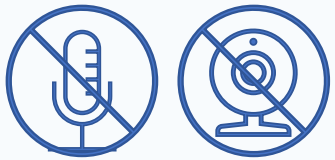
ESB Networks & EirGrid Joint System Operator Programme Virtual Briefing Webinar

Operating Model High Level Design Webinar

27 June 2024

Housekeeping



Please mute your microphone and turn off your camera during the webinar

Use MS Teams chat feature for comments/ reactions/ questions

This session will NOT be recorded. Voice/ Video/ Photo recordings are NOT permitted

Today's presentation will be shared after the session.

Please note that by registering for this webinar, your name and email address are visible to relevant programme teams at EirGrid and ESB Networks and used solely to process your invitation to our webinar.

This session will not be recorded, however by joining this webinar on Teams, your name will be visible to other attendees on the call today.

The Q&A at the end of the session will be limited to the questions posted in the chat which relate directly to the content presented today.

Agenda

1. General background and introduction
2. Overview of proposed operating model high level design
3. Worked examples

Speakers

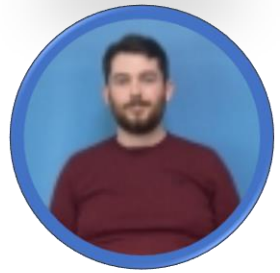
Teresa Fallon
ESB Networks, Head of DMSO Design

Eoin Kennedy
EirGrid, Head of Future Operations

Alan Keegan
ESB Networks, JSOP and R&S Lead

Emma Fagan
EirGrid, TSO/DSO Programme Manager

Martin Hickey
ESB Networks, DSO/TSO Technical Specialist



Martin Kerin
EirGrid, Senior Lead Engineer Future Operations

Background and Introduction

What is the purpose of this webinar for EirGrid and ESB Networks Stakeholders?

1 | Detailed briefing of Vision and Principles of the TSO-DSO Operating Model high level design

Including:
- Forecasting and bid management
- Optimisation and scheduling
- Activation and dispatch
- Settlement
- Day-in-the-life worked examples

2 | Opportunity to ask questions and provide initial feedback

- Answer questions and provide clarifications (recognising that some may be open questions for further design work)
- Feedback from this session will help to shape the next steps of work in further developing the model

Further industry engagement will be planned

N.B. | This will be communicated and feedback on our stakeholder engagement approach can be provided through the next Joint System Operator Programme multi-year plan call for input

TSO-DSO Joint System Operator Programme

Joint System Operator Programme

TSO-DSO co-ordination is essential for **a successful energy transition** and **long-term** resilience of electricity supply and demand meeting our climate plan targets

Both system operators work closely to deliver **milestones** and an **outturn report** each year.

The workstream focuses on delivering a **whole of system approach**, **reducing dispatch down**, **securing our future power system** and **facilitating new technologies**.

TSO-DSO Operating Model Process

Developing an approach **to optimise the electricity system as a whole** rather than focusing on the distribution or transmission systems in isolation.

Workshops held between EirGrid and ESB Networks since November 2022

Examples of topics discussed include system **security** and operating **constraints, climate action plan targets**, **safety** and **customer value**.

The Operating Model will act as the backbone across all four pillars, with a number of tasks in each pillar contributing to or relying on its development

TSO-DSO Programme

TSO-DSO Future Operating Model

- Whole of System Approach
- Facilitating New Technology
- Reducing Dispatch Down
- Secure Future Power System

Why are we pursuing a future TSO-DSO Operating Model?

The TSO-DSO Operating Model will also provide solutions to existing and potential challenges which are facing the system operators

Challenges

TSO Challenges

- Oversupply
- Curtailment
- Constraints
- Ramping
- System balance
- Security of supply
- System stability
- Service provision
- Decentralization of resources

DSO Challenges

- Network congestion
- Carbon abatement
- DER growth and co-ordination
- Cost and pace of capacity for electrification
- Customer participation
- Community energy

Solutions

TSO Solutions

- Access to distribution system resources for energy
- Services
- Forecast information
- Distribution system visibility

DSO Solutions

- Flexible connections
- Flexibility markets
- Visibility
- Forecasting and optimisation

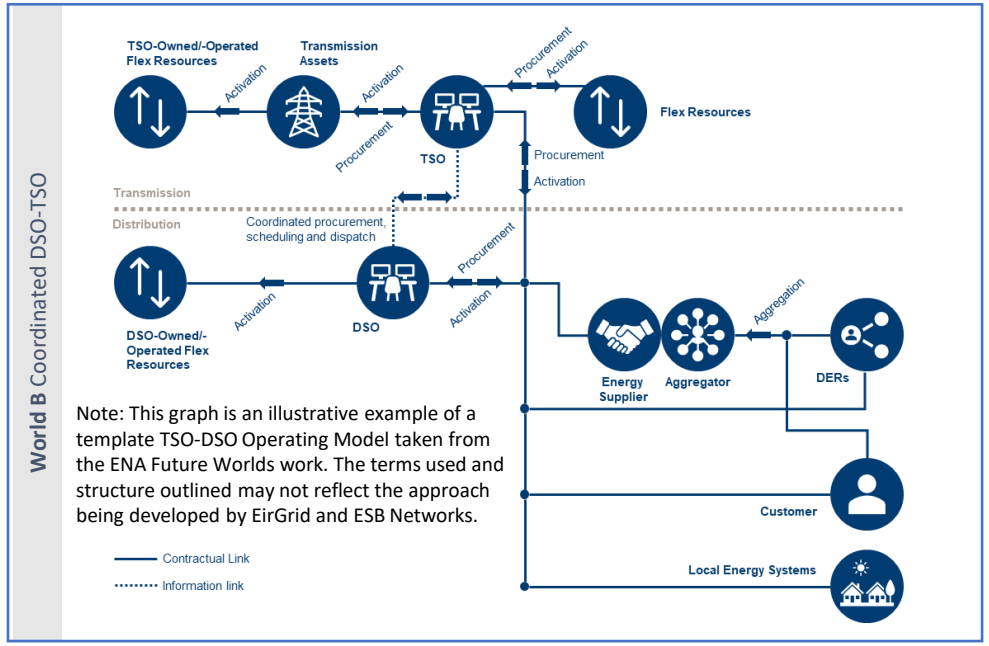
Examples of key considerations

Customer types	• Aggregated demand • Aggregated generation • Demand • Generation
Dispatch / Control Signals:	• Scheduled vs unscheduled vs contingency / emergency • MW position vs location / site specific requirement
Appropriate approach for different size units / levels of market participation	• In the SEM • Not in the SEM • MW size

