


# TSO-DSO coordination project with the Equigy platform

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- 1 TSO-DSO coordination and Equigy**
  - 2 Phase A: Ongoing pilot project**
  - 3 Lessons learned and outlook**

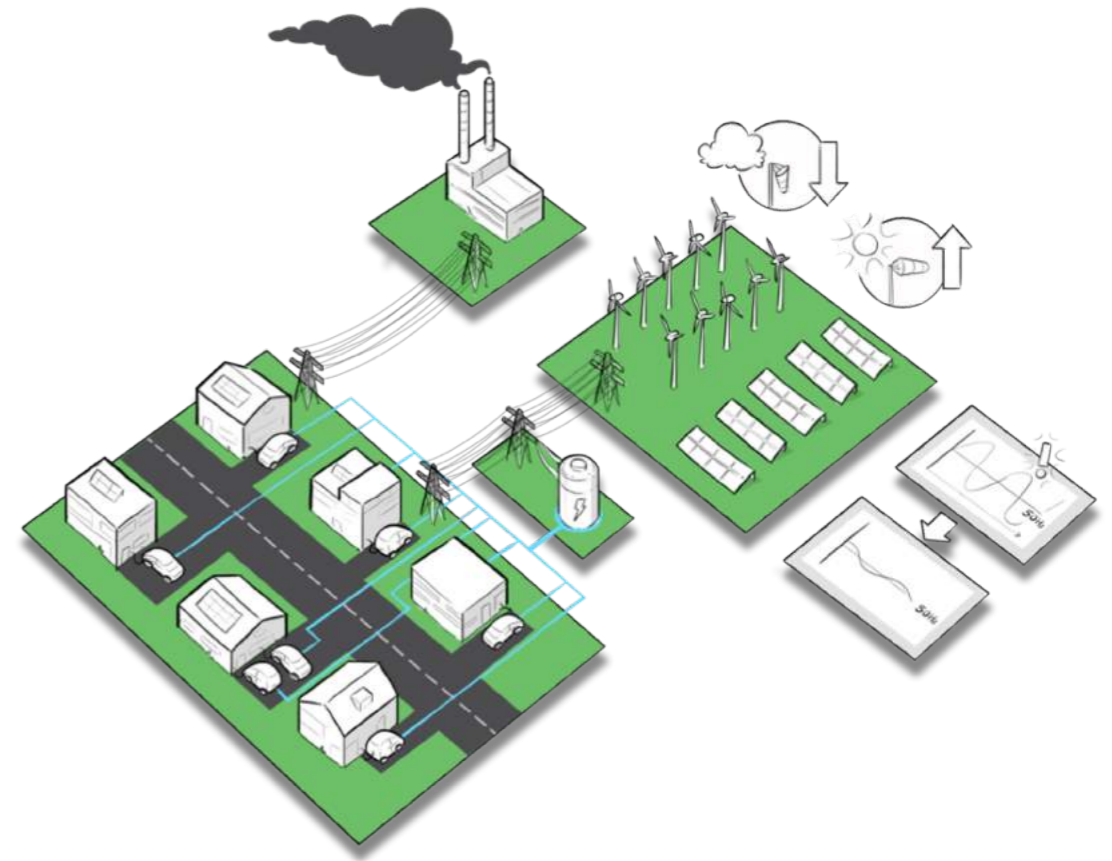
# Challenges and opportunities with Distributed Energy Resources (DERs)

- **Challenges**

- Higher flexibility needs.
- Fragmentation of power systems and internationalization of power markets.
- Increased penetration of DERs, typically in distribution grids.
- DERs are not trivial to control in large aggregations.

- **Opportunities**

- If appropriately controlled, DER aggregations can provide services to either the Transmission System Operator (TSO) or the local Distribution System Operator (DSO).
- DERs must have easy access to the ancillary services markets.
- Close collaboration among all stakeholders can help create standards (communication, processes, etc.).



# TSO-DSO coordination

- Stakeholders
  - TSO: Need for balancing energy, congestion management, etc.
  - DSO: Need for peak load and congestion management, etc.
  - Aggregator: Offer of aggregated flexibility from DERs.
- Goals
  - Systematic TSO-DSO coordination regarding the use of third-party DERs.
  - Market- and rule-based allocation of the available flexibility.
  - The aggregator markets the flexibility and the system operator with the highest need gets it.
- Benefits
  - For the TSO and DSO: Transparency, efficiency, situational awareness.
  - For the aggregator: Optimized revenue stream, standardized communication.
  - Key activity of particular importance for Switzerland.

