# EPRI Transmission and Distribution Coordination Initiatives

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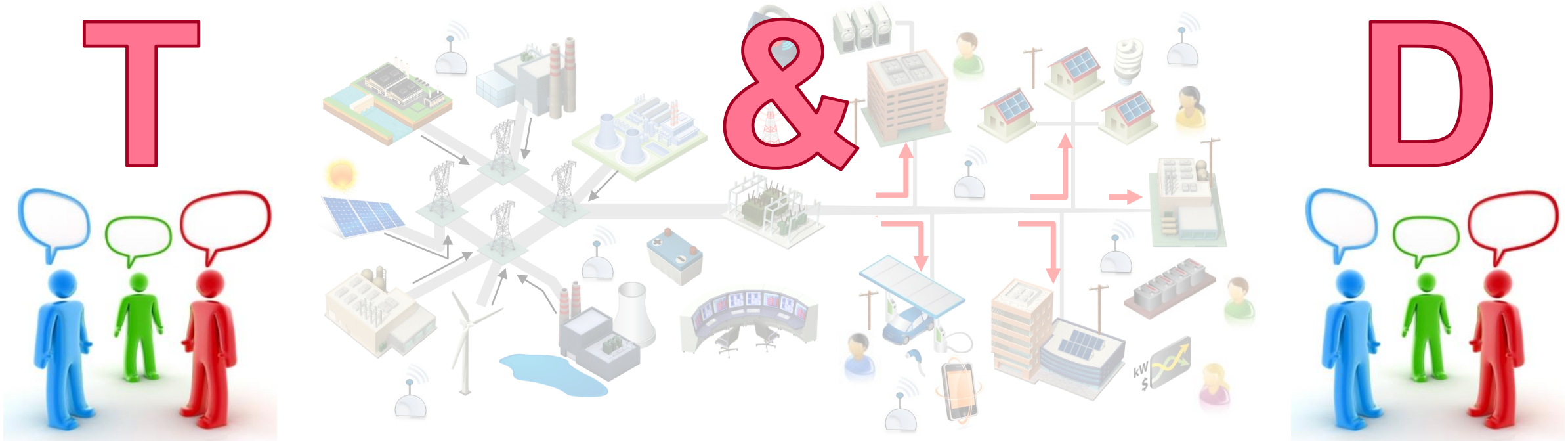
# EPRI's Integrated Grid




*A Power System that is Highly **Flexible**, **Resilient** and **Connected** and Optimizes Energy Resources*





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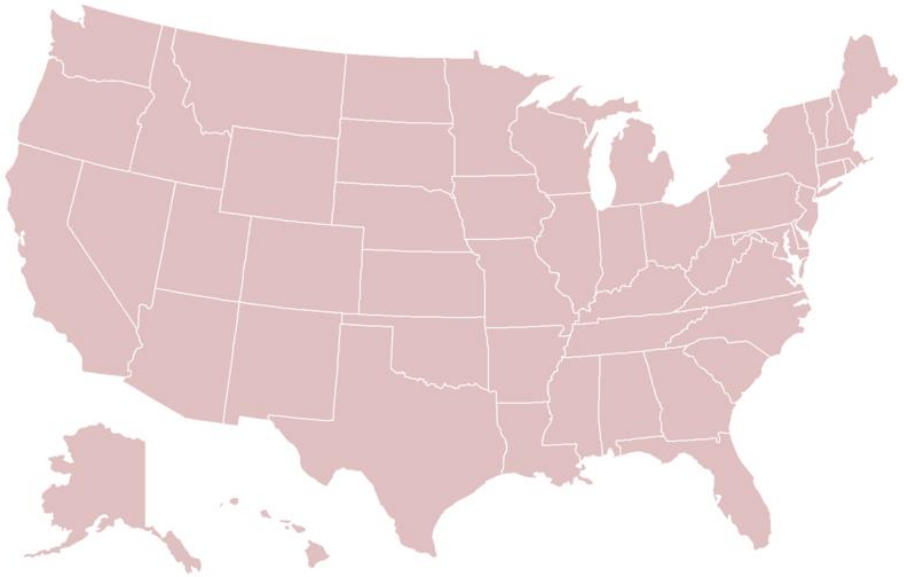
# Two Parallel EPRI Efforts

## U.S.



Advanced Grid Research
OFFICE OF ELECTRICITY
US DEPARTMENT OF ENERGY

Argonne NATIONAL LABORATORY

## Europe

50hertz
UK Power Networks
innogy
ESB NETWORKS
nationalgrid
EirGrid
ENERGINET.DK
entsoe
Reliable Sustainable Connected
STEDIN.NET
DANSK ENERGI





