Investment Policy Conclusions

Net Zero Market Reform programme

4 July 2023

Detailed slide pack

ESO

Agenda

Time	Session
09:30-09:40	Welcome and opening remarks Speaker: **Claire Dykta**, Director of Markets, ESO
09:40-10:00	ESO presentation: **Net Zero Market Reform to date** Speaker: **Cian McLeavey-Reville**, Head of Markets Development, ESO
10:00-10:50	Panel discussion: **How should investment policy evolve to support a net zero market** Chair: **Isabel Sunnucks**, Market Strategy Co-Manager, ESO Speakers: • **James Samworth**, Partner, Schroders Greencoat • **Rachel Fletcher**, Director of Regulation and Economics, Octopus Energy • **Andrew McAleavey**, Founder and COO, Penso Power Ltd

Agenda

Time	Session
10:50-11:10	Break
11:10-11:40	ESO presentation: **Net Zero Market Reform assessment of investment policy** Speaker: **Sarah Keay-Bright**, Market Strategy Co-Manager, ESO
11:40-12:20	Q&A with ESO Moderator: **Cian McLeavey-Reville**, Head of Markets Development, ESO Speakers: • **Sarah Keay-Bright**, Market Strategy Co-Manager, ESO • **Isabel Sunnucks**, Market Strategy Co-Manager, ESO • Market Strategy team
12:20-12:30	Concluding remarks Speaker: **Cian McLeavey-Reville,** Head of Markets Development, ESO

ESO Net Zero Market Reform to Date

Cian McLeavey-Reville

Q&A: please add questions using the Teams Q&A function.

ESO

We continue to examine the holistic changes needed to GB electricity market design, informed by our unique position as system operator

1 Our current electricity market was not designed for the high-renewable, flexible, low carbon system being developed in GB, and requires reform to avoid risking delivery of our carbon targets

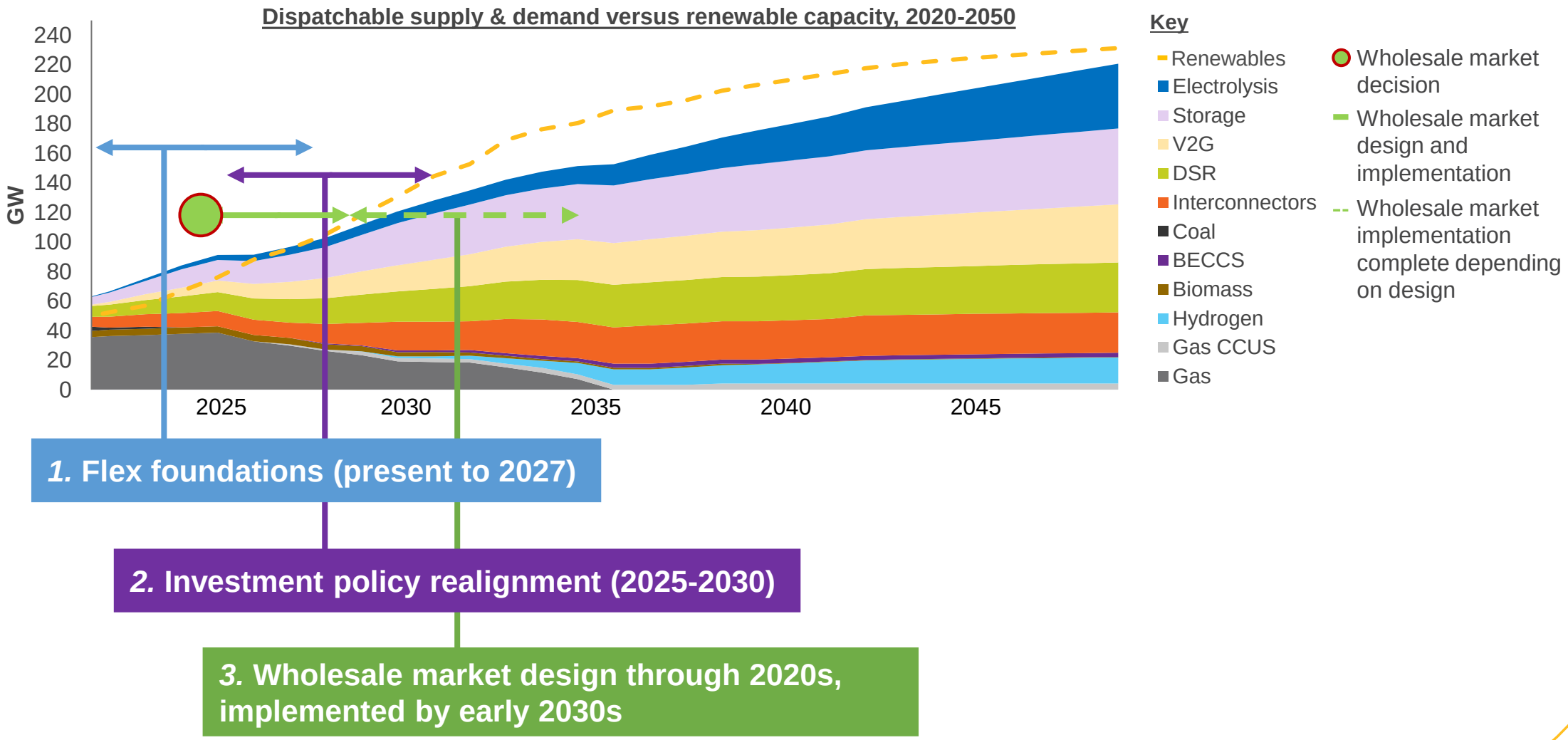
2 **NZMR findings:**

1. Greater transmission network investment, wholesale market reform, and changes to investment policy are all needed urgently
2. In the wholesale market, locational marginal pricing is needed to support effective operation of the future system and would deliver significant socioeconomic benefits
3. The Contracts for Difference and Capacity Mechanism designs must be adapted to better integrate with real time system needs

3 **Considerations for the transition:**

- Clarity on the direction of reform, a clear transition pathway, and arrangements to protect existing investments are needed to maintain necessary investor confidence
- Multiple options exist to mitigate concerns around the distributional impacts of market reform on residential consumers

Our holistic long-term vision for GB electricity market design emerges from three key implementation phases



Note: Year ranges represent illustrative implementation dates

Our current market was not designed for a high-renewable, flexible, low carbon system, and requires reform for net zero

Priorities for market design/policy:

1. Investment
2. Location
3. Flexible:Firm
4. Decarbonisation

Current market arrangements were introduced

Electricity Market Reform (EMR) was introduced in a fossil-dominated system to accelerate decarbonisation

Future

Current market design is not appropriate for the future system. Reformed markets must prioritise investment, location, flexible:firm capacity, and decarbonisation

% of total capacity	2001	2013 (EMR)	2021	2030	2050
Fossil fuel	77%	74%	38%	9%	0%
Renewables	2%	7%	42%	62%	67%
Storage	4%	4%	4%	13%	15%
Interconnectors	3%	5%	6%	9%	8%
Total capacity	71 GW	75 GW	107 GW	209 GW	344 GW
Zero carbon	19%	20%	49%	64%	70%

EMR success

Note: Fossil fuel = coal, gas and oil; Renewables = wind, solar and other renewables (e.g. tidal etc); Zero carbon includes nuclear and renewables, but not storage and interconnectors

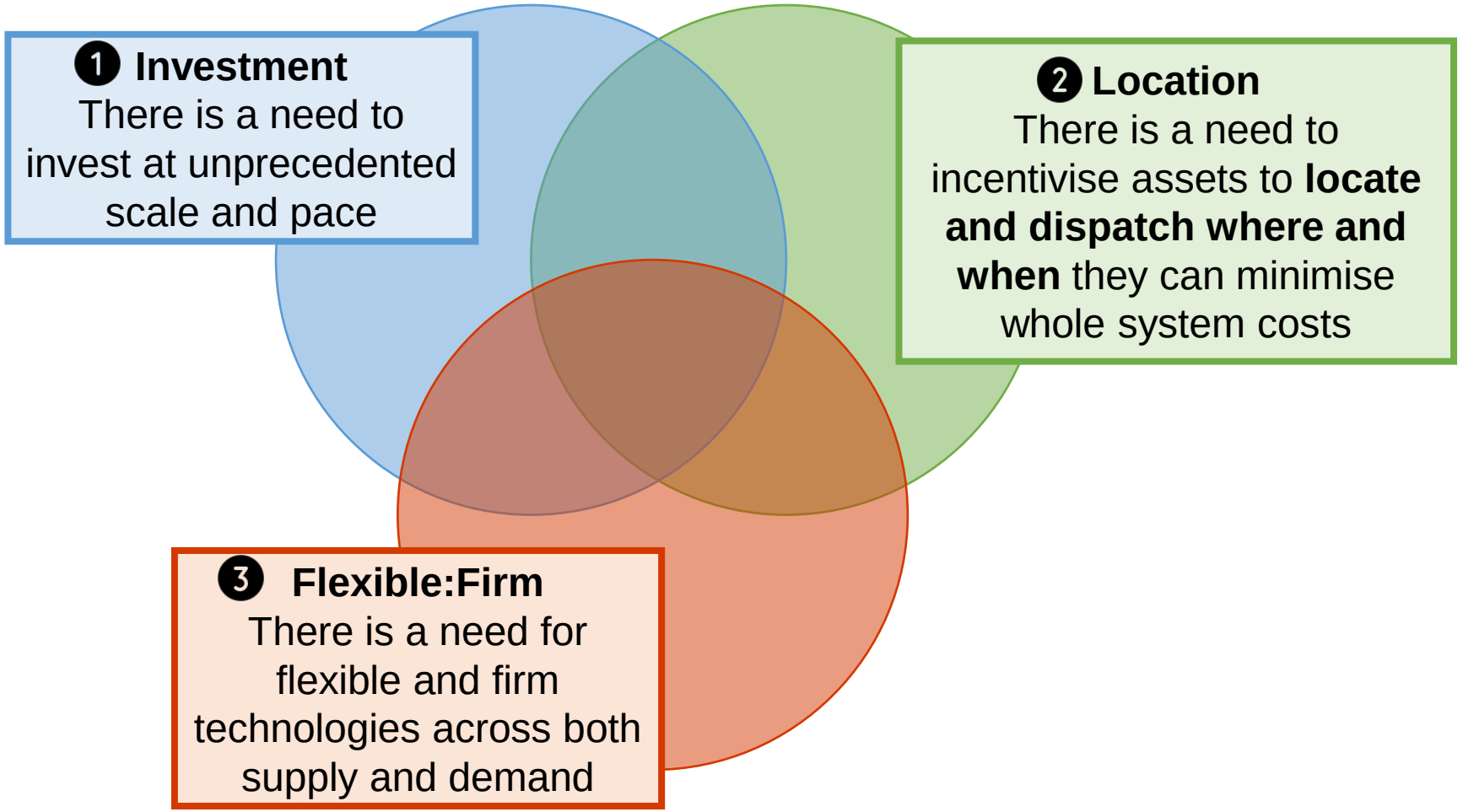
Source: DUKES 5.8 for all 2001 and 2014 data expect interconnector data from Ofgem; FES2022 for all 2021, 2030, 2050 data.