## Innovation



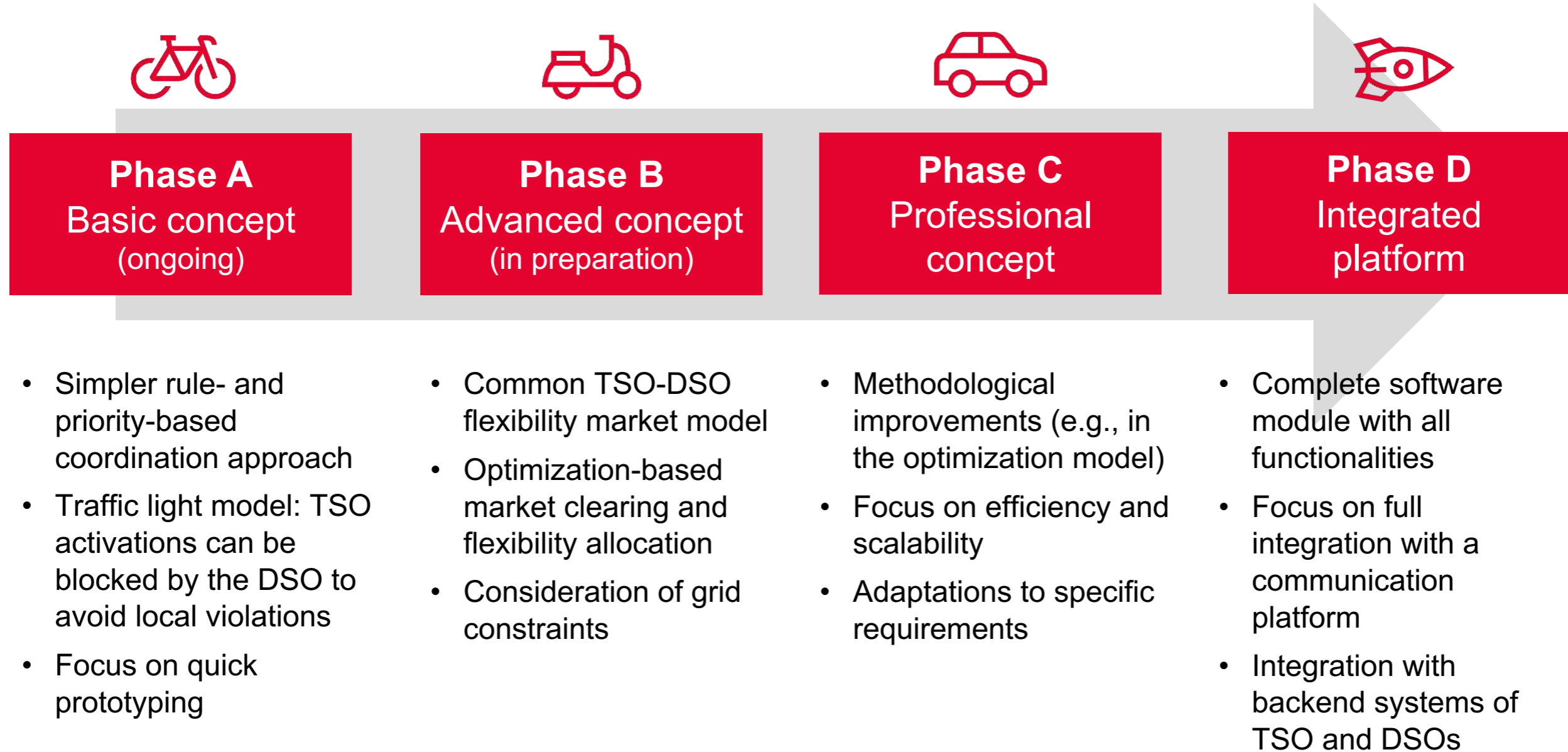
## Market efficiency



## Transparency

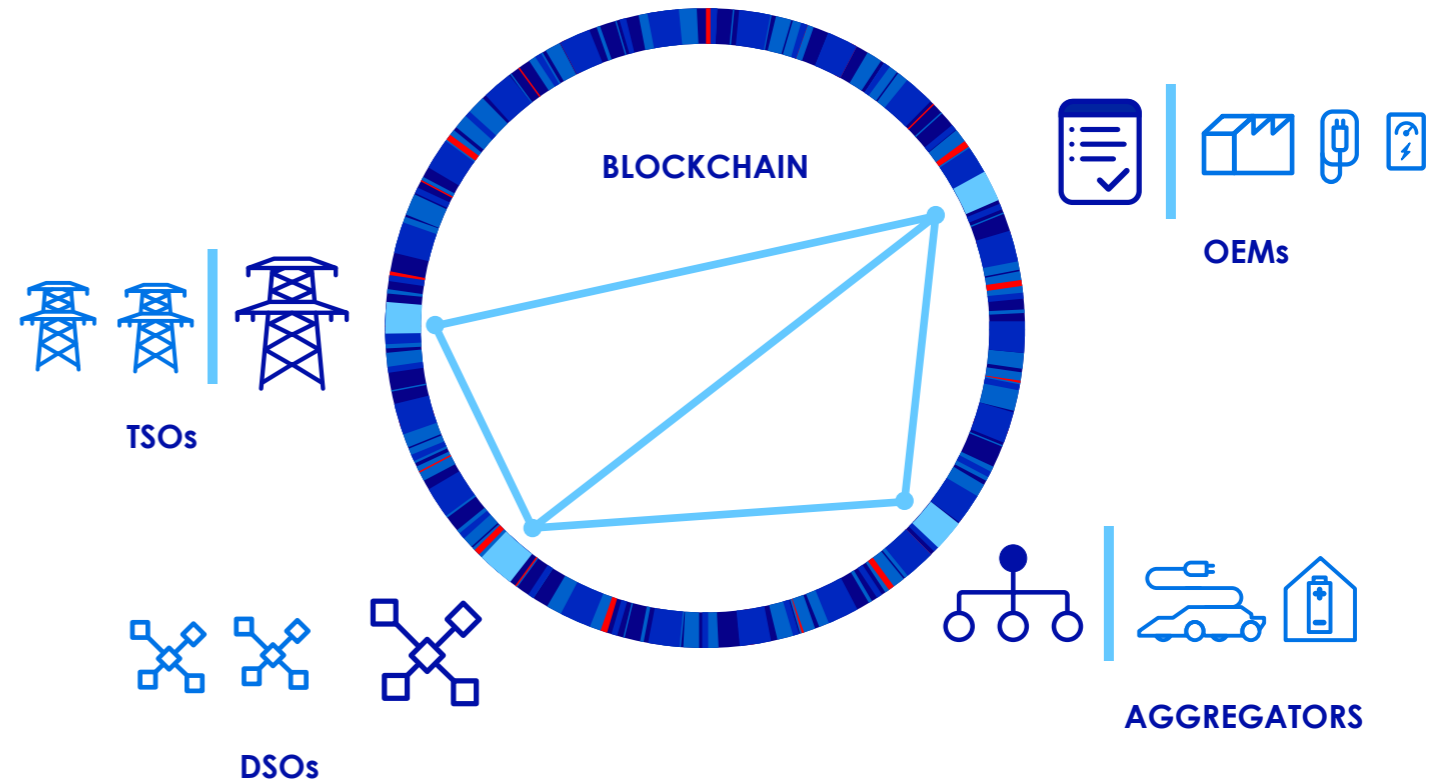


# TSO-DSO coordination is organized in phases



# EQUIGY – Crowd Balancing Platform (CBP) in a nutshell

- EQUIGY founded in December 2020 as a Joint Venture of TenneT (Netherlands and Germany), Swissgrid and Terna.
- Facilitates access of DERs to markets for ancillary services and congestion management.
- Collaboration with Original Equipment Manufacturers (OEMs) of DERs (electric vehicles, batteries, heating/cooling devices).
- Uses blockchain technology to link the various actors and increase transparency: DERs, OEMs, aggregators, TSOs, DSOs.
- CBP increases market liquidity and automates business processes.
- Allows TSOs to validate the delivery of ancillary services with the functionality to collect device measurements directly from the IoT cloud of DERs.