Overview of proposed operating model high level design

Contents

TSO-DSO Operating Model Overview

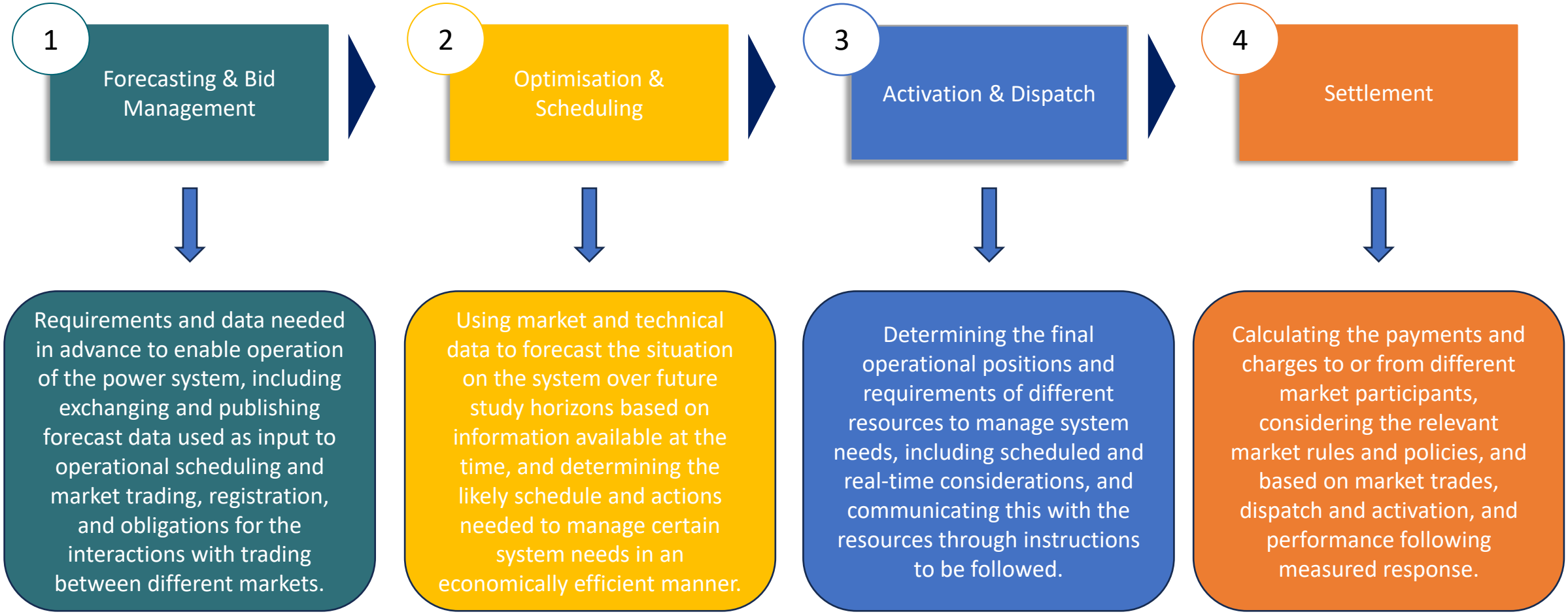


- Energy Network Association Future Worlds – published June 2018.
- The ENA Open Networks Project proposed five "future" worlds for co-ordination in the energy sector.
- **A World B** solution considers TSO-DSO procurement and dispatch – a World **where the DSO and TSO work together** to efficiently manage networks through coordinated procurement and dispatch of flexibility resources.
- The "world" is still high level and a wide variety of solutions could exist under this model. The following was discussed at TSO-DSO Operating Model workshops between November 2022 and October 2023.

Key areas where detail would need to be defined within World B…

1. Forecasting & Bid Management
2. Optimisation & Scheduling
3. Activation & Dispatch
4. Settlement

Operating Model Key Scope Areas



Operating Model Key Scope Areas

High Level Design

1 Forecasting & Bid Management

Requirements and data needed in advance to enable operation of the power system, including exchanging and publishing forecast data used as input to operational scheduling and market trading, registration, and obligations for the interactions with trading between different markets.

2 Optimization & Scheduling

Using market and technical data to forecast the situation on the system over future study horizons based on information available at the time, and determining the likely schedule and actions needed to manage certain system needs in an economically efficient manner.

3 Activation & Dispatch

Determining the final operational positions and requirements of different resources to manage system needs, including scheduled and real-time considerations, and communicating this with the resources through instructions to be followed.

4 Settlement

Calculating the payments and charges to or from different market participants, considering the relevant market rules and policies, and based on market trades, dispatch and activation, and performance following measured response.

What were the considerations for choosing a future world?

Energy Networks Association Future Worlds

The ENA Open Networks Project has considered future options for TSO-DSO coordination and has outlined five future worlds which together demonstrate the range of potential models

WORLD A	DSO COORDINATES
WORLD B	TSO&DSO COORDINATION
WORLD C	PRICE DRIVEN FLEXIBILITY
WORLD D	TSO COORDINATES
WORLD E	NEUTRAL MARKET FACILITATOR

Clear values considered

COST EFFICIENT

The operating model should minimise the costs associated with the delivery of flexibility and maximise customer benefits.

TECHNICALLY FEASIBLE

It should be technically feasible to implement the operating model in a given timeframe.

ALLOWS CUSTOMERS TO MONETIZE THEIR FLEXIBILITY

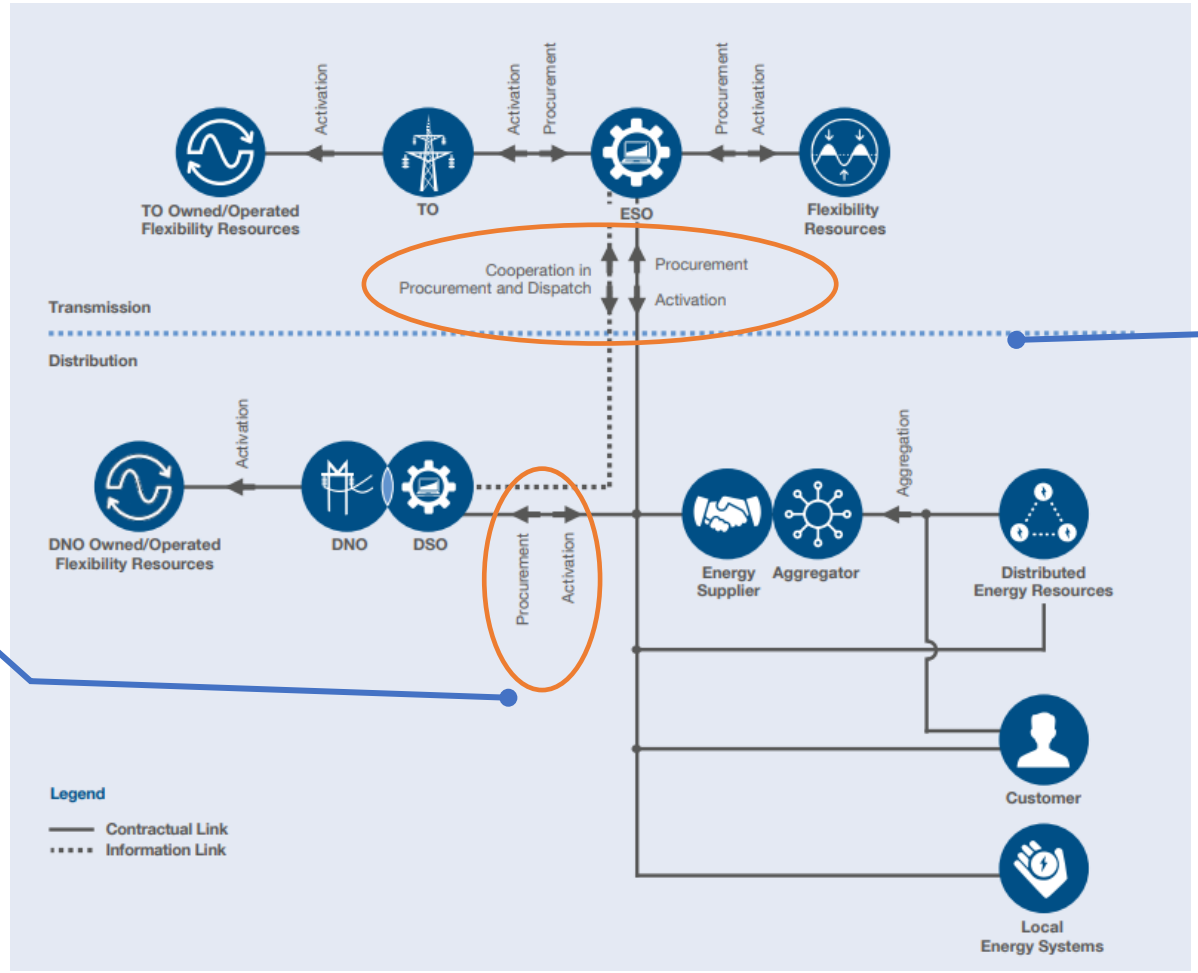
The operating model should allow market participants to monetise their flexibility to the greatest extent and to the greatest benefit to the whole system.

MAXIMISE BENEFITS FROM FLEXIBILITY

The benefits of flexibility are likely to be greatest when they can be unlocked quickly (before potentially avoidable capex investment is required). The operating model should therefore seek to unlock flexibility and its associated benefits (e.g. ability to meet RES-E targets, capex savings) as quickly as possible.

Why did we choose this operating model option?

Distribution-connected customers – SO interaction: Flexibility resources can provide **services to both SOs** and are able to **stack revenues** across different SOs' markets.