Over four phases, we have assessed the potential for current and reformed market design to enable the decarbonisation of GB's electricity system

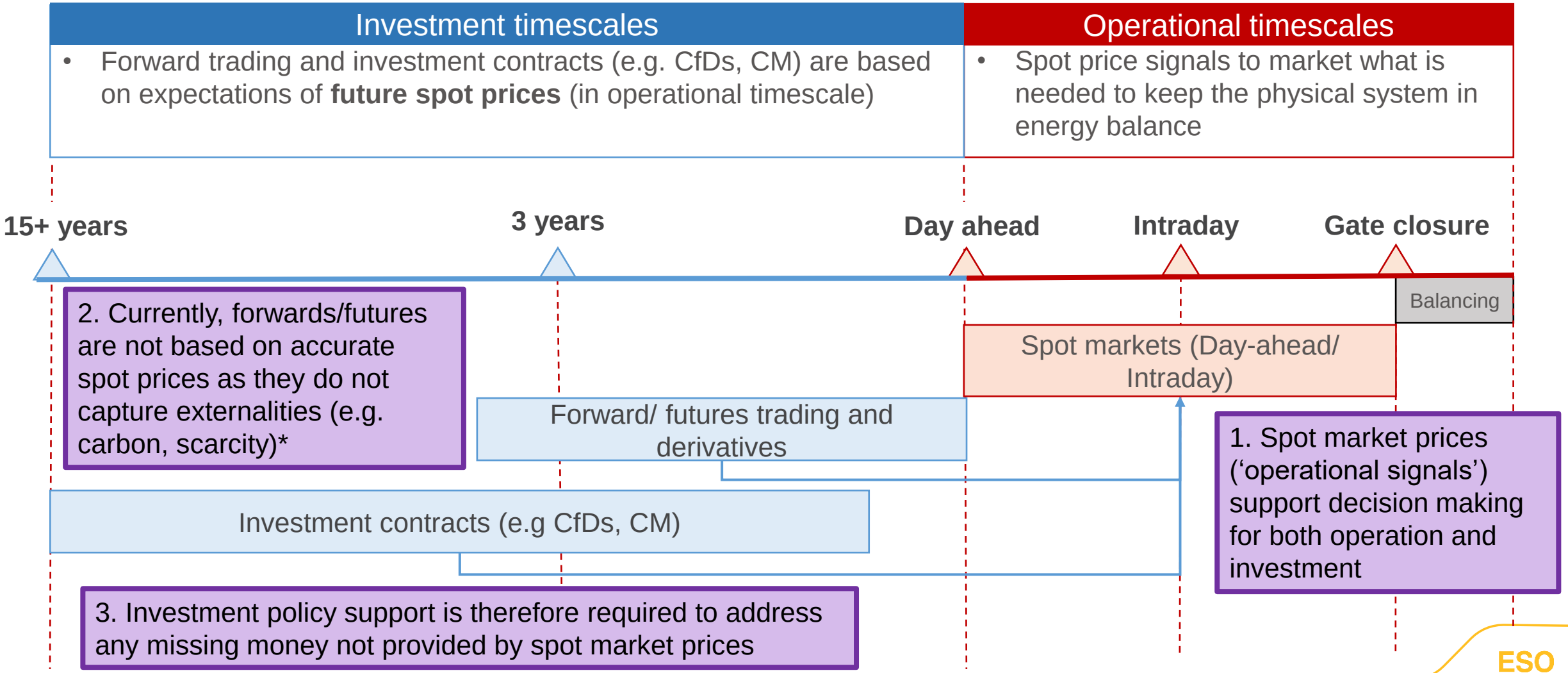
Today

	Phases 1&2	Phase 3	Phase 4		
Focus	• Scoping • **Case for change** • **Assessment framework** and options for reform	Assessment of **wholesale market design** options	Updated case for change with **focus on investment**	Assessment of **investment policy options,** drawing upon Baringa's assessment	ESO view on optimal market reform, with pathways to implement
Output	November 2021 report	May 2022 report	September 2022 presentation	Autumn 2023 report	Preliminary position is set out in next presentation

Our ‘Case for Change’ identified three key challenges facing the GB electricity market that need to be addressed by reform

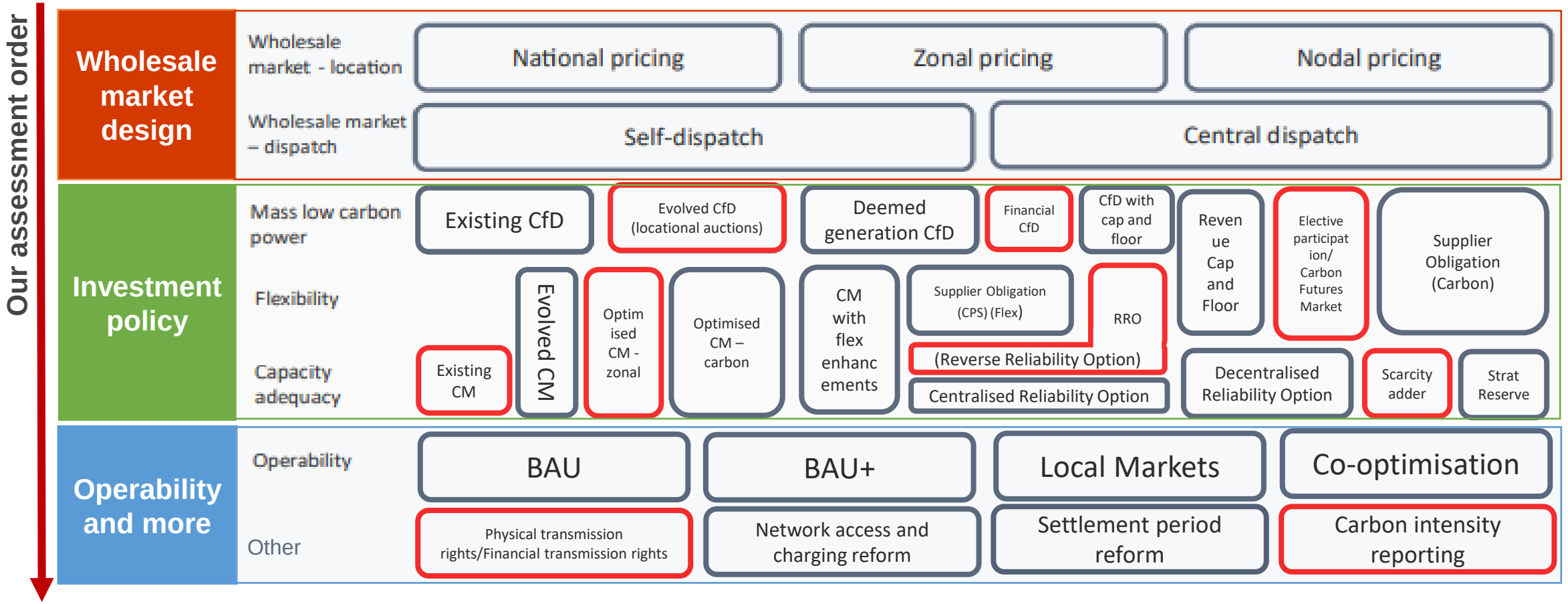


Decisions on wholesale market design should precede decisions on investment policy reform, as efficient investment is underpinned by real time price signals



* Locational externalities can be effectively captured by nodal/zonal pricing

We therefore first assessed wholesale market design when considering options for reform from both an operational and investment perspective



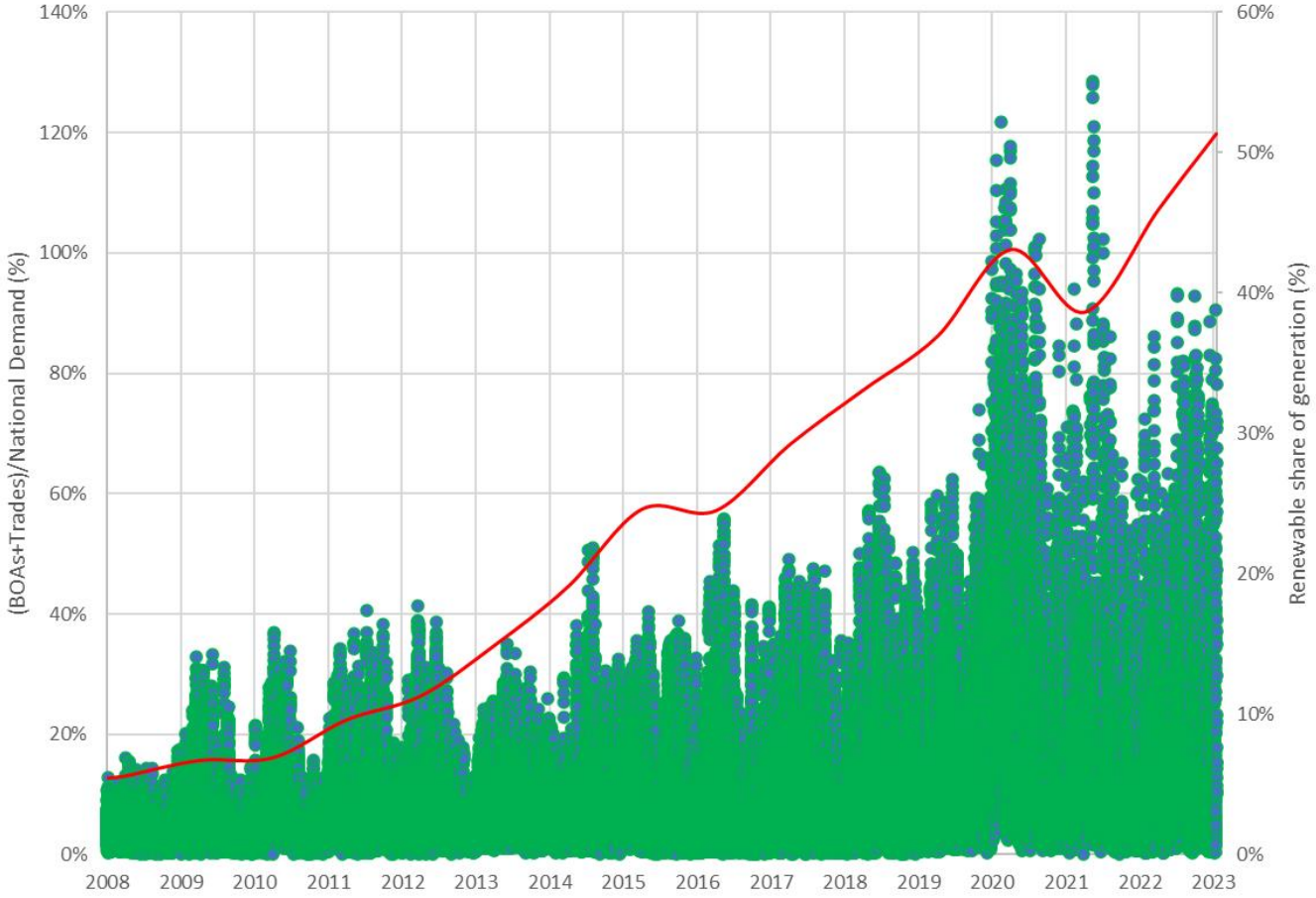
We have blended the REMA framework with our NZMR framework, adding sequencing of assessment and additional options