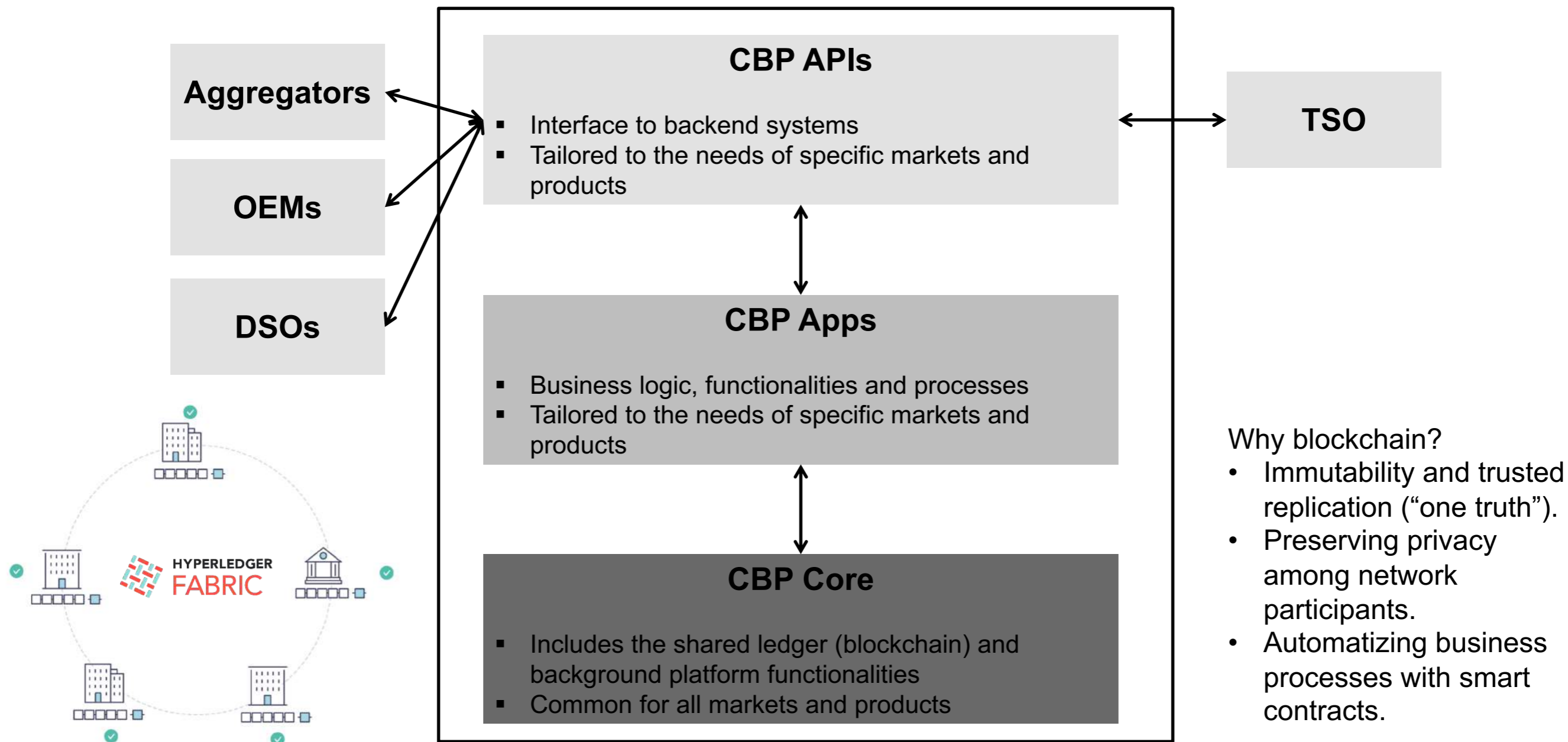


# EQUIGY: A rapidly growing ecosystem

- APG joined EQUIGY in Spring 2021 and TransnetBW in Spring 2022.
- European standardisation (common platform core) while maintaining independence (separate national deployments) and sharing relevant costs among TSOs.
- Increasing number of OEM, aggregator and DSO partners.
- Completed pilot projects
  - The Netherlands: automatic Frequency Restoration Reserve (aFRR).
  - Germany: redispatch.
  - Switzerland: Frequency Containment Reserve (FCR).




# Layered CBP architecture



## Why blockchain?

- Immutability and trusted replication (“one truth”).
- Preserving privacy among network participants.
- Automating business processes with smart contracts.



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# Pilot project between Swissgrid and ewz



ewz joins the project as DSO,  
aggregator and resource owner

Swissgrid's focus is on the products of  
the Integrated Market, namely tertiary  
control energy and international zonal  
redispatch

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## Wichtiger Schritt für die Integration dezentraler Energiequellen und Verbrauchern