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# Project Overview

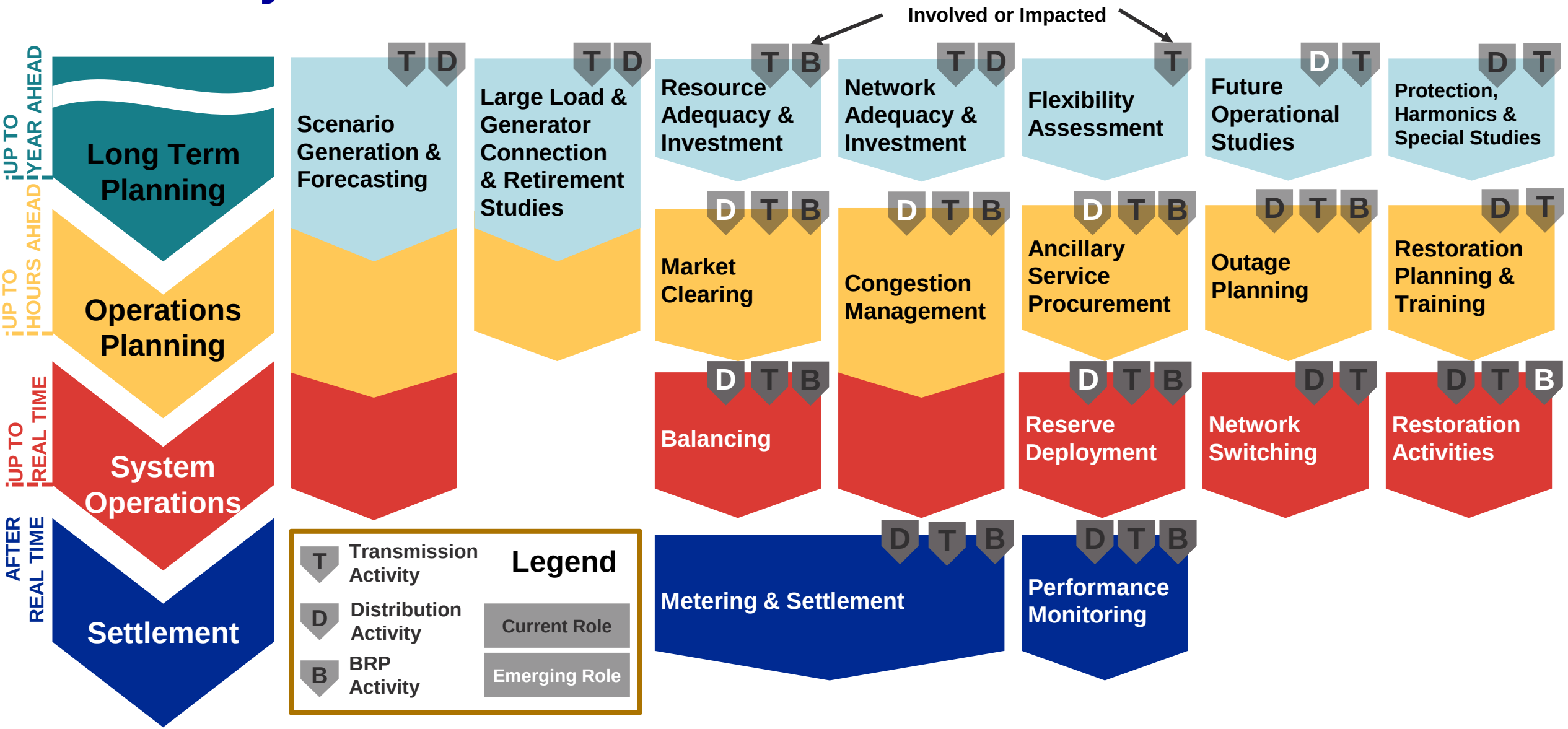
- Objective: Enable responsible entities to efficiently and effectively conduct their duties in planning & operations across the T&D interface.

- Focus/stakeholders: Transmission utilities/TSOs, distribution utilities/DSOs, and balance responsible parties

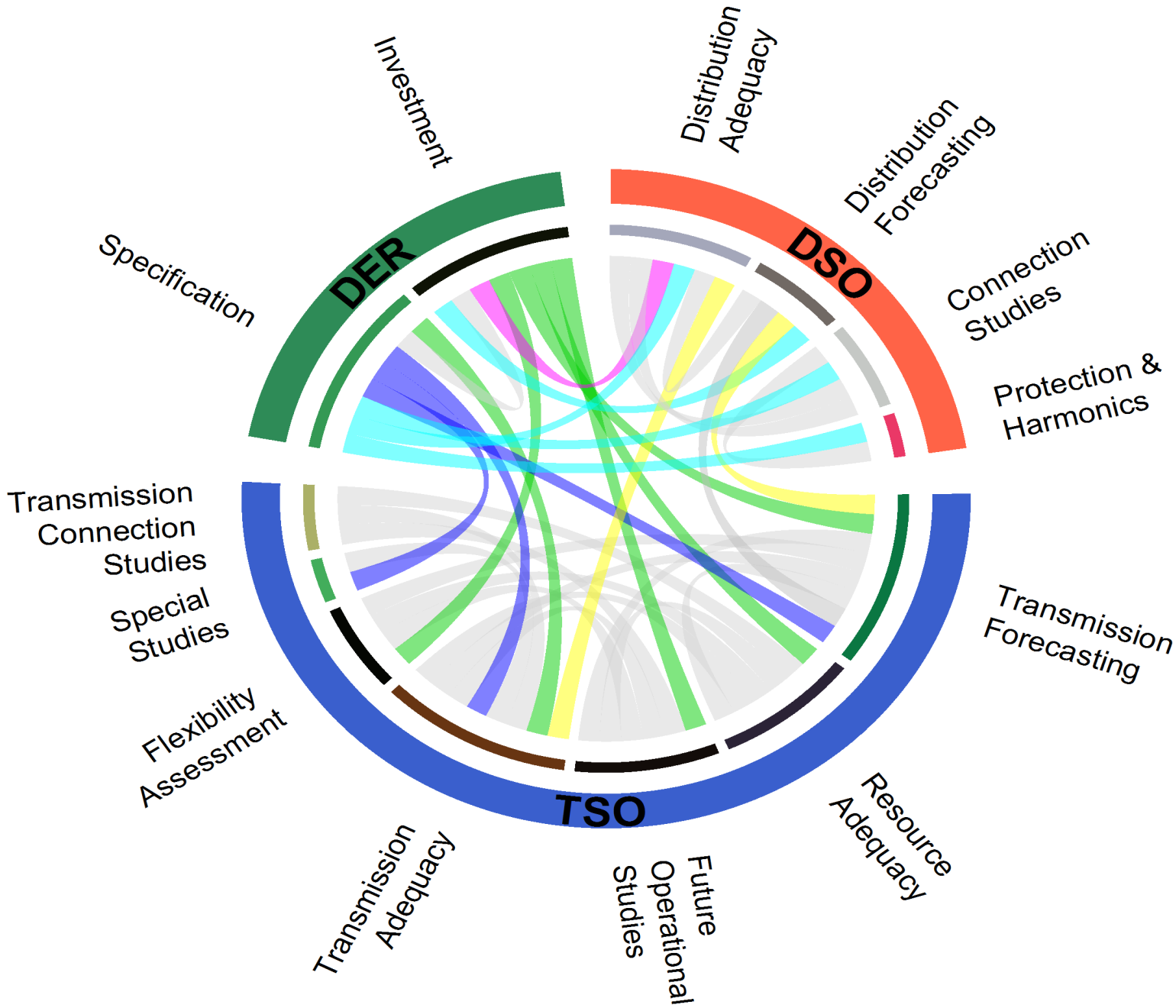
- Approach:
  - Review vital functions needed to plan & operate a power system with DERs.
  - Catalog current state and gaps associated with existing processes.