Key
- REMA options
- New options introduced

Wholesale market assessment

Increasing ESO redispatch actions indicate the link between wholesale market incentives and real-time system needs is broken

The proportion of ESO redispatch actions has increased as a % of National Demand, in line with higher renewables penetration



- The absence of accurate real-time wholesale prices means the market does not have sufficient visibility of underlying system value
- In operational timescales, GB's flexible resource can act counter to system needs/be under-utilised since it is not incentivised to schedule correctly prior to gate closure
- Locational value in operational timescales is conveyed opaquely and imprecisely via the Balancing Mechanism, a revenue stream ill-suited to underpinning investment decisions

Wholesale market assessment

By revealing the true real-time value of electricity, nodal pricing would enable flexible resources to maximise use of GB's renewable generation

	Today	Under locational pricing
Storage, demand-side flex	▪ Charge/export in response to single national price ▪ Locational value primarily realised in Balancing Mechanism – i.e at 1 hour's notice ▪ Inaccurate reflection of locational siting value	▪ Charge/export in response to local price ▪ Locational value visible to the market from day-ahead; allows asset to manage charging profile in time ▪ Accurate locational signal through wholesale price
Interconnectors	▪ Import/ export in response to single national price ▪ In North, can import and exacerbate north to south bulk transfer congestion ▪ In South, can export even when GB need for energy is high ▪ At times ESO takes costly actions to reverse or halt flows	▪ Import/ export in response to local price, avoiding need for redispatch ▪ In North, can export wind generation when there is surplus to avoid curtailment ▪ In South, can stop exporting/ import when local need is high, avoiding need for high carbon/ high price redispatch
Net impact on…		
…renewables	▪ Unnecessary curtailment when flexible resource is not enabled to use local surplus	▪ Flexible resource shifting effectively avoids/mitigates renewable curtailment

Investment policy assessment

Continued investment policy support is needed through this decade; however, reforms are needed to avoid costly market distortions

1 Investment policy support is needed

- Low carbon investment must accelerate at an unprecedented pace to achieve decarbonisation
- Wholesale market signals do not fully capture scarcity, system and carbon value, creating missing money for investments
- Market reforms are complex and introduce uncertainty to investors

2 Current investment policy is not fit for purpose

- Current policy distorts operational signals in the wholesale market, leading to inefficient investment and operation decisions
- Market participants' incentives do not align with market signals
- Asymmetry in how policy treats different resources and market actors → inefficient resource allocation

3 Reformed policy must be compatible with end-vision

- Address costly, unsustainable distortions
- Align generators' incentives with market signals
- Protect consumers against excessive inframarginal rent
- Allocate risks efficiently between consumers and generators

End-vision:

1. Reformed wholesale market that supports efficient operation and investment

2. Investment policy with minimal wholesale market distortion

3. Greater demand-led contracting longer-term

The next presentation and our September publication will set this out in more detail

Summary of assessment

Market reform must be implemented with clear transitional pathways to retain investor confidence in order to achieve net zero at lowest cost to consumers

Our market reform priorities

- Re-establish link between wholesale market incentives and real-time system needs, by introducing locational energy pricing
- Retain investment policy but reform to address distortions and ensure participants' incentives align with market signals

Implementation considerations

- Enduring investment reforms should be coherent with future wholesale market design
- Potential short-term reforms, to *partially* address emerging issues, must be carefully considered due to additional disruption and potential for unintended consequences
- Reform pathways which set out how the package of reforms are phased in over time are critical to minimise regulatory risk and ensure investor confidence
- Need to coordinate with complementary strategic transmission network build

Our preferred pathway

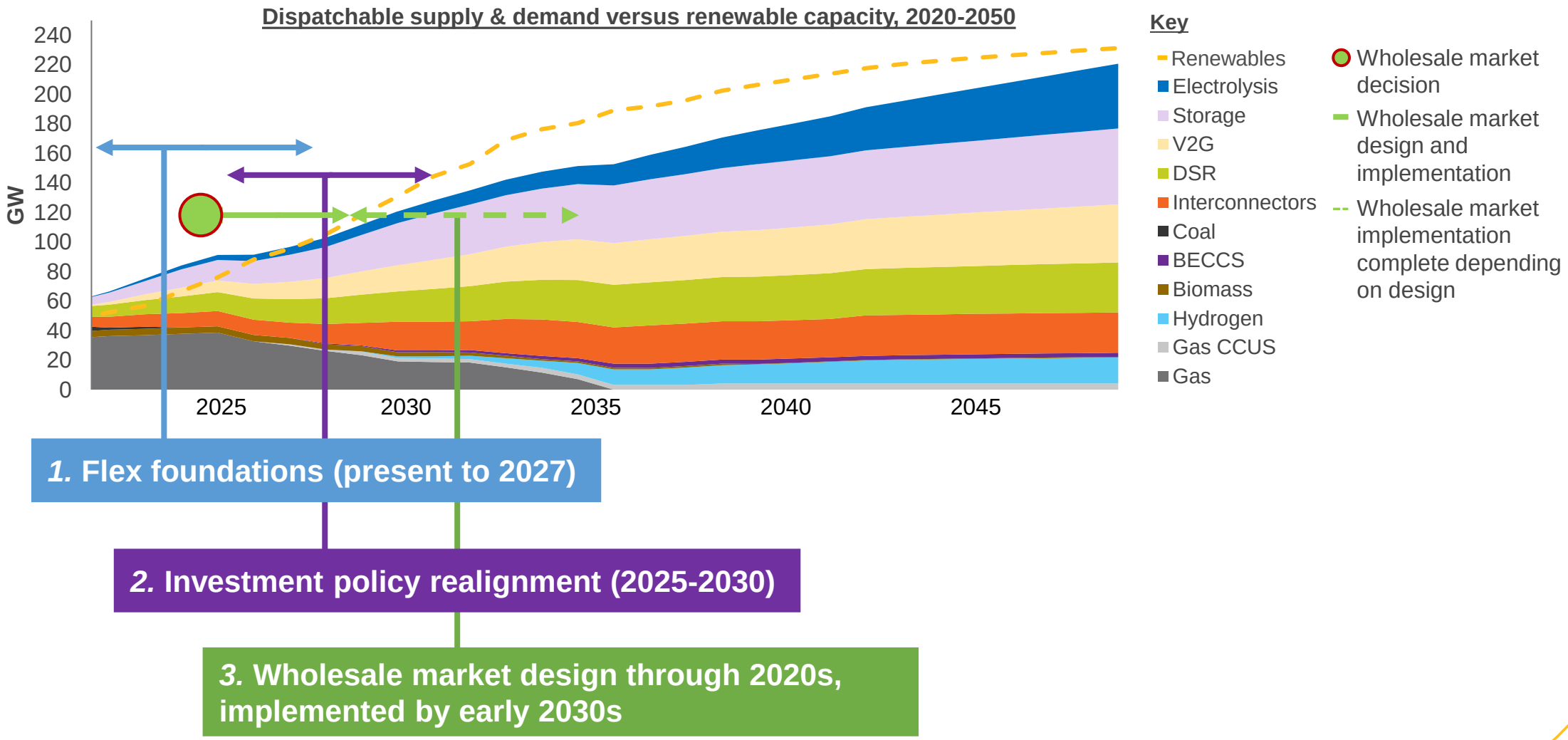
We have identified three key implementation phases in the overall package of reforms:

1. Flex foundations (present to 2027)
2. Investment policy realignment (2025-2030)
3. Wholesale market transition (2028-2035)

See next slide for detail

Implementation

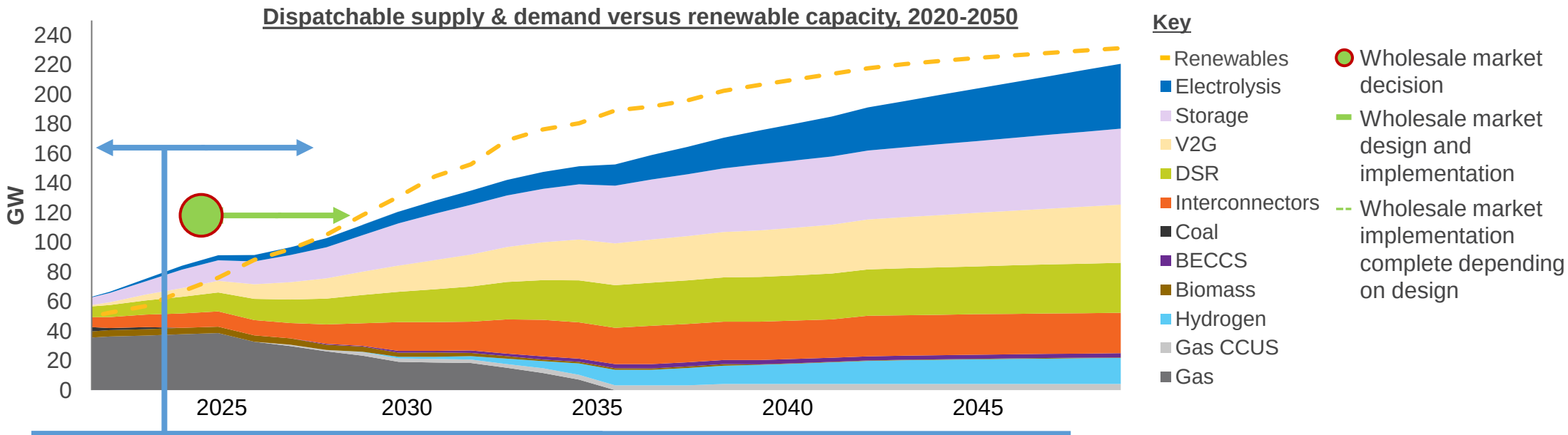
Our holistic long-term vision for GB electricity market design emerges from three key implementation phases