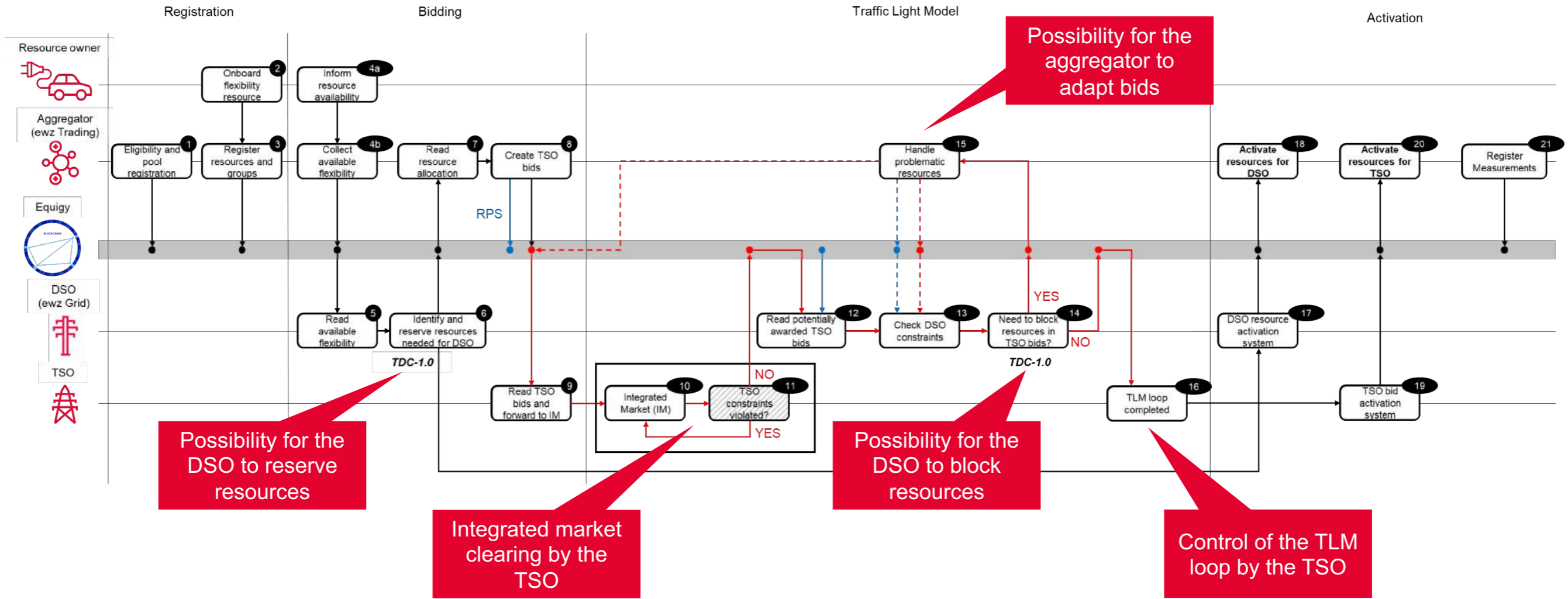
Swissgrid und ewz starten gemeinsames Equigy-Pilotprojekt zur  
Koordination von Übertragungsnetz- und Verteilnetzbetreiber

Swissgrid und ewz haben im zweiten Quartal 2021 ein neues Pilotprojekt in Verbindung mit der Crowd Balancing Plattform Equigy begonnen. Mit dem Projekt wird ein innovativer Ansatz für die zukünftige Nutzung von dezentralen Energiequellen und Verbrauchern, wie Heimbatteriespeicher, Photovoltaik-Anlagen, Wärmepumpen oder Elektro-Mobilität, für die Bedürfnisse des Übertragungs- und Verteilnetzes entwickelt und getestet.

Die Zusammenarbeit zwischen der Übertragungsnetzbetreiberin (ÜNB) Swissgrid und den verschiedenen Verteilnetzbetreibern (VNB) spielt schon heute eine wichtige Rolle innerhalb des Schweizer Stromsystems. Zukünftig wird ihr voraussichtlich noch eine grössere Bedeutung zukommen. Swissgrid und ewz (zusammen mit ihrer Tochtergesellschaft Smart Grid Solutions AG) führen aus diesem Grund gemeinsam ein Pilotprojekt in Verbindung mit der Crowd

# Concept: User journey

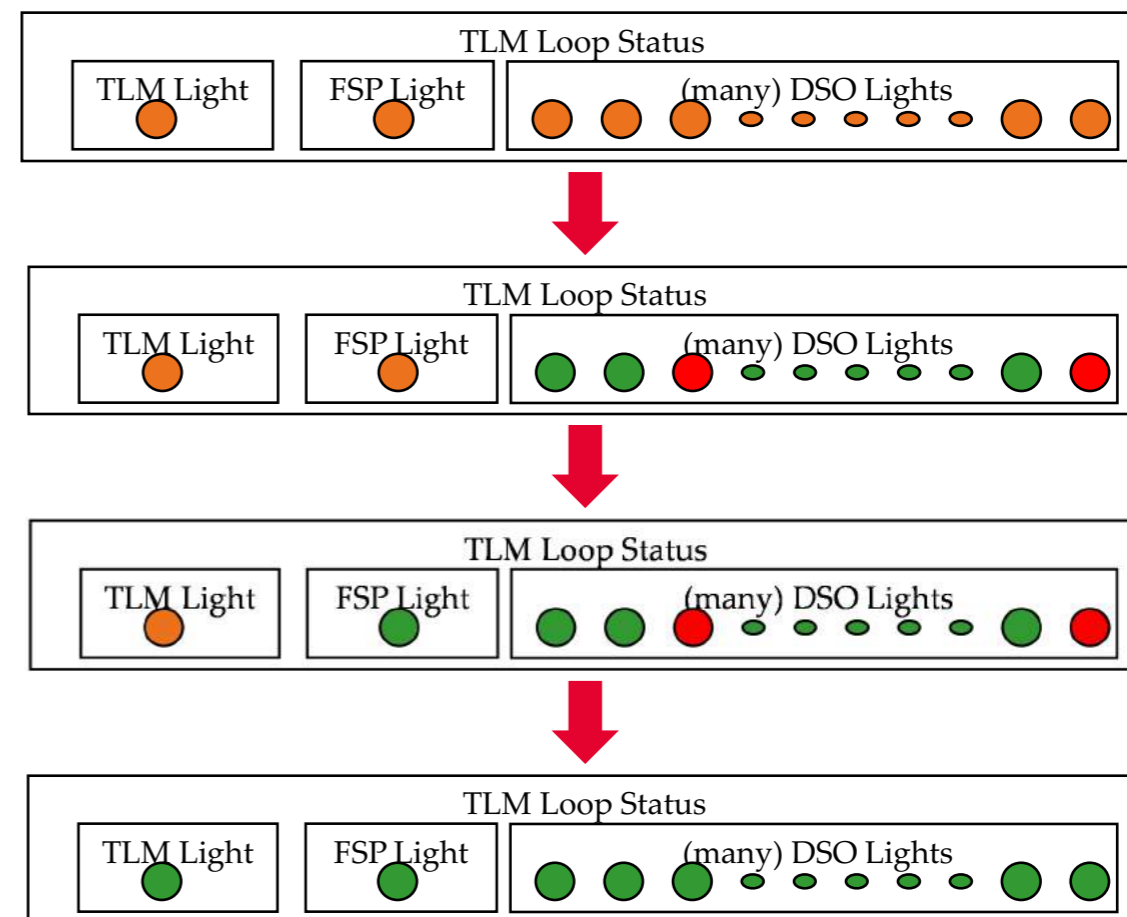
- Red arrows: Traffic Light Model loop
- Blue arrows: RPS transmission
- Dashed arrows: second iteration
- Gray shading: step may be redundant
- TDC-1.0** Key processes of TSO-DSO coordination



