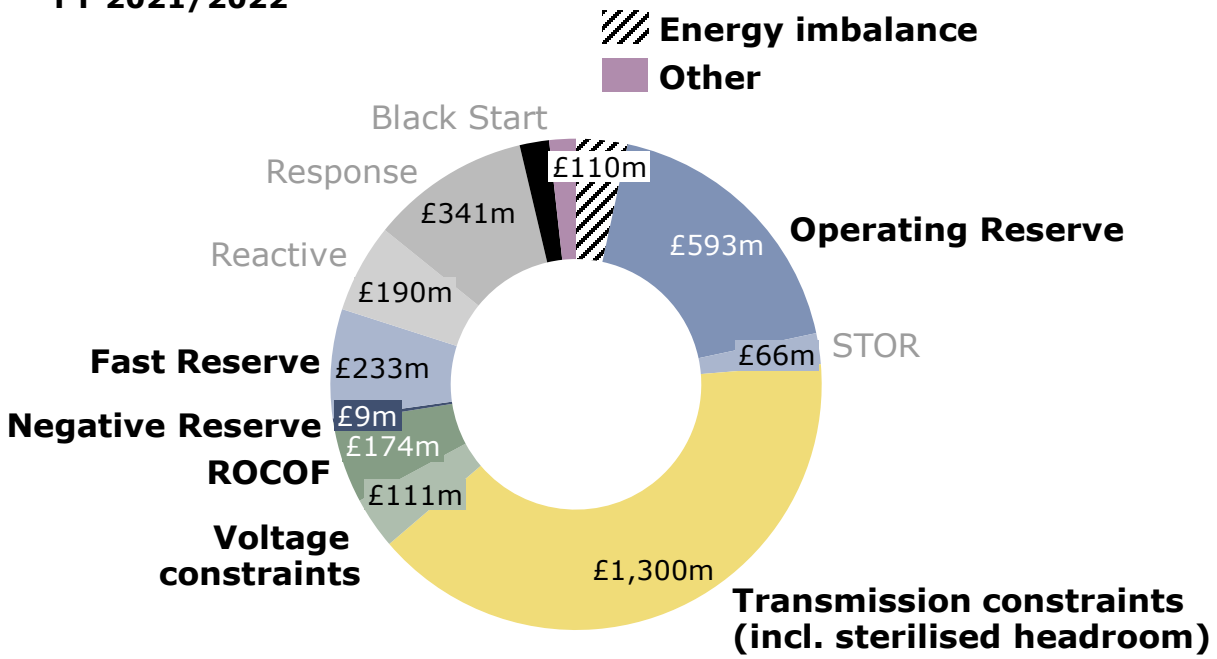
Note: 'Constraints' in this chart include transmission constraints and other system needs (e.g. inertia and voltage)
Source: Daily BSUoS volume Data, AFRY analysis

- Electricity is traded in the ex-ante markets assuming away network constraints and some other key system needs (such as operating reserve) – trading in the markets is on an 'unconstrained' basis. Market participants' incentives are therefore incomplete
- ESO needs to start from the 'unconstrained' PNs submitted by market participants, and redispatch units to manage system constraints and ensure sufficient operating reserves
- The volume of balancing actions for system constraints and reserve is now significantly greater than the volume of pure balancing energy actions

INCENTIVES

It is not only the volume of BM actions for reserve and constraints that is high, but also the associated costs

TOTAL BALANCING AND ANCILLARY SERVICES COSTS FY 2021/2022



Almost exclusively managed through the BM or trades

Managed/procured through separate arrangements (e.g. auctions, mandatory provision)

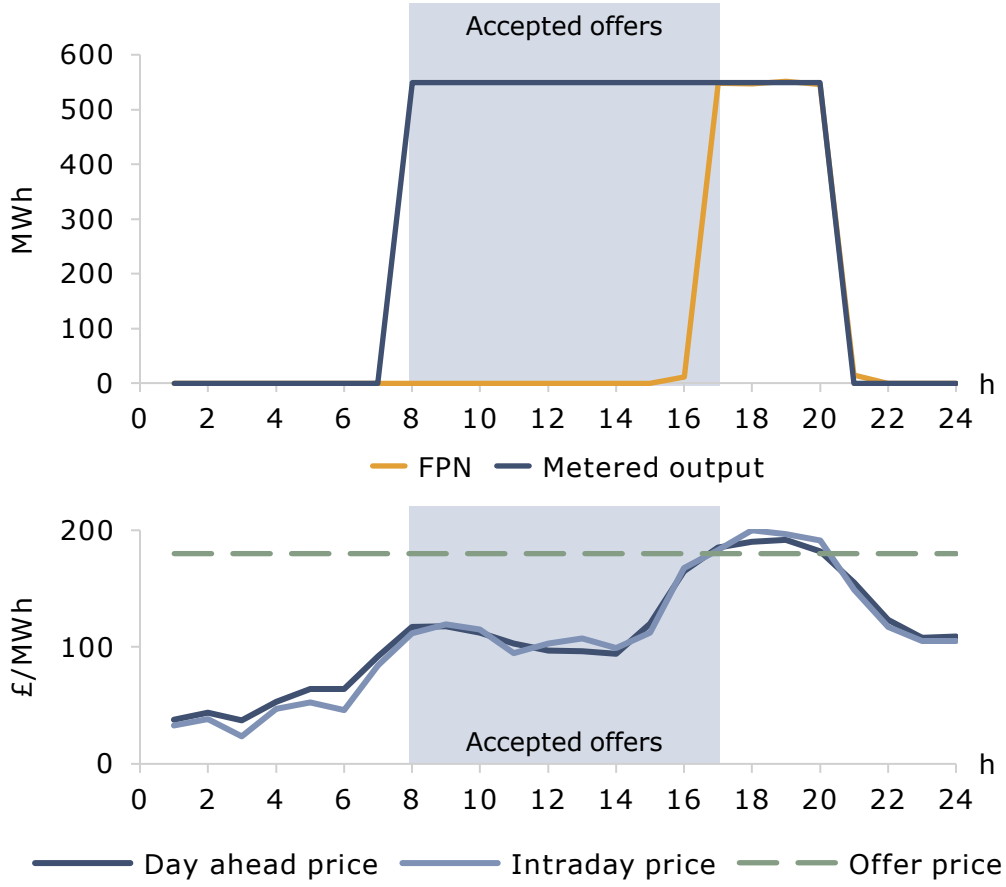
- There have been changes in the procurement of system services over time, and more changes and improvements are underway, e.g.:
  - ESO has been consolidating the procurement of system services at the Day Ahead stage (Dynamic Response Services, planned introduction of Balancing Reserve)
  - longer-term contracts have been put in place (Pathfinders) to encourage entry from alternative providers, and this should limit the need for synchronising thermal units for inertia and voltage control;
- However, the Balancing Mechanism remains ESO's primary market tool to maintain energy balance, procure sufficient operating reserve, manage transmission constraints, and ensure system stability
- It is not only the volumes of BM actions for reserve and constraints that are high, but also the associated costs

Source: MBSS

'UNCONSTRAINED' MARKET INCENTIVES

Incentive provided by national imbalance price does not align with network constraints and other system needs [1/2]

ILLUSTRATIVE FPN AND BOAS FOR THERMAL GENERATION LOCATED IN FRONT OF A CONSTRAINT

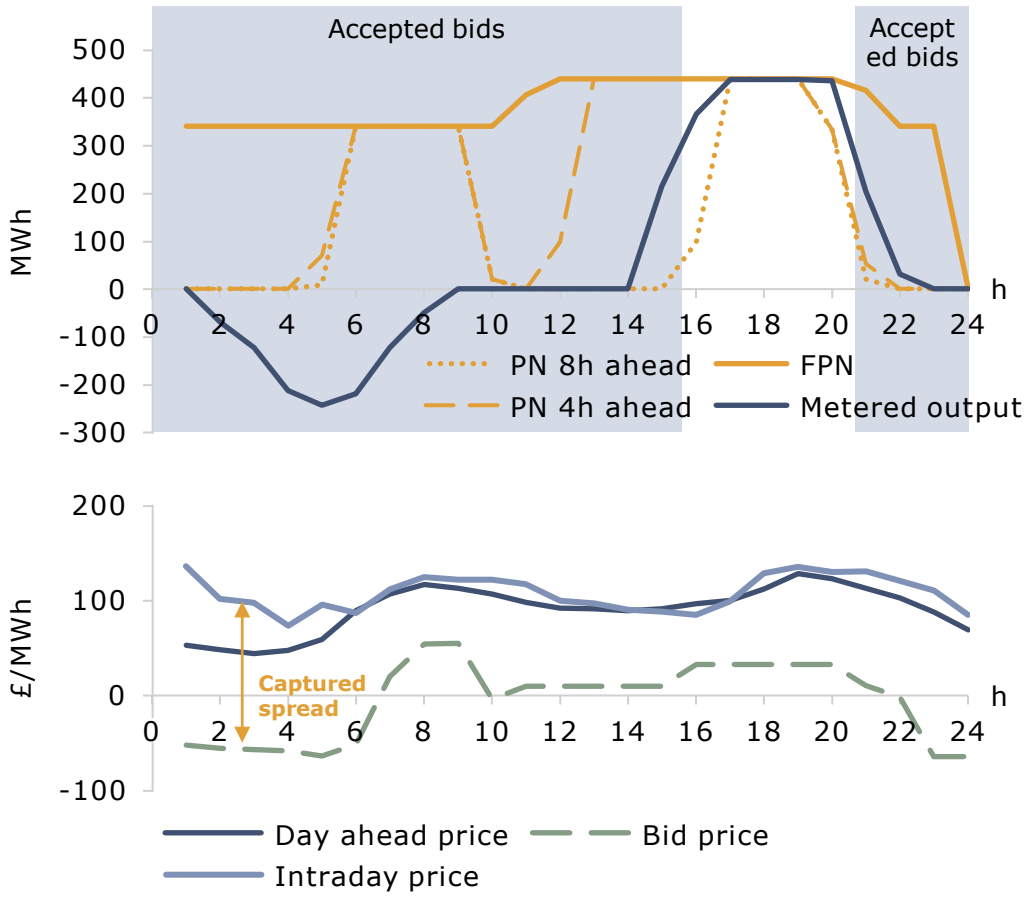


- A unit in an import-constrained location trades volumes in the ex-ante 'unconstrained' markets and submits a positive FPN over the evening peak periods
- Market prices are, however, below its short-run cost of operation in the morning and in the afternoon, and the unit is not scheduled to generate
- ESO issues BOAs to synchronise the unit earlier to relieve the import constraint
- The national System Imbalance Price does not provide a signal for the unit to synchronise in the morning

'UNCONSTRAINED' MARKET INCENTIVES

Incentive provided by national imbalance price does not align with network constraints and other system needs [2/2]

FPN AND BOAS FOR PUMPED STORAGE ON THE 12/04/2023



- A unit in an export constrained location trades volumes in the markets and submits a positive FPN
- ESO has to bid down this unit for most of the settlement periods to relive the export constraint
- The resulting output broadly follows the underlying market fundamentals in this case. In other situations, even the resulting dispatch may be inefficient and flexible resources may be used in a suboptimal way

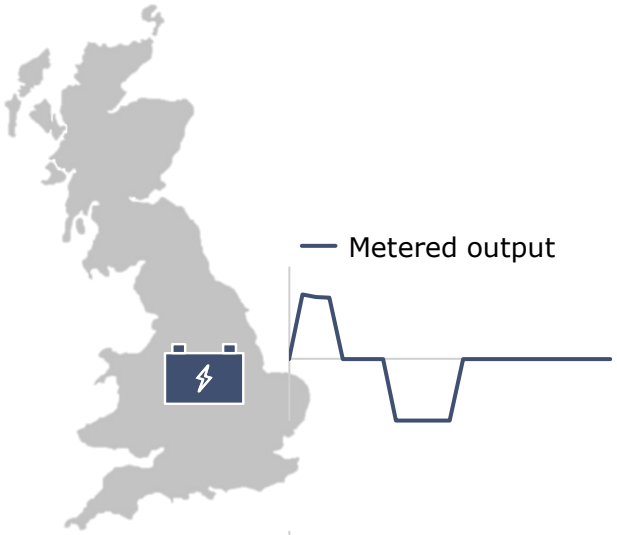
KEY IMPACT

- **Greater volume of actions than could be necessary, increasing costs to consumers**
- **Misallocation of flexible resources**

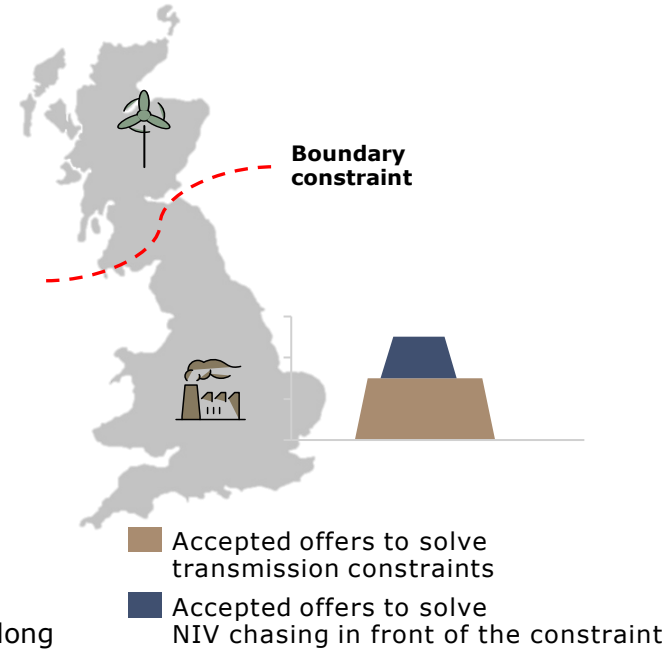
'NATIONAL' IMBALANCE PRICE

National System Imbalance Price can lead to NIV chasing in 'wrong' locations, exacerbating constraints instead of supporting system operation

'Net Imbalance Volume (NIV) chasing' is a practice where market participants try to anticipate the system position and adjust their own positions: they aim to support system balancing by being imbalanced in the opposite direction of the system.