Note: Year ranges represent illustrative implementation dates

Implementation

Our holistic long-term vision for GB electricity market design emerges from three key implementation phases: 1) Flex Foundations



1. Flex foundations (present to 2027)

Drivers for phase: rapid expansion in flexible capacity

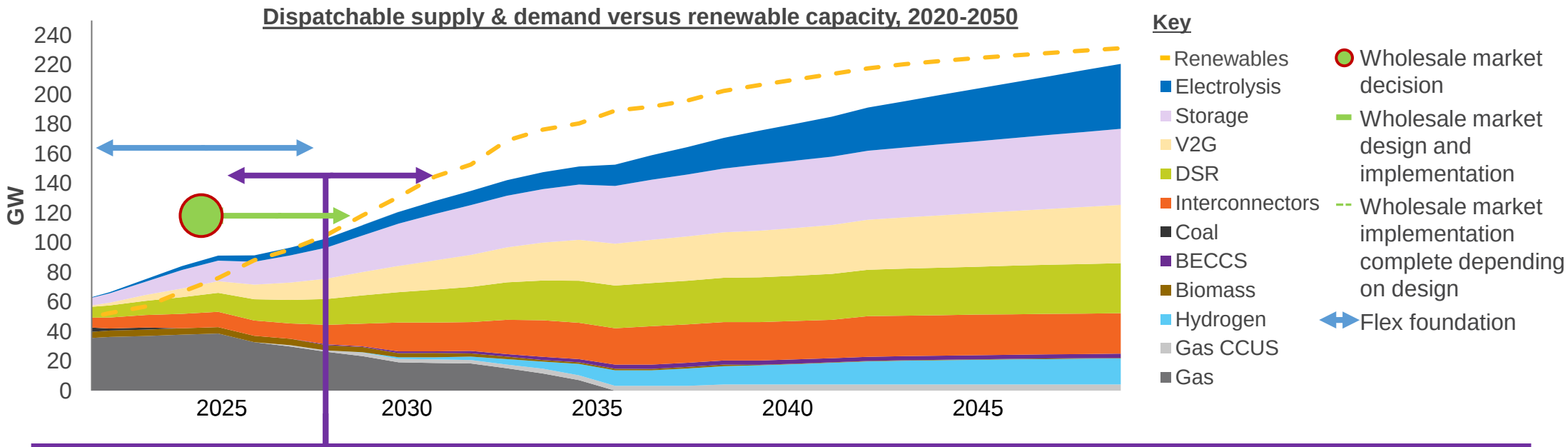
Focus: expedite flex enablers including:

- Smart metering rollout
- Market half hourly settlement
- Retail market reforms
- Wider access to Balancing Mechanism
- Connections reform

Note: Year ranges represent illustrative implementation dates

Implementation

Our holistic long-term vision for GB electricity market design emerges from three key implementation phases: 2) Investment policy realignment



2. Investment policy realignment (2025-2030)

Drivers for phase: Total £bn CfD support triples between 2025-35*/ average length of tight periods triples between 2030-35

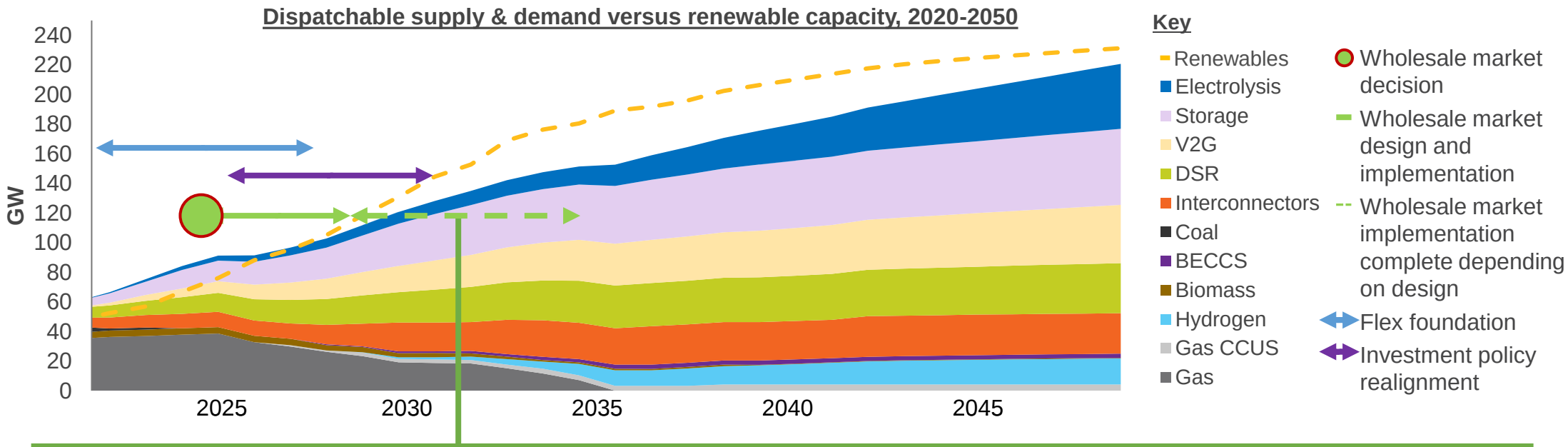
Focus:

- In the short term, implement reform to CfD scheme and improvements to the Capacity Market
- Reform investment policy for post 2030 to reflect radically different nature of system security requirements
- Ensure coherent with chosen wholesale market design

Note: Year ranges represent illustrative implementation dates; * ESO Net Zero Market Reform Phase 2: analysis by LCP

Implementation

Our holistic long-term vision for GB electricity market design emerges from three key implementation phases: 3) Wholesale market transition



3. Wholesale market design through 2020s, implemented by early 2030s

Drivers for phase: Demand, storage and interconnectors dominate GB's dispatchable capacity

Focus:

- Locational marginal pricing required to align assets with two-way flows with system needs
- Introduce dynamic and granular wholesale market signals with demand side exposure to unlock our growing flexible resource

Note: Year ranges represent illustrative implementation dates

NZMR ongoing work and next steps

1. Preliminary conclusions on investment policy in today's **next ESO presentation**

2. Final conclusions on investment policy will be set out in our **autumn publication**, taking into account stakeholder feedback from today's session

3. ESO best-view reform package that coherently combines investment policy and wholesale market design, will be set out in our **autumn publication**

4. In depth assessment of centralised and decentralised scheduling ongoing; stakeholder engagement will start in Autumn

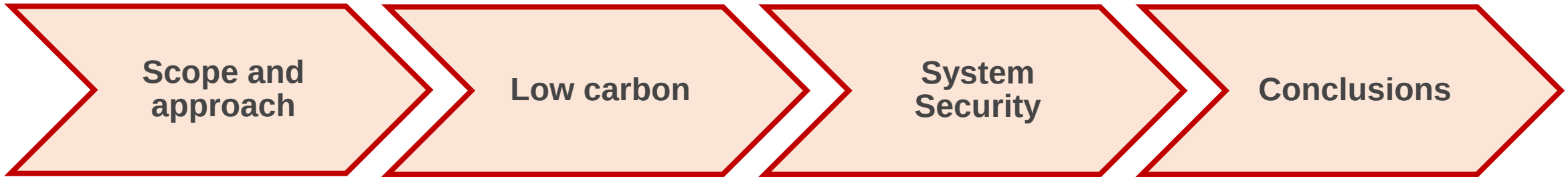
5. We continue to work with government and Ofgem on REMA, advising from unique System Operator viewpoint

Assessment of Investment Policy

Sarah Keay-Bright

ESO

Overview of presentation



EMR successfully facilitated early-stage investment in low carbon technologies but the economic, policy and system context has changed

The Government introduced the Electricity Market Reform (EMR) policy package in 2012 to address the trilemma objectives. The main instruments are the Contracts for Difference (CfD) and Capacity Market (CM) schemes but also included a Carbon Price Floor and Emissions Performance Standard.

Late 2010s energy challenges

- Retirements
- Nascent technologies
- Missing money and carbon
- Moderate carbon ambition

EMR success

- ✓Contracts worth ~30GW by 2030
- ✓Lower cost of capital
- ✓Returned money to consumers during high prices
- ✓Competition through auctions
- ✓Supplied ‘missing money’
- ✓Coal phased out

Challenges for REMA

- Ambitious climate targets
- Accelerated low carbon investment
- Need for accurate flexibility
- Changing nature of reliability/security with different risks and system needs
- Managed exit of fossil fuels

We have identified three key limitations of the current policy framework

The limitations of developing a cost-efficient, decarbonised and reliable system under the current investment policy framework have already emerged, leading to inefficient investment, operational issues and rising costs. This will be exacerbated with scaled up investment. We conclude the current framework is not fit for delivering the REMA objectives and net zero.