- Deliverables:
  - Specify data exchange needed for grid ops & planning with DERs.
  - Propose architectural framework and develop guidelines for T&D coordination.

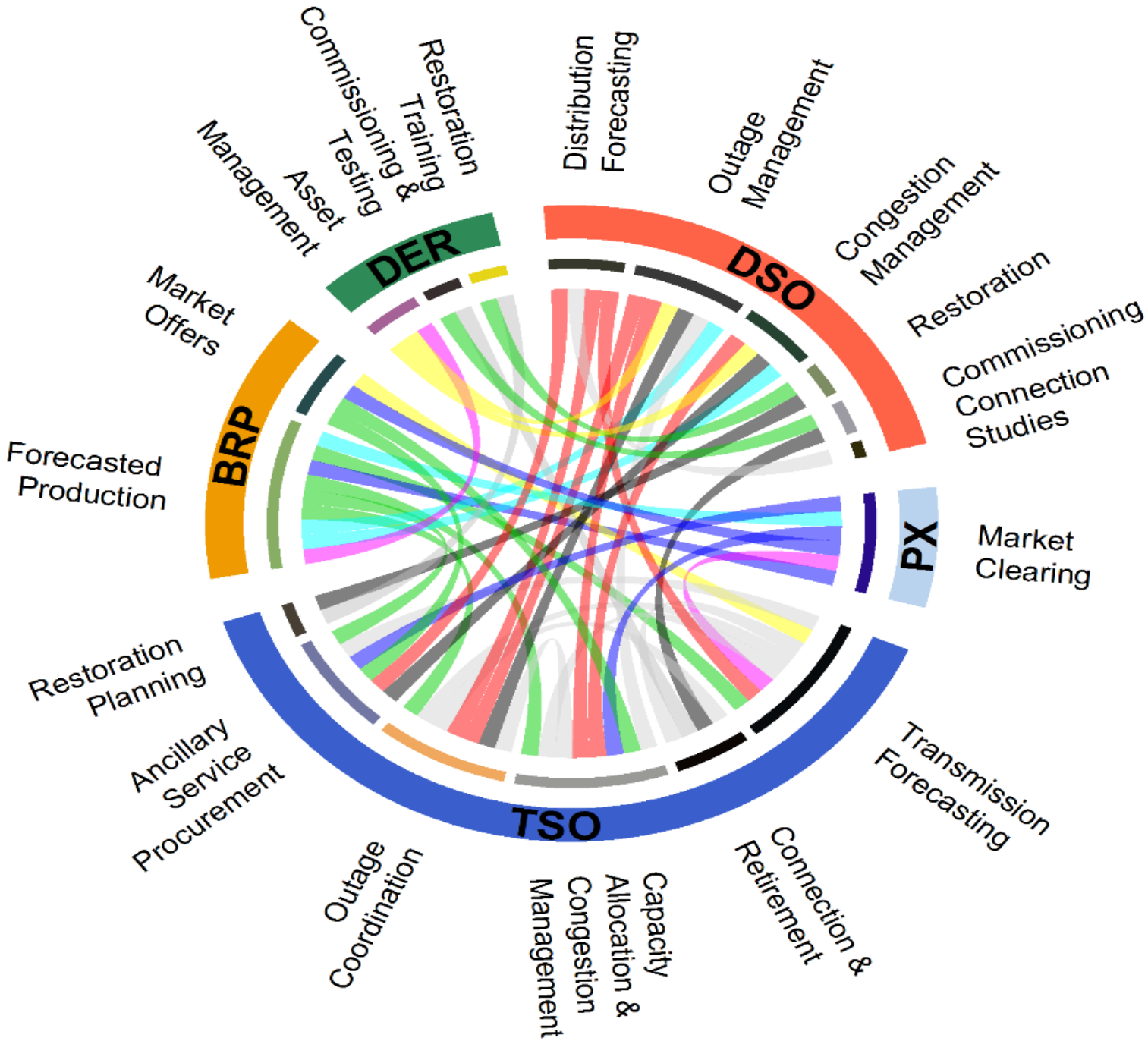
# Power System Functions and Roles



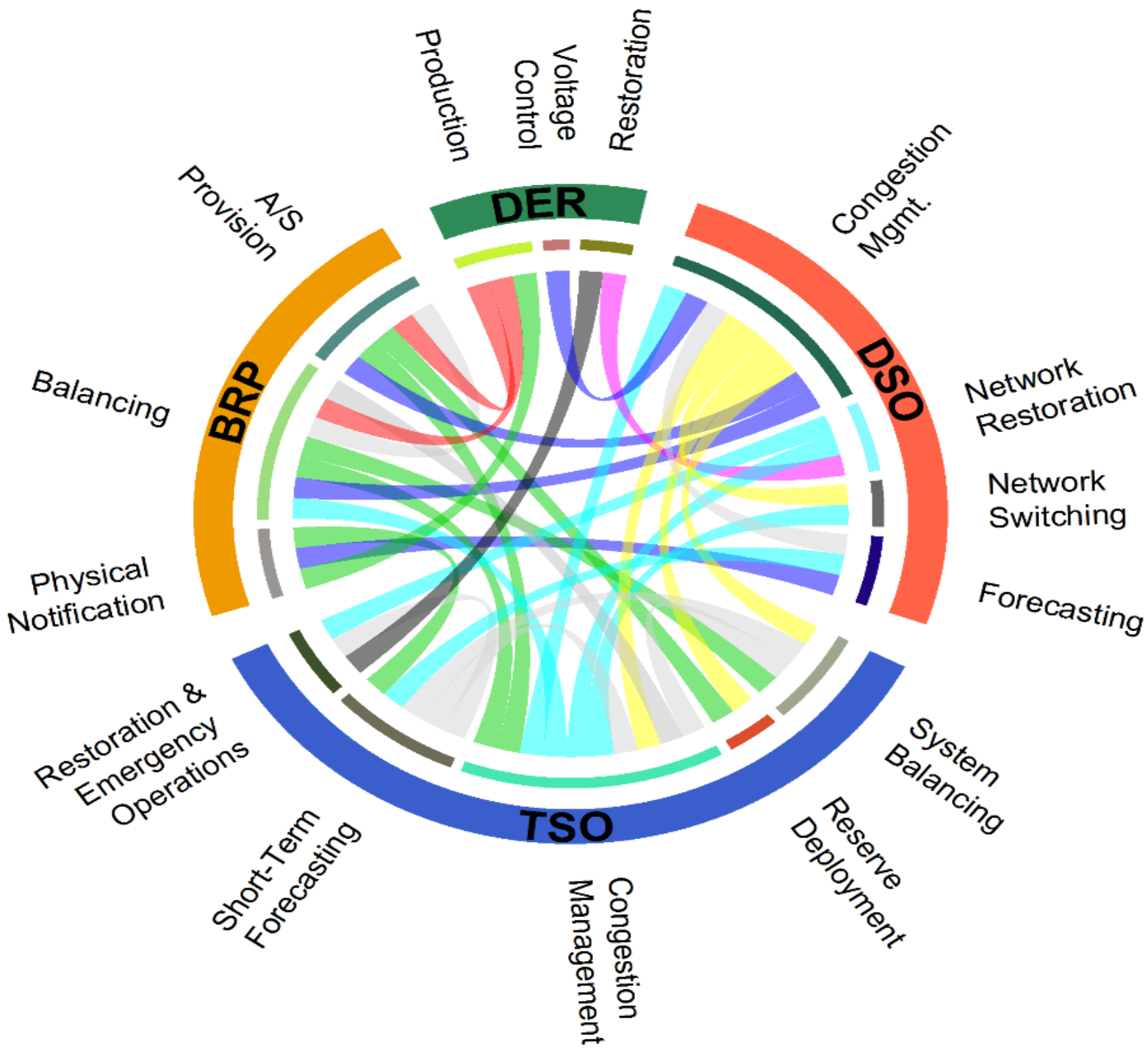
# Long – Term Planning



# Operational Planning

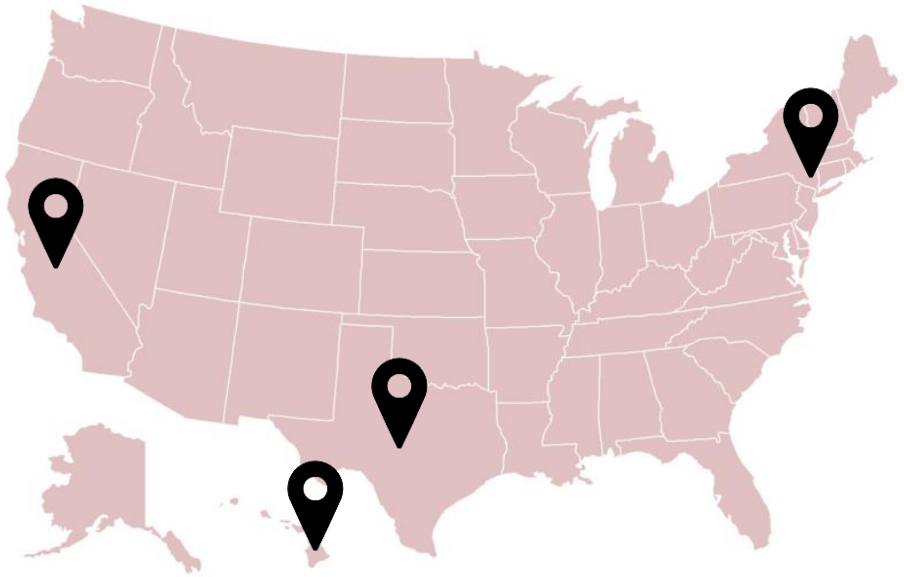


# Real Time Operations



# Ongoing Initiatives

## U.S.



- FERC orders and proposals
- New York NYISO roadmap
- California DR, DER, market integration
- Texas ERCOT DER integration
- Hawaii HECO programs

## Europe

- European Network Codes
- ENTSO-e + DSO Group Initiatives
- Germany National Processes
- Netherlands ETPA
- SmartNet H2020 multiple partners