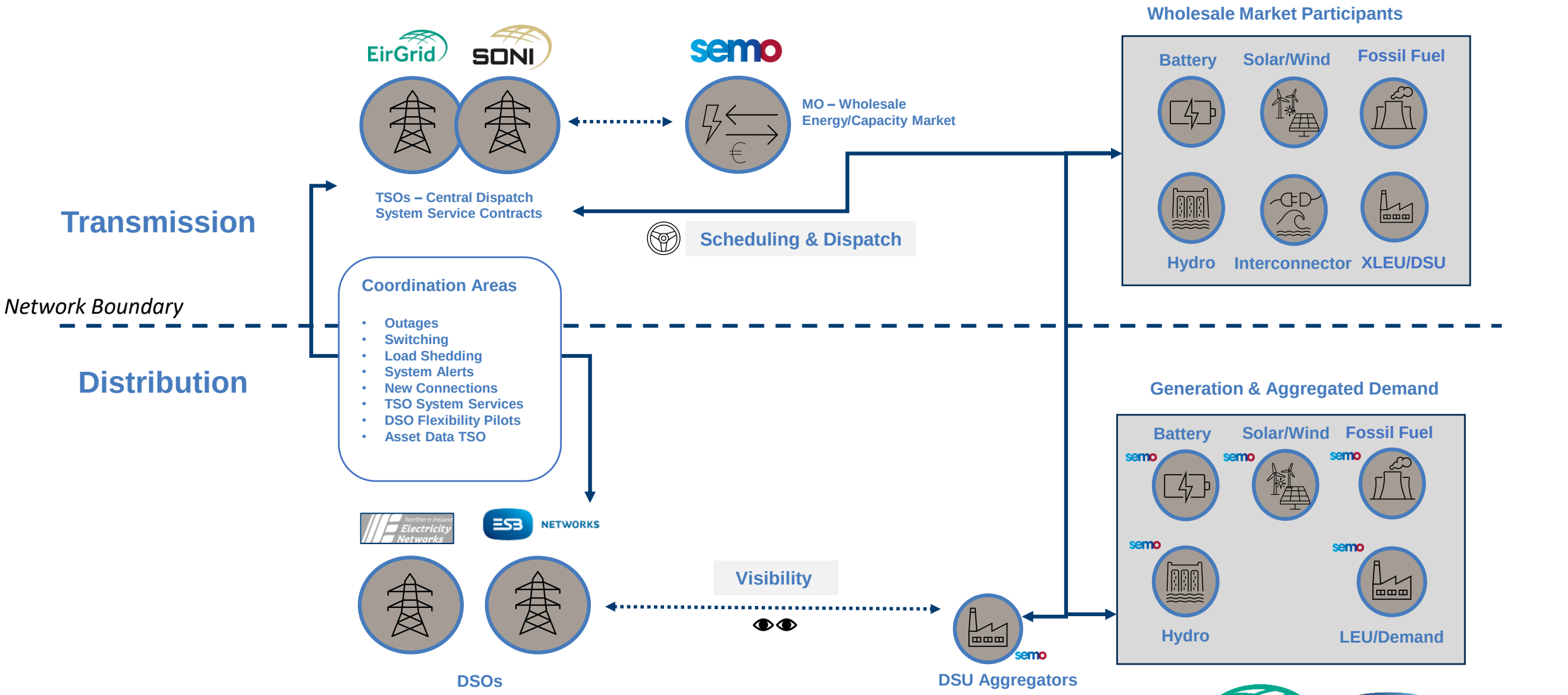


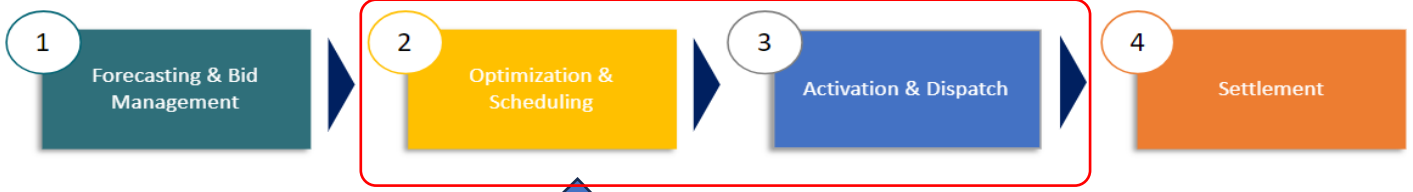
TSO-DSO interaction: The TSO and the DSO will **work together** to ensure efficient procurement and dispatch decisions are made across TSO and DSO-led markets.

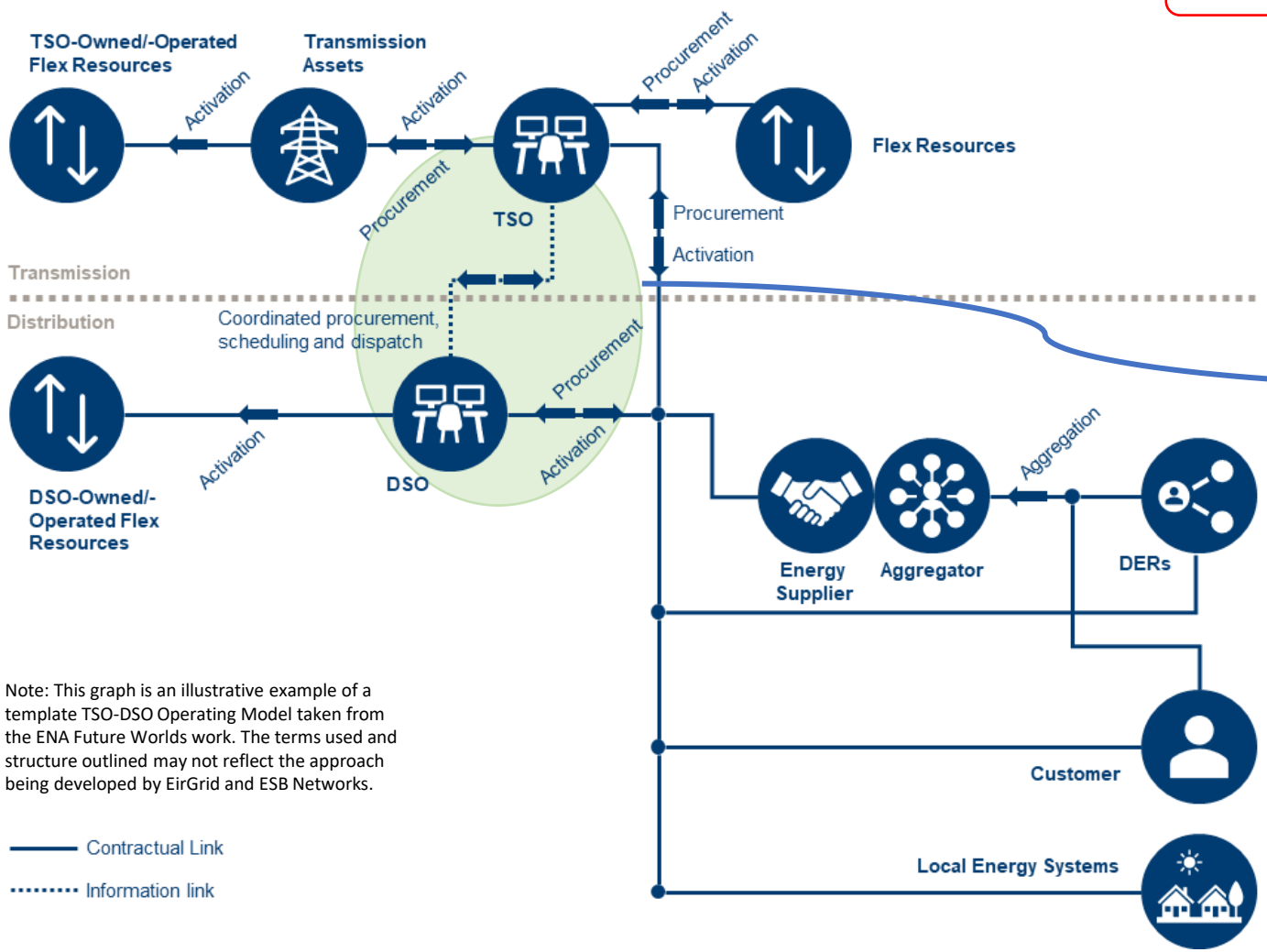
World B is considered to be the central scenario, as it requires the least disturbance from where we are today. Given this, World B is the chosen model in other jurisdictions, such as the UK.

Note: This graph is an illustrative example of a template TSO-DSO Operating Model taken from the ENA Future Worlds work. The terms used and structure outlined may not reflect the approach being developed by EirGrid and ESB Networks.