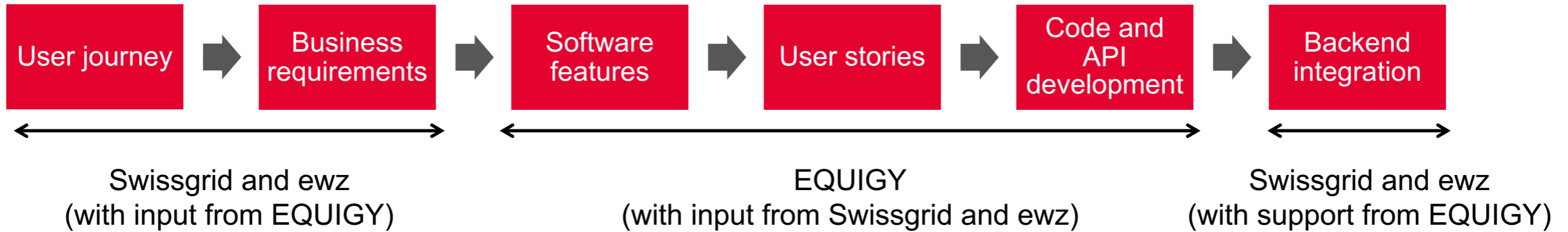
# Concept: Traffic Light Model

New data asset on CBP for the Traffic Light Model (TLM).

1. The TSO preliminarily awards bids and initializes the TLM object for the upcoming delivery period.
  - 1 TLM object per aggregator (FSP), all lights are **orange**.
2. Each DSO reports grid constraints or gives green light.
3. In case of grid constraints, the FSP has two options:
  - **Green** light: Reallocation of the flexibility among the resource groups without adjustment of the bid quantity.
  - **Red** light: Reduction of the bid quantity or bid removal.
4. The TSO announces through the TLM light the repetition of the market clearing or the final acceptance of bids.



# Software development



## Impressions from the Kanban board and the first demo

**FEATURE IN DEVELOPMENT 6 OF 26**      **REALISED / CLO... 16 OF 59 Release...**

**TC-6196**  
 CH TLM - Step 06 Publish DSO GRID Constraints

**TC-6192**  
 CH TLM - Step 03.2 Group Registration

**TC-6177**  
 CH TLM - Step 11 TSO constraints violated?

**TC-6193**  
 CH TLM - Step 03.3 Resources and Resource Groups Relations

**TenneT CBP / TC-6532**  
 CH TLM - Share (forward/query) Information  
 Status: **FEATURE COMPLETE** (View Workflow)  
 Priority: Highest  
 Component/s: None  
 Labels: feature  
 Affects Version/s: None  
 Fix Version/s: 2022-Q2  
 Epic Link: None