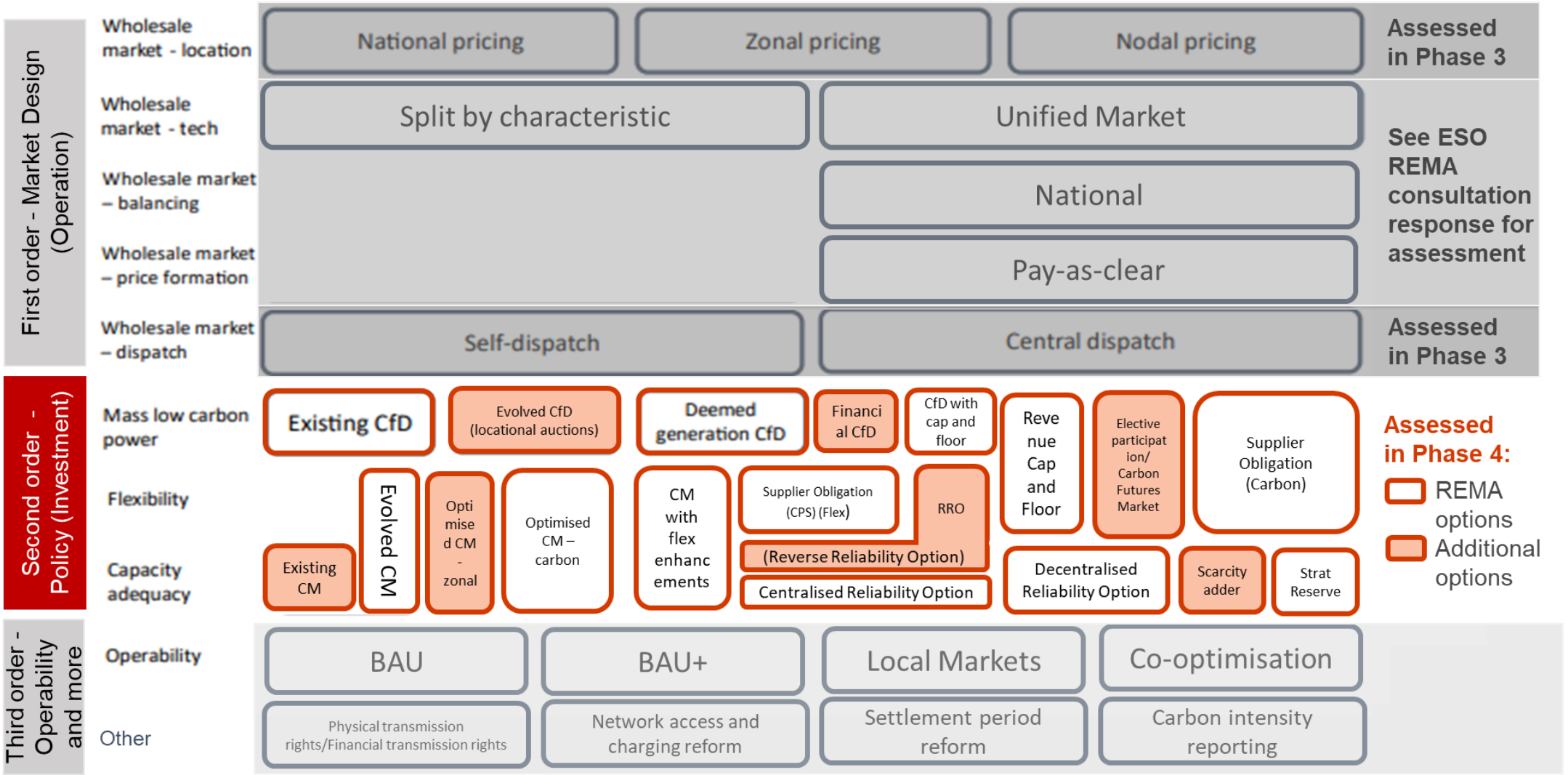
We have identified three issues below:

1. Today, operational signals do not fully capture important externalities (e.g. system constraints, carbon), leading to inefficient investment and retirement decisions

2. Moreover, current investment policy distorts underlying operational signals and supported market participants' incentives are not aligned with market signals, leading to inefficient investment and dispatch decisions

3. There is asymmetry in how market design and policy treat different resources and market actors, which results in inefficient resource allocation

As part of Phase 4, we have assessed investment policy options in REMA and additional options



Low carbon

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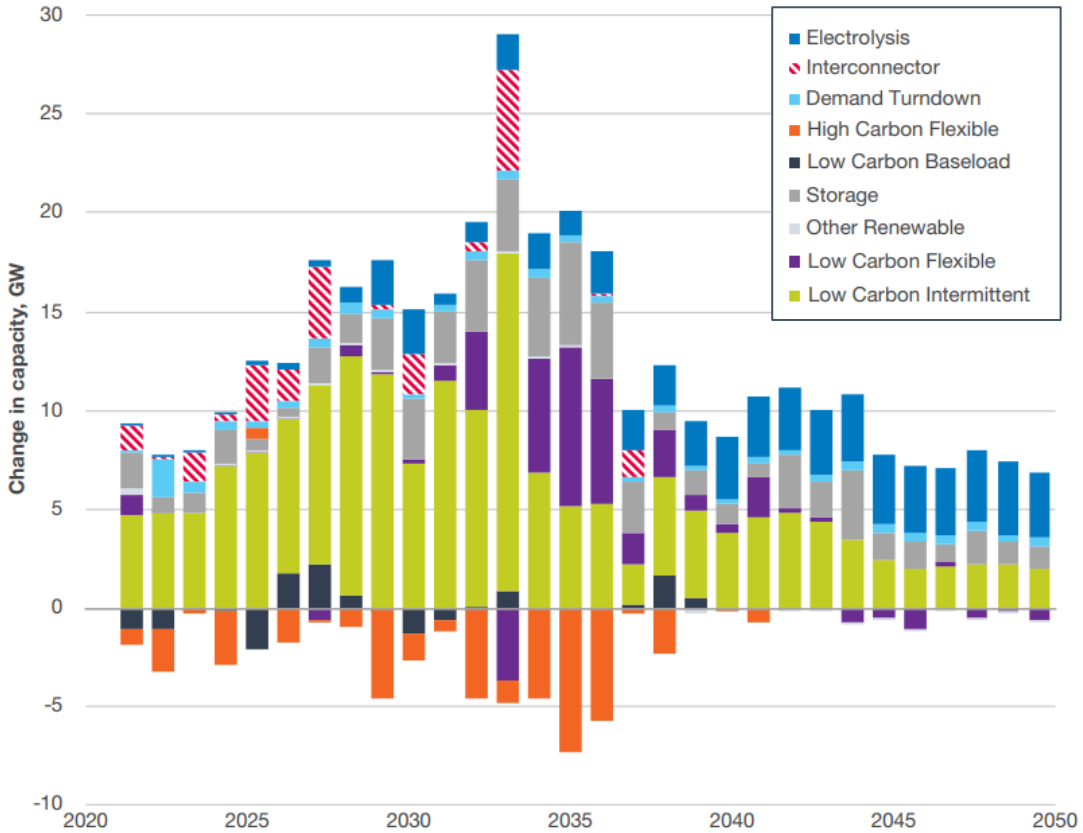
CfDs have accelerated investment and provided some protection for consumers against very high prices, but create distortions and impact generators' incentives

- Central procurement has delivered significant investment in low carbon capacity to date, and will be needed to drive necessary investment for 2035 targets
- Current Contracts for Difference (CfD) design disincentivises assets from delivering added system value, and has a distorting impact on wider markets:
  - Bidding distortions in intraday market, balancing mechanism
  - Herding behaviour around price thresholds/rules
  - Lack of incentives to support system (ancillary services, respond to scarcity prices, efficiently schedule maintenance, invest in system-supporting technologies, repower/retrofit based on system needs)
  - Reduced liquidity in forward markets
- Policy reform should address distortions while retaining CfD benefits

1 Inaccurate operational signals 3 Unequitable treatment of demand versus supply

Centralised, directed procurement is required for accelerated investment, evolving towards greater demand-led investment longer-term

Capacity build and retirements – Leading the Way FES [2021]*



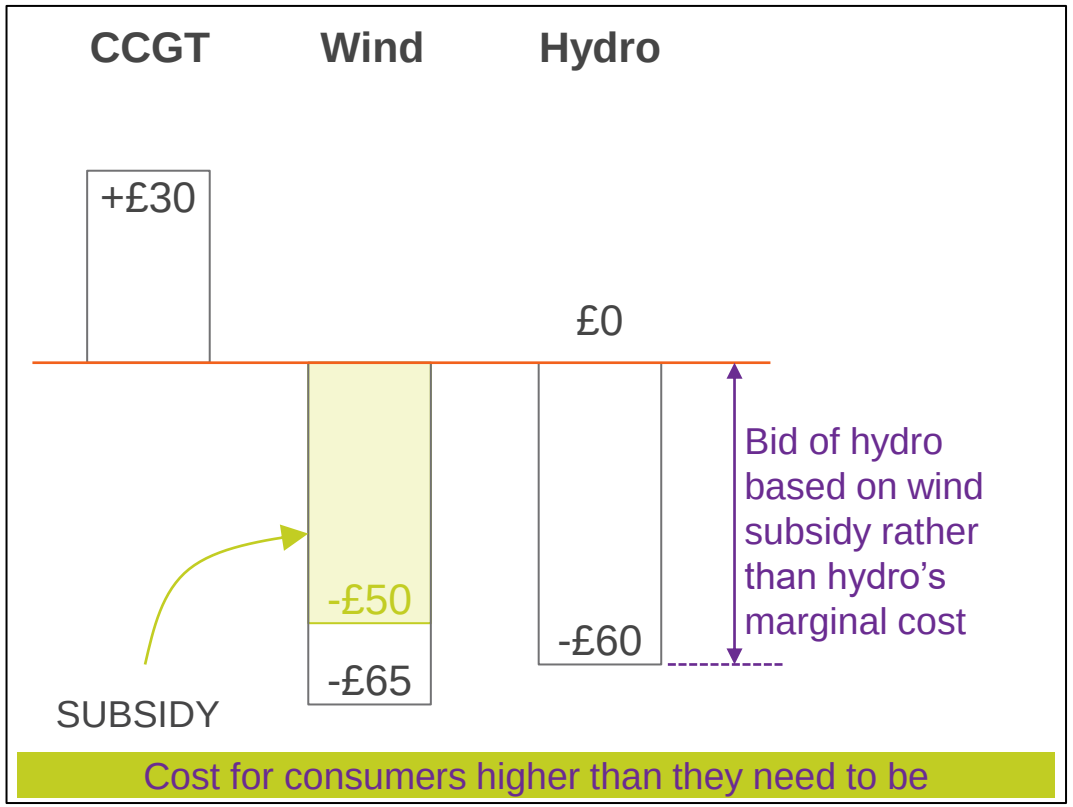
- Continued centralised procurement needed to attract financing at required pace and scale
- Challenges to consider when determining optimal procurement:
  - System sizing: uncertain demand profile raises risk and costs. Mitigate with ambitious, robust energy efficiency policy and symmetric treatment of demand/supply
  - Coordination: more transparent, coordinated approach needed to ensure coherence across decision-making processes
- Longer-term, demand-led investment driven through markets could deliver more efficient outcomes

Source: ESO NZMR Phase 2

2 Policy distorting operational signals

CfD design causes wholesale market distortions

Example of bidding behaviour in the BM



- CfD reward based on output and top up from the reference price (based on the DA price) to the strike price, so:
  - Generators shielded from low prices and the price cannibalisation effect
  - Subsidies are incorporated into ID/BM bids, distorting prices and harming competition as unsubsidised participants are incentivised to adjust their bid prices to similar levels
- Supported generators can earn more than their strike price to be constrained off via the BM - perverse incentive to locate where high likelihood of curtailment
- **The above means supported generators are driving up system costs they are not exposed to**

2 Policy distorting operational signals

CfD design distorts incentives to provide ancillary services, despite asset technical capability