Current TSO – DSO Coordination







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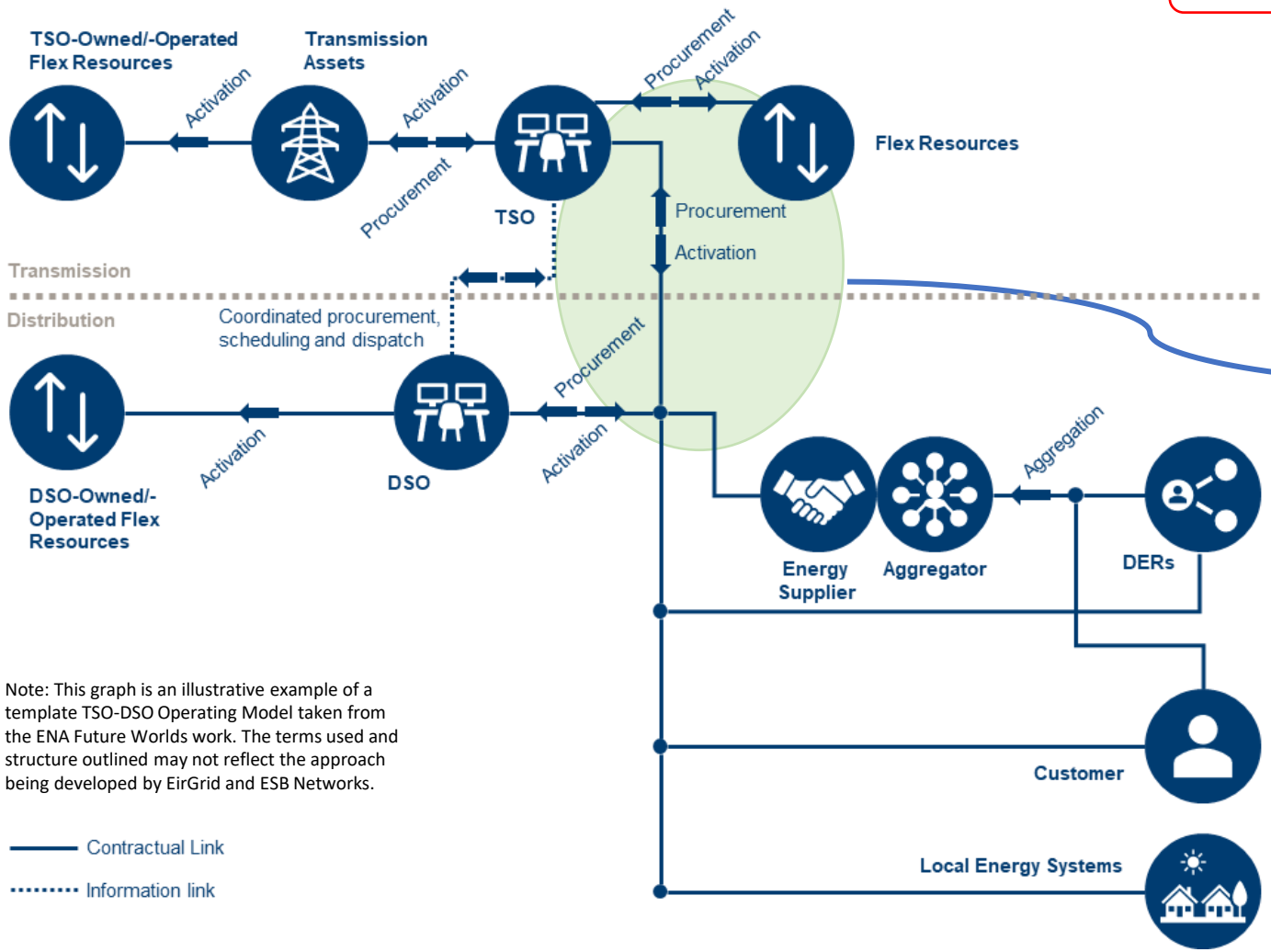
What's changing for scheduling?

The DSO will need to be actively involved in the scheduling process

This will require new capabilities for the DSO in the form of new:

- ***Data acquisition***
- ***Scheduling tools***
- ***Sharing protocols***



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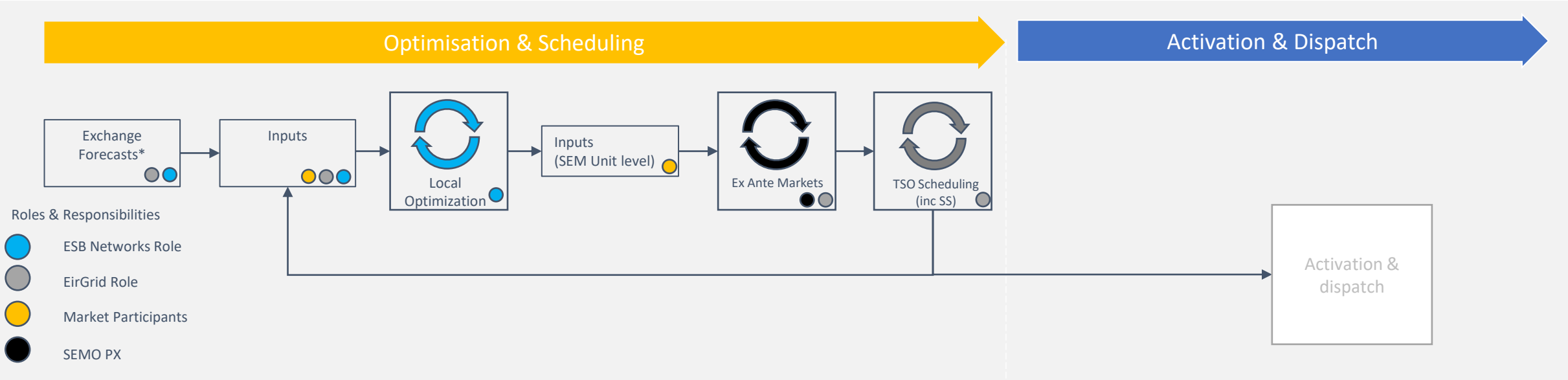
What's changing for Activation & Dispatch?

The DSO will need to be actively involved in the activation and dispatch process

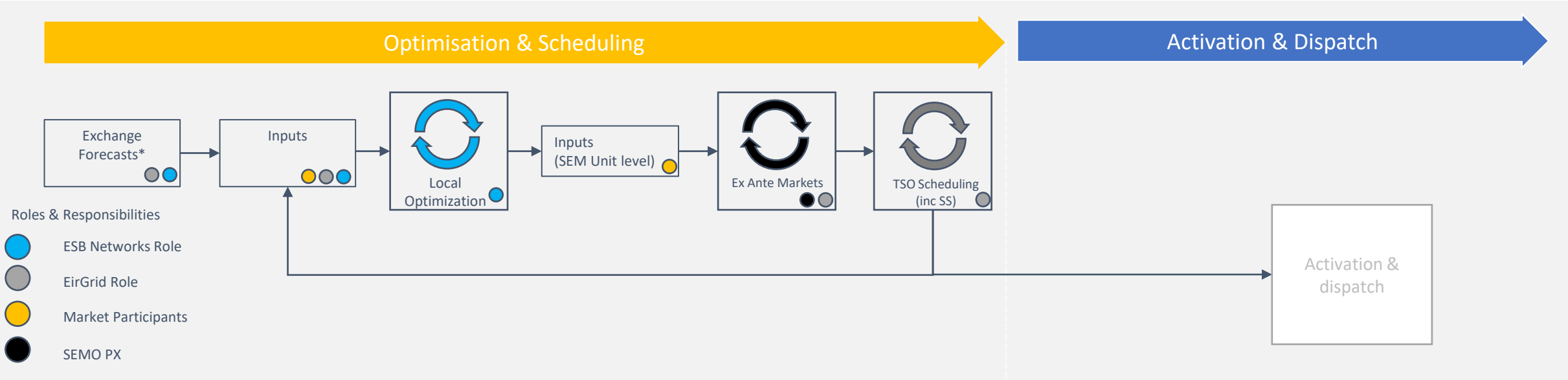
This will require new capabilities for the DSO in the form of new:

- ***Signals and instructions***
- ***Information exchange***
- ***Communication protocols***