In case of transmission constraints, ESO needs to accept offers 'in front of' the constraint.
ESO also needs to ensure energy balancing, effectively replacing the volumes from NIV chasing units located 'in front of' the constraint.



- Market participants respond to a national System Imbalance Price ignoring locational factors
- In case of transmission constraints, NIV chasing may be in the 'wrong' location. ESO needs to take actions to both:
  - resolve congestion, and
  - ensure energy balance (effectively undoing the NIV chasing position).
- NIV chasing is in theory helpful as it supports system balance, however when there are transmission constraints, NIV chasing can lead to an increase in balancing actions

KEY IMPACT

- **Greater volume of actions than could be necessary, increasing costs to consumers**
- **Misallocation of flexible resources**

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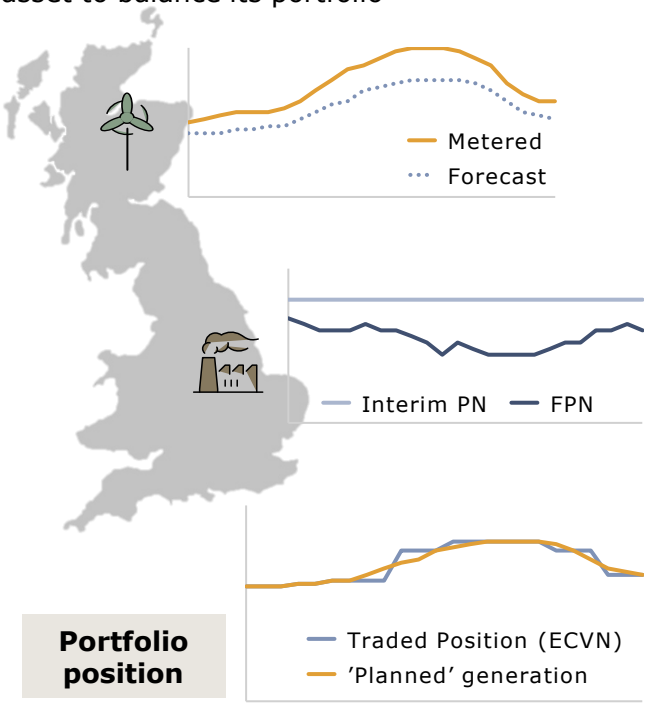
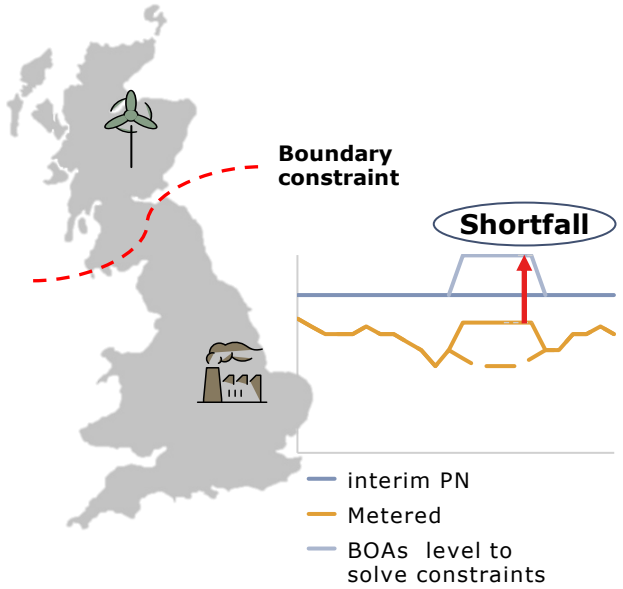
'NATIONAL' IMBALANCE PRICE

Portfolio level balancing can lead to dispatch decisions increasing network constraints instead of supporting system operation

In case of a sudden increase in wind generation forecast, a portfolio manager (owing wind assets and thermal units located on opposite side of a transmission constraint) may decide to lower the PN for its thermal asset to balance its portfolio



ESO may need to bid down wind and to accept offers from thermal generation to alleviate network constraints. The lower FPN from the thermal unit exacerbates the issue and increases the balancing action needs from ESO.



- Imbalances are calculated based on the portfolio contracted position against the aggregated metered output of units in the portfolio
- A limitation of the portfolio level balancing is that units providing balancing ignore transmission system constraints : a portfolio owner may seek to balance its portfolio (to avoid imbalance charges) by relying on units located in the wrong side of the constraints
- In theory, the System Imbalance Price should support system operation by incentivising market participants to be balanced, however when there are transmission constraints the imbalance mechanism at portfolio level can lead to an increase in balancing actions

KEY IMPACT

- **Greater volume of actions than could be necessary, increasing costs to consumers**
- **Misallocation of flexible resources**

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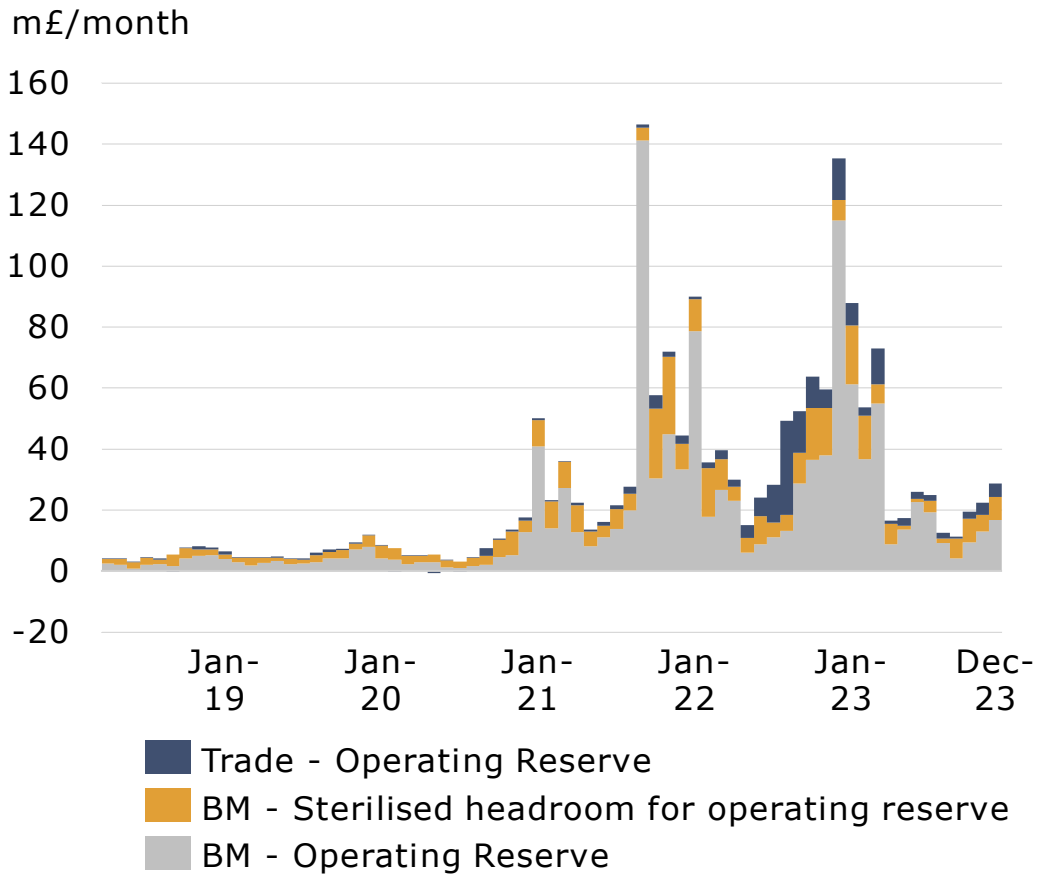
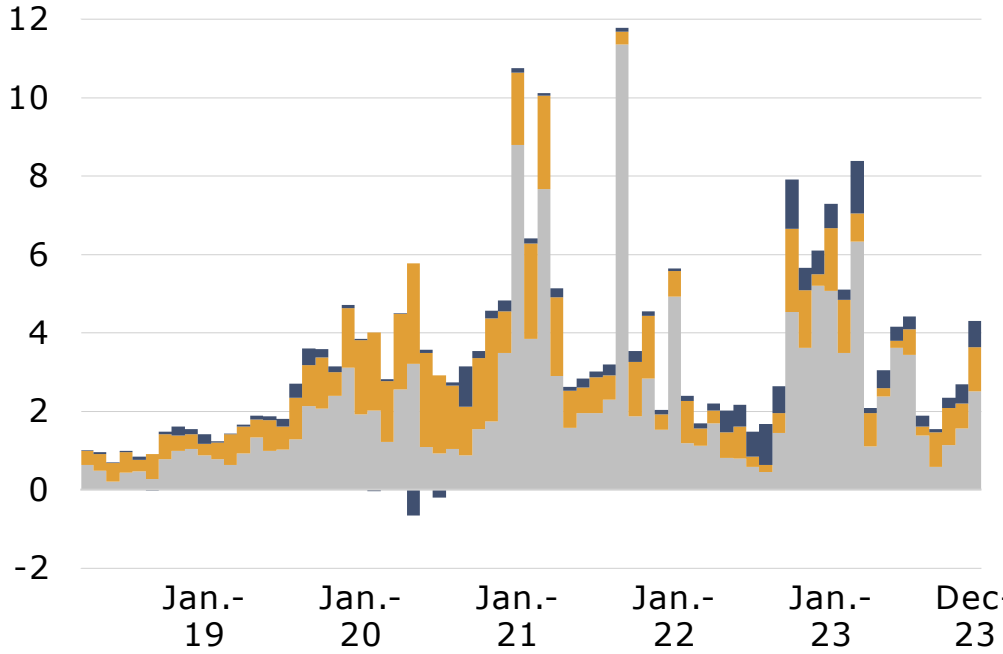
MISSING SIGNALS FOR REAL TIME RESERVE PROCUREMENT

Costs of procuring operating reserve have grown markedly in recent years – beyond the impact of the rise in commodity prices

MONTHLY OPERATING RESERVE COSTS - ABSOLUTE



NORMALISED BY MONTHLY GAS PRICES



- Monthly costs for operating reserve procurement divided by monthly spot NBP gas prices
- Indexed to April 2018 = 1

Source: MBSS, AFRY analysis

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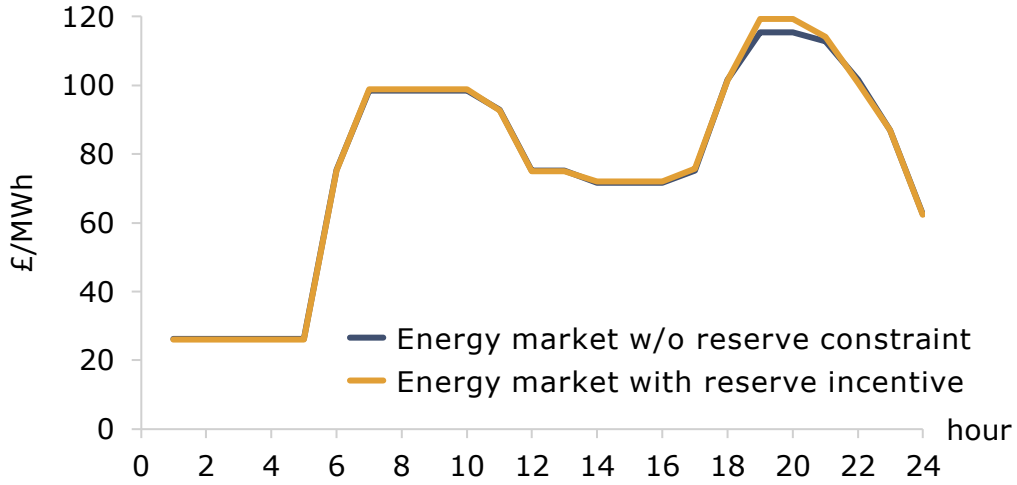
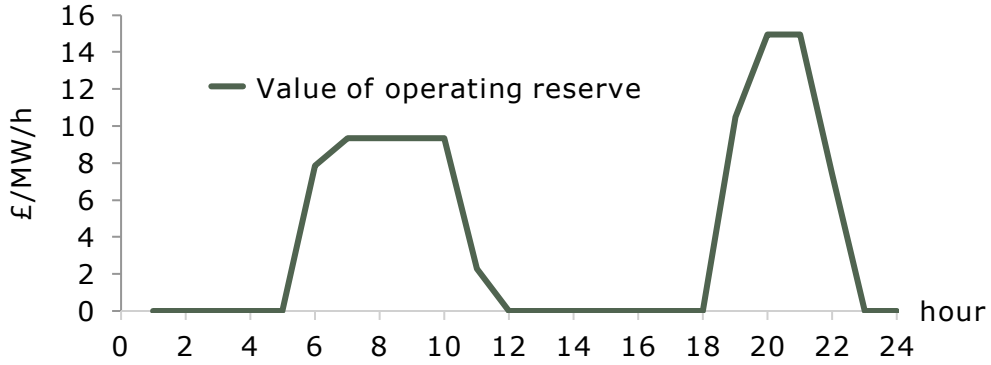
MISSING SIGNALS FOR REAL TIME RESERVE PROCUREMENT

Market is not incentivised to provide reserve capacity where and when needed

MODELLED RESULTS 12/04/2023
WHOLESALE ELECTRICITY PRICE



OPERATING RESERVE PRICE



- As part of our analysis we have modelled a) an ex-ante market assuming no constraints (i.e. the market is simply trying to meet demand), and b) an ex-ante market assuming a signal for real-time operating reserve provision
- On one of the modelled days, we see the following:
  - Ex-ante wholesale electricity prices would have been higher in some settlement periods if the market was incentivised to also deliver the required operating reserve volume
  - On this specific day, the price is higher during the 'peak'
  - There is a significant value in 'reserving' capacity during the morning ramp and the 'peak' – in all other periods reserve is practically 'free' (i.e. there is sufficient headroom and the constraint is not binding)
- The presence of an incentive to provide operating reserve does not always mean electricity prices will be higher – it may also put downward pressure in some periods