**Planned Resource Schedules**  
 POST /api/plannedResourceSchedules Create a Planned Resource Schedule

Parameters: No parameters  
 Request body: application/json

```

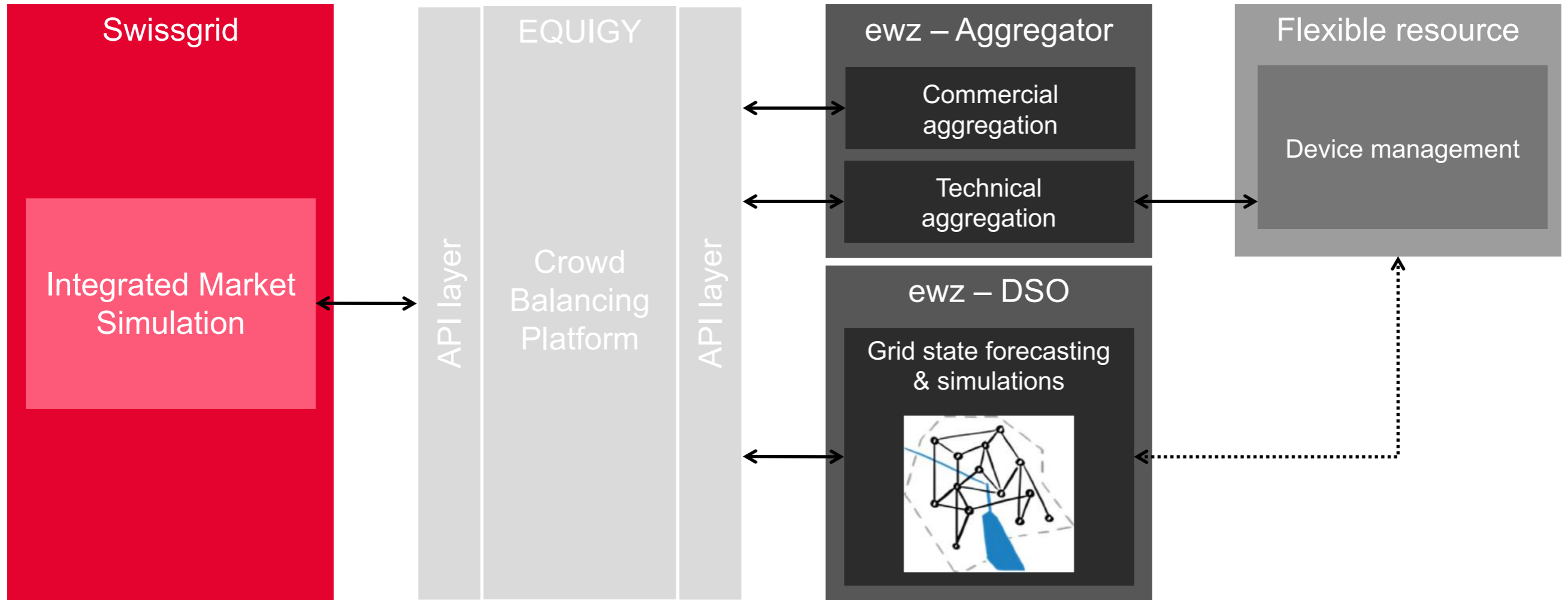
{
  "start": "2022-03-01",
  "seriesPeriod": "PT12H",
  "interval": "PT12H",
  "startDateTime": "2022-03-01T00:00:00",
  "endDateTime": "2022-03-01T12:00:00",
  "resourceProviderCodingSchemeType": "ABP",
  "acquiringDomainId": "ACQ-DM-01",
  "acquiringDomainCodingSchemeType": "ABP",
  "marketAgreementId": "MKT-AG-01",
  "marketAgreementType": "ABP",
  "product": "87168299998",
  "direction": "ABP",
  "connectingDomainId": "CND-DM-01",
  "connectingDomainCodingSchemeType": "ABP",
  "resourceProviderCodingSchemeType": "ABP",
  "substituteResourceProviderId": "S123456789",
  "substituteResourceProviderCodingSchemeType": "ABP",
  "quantity": 1,
  "unit": "MWh",
  "message": "Message fully accepted"
}
  
```

Response:

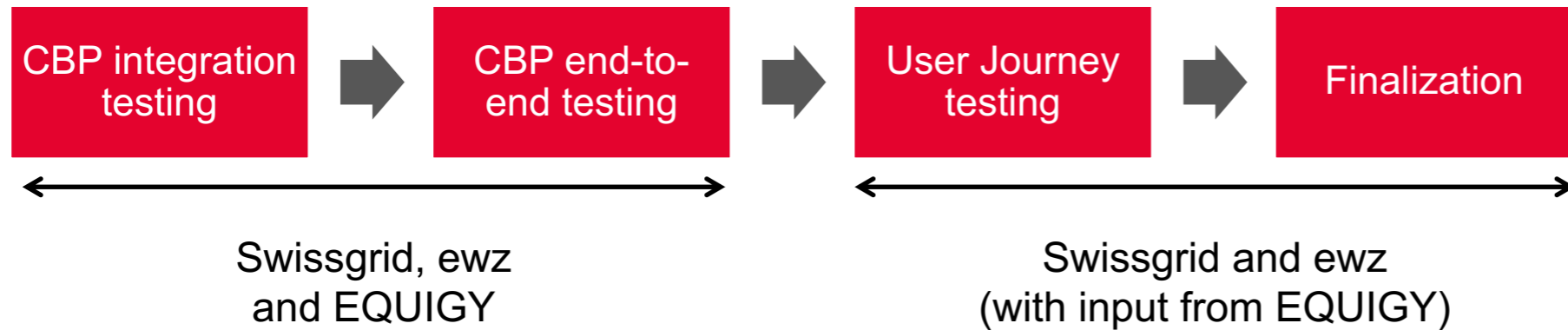
```

{
  "status": "OK",
  "message": "Message fully accepted"
}
  
```


# Backend integration: System overview



# Outlook: Testing



- Integration and end-to-end testing to ensure connectivity and proper data flow between CBP and all participants' backend systems, as well as compliance with the business requirements.
- Full User Journey testing based on multiple test cases including a physical flexible resource in the distribution grid.
- Result processing, documentation and recommendations for future projects.
- The pilot is expected to be finalized in autumn 2022.

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# Achievements and learnings

## Achievements

- Collaboration across multiple organizations and countries.
- Working with distinct aggregator and DSO roles, even if taken over by entities with the same ownership.
- Conceptualization of a coordination mechanism accepted by both the Swiss TSO and a large Swiss DSO.
- Definition of required data exchanges for each of the involved business processes.
- Further software development of CBP to support the TSO-DSO coordination mechanism.

## Learnings

- Challenge: Development of a new concept, with a new partner (EQUIGY), and using a new technology (blockchain).
- Implementation of even a simple rule-based coordination mechanism is not trivial due to many dependencies.
- CBP's blockchain works best with automatic forwarding of a message from the sender to the receiver.
- By introducing a new role called “DSO data steward” in the blockchain network, the coordination mechanism can be scaled to hundreds of DSOs.

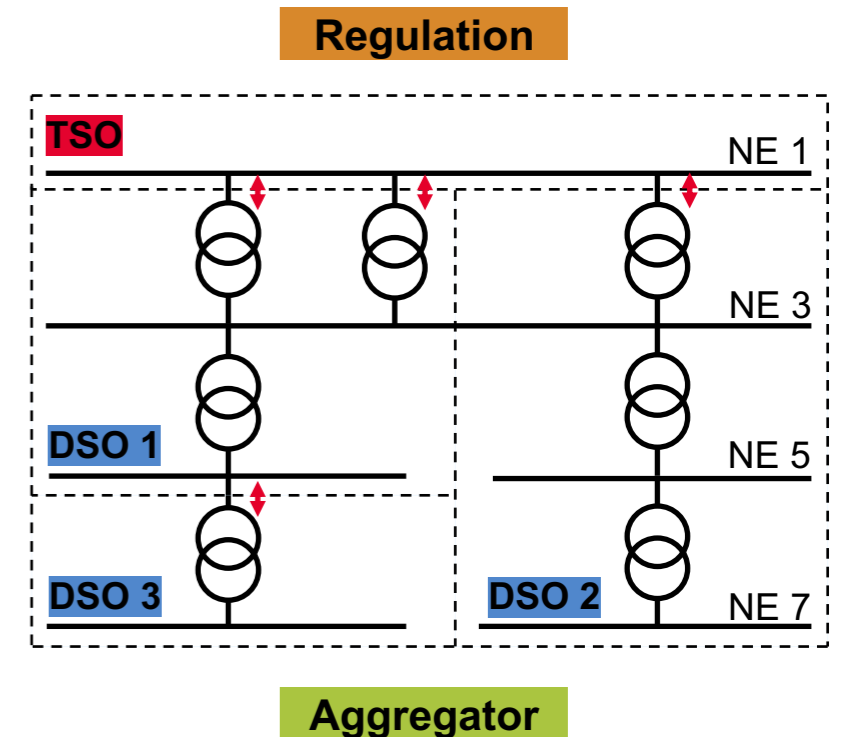
# Outlook

## Follow-up of Phase A

- Improved (data-driven?) estimation of DER activations in DSO grid studies.
- Extension to multiple DSOs (possibly nested DSOs) and multiple aggregators.
- Analysis of TLM convergence under different conditions and behaviours.

## Phase B

- Further investigation of optimization-based TSO-DSO-aggregator flexibility market concepts.
- Development of software prototype for preliminary simulation analysis.
- Engagement of more DSOs.
- ...





**Thank you for your  
interest**