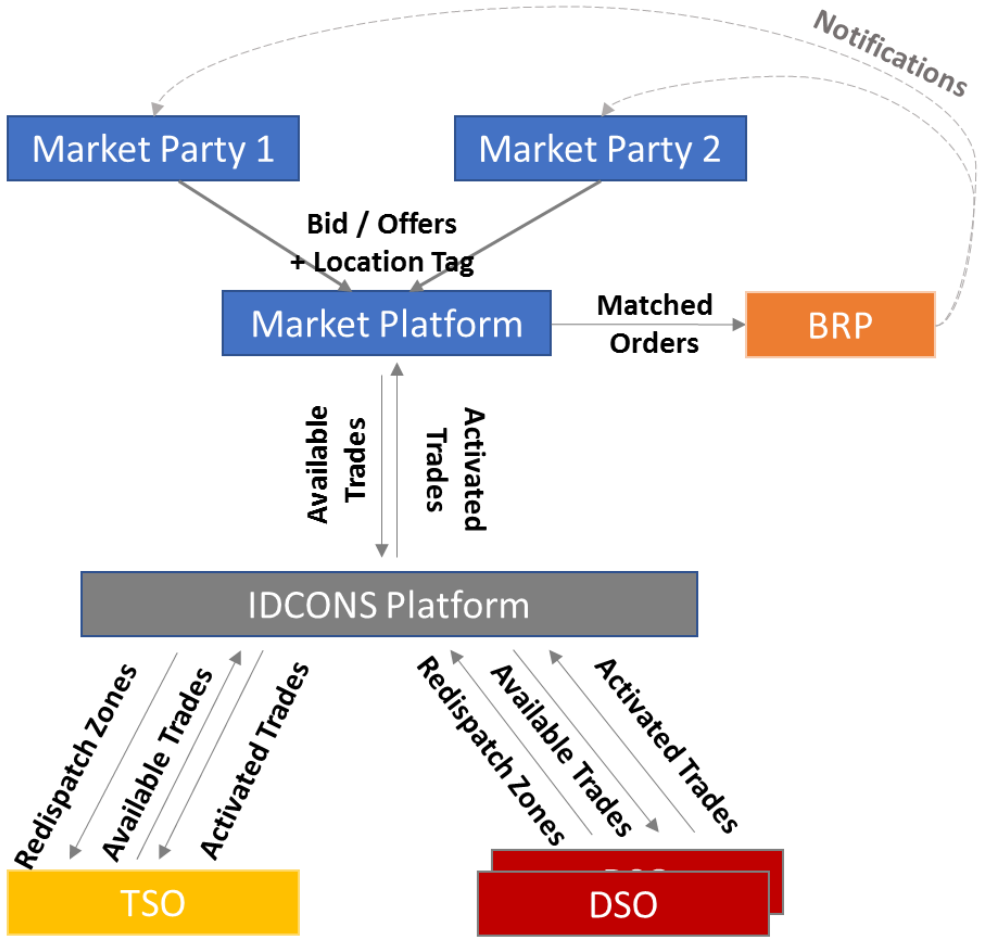
# Europe – Network Codes

- System Operations Guidelines
  - Released in 2017, in force from 2019
  - Includes provisions for mandatory data sharing between TSOs and DSOs

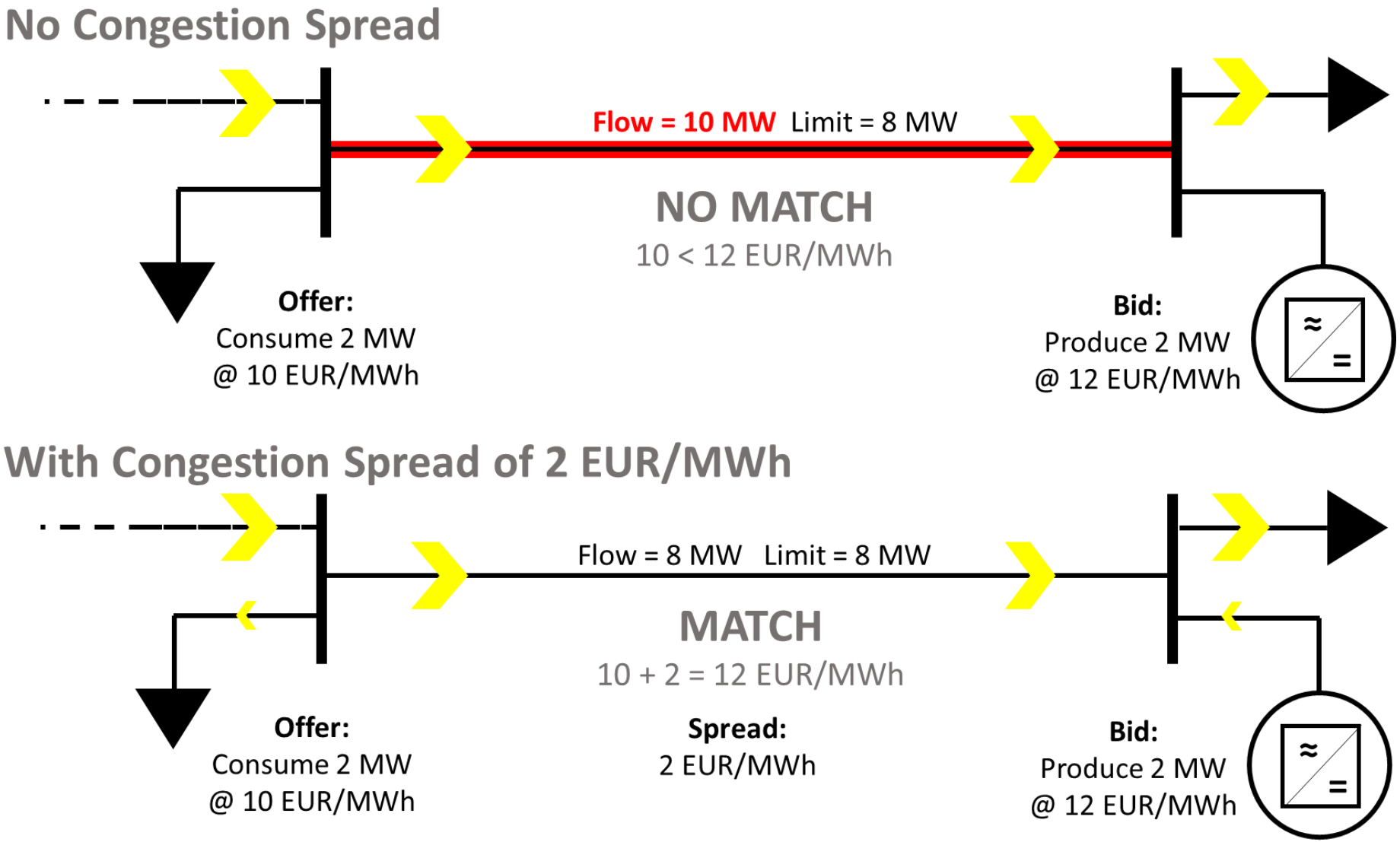
- Generation and Load Data Provision Methodology (GLDPM) established to collect planning timeframe data on generation and load composition, including from DER

# Netherlands – Tennet, Stedin, ETPA

- Market based pilot project for congestion management launched
- TSO and DSO jointly managing congestion using DER
- IDCONS platform to forecast congestion and identify potential remedies from multiple markets
- Congestion spread principle