KEY IMPACT

- **Transparency on what is an energy and what is a reserve action is reduced, limiting understanding of underlying value by market participants**

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NO EXPLICIT RESERVE MARKET

Potential missing signals for operating reserve in near real time

SITUATION

The BM secures reserve as well as energy

- In theory, the market is expected to make some headroom available:
  - in the expectation of a potential activation in the BM
  - for balance parties to manage imbalance risk
- However, the amount of headroom provided by the market is not always enough to meet ESO Regulating Reserve requirements

ESO is creating a new market for regulating reserve

- Regulating Reserve is currently procured indirectly via the BM, when ESO pays thermal units to run below their maximum capacity so that they can increase their generation quickly if needed
- ESO is introducing a new day-ahead auction for Regulating Reserve ('Balancing Reserve') which will allow it to compensate directly for the service

But procuring at day-ahead risks over/under procurement

- Procuring the full forecast need for Regulating Reserve day-ahead risks 'sterilising' capacity behind constraints
- It is likely that the BM will continue to be used for some reserve actions, in addition to pure energy balancing

KEY IMPACTS

ESO needs to synchronise units through the BM or trades to ensure there is sufficient operating reserve continuously, potentially leading to inefficient dispatch decisions (cf. section on intertemporal issues)

Given the Balancing Reserve product is national, there is potential for **'sterilised headroom'** meaning the BM will still be used to ensure sufficient reserve

Transparency on what is an energy and what is a reserve action is reduced, limiting understanding of underlying value by market participants

Discussion

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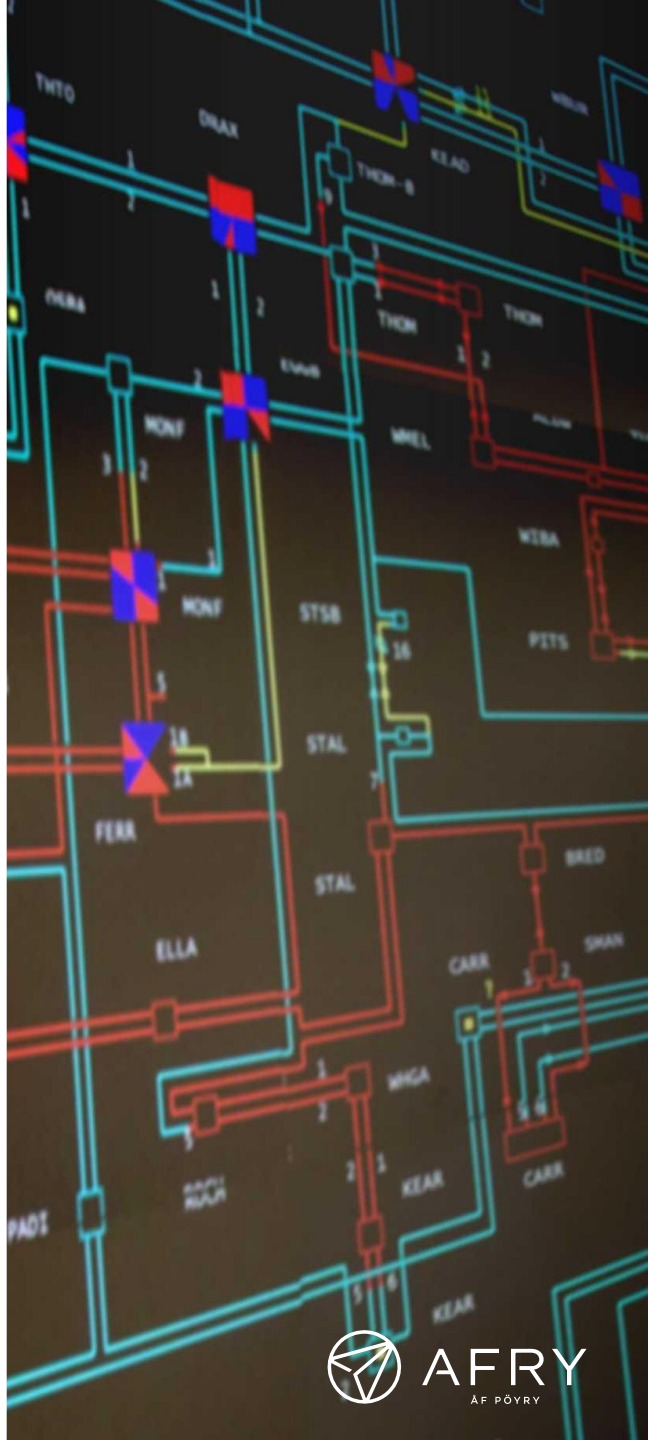


Embedded generation and flexible capacity is on the rise

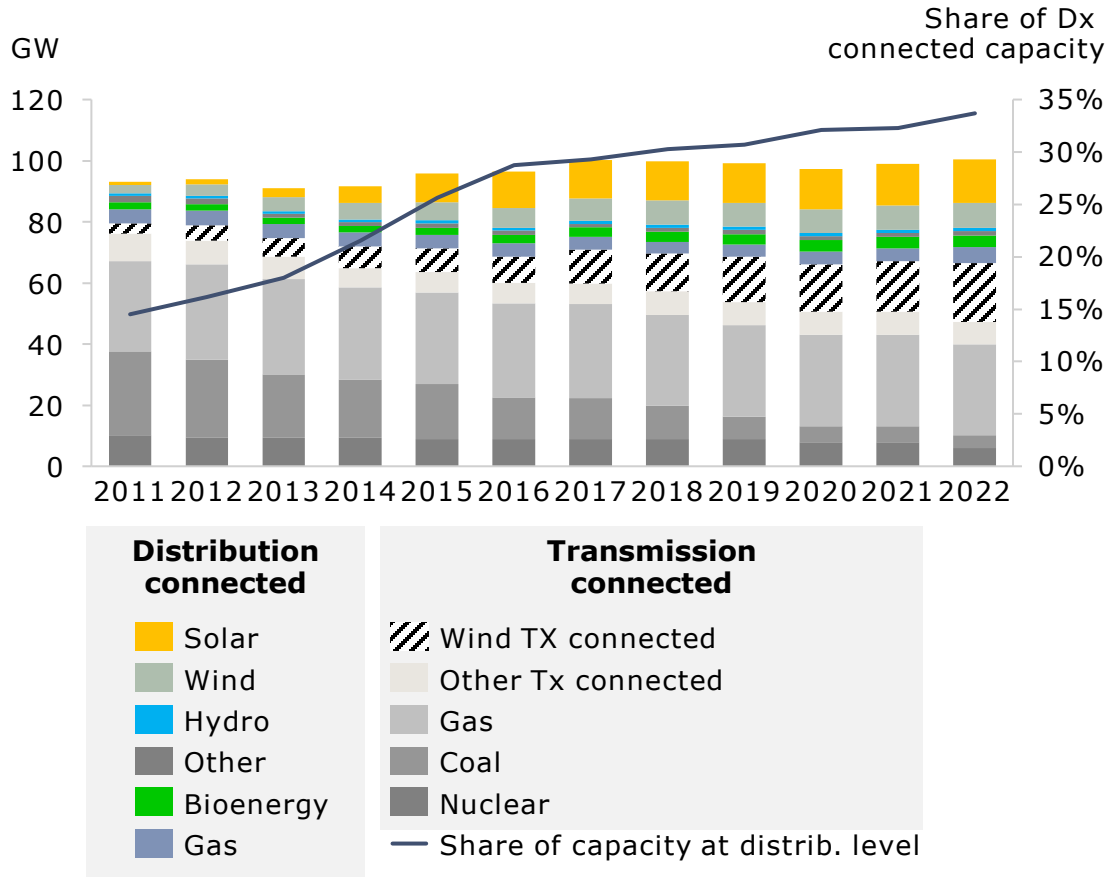
INCREASE IN EMBEDDED GENERATION

- In the early 2000s, the electricity generation fleet in Great Britain consisted primarily of controllable thermal plants connected at the transmission level
- Since then, embedded generation has been steadily increasing

INCREASE IN FLEXIBLE RESOURCES, BUT NOT ALWAYS SUPPORTING SYSTEM BALANCE

- Flexible resource capacity is also on the rise. However, this resource is not all visible to or accessible by ESO
- The introduction of the single Imbalance Price gives incentives to the market to manage system imbalance, but from an ESO perspective this adds an additional layer of uncertainty as non-BMU resources are acting in ways which ESO finds hard to predict

HISTORICAL INSTALLED CAPACITY IN GB, BY CONNECTION LEVEL



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VISIBILITY AND ACCESS

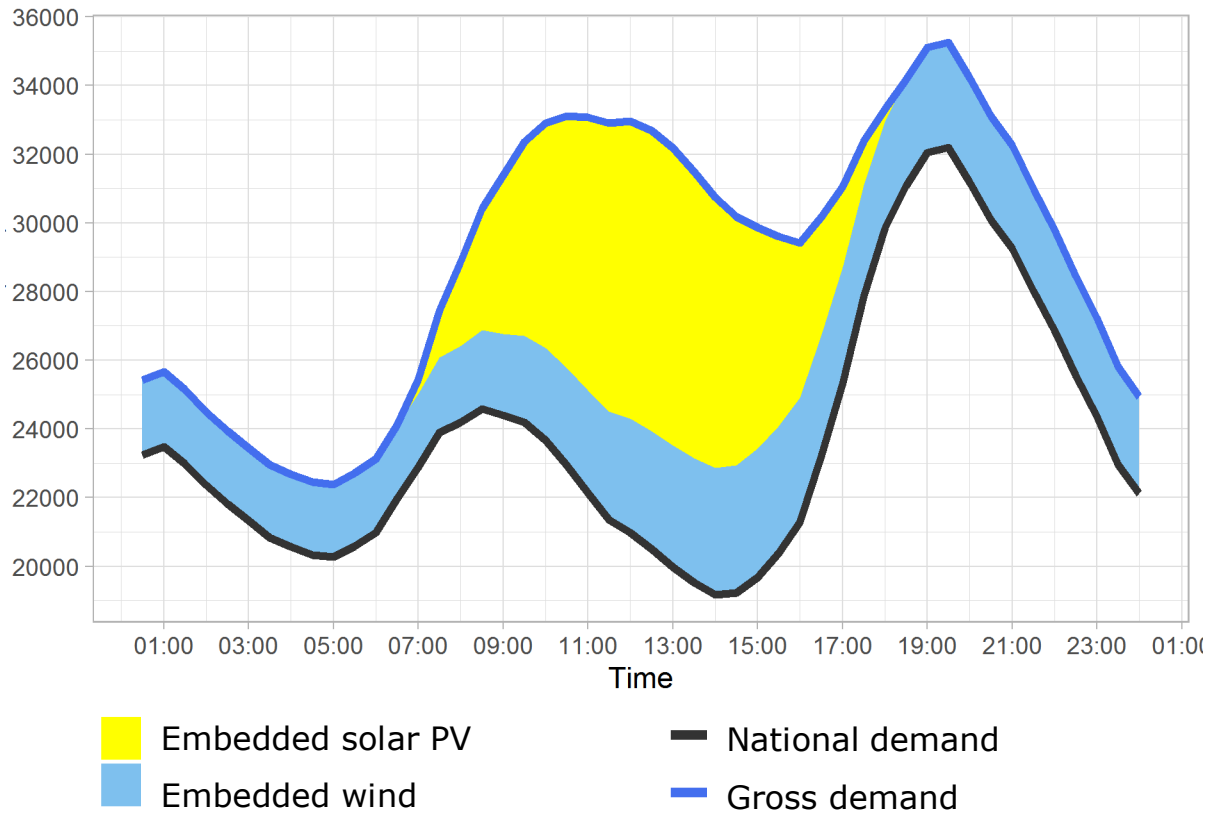
Incomplete ESO visibility of market outcomes and limited access to some resources impacts coherence between wholesale market and balancing

1. **Incomplete coverage:** Coverage of FPNs is incomplete, particularly for the growing share of flexible non-BM resources, meaning ESO has limited visibility of full market schedules when doing contingency planning
2. **Inaccurate information:** Schedules change significantly before gate closure meaning ESO decisions are taken with inaccurate information
3. **Behaviour:** Uncertainty on the expected level of system support for balancing by flexible non-BM resources (e.g. NIV chasing or response to retail tariffs)
4. **ESO access to resources:** Key resources respond to wholesale market signals but are not dispatchable by ESO in balancing timeframes
5. **Coordination:** Sequential procurement of balancing services adds uncertainty to decision making for both ESO and market participants

INCOMPLETE COVERAGE

Coverage of FPNs is incomplete meaning both ESO and the market are dealing with poor information

NATIONAL DEMAND FORECAST 19/03/2022, MW



- ESO predicts 'national demand' – total demand net of embedded generation
- It then compares national demand against the sum of FPNs to form a view of the overall system position for scheduling and dispatch
- In practice, ESO forecasts total 'gross' demand, and then subtracts embedded RES generation forecasts to obtain the national demand
- Reaction to market prices by controllable embedded generation and demand response cannot be considered in the published national demand forecast (according to the Grid Code)
- The published demand forecast does not consider price responsive embedded generation and demand, and this can have an impact on the market expectations and price formation