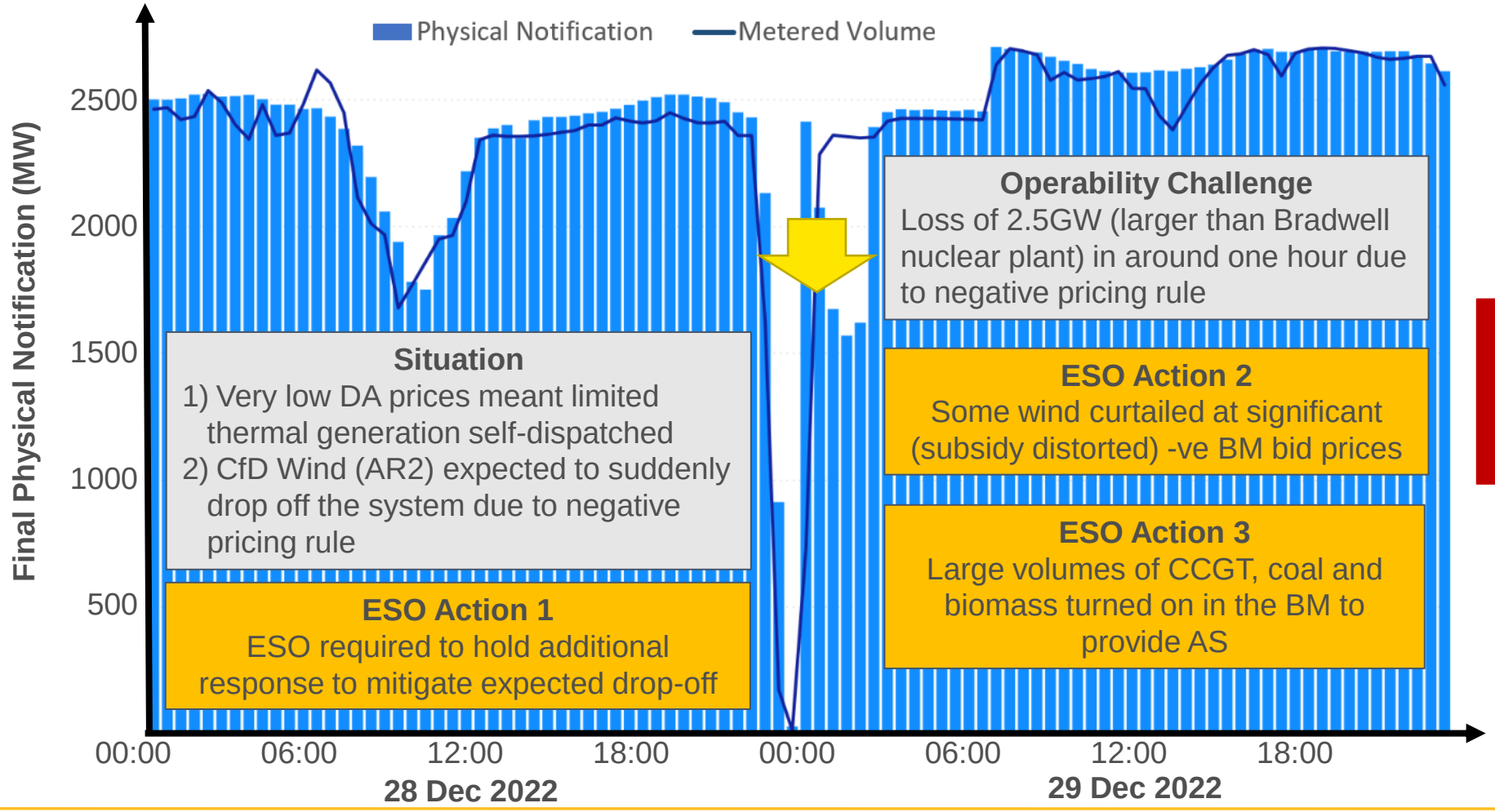
Service	Wind			Solar		
	Tech capable	Access	Providing	Tech capable	Access	Providing
Response	✓	✓	✗	✓	✓	✗
Positive reserve	✓	✗	✗	✓	✗	✗
Stability	✓	✓ (in future)	✗	✓	✓ (in future)	✗
Reactive	✓	✓	✓	✓	✓	✓
Local constraint market/MW Dispatch	✓	✓	✗	✓	✓	✗

- Ancillary service (AS) provision very limited today as subsidies represent high opportunity costs to overcome
- Growth in renewables will drive up AS demand
- Demand for energy (WM price) and for the AS service **will vary dynamically by time & location** and prices should reflect this

2 Policy distorting operational signals

Example of a high balancing cost day due to CfD impacts, including 2nd order "herding" effect due to the negative pricing rule that aimed to fix CfD distortions

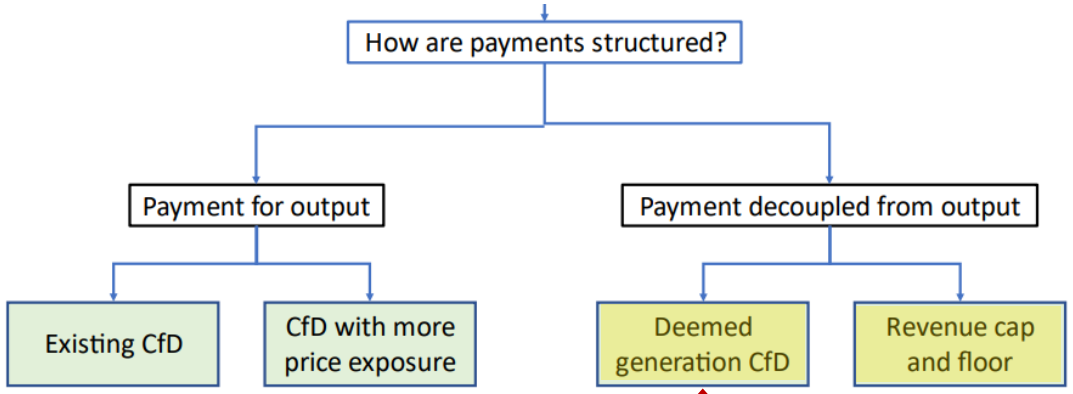
Aggregate output of wind generating units de-synched over 28/ 29 December due to negative prices



Outcome:
11th highest balancing cost day in 2022 (£11.9m)

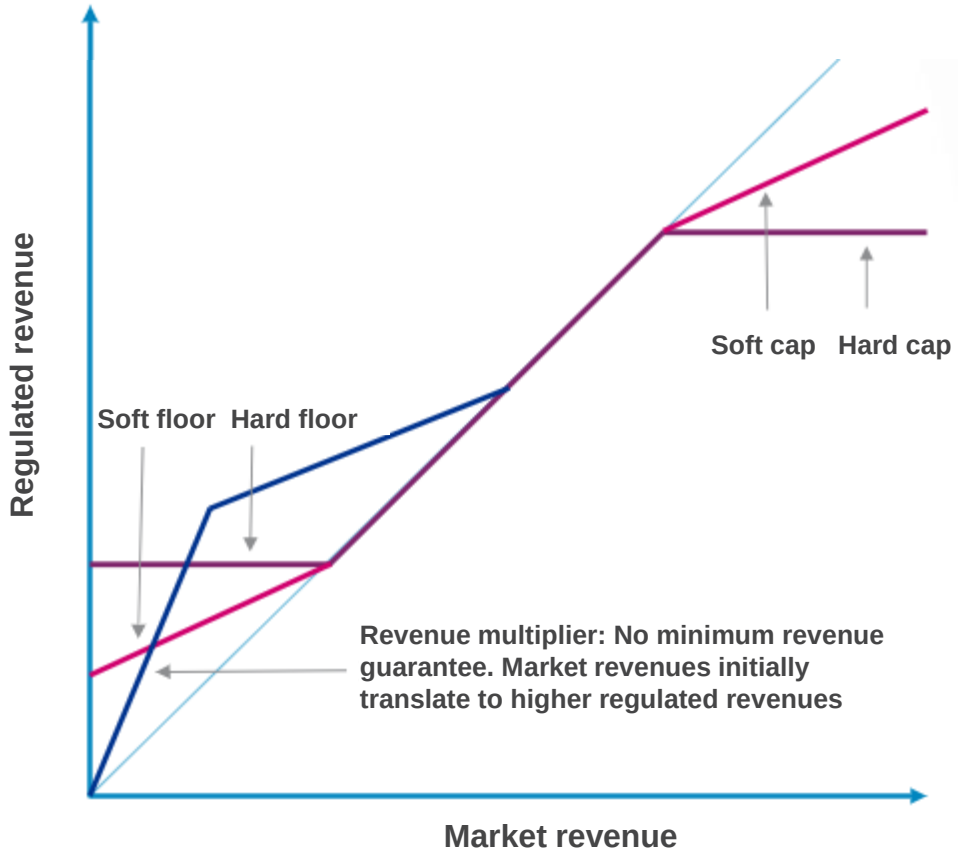
Low carbon investment policy options assessed as potential alternatives to current Contract for Difference (CfD) support scheme

Deemed Generation CfD



- Generators paid based on their potential to generate in a particular period, rather than actual generation output
- Generators would not have to export energy to receive their CfD top-up payment, as they do currently
- Aim to remove dispatch distortions by decoupling support from output

Revenue cap and floor



Some reform options could address distortions while retaining CfD benefits

- Reform options exist that could align generators' incentives with market signals in operational timescales while retaining benefits of current scheme to some degree
- In design, there is a trade off between cost of capital (CofC) reduction versus system net benefits
- It is important that reforms do not introduce new distortions/issues

Performance of some options against issues relevant to operational timeframes**

Option / **Issue**	*Revenue hard C&F	*Revenue soft C&F	Deemed generation	Financial CfD	CfD+ (removal of subsidies from bids)
Wholesale/BM distortion					
Herding behaviour					
Anc. service disincentive					
Scheduling maintenance					

*e.g. annual
** Subject to further analysis - detailed results to be presented in autumn report. Split amber-green RAG ratings reflect variation in design choices