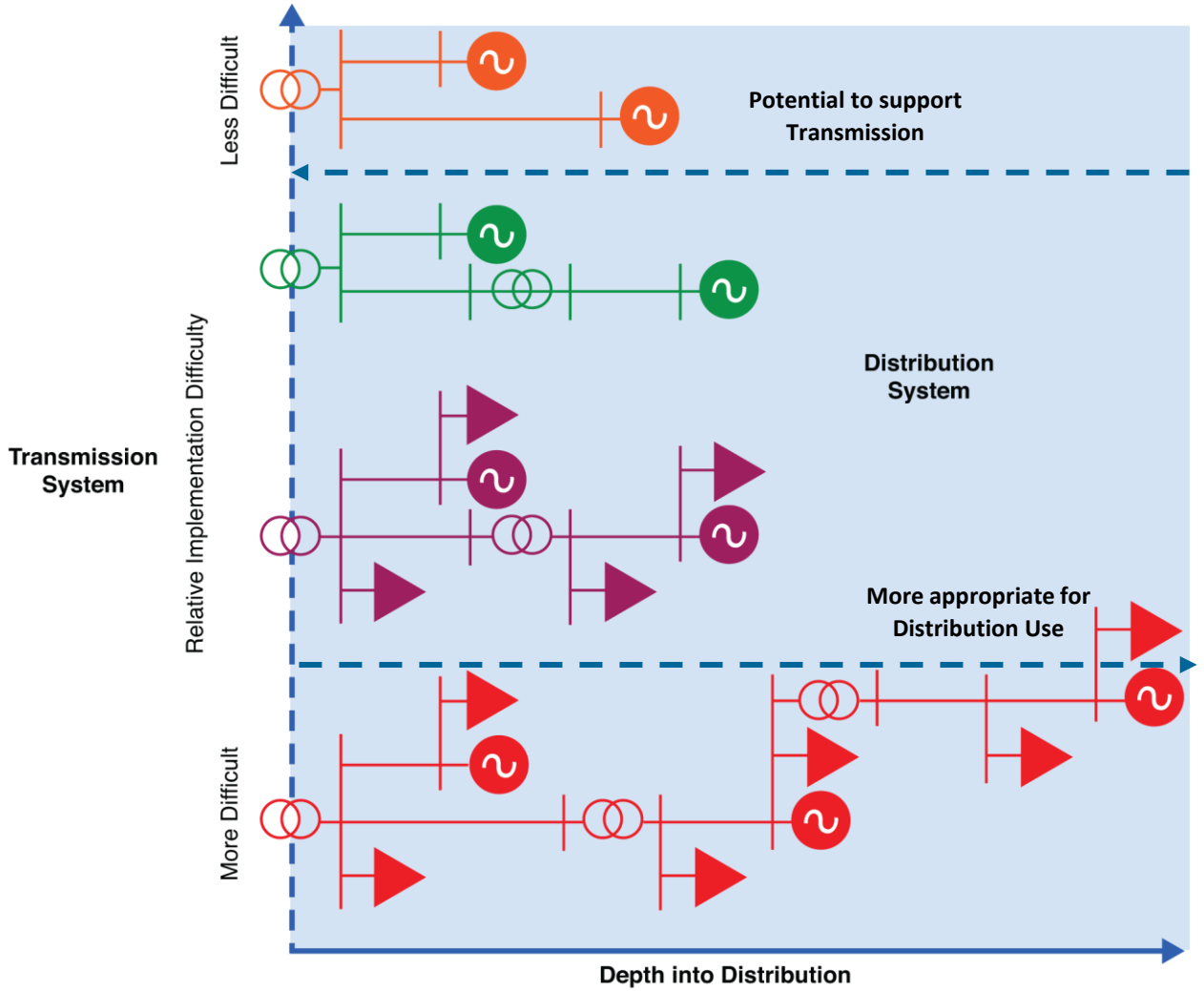
# Netherlands – Tennet, Stedin, ETPA



# Reactive Power Control

- Initiatives in:
  - Ireland
  - UK
  - Germany
  - Spain

- Leveraging Dx connected uDER to manage Tx voltage




*Source: Tony Hearne, ESB Networks*

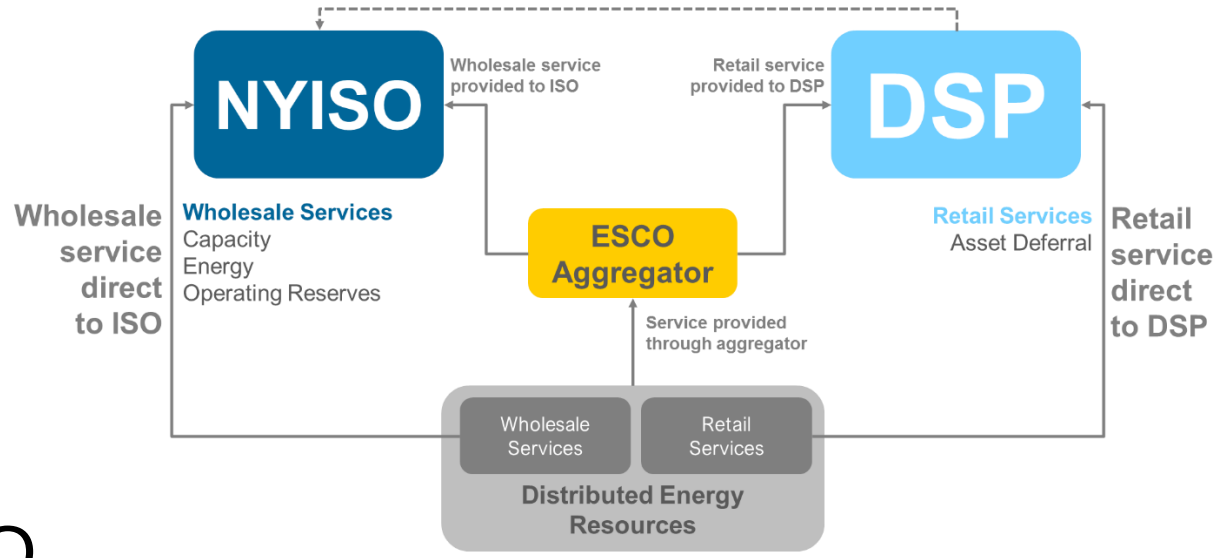
# FERC – DER NOPR Workshop

- **DER split from FERC NOPR on Storage**
  - Order 841 for storage route to market could extend to DER