Optimisation and Scheduling



Optimisation and Scheduling



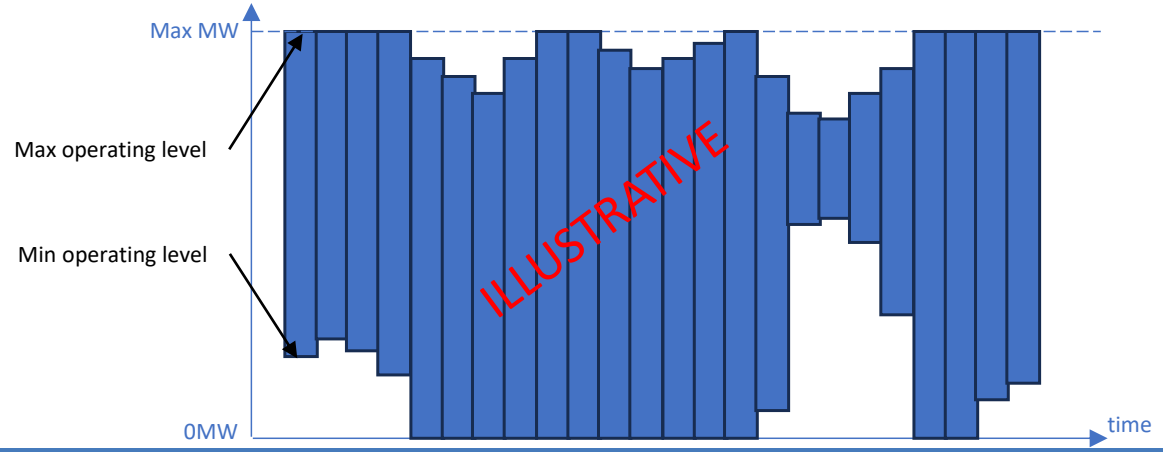
Operating Envelope

Max and min export and/or import MW levels for each unit for each period

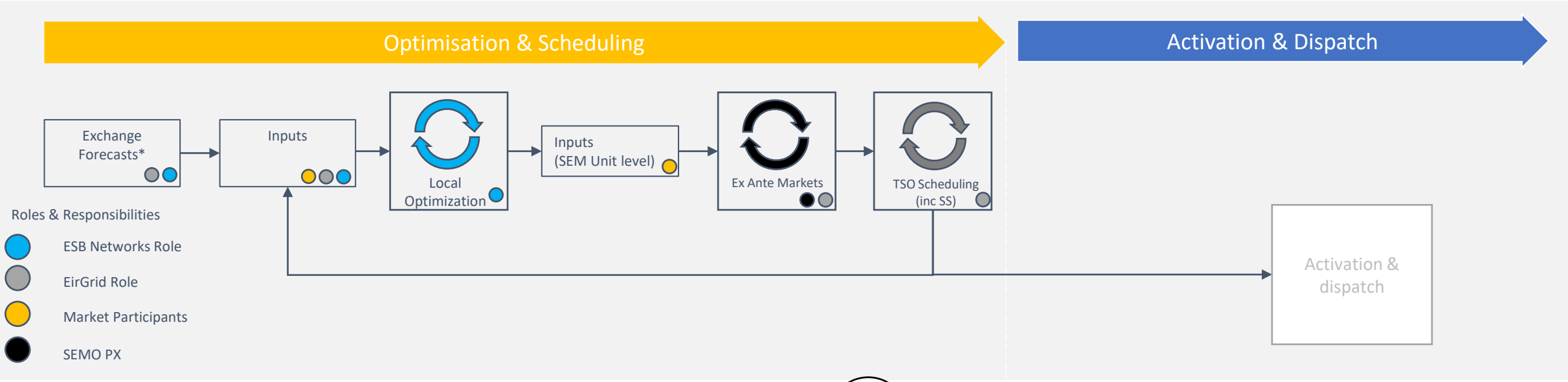
To manage congestion due to various drivers

Creates a range within which units can be safely operated while maintaining distribution system security

More flexible than fixed limits



Optimisation and Scheduling



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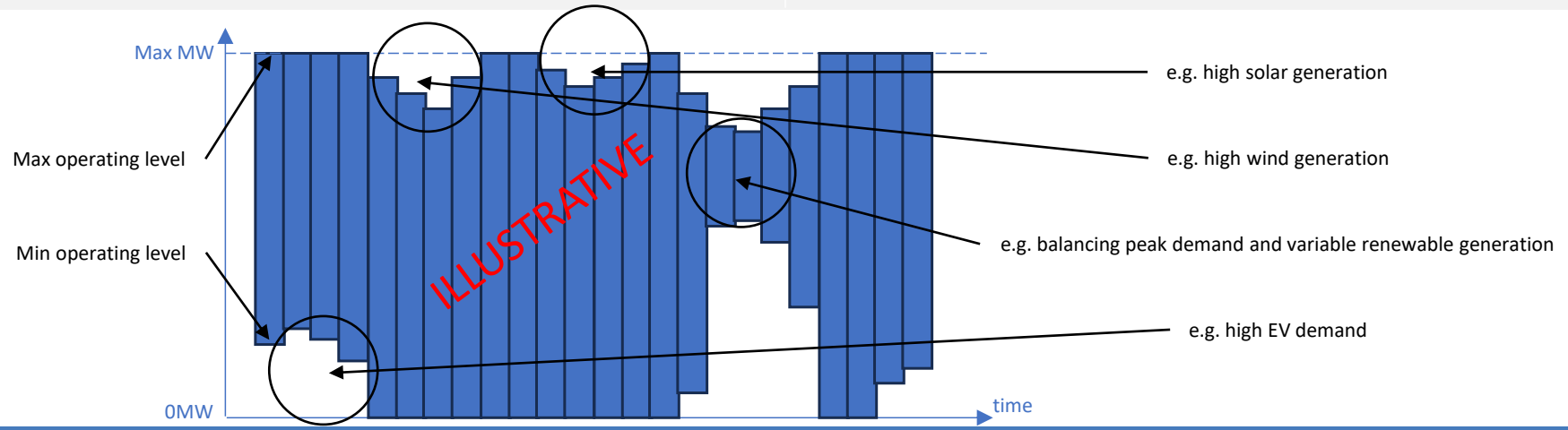
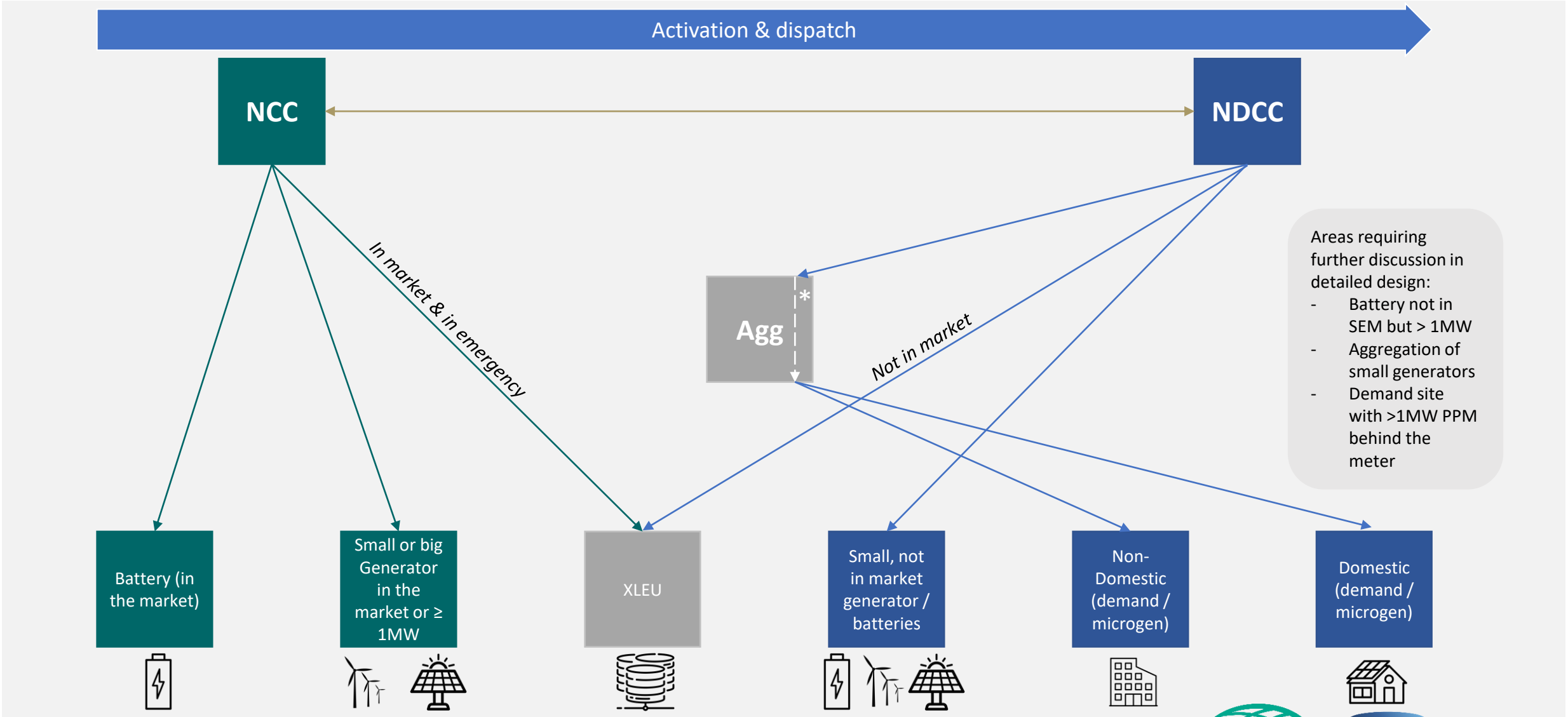
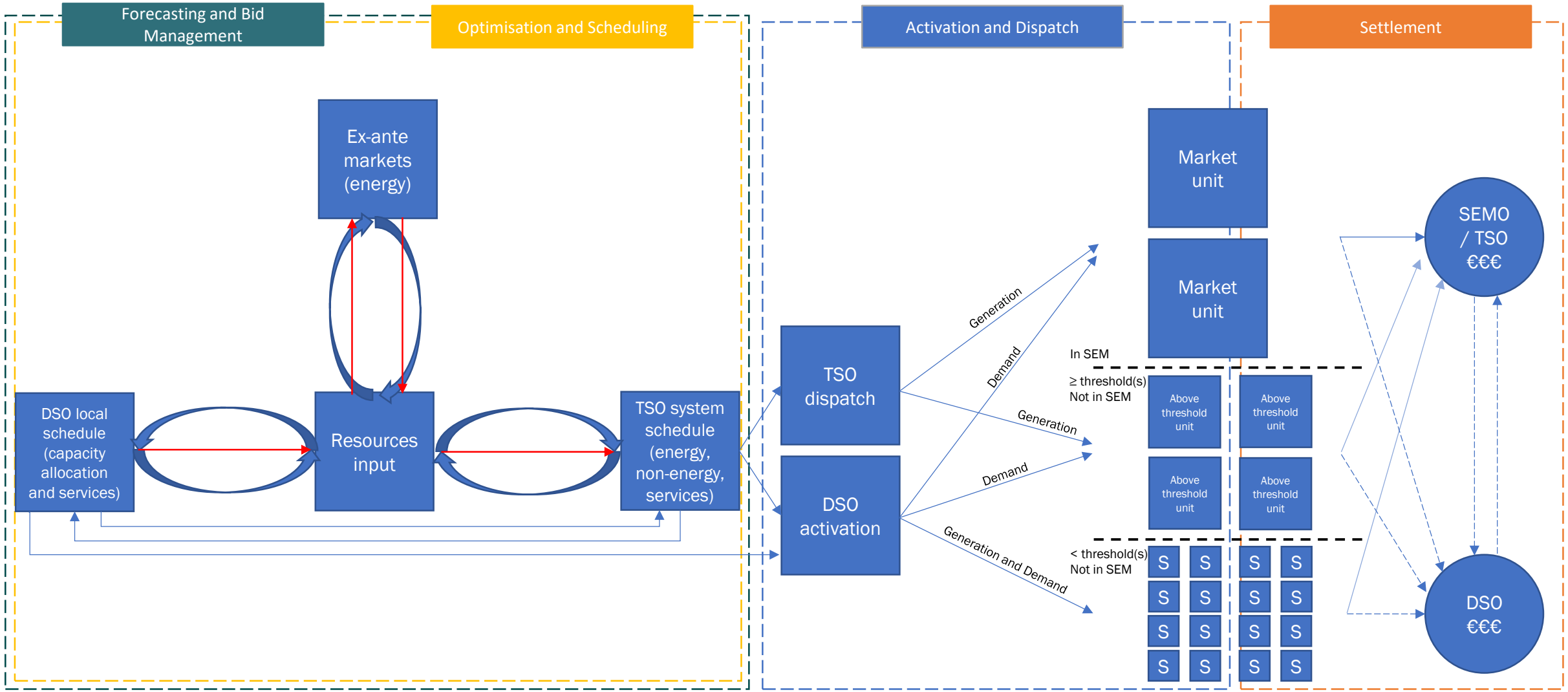