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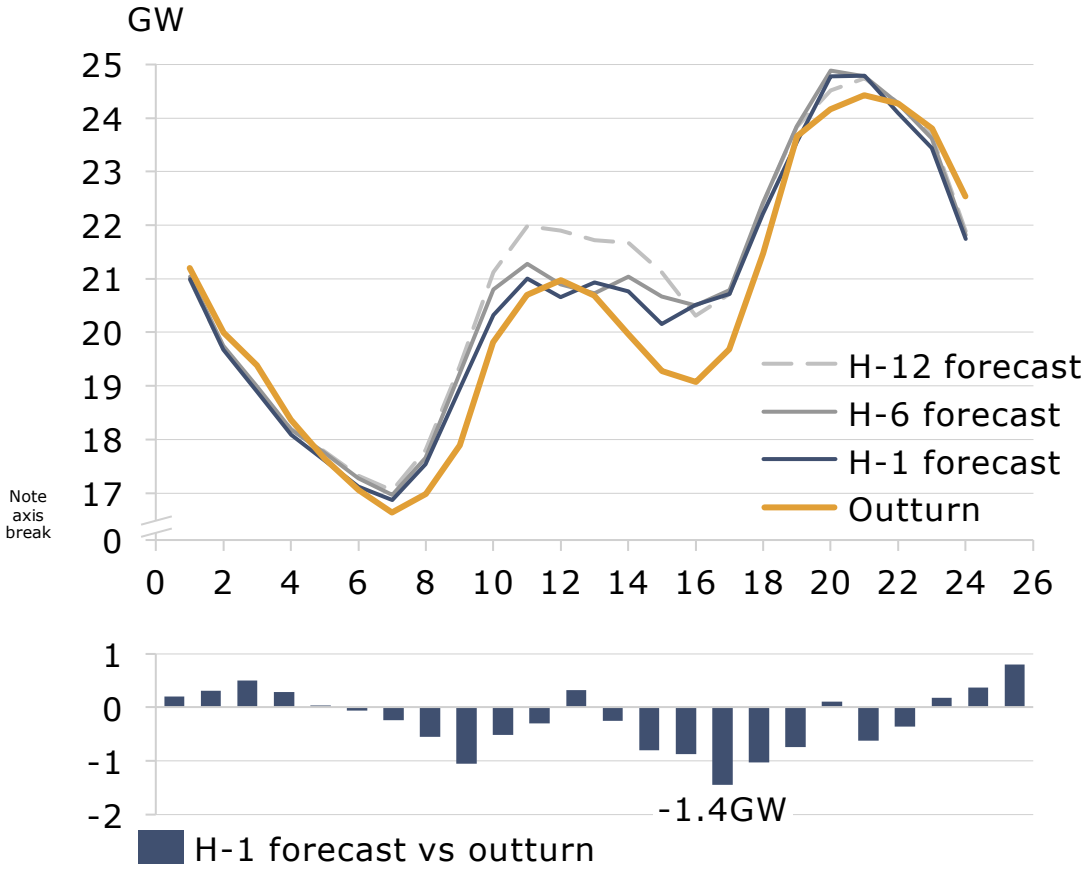
INCOMPLETE COVERAGE

Coverage of FPNs is incomplete, meaning ESO has limited visibility of full market schedules when doing contingency planning

NATIONAL DEMAND FORECAST AND OUTTURN ON 09/07/2023



- When the market was set up, aggregate FPNs were a good indication of the overall market position
- Aggregate PNs are no longer a meaningful indication of the system position with more than 30% of overall installed capacity now being embedded
- Most of the embedded generation does not participate in the BM, and is not required to submit PNs
- Forecasting expected output from embedded RES is challenging enough on its own right. Trying to predict price responsive generation adds further complexity

KEY IMPACT

- **Over- and under-procurement of energy and reserve**
- **Potential for inefficient dispatch decisions**

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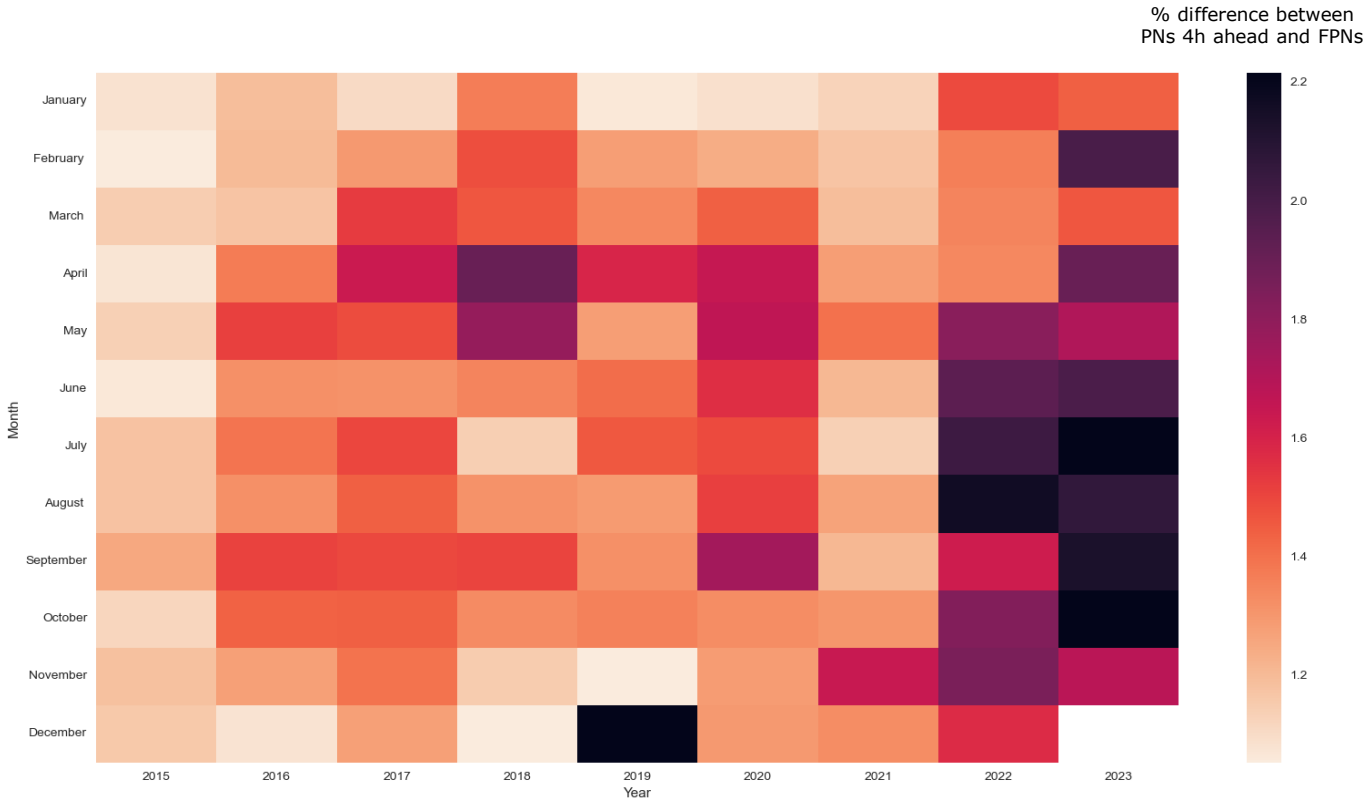
INACCURATE INFORMATION

Schedules change significantly before gate closure

MONTHLY VOLUME DIFFERENCE BETWEEN PNS 4H AHEAD AND FPNS, %



- Changes in PNs as we approach real-time are increasing
- ESO needs to take decisions with increasingly inaccurate information

KEY IMPACT

- **Unnecessary risk mitigation**
- **Potential for inefficient dispatch decisions**

Source: ESO analysis, monthly average of % difference between PNs 4h hours ahead and FPNs for each settlement period

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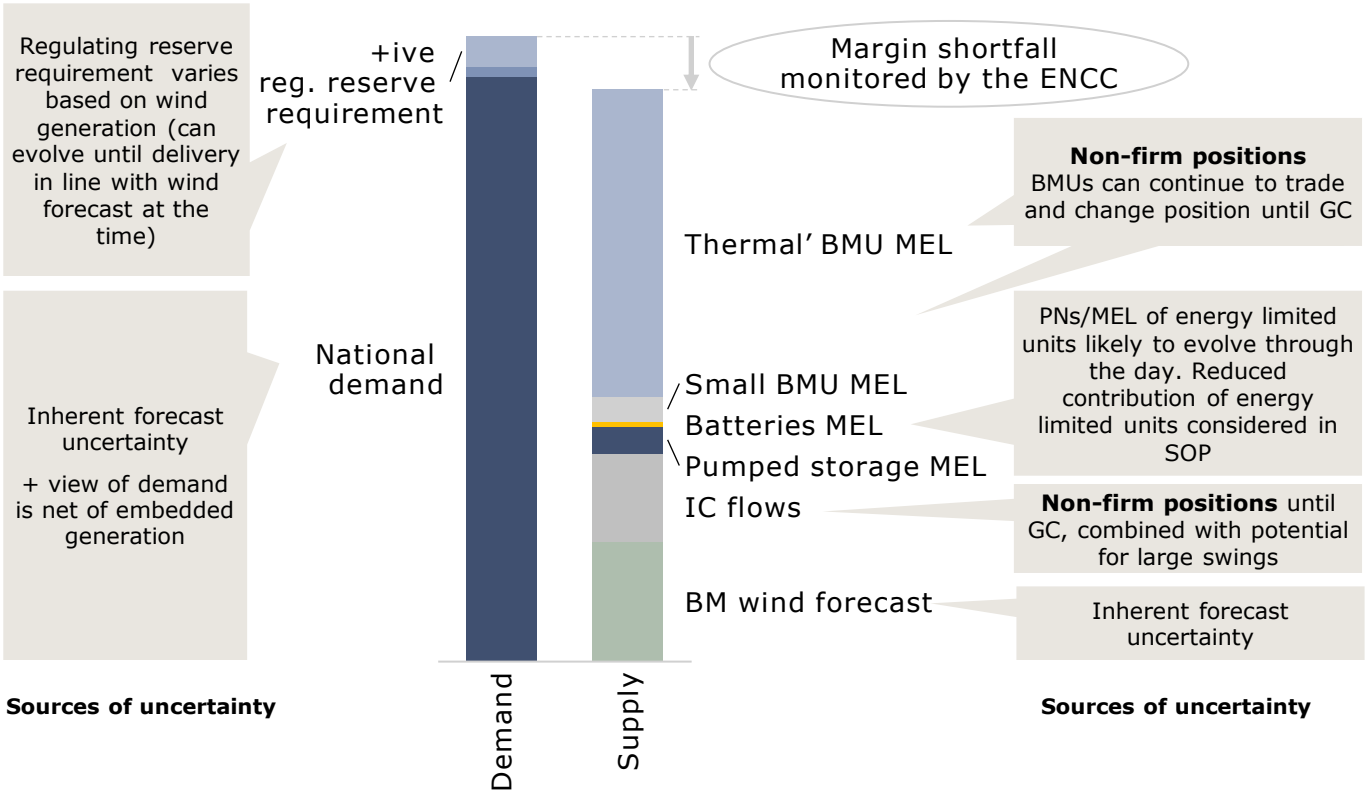
INACCURATE INFORMATION

ESO takes scheduling decision based on inaccurate information [1/2]

OVERVIEW OF INFORMATION AVAILABLE TO THE CONTROL ROOM TO TAKE SCHEDULING ACTIONS



- There are many moving parts when ESO takes scheduling actions:
  - national demand uncertainty is compounded by embedded generation;
  - there is inherent uncertainty of BM RES output; and
  - PNs from controllable BMUs are non-firm
- Market parties are not remunerated based on the accuracy of their information to ESO

KEY IMPACT

- **Unnecessary risk mitigation**
- **Potential for inefficient dispatch decisions**

MEL= Maximum Export Limit, SOP=System Operating Plans

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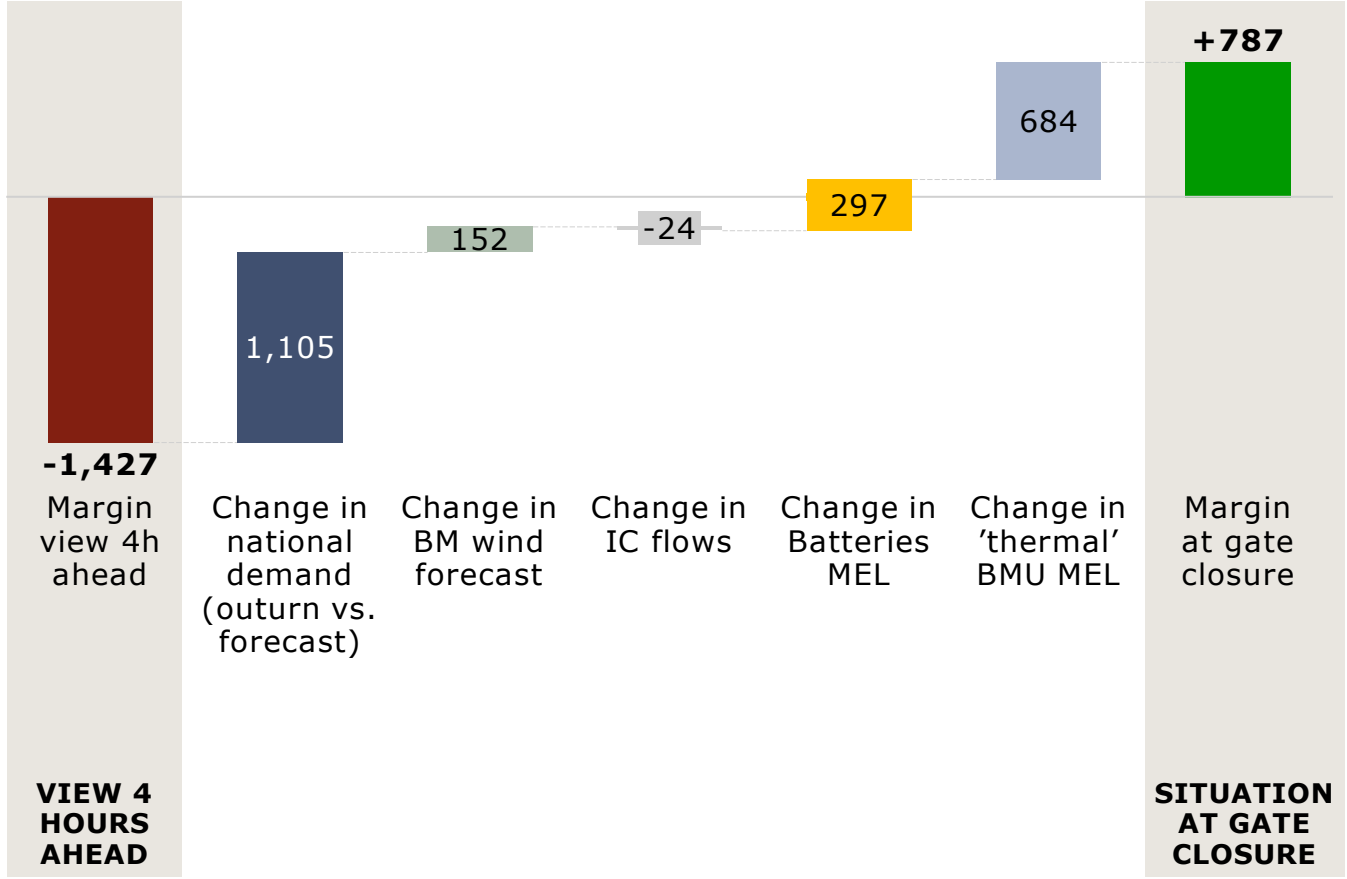
INACCURATE INFORMATION