System security

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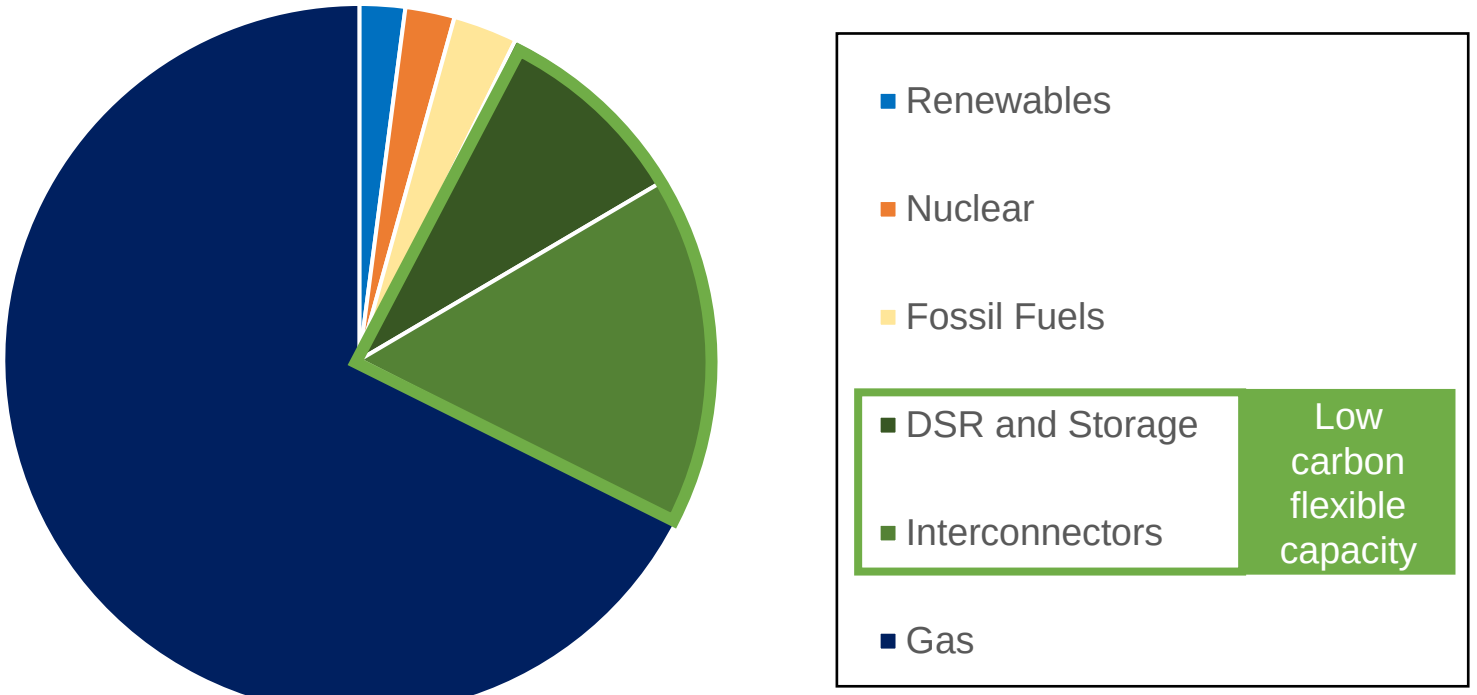
Capacity Market can be optimised to resolve some existing issues, but longer-term changing nature of system security may require alternatives

1. Current CM promotes high-carbon technologies and does not sufficiently reward flexibility, this can be addressed with reforms to the mechanism
2. The nature of the system security challenge is changing significantly: stress events will increasingly involve generation excess as well as scarcity, with tight periods less exclusively driven by winter peak and distributed throughout the year, often lasting for days/weeks rather than hours
3. There are fundamental limits to the ability of the Capacity Market to address future system security challenges, alternative mechanisms show promise in addressing these

Short-term reforms to the Capacity Market are beginning to address urgent issues of carbon intensity and flexibility requirements

T-4 Auction results (2026/27) breakdown of CM agreements awarded by fuel type



- Current CM has procured lots of high-carbon capacity and limited low-carbon flexibility
- Government has confirmed plans to take forward proposals to improve the CM:
  - Improving delivery assurance by strengthening the non-delivery penalty regime
  - Improving carbon intensity through reduction of emissions intensity limit applicable to new build plants from Oct 2034
- Government is also progressing with FOAK support for low carbon dispatchable technologies (e.g. CCUS, long-duration energy storage)

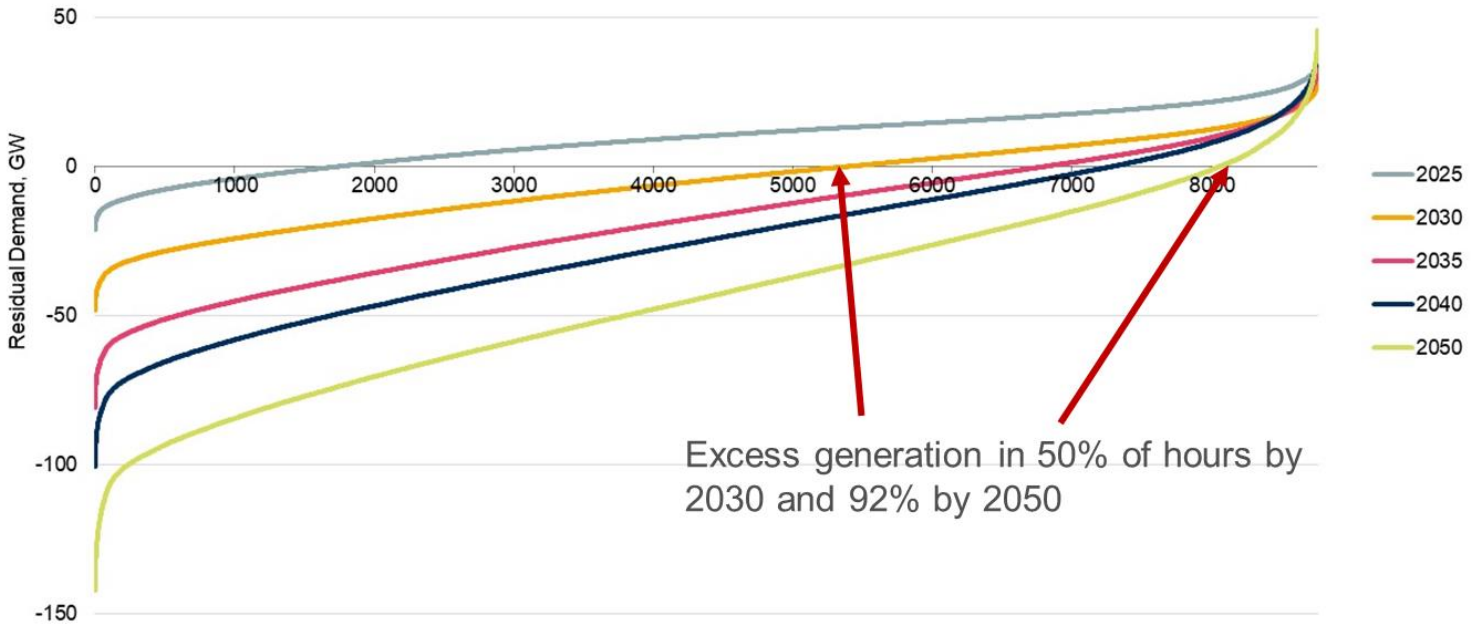
Note: low carbon flex includes DSR, nuclear and storage

① Inaccurate operational signals ② Policy distorting operational signals ③ Unequitable treatment of demand versus supply

The nature of the system security challenge is changing significantly

Stress events will increasingly involve generation excess as well as scarcity, with tight periods less exclusively driven by winter peak and distributed throughout the year

Excess Demand/Generation Distribution (GW): Leading the Way
(Source: ESO)



- CM procures capacity to meet **winter peak** demand – will be increasingly less appropriate.
- **CM penalties** do not accurately reflect system stress, increasing risk of non-delivery.
- **Bidirectional Reliability Options** would provide accurate and stronger incentives, as **spot prices** can accurately reflect system stress,
- ROs are tradeable **financial (not physical) contracts**, so generators manage delivery risk, removing the need for the problematic **derating factors**

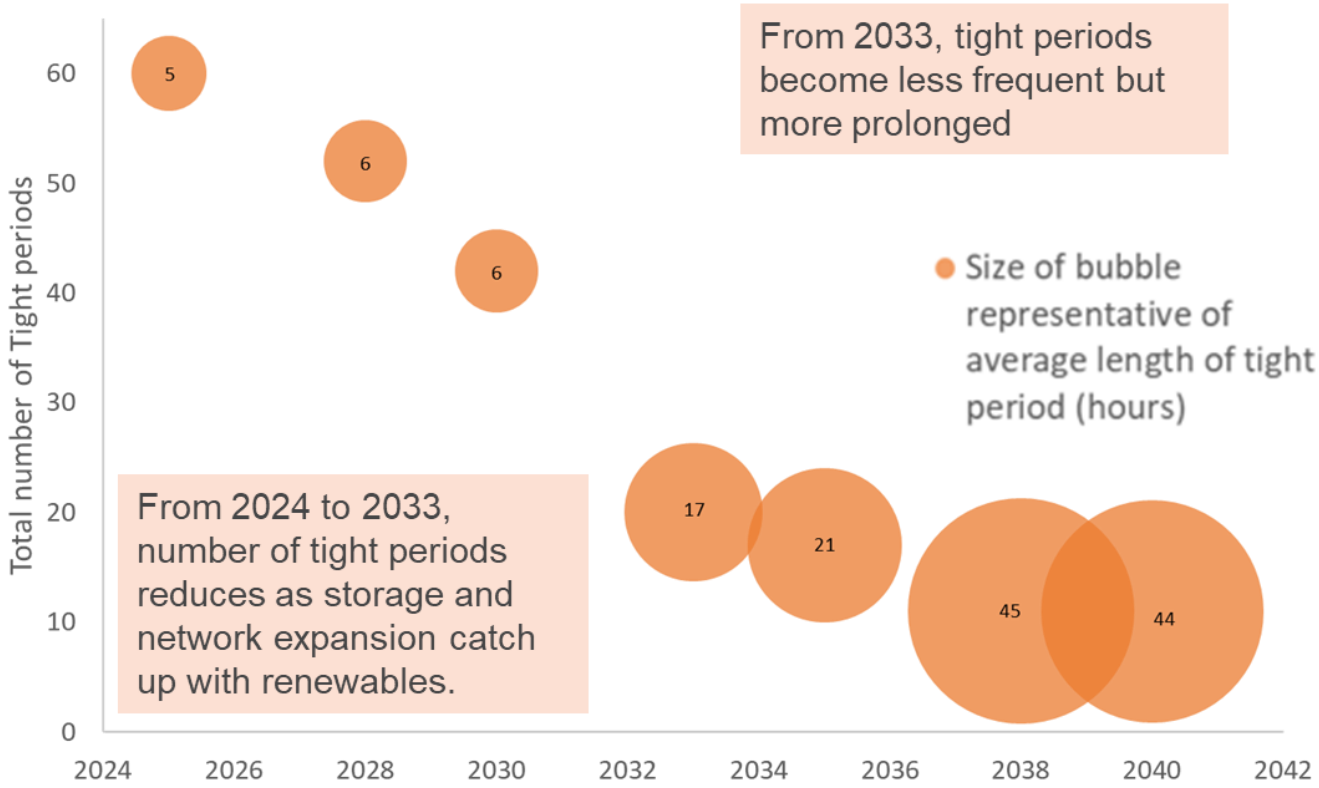
Requirements based on **dynamic and bidirectional residual demand**