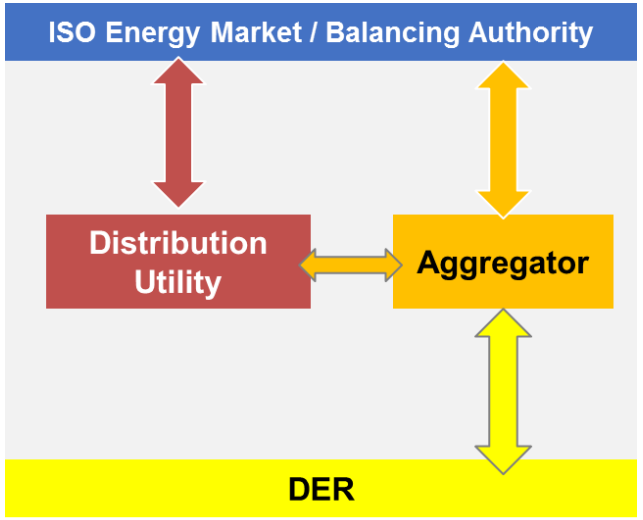
- **April 2018 workshop on DER integration**
  - Economic Dispatch, Pricing, and Settlement of DER Aggregations
  - Discussion of Operational Implications of DER Aggregation with State and Local Regulators
  - Participation of DERs in RTO/ISO Markets
  - Collection and Availability of Data on DER Installations
  - Incorporating DERs in Modeling, Planning and Operations Studies
  - Coordination of DER Aggregations Participating in RTO/ISO Markets
  - Ongoing Operational Coordination

# New York

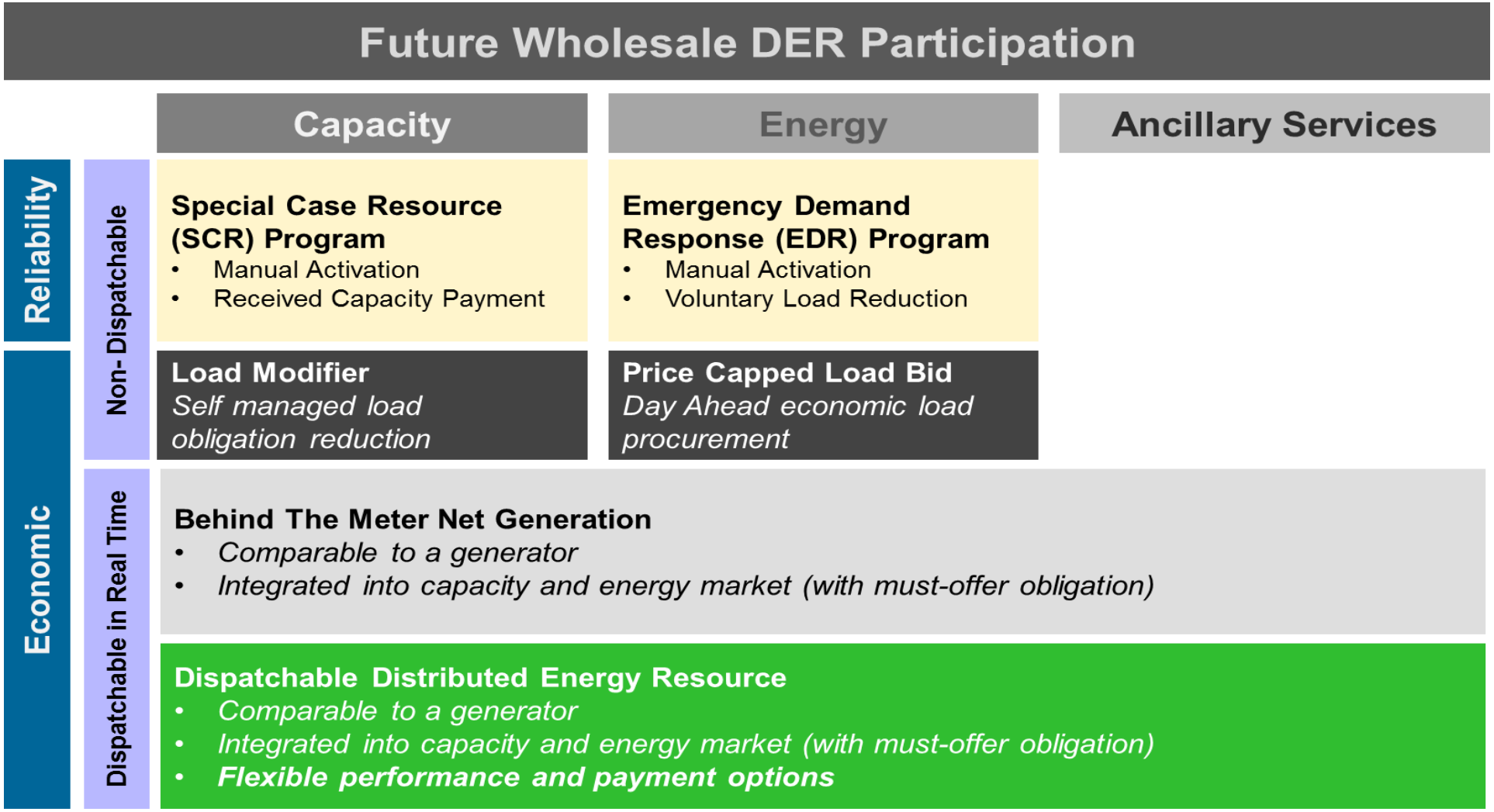
- DER Roadmap - 2017
- DER Market Integration - 2018
- Metering Study – 2018




- Allows for both DSP and NYISO to coordinate with DER



# NYSIO – Future DER Participation



# ERCOT – DREAM Initative

- Concept paper released in 2015
- Stakeholder group including DER, Transmission, Distribution, Market Parties

- **Three proposals for market participation**
  - DER Minimal
  - DER Light
  - DER Heavy

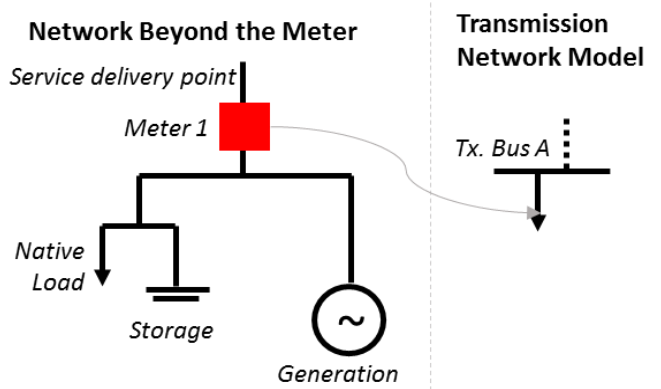
- DER is <10MW and connected <60kV. Does not include DR