Activation & Dispatch



* Communication with demand customers may be via aggregator or direct – this version used for simplicity on the slide.

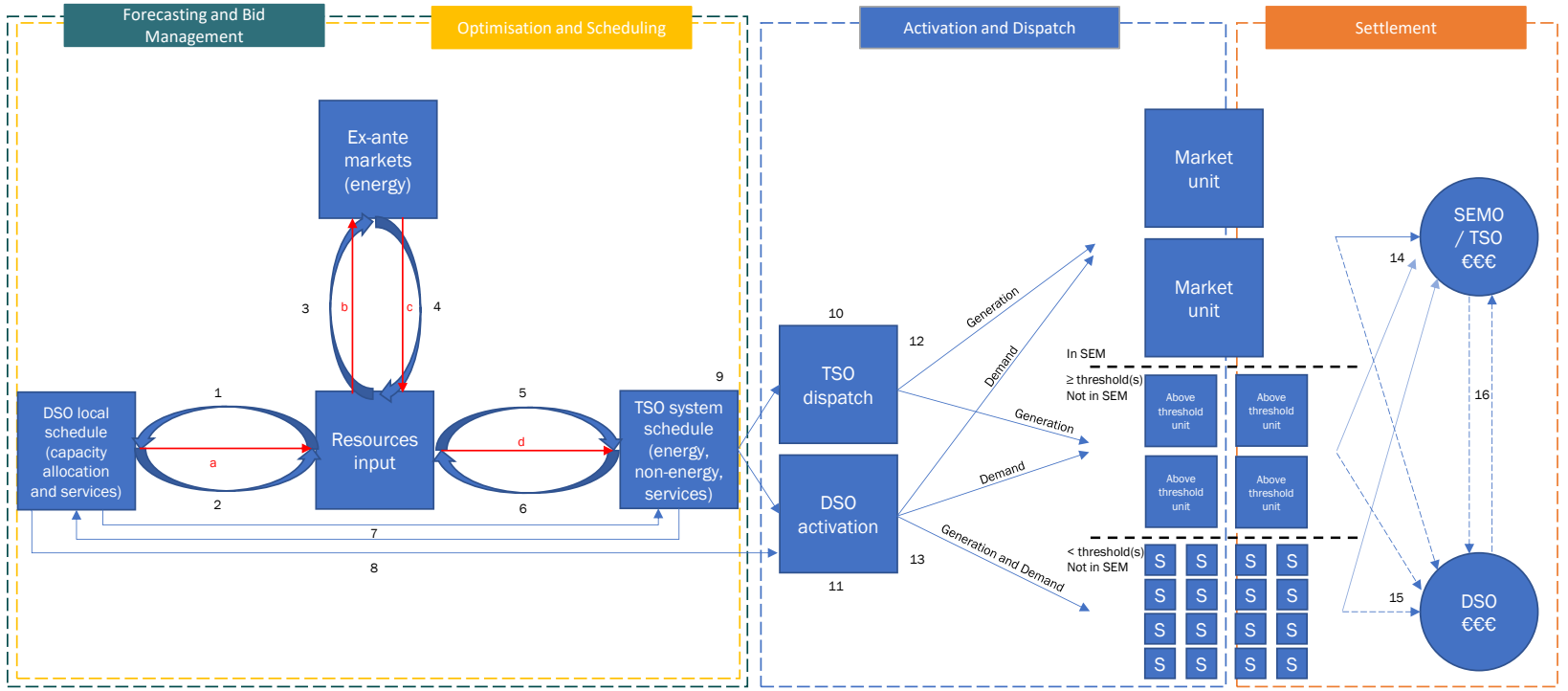
End-to-end model



Note: the information flow shown on this slide is illustrative based on the design discussions to date. Further design and implementation discussions could lead to changes and additions

End-to-end model

A high-level end-to-end picture of the TSO-DSO operating model was developed in advance of discussions on the details in these individual areas in order to provide an overarching representation of the interactions between the TSO and the DSO in operating this model, as outlined in the graph and the following text matching the numbers below:



1. Flexibility service bids, energy availability
2. Limits and flexibility service requirements for DSO-connected sites with locational information for DSO constraints
3. DAM and IDM bids and offers
4. Market clearing results for an energy position
5. Physical Notifications, BM Commercial Offer Data and Technical Offer Data, energy and service availabilities, FASS bids
6. FASS auction results for a service position, Indicative Operating Schedules for market units and units above defined control thresholds for energy balance, system services, system stability, TSO constraints, policy requirements
7. Aggregated impact for non-market units and units below defined control thresholds for DSO limits and flexibility service requirements – some aspects of TSO schedule may be shared with the DSO for their processes

a-b-c-d: Process for getting the DSO limits and flexibility service requirements for market units and units above defined control thresholds into the TSO schedule.