ESO takes scheduling decision based on inaccurate information [2/2]

OVERVIEW OF THE MARGIN FOR DARKNESS PEAK AT 5:40 PM (01/01/2023)



- On 01/01/2023, ESO was expecting a margin shortfall for the evening peak based on information 4h hours ahead
- This led to the synchronisation of several units during the afternoon to ensure sufficient margin
- Compared to the view 4 hours ahead, at GC:
  - National demand didn't reach the forecast level
  - Several BMUs with an interim PN=0 at the peak self-scheduled in the afternoon, resulting in an increase in the overall headroom
  - Outturn battery contribution at the peak was higher than the operating plan estimate
  - Wind generation slightly higher than forecast

MEL= Maximum Export Limit, SOP=System Operating Plans

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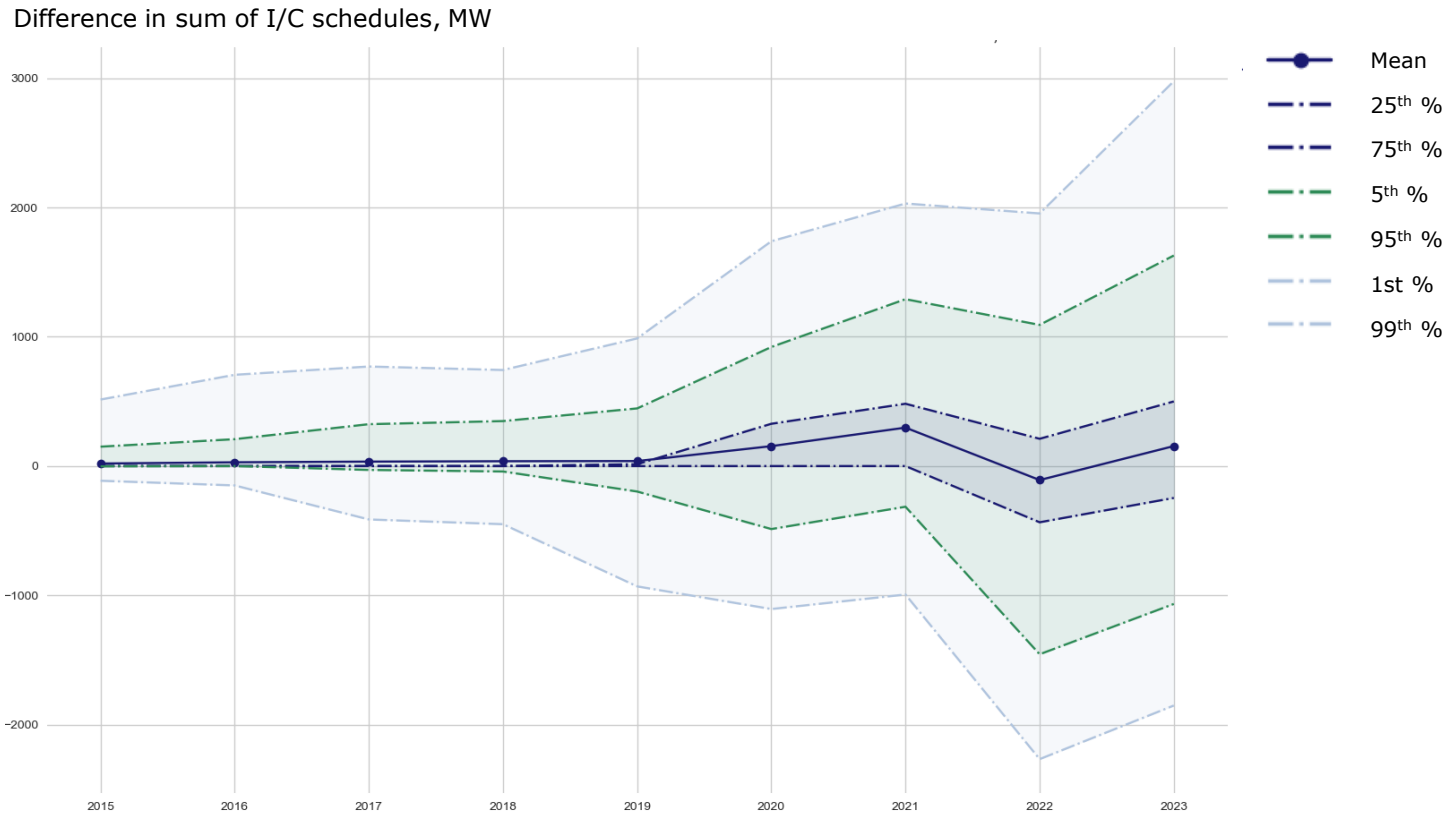
INACCURATE INFORMATION

Large changes in interconnector schedules before gate closure are becoming increasingly frequent

DISTRIBUTION OF DIFFERENCE IN PNS 4H AHEAD AND FPNS FOR INTERCONNECTOR SCHEDULES



- Interconnector capacity between GB and other European countries has increased over the last few years
- They have now become the single largest source of change in schedules close to real-time
- Predicting changes in interconnector schedules is challenging, as it typically reflects the relative price evolution in two markets

Source: ESO analysis

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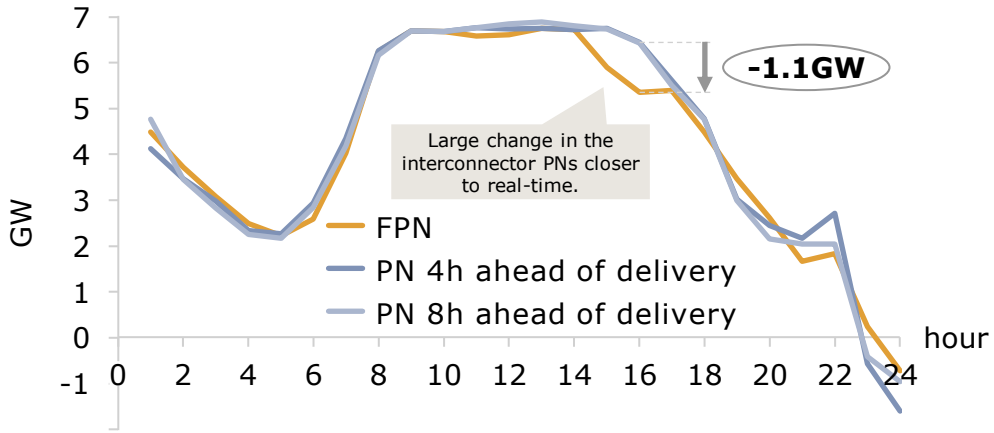
INACCURATE INFORMATION

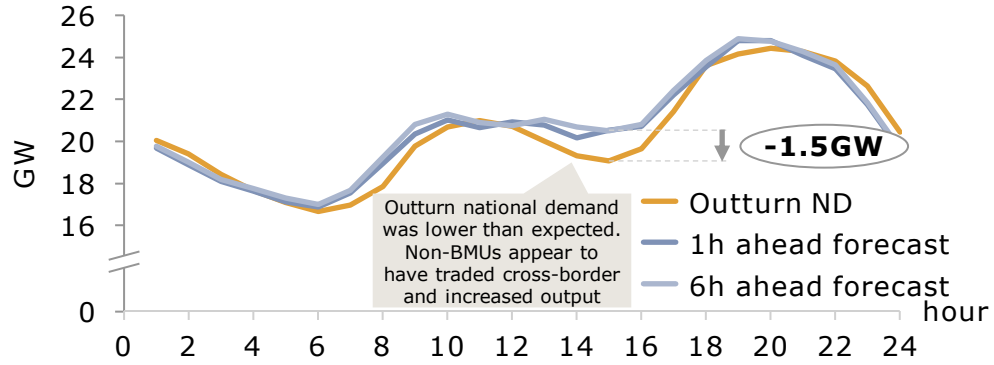
Changes in interconnector schedules close to delivery are particularly significant

EVIDENCE FROM 09/07/2023

TOTAL INTERCONNECTOR PHYSICAL NOTIFICATION (NET IMPORTS TO GB)



NATIONAL DEMAND FORECAST AND OUTTURN



- Interconnector schedule swings typically come alongside a corresponding change in generation (embedded or otherwise), and should therefore not lead to a large energy imbalance. However:
  - changes in interconnectors flows can have an impact on the level of available reserve and on transmission constraints; and
  - such large, sudden changes can still be a risk for system operation from an ESO perspective

KEY IMPACT

- **Need to react fast to large changes, leading to operational difficulties and expensive actions**

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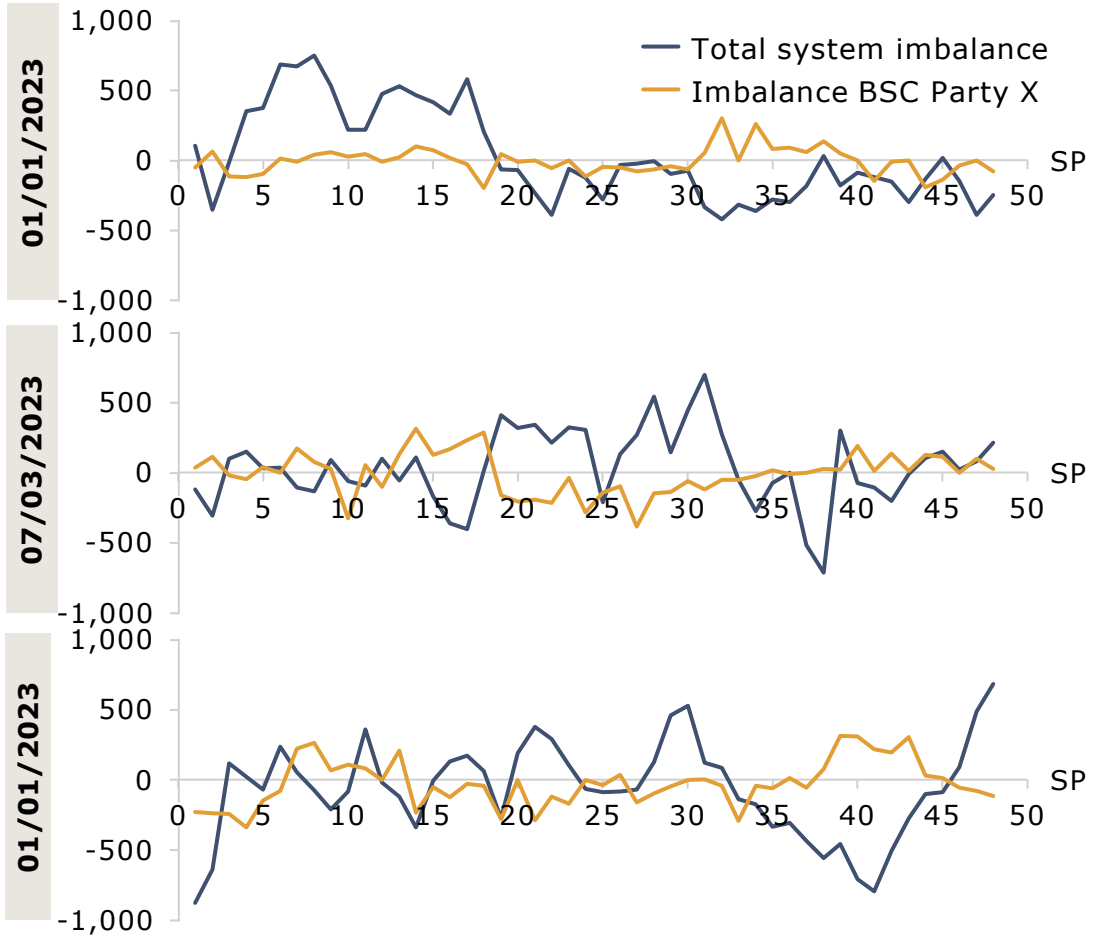
BEHAVIOUR

Uncertainty on the expected level of system support for balancing by flexible non-BM resources (e.g. NIV chasing or response to retail tariffs)

BSC PARTY IMBALANCE VS. SYSTEM POSITION, MWH



- NIV chasing is in theory helpful as it supports national system balance
- A growing share of distributed resources is controllable and responds in ways which are difficult for ESO to predict and does not deal with within-SP imbalance
- ESO might expect a level of imbalance based on demand forecast and FPNs, and take balancing actions to solve it. The market will also react, with some market participants NIV chasing
- ESO has no visibility on the potential level of NIV chasing and cannot formally rely on it when making balancing decisions

KEY IMPACTS

- **Over- and under-procurement of energy and reserve**
- **Potential for unnecessary actions**