1 Inaccurate operational signals 2 Policy distorting operational signals 3 Unequitable treatment of demand versus supply

The nature of the system security challenge is changing significantly

Tight periods will become less frequent but longer in duration, often lasting for days rather than hours

Frequency and duration of tight periods over time



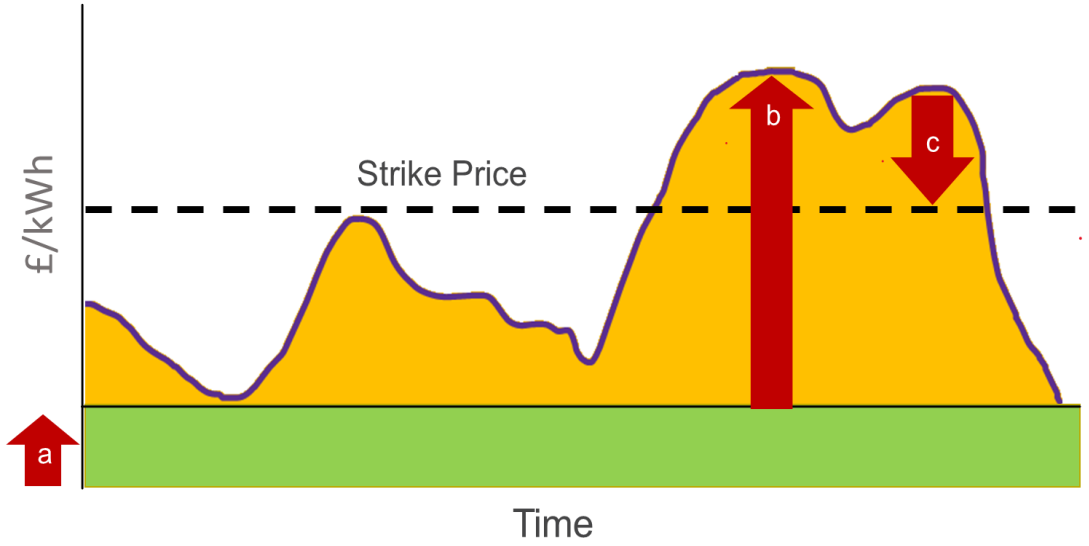
- Greater value of **prolonged response** should be explicitly recognised, but challenging to adapt the CM for this.
- **Reliability Options** are defined for specific settlement periods, rather than isolated peak events, ensuring **reward proportional to duration** of provider's contribution.
- Post 2030, prolonged but rare stress events could be very **expensive to serve.** Innovation outcomes for FOAK technologies are highly uncertain and the market-wide CM could become costly. A **Strategic Reserve** could be an attractive option for managing carbon and costs.

Future requirements more typically based on **rare, long duration** tight periods

Note: Tight periods are periods where energy prices reach VoLL

Investment policy options for system security assessed as potential alternatives to current Capacity Market (CM) support scheme

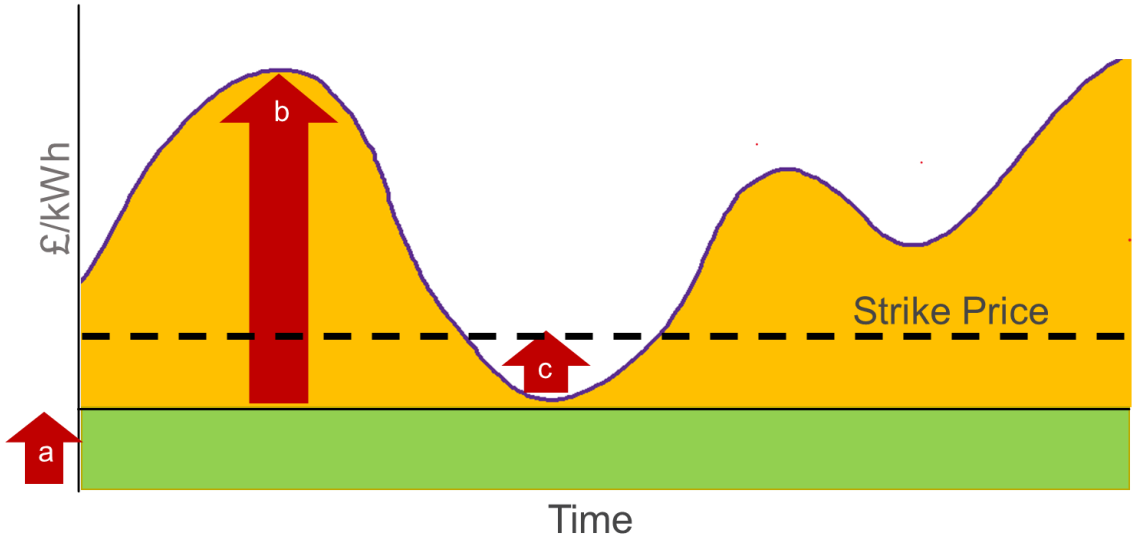
Centralised Reliability Option (CRO)



CRO = Buy option (central body has the ability to buy electricity at a set price)

A. Reliability contract fee – fixed payment for the option contracts (£/kWh/day)
B. Revenues in existing Wholesale market (£/kWh)
C. Reliability contract payback – payback the difference between strike price and reference price (£/kWh)

Reverse Reliability Option (RRO)



RRO = Sell option (central body has the ability to sell electricity at a set price)

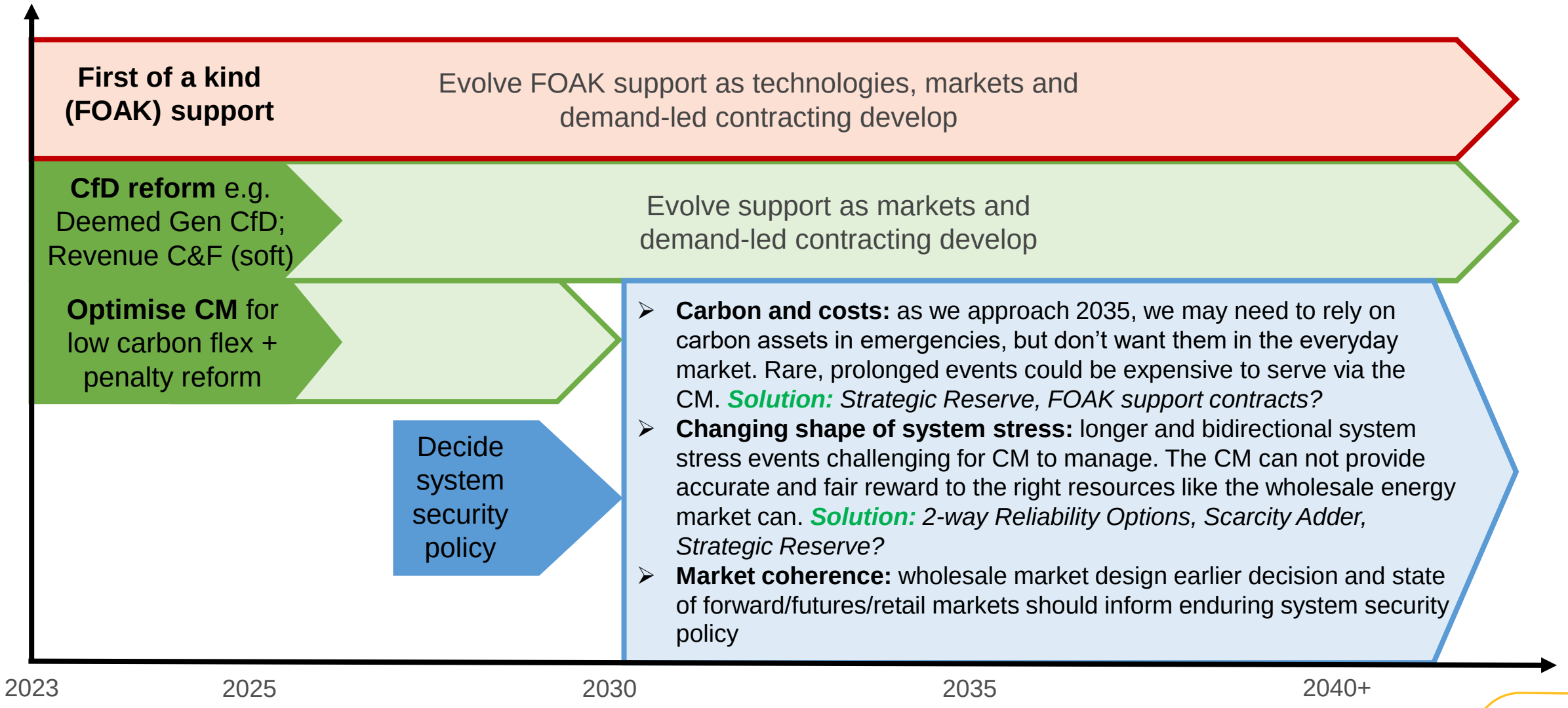
A. Reverse Reliability contract fee – fixed payment for the option contracts (£/kWh/day)
B. Price paid in existing Wholesale market for electricity (£/kWh)
C. Reverse Reliability contract payback – payback the difference between strike price and reference price (£/kWh)

Conclusions

Continue centralised procurement but adapt EMR schemes to complement market design reforms

1. **Centralised, directed procurement is required** for accelerated investment but challenges in determining optimal power mix will need attention and policy should evolve towards demand-led investment longer-term
2. **CfDs should be reformed to align generators' incentives with market signals** in operational timescales, but in a way that retains the perceived benefits of the current CfD scheme and prevents new distortions
3. **Choice of CfD reform option should be considered in parallel with wholesale market reform**
4. Complement FOAK low carbon support for dispatchable resources (e.g. DPA for CCUS) with near-term **reforms to the CM that prioritise low carbon flexibility** but strengthen penalties to ensure delivery
5. The nature of system stress is changing, dramatically from 2030, which is challenging for the CM to adapt to. **For the longer term, alternatives to the CM are likely needed** that are coherent with future market design to ensure cost-effective system security
6. The need for and form of the optimal enduring reform package for system security will depend on the extent to which wholesale market reforms **restore system value to spot prices** and **demand response is mobilised**

Possible timeline for investment policy reforms



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