8. DSO limits and flexibility service requirements informing the DSO's activations
9. DSO limits and flexibility service requirements included in TSO schedule informs the TSO's dispatches – some aspects of the TSO dispatch may come through requesting DSO activation
10. TSO schedules and dispatches to meet multiple needs while respecting limits and service requirements set by the DSO.
11. DSO schedules and activates limits and flexibility service requirements for DSO congestion while respecting limits such as materiality thresholds
12. TSO has some element of dispatch control over units
13. DSO has some element of activation control over units
14. SEMO and TSO directly settle those in the wholesale markets and FASS arrangements with inputs of dispatch, trades, PNs, and availabilities. SEMO indirectly settles those not in the wholesale market through impact of position / limit on meter settled through supplier
15. DSO directly settle those subset of sites who participated in flexibility service
16. The approach to settlement and cost recovery needs to be further developed and discussed with the RAs.

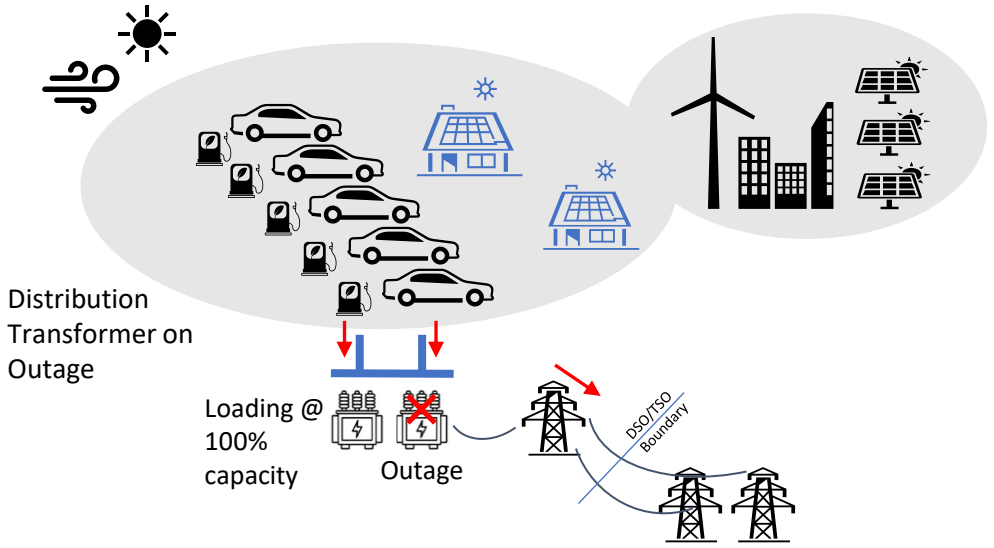
Note: the information flow shown on this slide is illustrative based on the design discussions to date. Further design and implementation discussions could lead to changes and additions

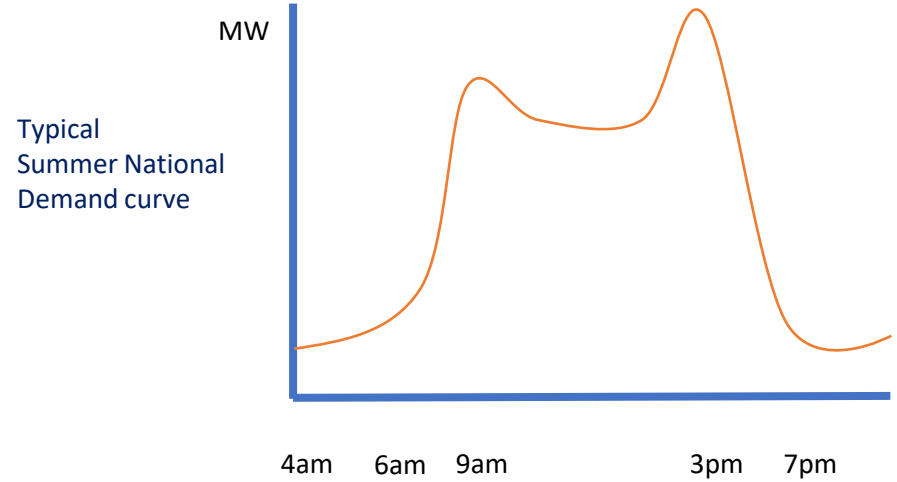
Day-in-the-life worked examples

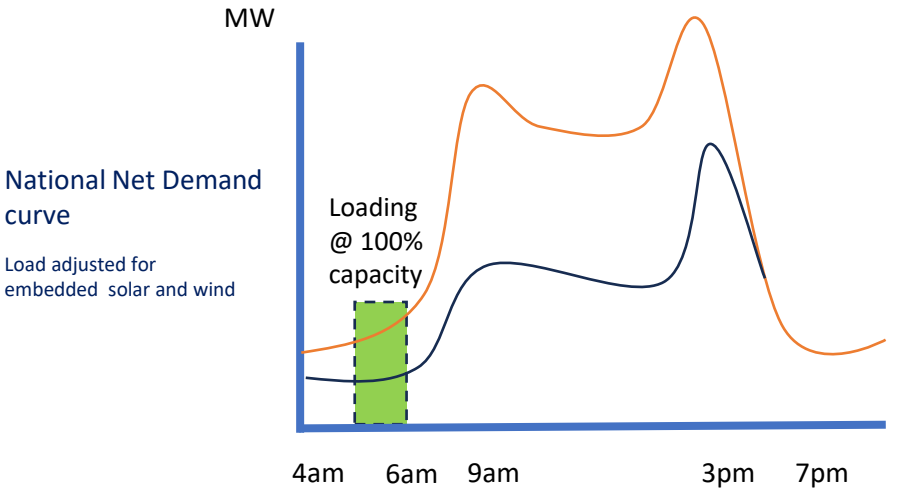
Distribution System Congestion Example

Weather:	A sunny and windy morning
Demand Profile:	Low EV load - charged overnight
Network Status:	Distribution Transformer Outage – summer maintenance less capacity Underlying load is low at 6am
Generation Profile:	Solar and Wind embedded generation DERs are exporting from DSO
Operations Alarms:	Distribution transformer close to Overload capacity overloaded

Typical DSO Station with 2 transformers







Note: The images and graphs on this slide do not reflect real-time data. They are created for illustrative purposes only.

DSO Congestion - Operations Perspective

Tomorrow's weather will be 18C and sunny/windy. DSO outages scheduled

DSO runs power system study using:
1) real-time measurements estimates
2) as-operated network model
3) load/DER forecast
…and predicts low load and high DER output

DSO evaluates potential violations on the distribution network with high-PV/wind penetration

DSO sends day-ahead "activations" to flexibility assets, to mitigate potential network violations

DSO routes "activations" to flexibility aggregators based on need & submitted prices. TSO visibility of activations

DSO operations reviews confirmed flexibility activations for Day Ahead

Per the "Scheduled" activations, Flexibility providers control DER (e.g. charge batteries, curtail real power output), and acknowledge to DSO service delivery has been activated

Settlement occurs to compensate Flexibility providers

Note: The process shown on this slide is illustrative of the approach based on an example of certain types of flexible service providers (e.g. small generators not in wholesale market). Other approaches to these processes will be relevant to other types of flexible service provider.

Generator/storage resource in local flexibility and wholesale markets

1 DSO Scheduling Inputs

FSP to DSO

FSP submits bids for each of its FSUs to the DSO for the Flexibility Market

2 DSO Scheduling Process and Outputs

DSO to FSP and MP

DSO runs scheduling process

DSO sends flexibility schedules to FSP for each of its FSUs containing volumes and durations of required flexibility in line with locational requirements. These are translated into operating envelopes for MPs for their GUs which share resources with FSUs

3 Ex-ante Market Trading

MP to NEMO, NEMO to MP (and in future MP to TSO, TSO to MP)

MP submits bids and offers for each of its GUs to NEMO for day-ahead and intraday energy markets (and in future to the TSO for system service markets), ensuring that their trades can be fulfilled within the max and min limits from their operating envelope.