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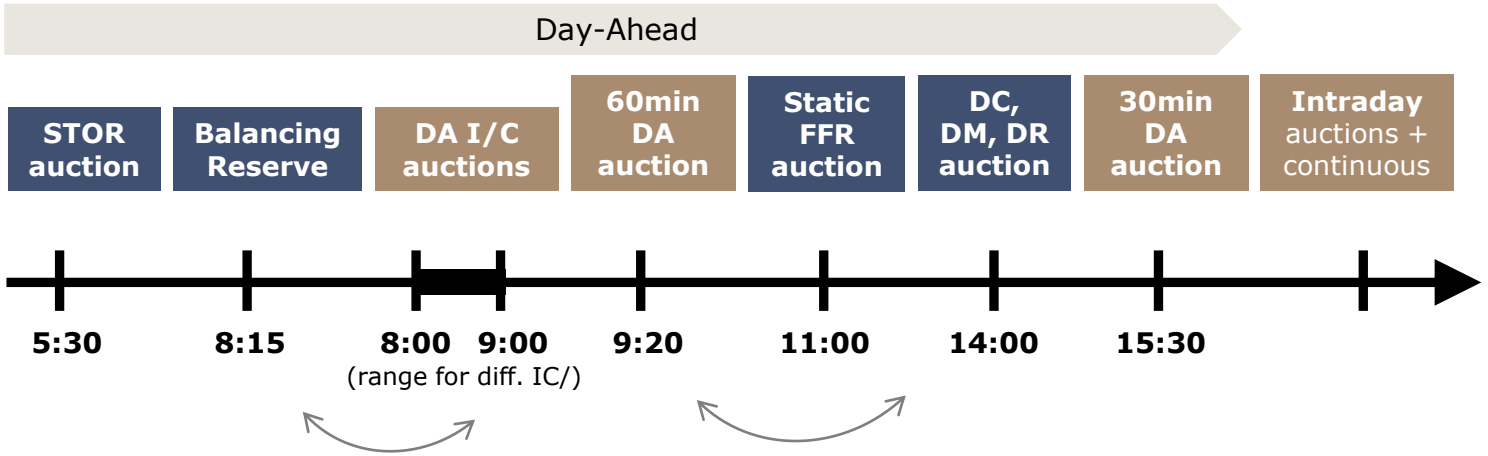
COORDINATION

Sequential procurement of balancing services adds uncertainty to decision making for both ESO and market participants



Pro/cons of procuring Balancing reserve before the DA auction

- \+ Allows market to trade out its position for scheduling units
- − Difficulty for market participants if their estimate of the DA price is wrong

Pro/cons of response products after the DA auction

- \+ Allows ESO to determine response requir. based on largest loss (I/C)
- − Less opportunity for market participants to trade out their position

Reserve and AS procurement

Energy markets

- Balancing services are procured at different times
- Market players need to take decisions in different timeframes against a moving intraday target
- For some services, ESO does not procure the entire volume (e.g. headroom for reserve) in advance

KEY IMPACT

- **Market players face conflicting incentives and risk forecast errors when bidding**
- **Potential for inefficient dispatch**
- **Reduced competition**

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Discussion

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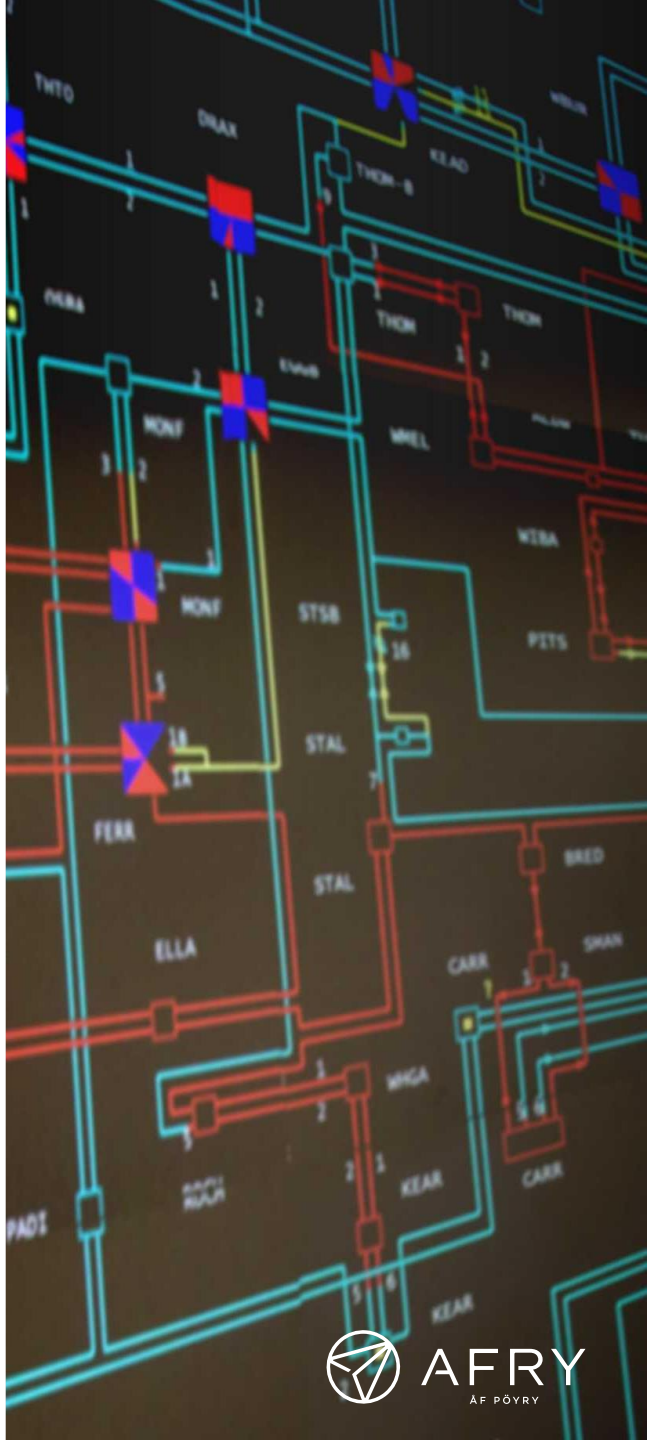
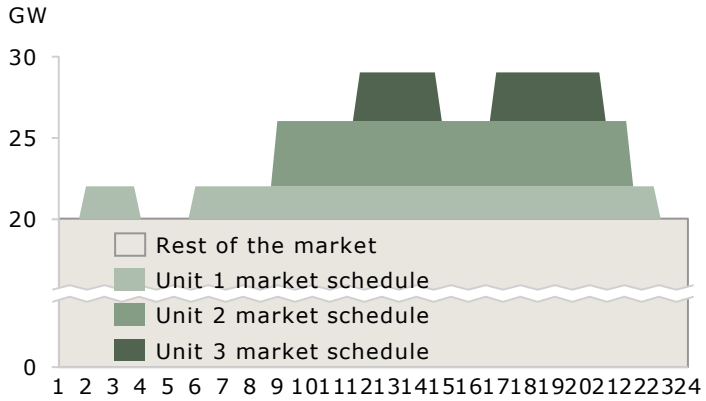


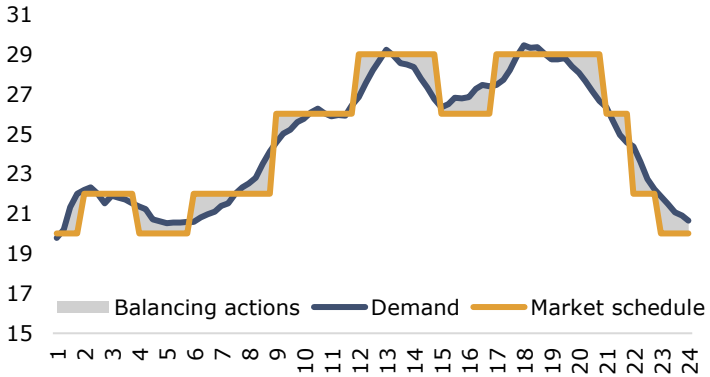
The market is intended to make unit commitment decisions with ESO dealing only with residual balancing – however, this is not what happens in practice

In theory …

UNIT COMMITMENT

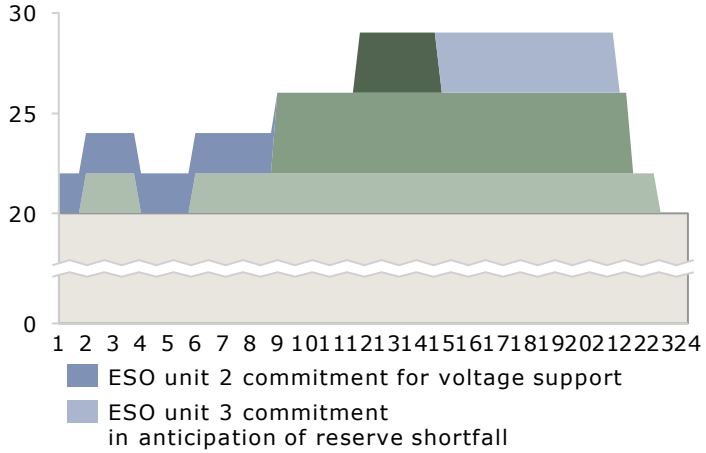


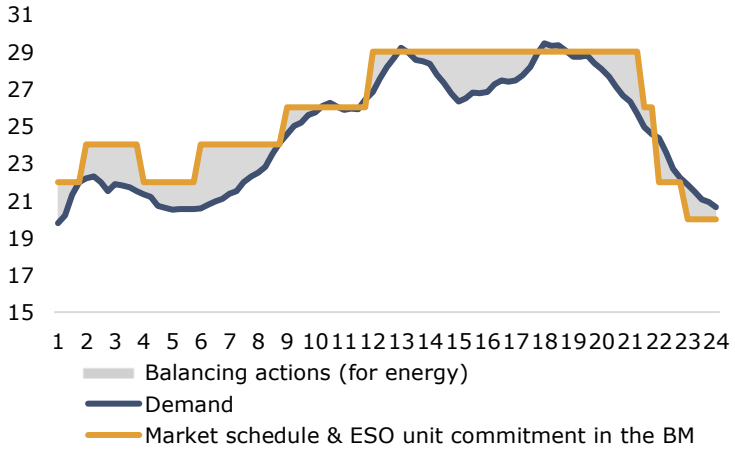
ILLUSTRATIVE BALANCING ACTIONS



- Unit commitment decisions should be taken by market participants in response to expected market prices
- The role of the SO is 'residual' ensuring energy balance within SP

In practice …





- This, however, does not happen in practice
- ESO ends up taking unit commitment decisions for:
  - other system needs; but also
  - reserve margin and energy balance

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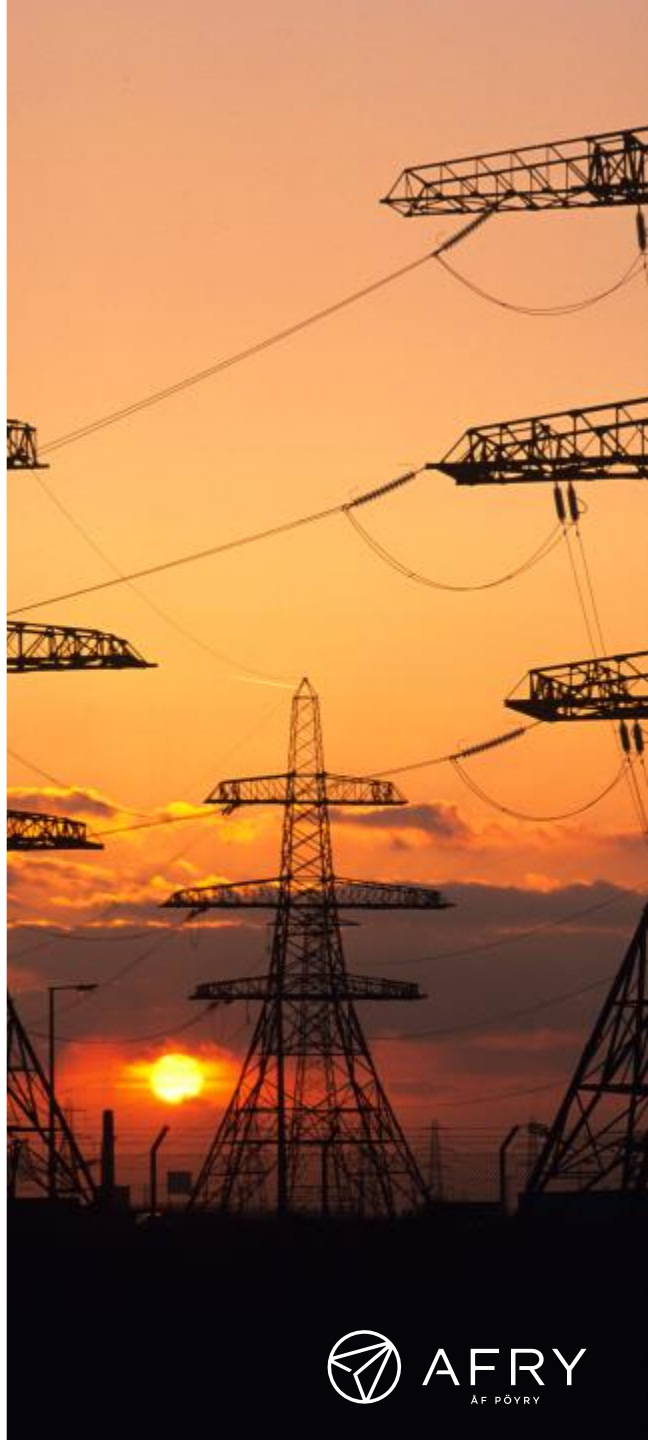
INTERTEMPORAL ISSUES

The current dispatch mechanism does not facilitate effective optimisation of costs and unit constraints over time