NEMO sends cleared energy volumes to MP for each of GUs (and in future TSO sends cleared service volumes)

4 TSO Scheduling Inputs

MP to TSO and MO

MP submits and updates data for each of its GUs to TSO and MO for Physical Notifications, Commercial Offer Data, Technical Offer Data, and availability information, ensuring that they can fulfil these within the maximum and minimum limits from their operating envelope

5 TSO Scheduling Process and Outputs

TSO to MP and DSO

TSO runs scheduling process

TSO sends indicative operations schedule to MP for each of its GUs and to DSO, where the scheduled output for the GUs should be within the maximum and minimum limits from their operating envelope

6 Activation and Dispatch

TSO to MP

TSO issues dispatch instruction to MP for each of its GUs for MW level within the maximum and minimum limits from their operating envelope

GUs operate to this MW level

7 TSO, NEMO, and MO Settlement

TSO, NEMO, and MO to MP

TSO settles with the MP for each of its GUs for system services

NEMO settles with the MP for each of its GUs for ex-ante energy markets

MO settles with the MP for each of its GUs for balancing market and imbalances

8 DSO Settlement

DSO to FSP

DSO settles with the FSP for each of its FSUs for flexibility market

Underlined text indicates something new or changed through this operating model

Forecasting & Bid Management

Optimization & Scheduling

Activation & Dispatch

Settlement

Glossary

DSO	Distribution System Operator
DSU	Demand Side Unit
FSP	Flexible Service Provider
FSU	Flexible Service Unit
GU	Generator Unit
MO	Market Operator
MP	Market Participant
NEMO	Nominated Electricity MO
TSO	Transmission System Operator

Note: the information flow shown on this slide is illustrative based on the design discussions to date. Further design and implementation discussions could lead to changes and additions

Demand Side Unit resource in local flexibility and wholesale markets

1 DSO Scheduling Inputs

FSP to DSO

FSP submits bids for each of its FSUs to the DSO for the Flexibility Market

2 DSO Scheduling Process and Outputs

DSO to FSP and MP

DSO runs scheduling process

DSO sends flexibility schedules to FSP for each of its FSUs containing volumes and durations of required flexibility in line with locational requirements. These are translated into operating envelopes for MPs for their DSUs which share resources with FSUs

3 Ex-ante Market Trading

MP to NEMO, NEMO to MP (and in future MP to TSO, TSO to MP)

MP submits bids and offers for each of its DSUs to NEMO for day-ahead and intraday energy markets (and in future to the TSO for system service markets), ensuring that their trades can be fulfilled within the max and min limits from their operating envelope.

NEMO sends cleared energy volumes to MP for each of DSUs (and in future TSO sends cleared service volumes)

4 TSO Scheduling Inputs

MP to TSO and MO

MP submits and updates data for each of its DSUs to TSO and MO for Physical Notifications, Commercial Offer Data, Technical Offer Data, and availability information, ensuring that they can fulfil these within the maximum and minimum limits from their operating envelope

5 TSO Scheduling Process and Outputs

TSO to MP and DSO

TSO runs scheduling process

TSO sends indicative operations schedule to MP for each of its DSUs and to DSO, where the scheduled output for the DSUs should be within the maximum and minimum limits from their operating envelope

6 Activation and Dispatch

TSO to DSO, DSO to MP

TSO sends dispatch instruction for DSUs to DSO for MW level within the max and min limits from their operating envelope

DSO issues dispatch instruction to MP for each of its DSUs with additional locational requirements

DSUs operate to this MW level and meet locational requirements

7 TSO, NEMO, and MO Settlement

TSO, NEMO, and MO to MP

TSO settles with the MP for each of its DSUs for system services

NEMO settles with the MP for each of its DSUs for ex-ante energy markets

MO settles with the MP for each of its DSUs for balancing market and imbalances

8 DSO Settlement

DSO to FSP

DSO settles with the FSP for each of its FSUs for flexibility market

Underlined text indicates something new or changed through this operating model

Glossary

Forecasting & Bid Management

Optimization & Scheduling

Activation & Dispatch

Settlement

DSO	Distribution System Operator
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Generator <1MW/demand resource in local flexibility but not wholesale markets

Underlined text indicates something new or changed through this operating model

Forecasting & Bid Management

Optimization & Scheduling

Activation & Dispatch

Settlement

Glossary

DSO	Distribution System Operator
DSU	Demand Side Unit
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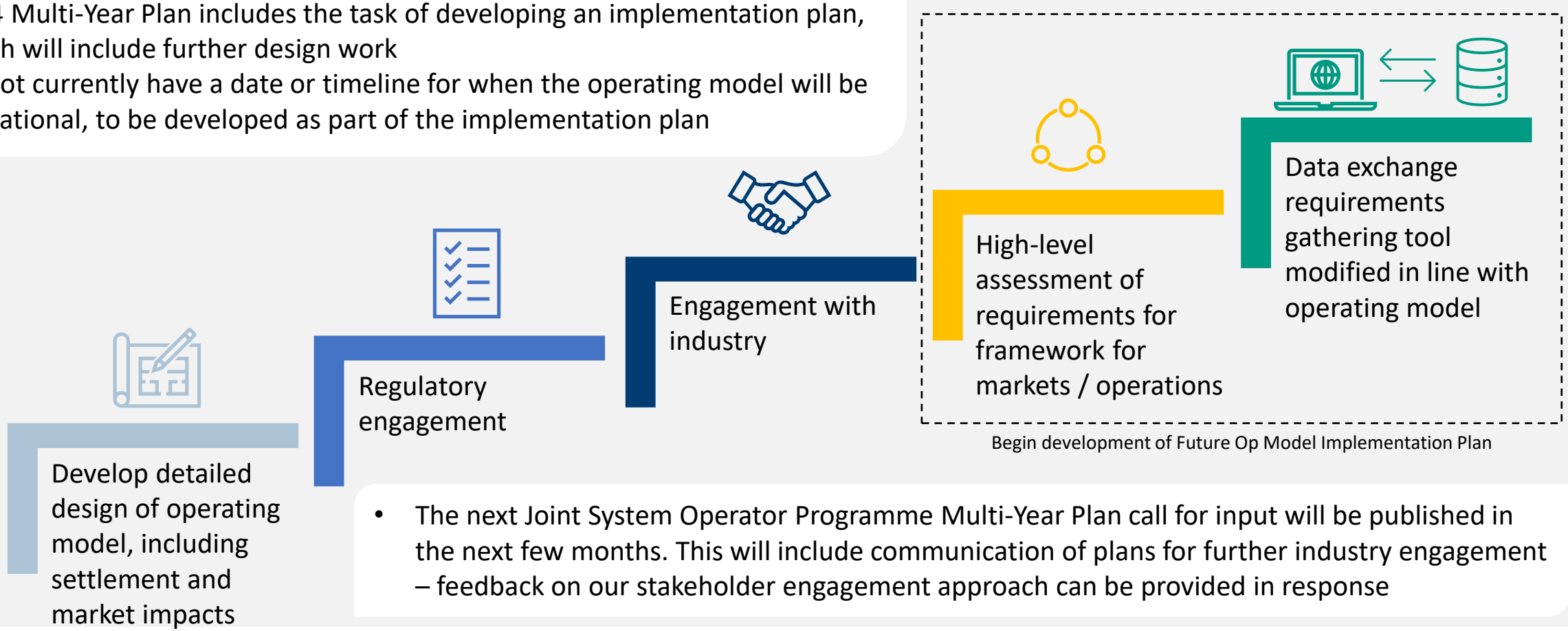
Next Steps

- A number of design questions, and further detail on the concepts in the high level design, are still open to be discussed and developed further
- 2024 Multi-Year Plan includes the task of developing an implementation plan, which will include further design work
- Do not currently have a date or timeline for when the operating model will be operational, to be developed as part of the implementation plan



- The next Joint System Operator Programme Multi-Year Plan call for input will be published in the next few months. This will include communication of plans for further industry engagement – feedback on our stakeholder engagement approach can be provided in response

Q&A

Please submit any questions on the operating model high level design.

Teresa Fallon
ESB Networks Head of DMSO Design

Eoin Kennedy
EirGrid, Head of Future Operations

Alan Keegan
ESB Networks JSOP and R&S Lead

Emma Fagan
EirGrid, TSO/DSO Programme Manager

Martin Hickey
ESB Networks DSO/TSO Technical Specialist

Martin Kerin
EirGrid, Senior Lead Engineer Future Operations

We'd love to hear your feedback!

Please use the QR code to submit your feedback or kindly go to chat box to click the survey link.

EirGrid ESB NETWORKS

Thank You

*Please **register for our mailing lists** to keep up-to-date with further engagements and developments on the TSO-DSO Programme.*

Email info@eirgrid.com to join the EirGrid mailing list
Complete the form at www.esbnetworks.ie/nnlc-form to join the ESB Networks mailing list