1. **Timing:** ESO is obliged to take proactive decisions with consequences for future periods beyond Gate Closure, which overlaps with the operation of the intraday market
2. **Information:** ESO takes decisions with inter-temporal consequences based on imperfect and incomplete forward-looking data
3. **Transparency:** Beyond-the-wall protocols and advance commitments cloud transparency and may distort imbalance pricing

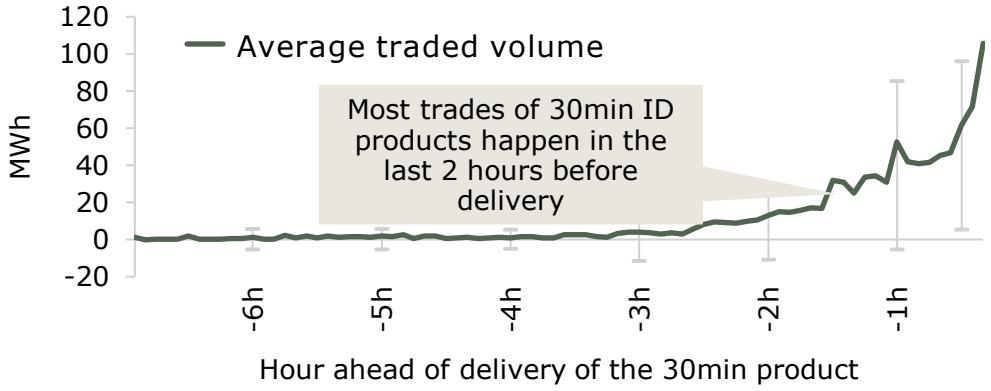


TIMING

ESO is obliged to take proactive decisions with consequences for future periods beyond Gate Closure, which overlaps with the operation of the IDM

- ESO typically needs to take actions for energy and Regulating Reserve 4-5 hours before Gate Closure given CCGT minimum on and off times
- Most of the intraday trading, however, happens over the two hours before Gate Closure
- This means the system may look short when ESO needs to decide whether to secure margin

TRADED VOLUMES FOR 30MIN PRODUCT ON THE GB CONTINUOUS INTRADAY MARKET



Impact:

- The market may expect that ESO will intervene ahead of time to ensure sufficient margin
- Do ESO actions drive poor liquidity in the intraday market or is it that the intraday market is not facilitating effective repositioning?
- In any case, market players face conflicting incentives, with a lack of coordination between ESO actions and market scheduling decisions

Average dynamic parameters across the CGGT fleet:

	Notice to deviate from zero	Time to full load (based on run up rate)	Min. nonzero time
CCGT	1.5h	1.5h	4.5h

Notes: Analysis based on 18 days in 2023, based on key study days
Source: EPEX, AFRY analysis

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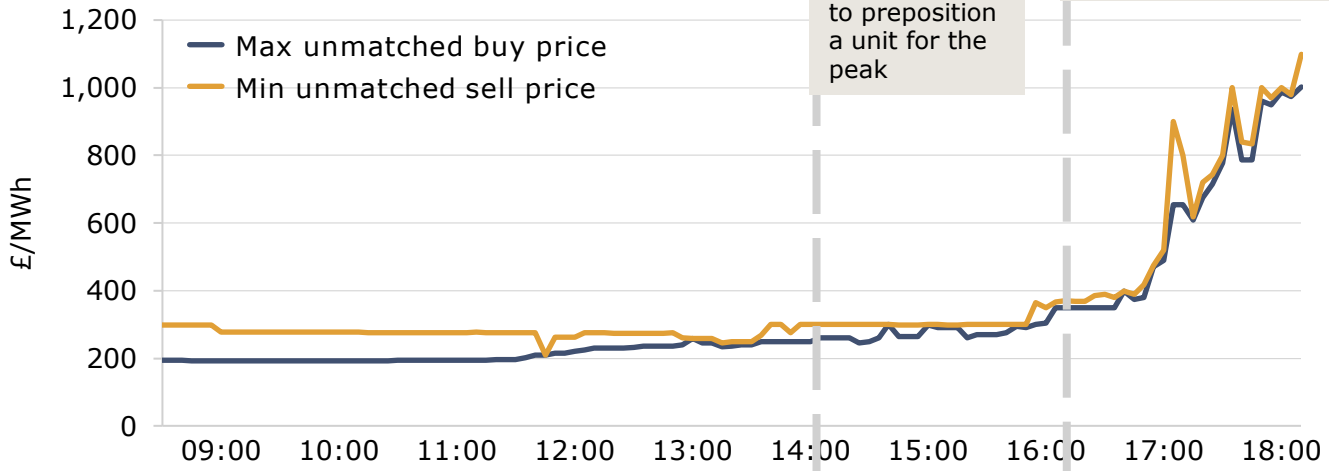
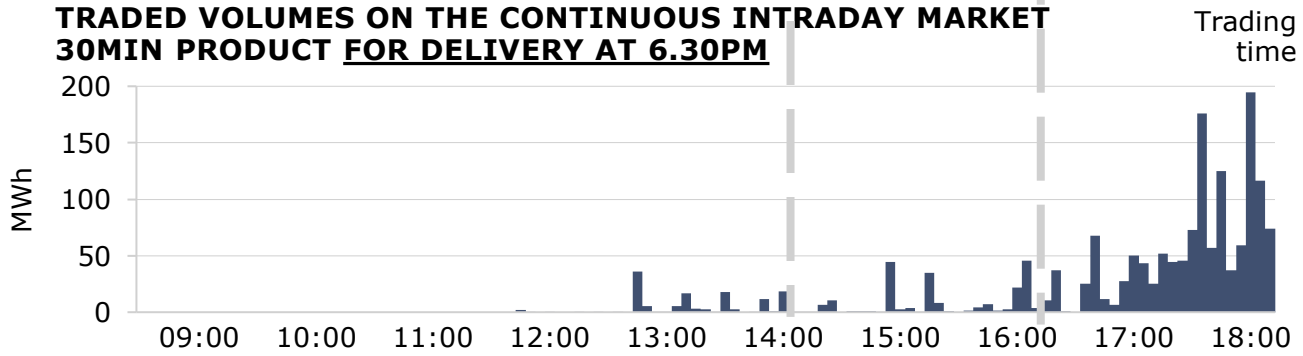
TIMING

ESO is obliged to take proactive decisions with consequences for future periods beyond GC, which overlaps with the operation of the IDM

ORDERS ON THE CONTINUOUS INTRADAY MARKET
30MIN PRODUCT FOR DELIVERY AT 6.30PM



TRADED VOLUMES ON THE CONTINUOUS INTRADAY MARKET
30MIN PRODUCT FOR DELIVERY AT 6.30PM



Source: EPEX

- On 03/07/2023, the intraday market did not lead to effective repositioning of units. While ESO accepted expensive BM offers through the afternoon in anticipation of the peak, the intraday order data for delivery at 18.30 show limited market activity through the afternoon
- The continuous intraday price reached high peak levels, but:
  - were not as high as the Imbalance Price (ID@7pm=£540/MWh, IP@7pm=£1950/MWh)
  - ID prices converged late, close to delivery time
- The BM appears to be supplanting the ID market because of ESO risk management

KEY IMPACT

- **Market players face conflicting incentives, with a lack of coordination between ESO actions and market scheduling decisions**

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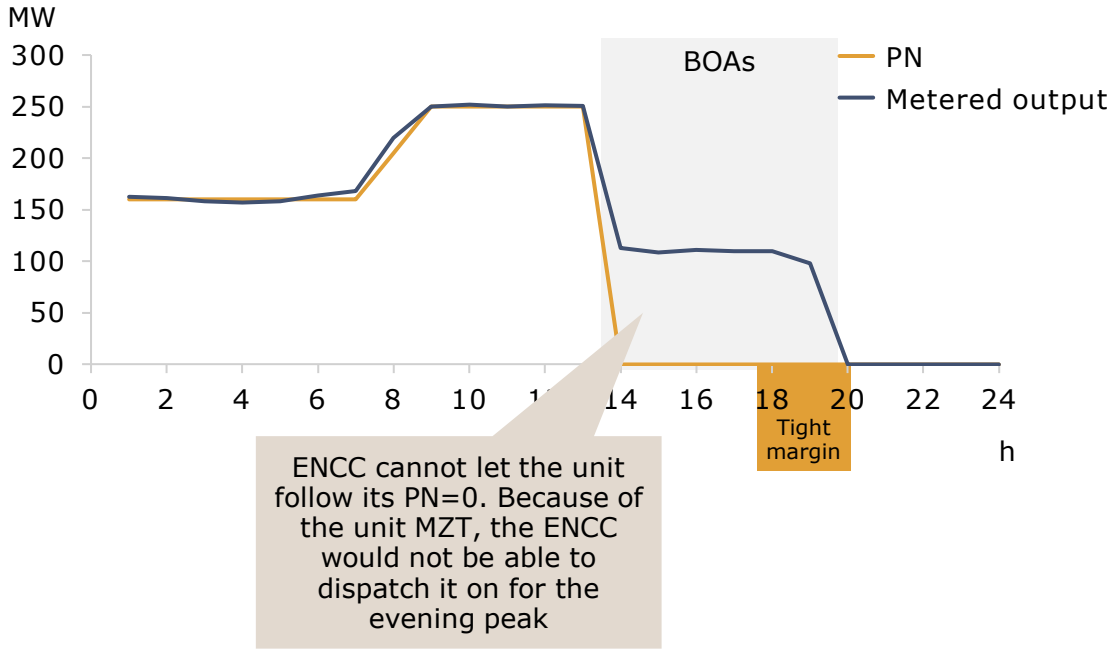
INFORMATION

When taking long notice scheduling actions in the BM, forward-looking data available to ESO is incomplete and non-firm

DELAY DE-SYNC EXAMPLE WITH MIN-ZERO TIME OF 6H



- In this example, ESO expects a deficit at the evening peak based on information available in the afternoon, and needs to take action to ensure there is sufficient headroom at the peak
- It needs to keep a CCGT synchronised to then be able to use it at the peak
- This unit commitment decision is taken at a time when other BMU PNs are not firm, and BOD have not been finalised
- The structure of unit cost and technical submission data does not provide a complete representation of capabilities and cost of resources for future periods

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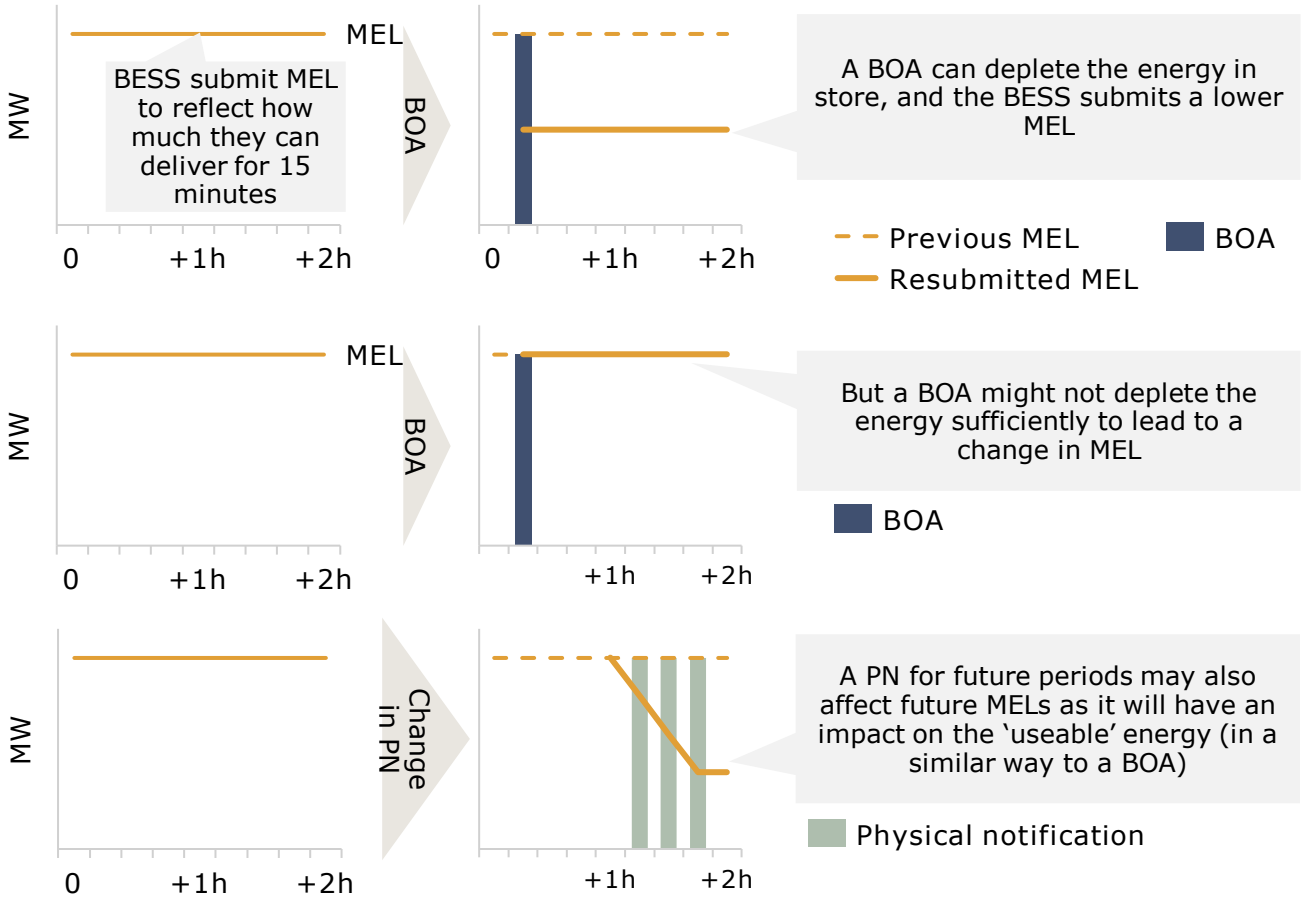
INFORMATION

Energy-limited asset capability is uncertain when ESO is making 'advance' scheduling decisions

CURRENT APPROACH FOR THE MANAGEMENT OF BATTERIES IN THE BM



MEL = Maximum Export Limit

- For energy-limited units, ESO does not have information about the State of Charge, and the '15 minute' rule (soon to be '30 minute') is used as a compromise
- When a BESS receives a BOA, it should redeclare its MEL to reflect its capability (based on its State of Charge) for another 15 minutes
- Even if ESO had clear visibility of the State of Charge of energy-limited assets, it cannot be certain about the 'usable' energy for future settlement periods
- Energy-limited assets can change their PNs until gate closure as trading continues

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INFORMATION

ESO takes decisions with inter-temporal consequences based on imperfect and incomplete forward-looking data

Impact of dynamic parameters of thermal assets

- Long notice scheduling decisions need to be made by ESO in the BM due to asset technical characteristics
- Such unit commitment decisions reduce uncertainty for ESO and are in most cases unavoidable, but they have inter-temporal consequences, e.g. more cost-effective solutions could potentially emerge closer to delivery

Impact of energy limited nature of storage units

- Energy-limited unit capability is uncertain for future settlement periods as the potential 'usable' energy can change until close to delivery
- ESO cannot 'commit' energy limited asset in anticipation of future needs

KEY IMPACT

- **Inefficient dispatch**
- **Under-utilisation of energy-limited assets**

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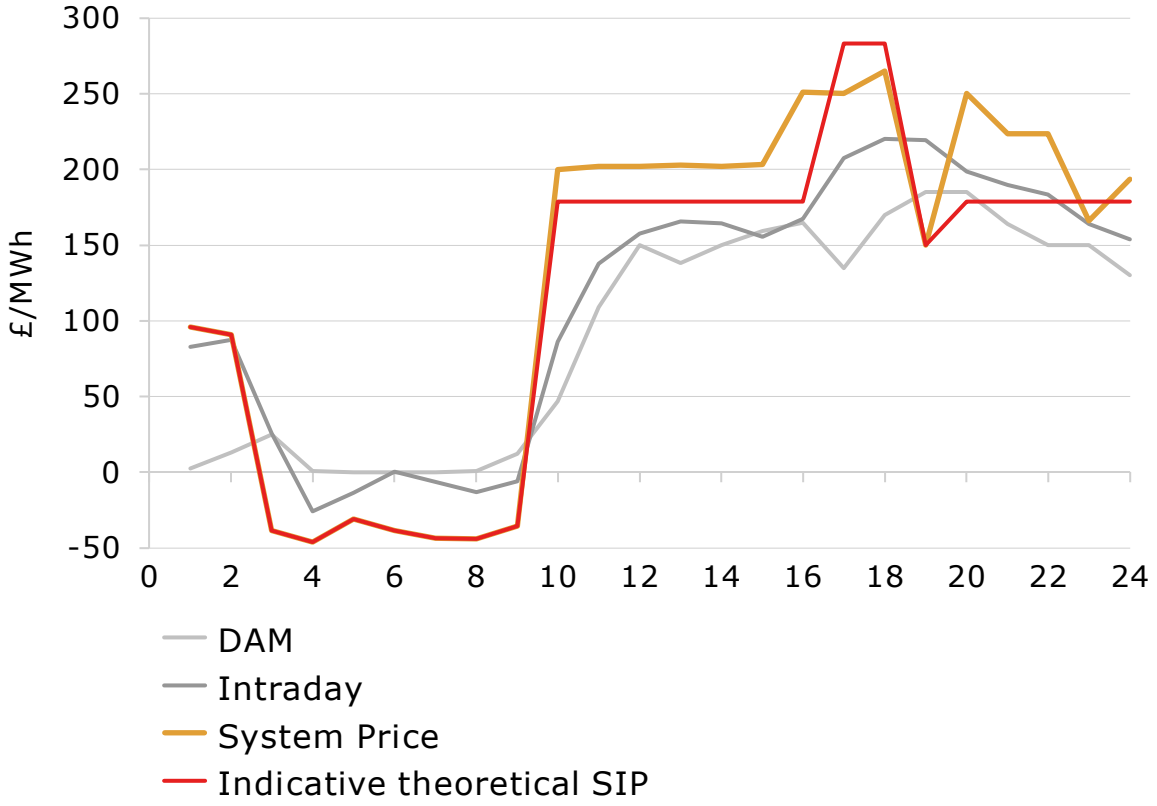
TRANSPARENCY

Beyond-the-wall actions and advance commitments cloud transparency and may distort imbalance pricing

THEORETICAL SYSTEM PRICE ON THE 01/01/2023 ASSUMING START-UP COSTS OF UNITS SYNCHRONISED FOR IS RECOVERED DURING THE PEAK



- On 01/01/2023, actions were taken:
  - in the morning for inertia and voltage (run-through of units); and
  - in the early afternoon to cover for the evening peak
- Part of the cost of the 'early' actions is allocated to those early periods when the need is actually for the evening peak period
- Market participants embed their start-up costs in their offer price. This is because there is no means of allocating costs to the imbalance settlement intervals other than those when the energy was purchased/sold
- As a result, Imbalance Price formation is unclear, potentially impacting incentives for market participants to support system level energy balance

KEY IMPACT

- **Cross-subsidisation between periods**
- **Dampened incentives for market participants to support system energy balance**
- **Under-utilisation of flexible assets**

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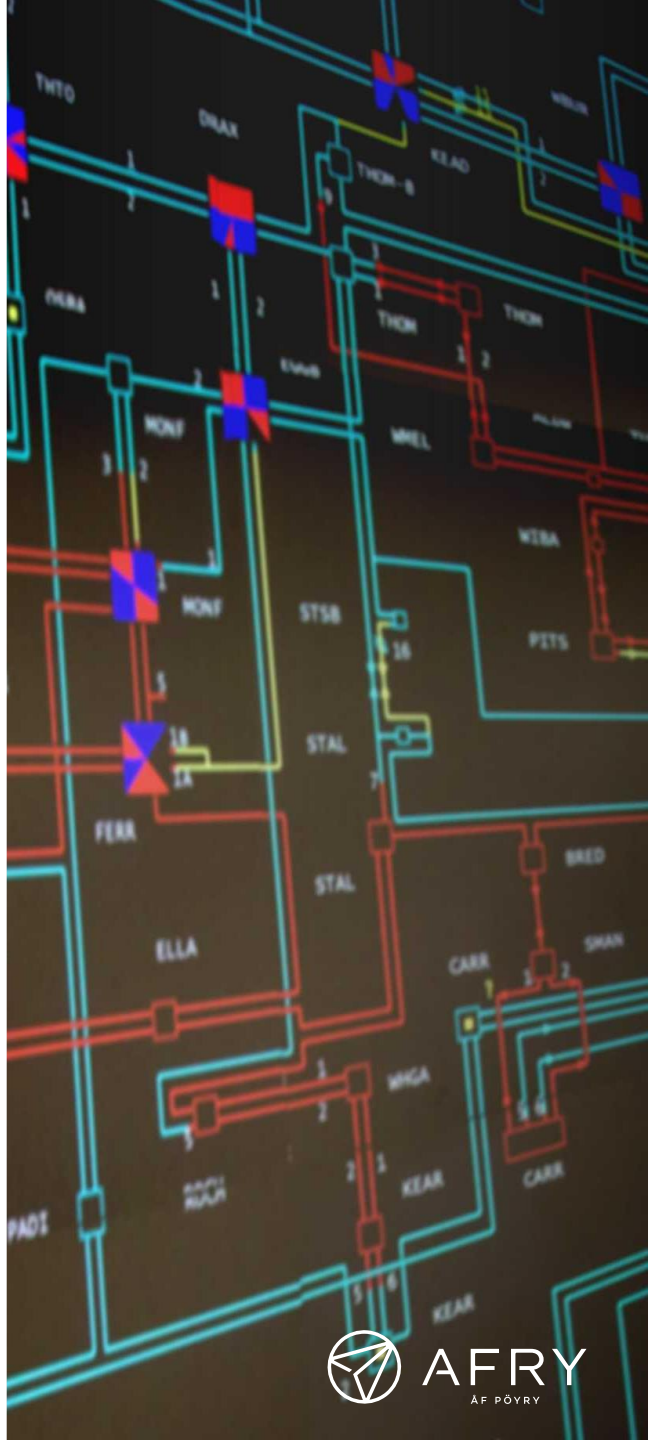
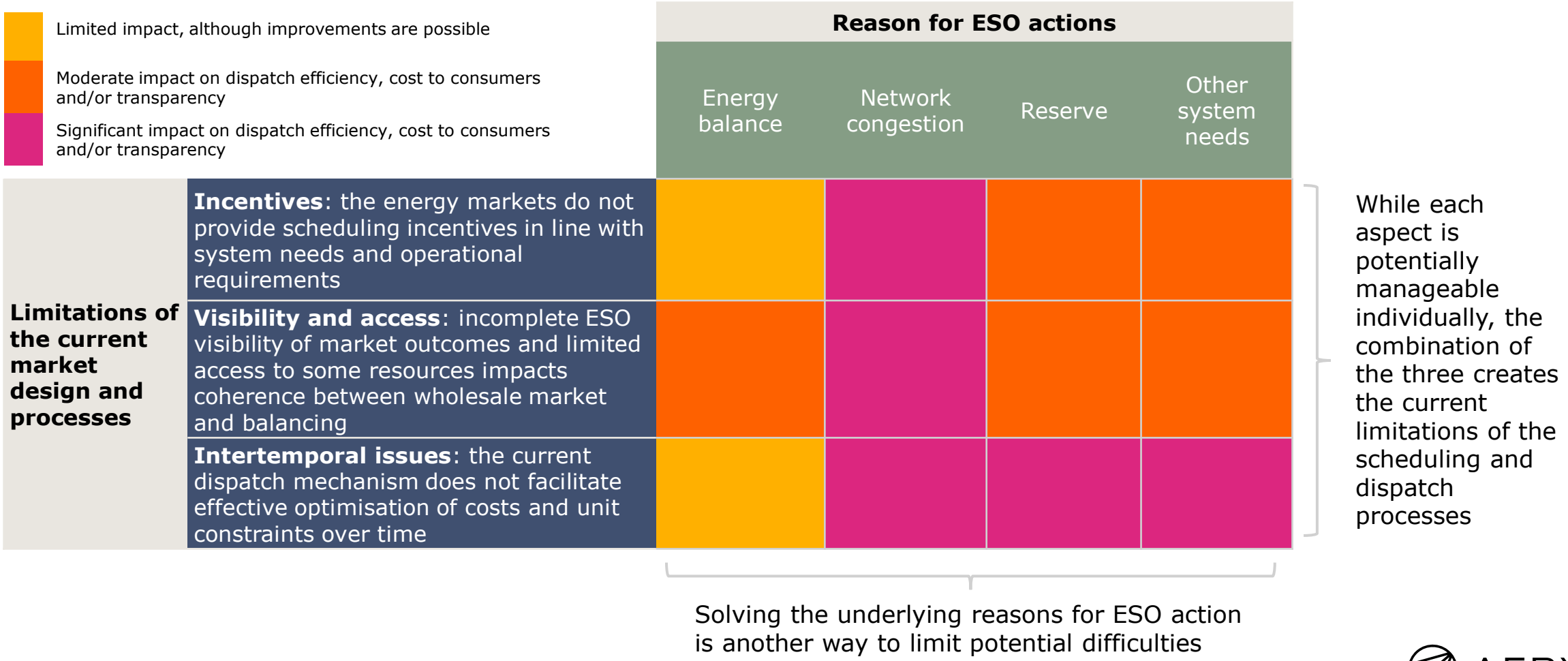


There is a clear case for change of the ‘status quo’ as the underlying conditions have changed since NETA was introduced

What are the key limitations of the ‘status quo’ scheduling and dispatch regime?

1. **Incentives** — The energy markets do not provide scheduling incentives in line with system needs and operational requirements
2. **Visibility and access** — Incomplete ESO visibility of market outcomes and limited access to some resources impacts coherence between wholesale market and balancing
3. **Intertemporal issues** — The current dispatch mechanism does not facilitate effective optimisation of costs and unit constraints over time

In addition to network capacity challenges, the limitations of the current market design challenge system operation and can result in inefficient dispatch



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What is less clear is what to change to …

There are two high-level approaches:

Giving market participants **better incentives** and better information to support system operation

This may include some or all of the following:

- shorter imbalance settlement intervals
- smaller zone size
- improved signals for ancillary services
- improved information sharing between market participants and ESO

Formalise ESO de facto role by giving **greater control earlier**

Effectively allowing ESO to coordinate unit commitment decisions and operation of storage, as well as within-day positions

Discussion

Glossary

Glossary

- **BMU**: A Balancing Mechanism Unit (BMU) is a unit which participates in the balancing mechanism and exports or imports electricity. and to ensure the security and quality of electricity supply across the transmission system. These services include reserve, frequency control and voltage control.
- **non-BMU**: A unit whose output or usage cannot be changed by ESO in the Balancing Mechanism timescales
- **System Imbalance Price**: The System Imbalance Price is the price used to settle the difference between contracted production (and consumption) and the amount actually generated (or consumed) in each settlement period
- **PN:** A Physical Notification (PN) is the best estimate of the level of generation or demand that a participant in the BM expects a BM Unit to export or import, respectively,
- **FPN:** A Final Physical Notification (FPN) is the Physical Notification, which is submitted to the System Operator by Gate Closure for each Settlement Period and used in Settlement calculations.
- **NIV:** The Net Imbalance Volume (NIV) is the volume of the overall System energy imbalance, as a net of all System and energy balancing actions taken by the ESO for the Settlement Period
- **Operating reserve:** headroom or footroom capacity that can be called on with short notice to correct energy imbalances (differences between generation and demand) on the GB power system. Currently, operating reserves consist of 'regulating reserve' procured continuously and via the newly introduce 'Balancing Reserve' service and STOR (Short term operating reserve)


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