# ERCOT - Market Integration Options

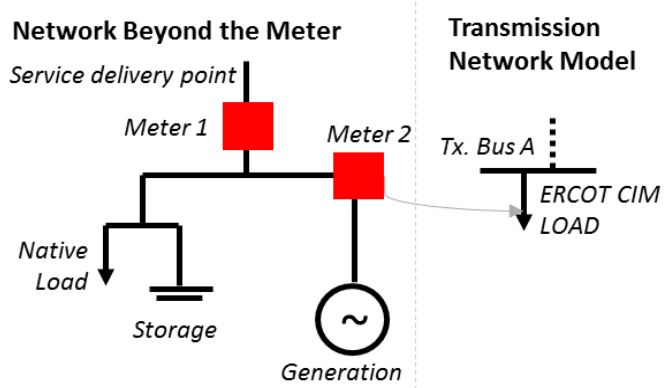
| Features | DER Minimal | DER Light | DER Heavy |
|---|---|---|---|
| **Energy Settled at:** | Load Zone SPP | Price at Local electrical bus(es) | Logical Resource Node (price at Local electrical bus(es)) |
| **Energy Market Participation** | Self-responding | Self-responding | SCED-dispatched |
| **Ancillary Service Market Participation** | Not eligible | Not eligible | Eligible |
| **Aggregation Allowed?** | N/A | Yes | Yes |
| **Metering Required** | Single meter OK (15-minute revenue quality) at POI | Separate (dual) metering for Generation and native Load | Separate (dual) metering for Generation and native Load |
| **Telemetry or telemetry-light to and from ERCOT** | Not required | Real-time or near real-time with multiple attributes | Real-time or near real-time with multiple attributes |
| **COP, Outage Schedule, Offers/Bids, etc.** | N/A | Possible “light” version required | Required |
| **CRR/PTP Implications** | None | None | Yes |

# ERCOT – The Importance of Metering Configuration

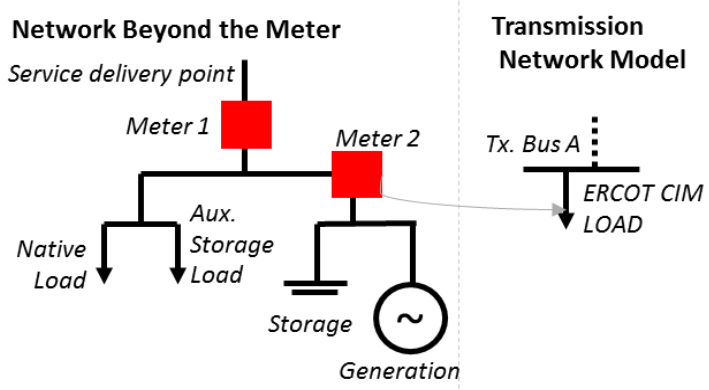
**DER Minimal**




**DER Light & DER Heavy**



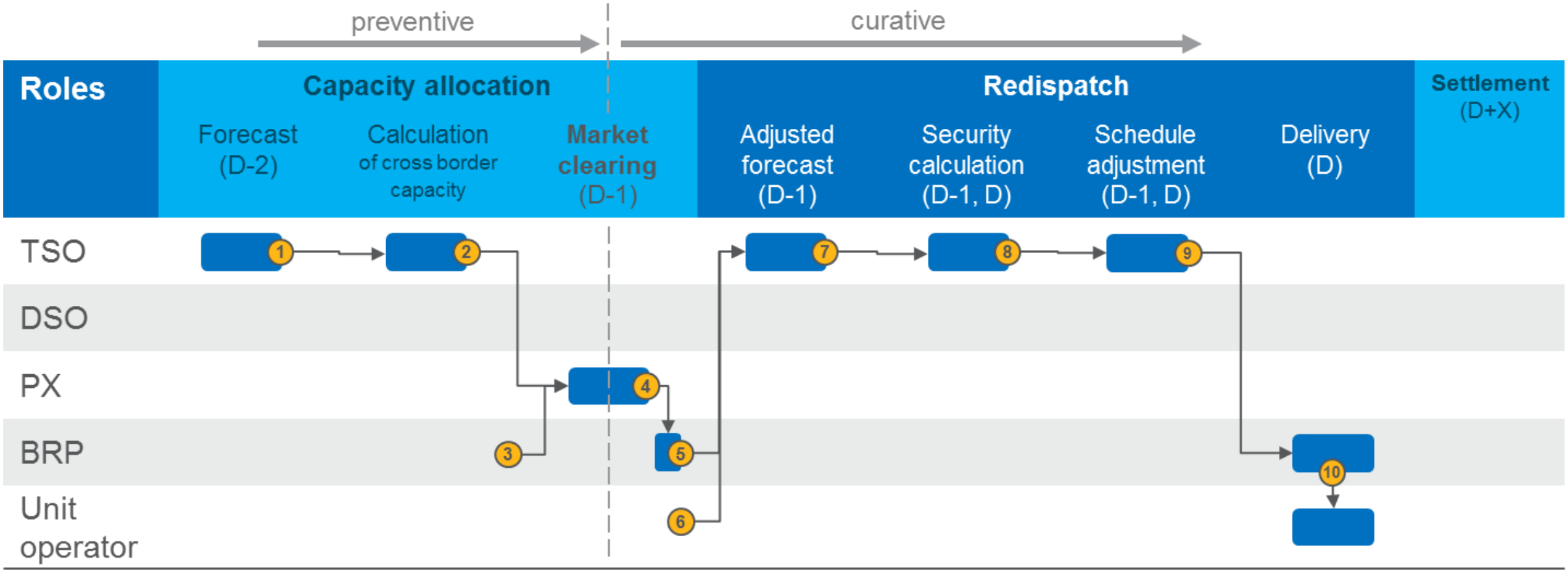

Non Wholesale Storage Load




Wholesale Storage Load

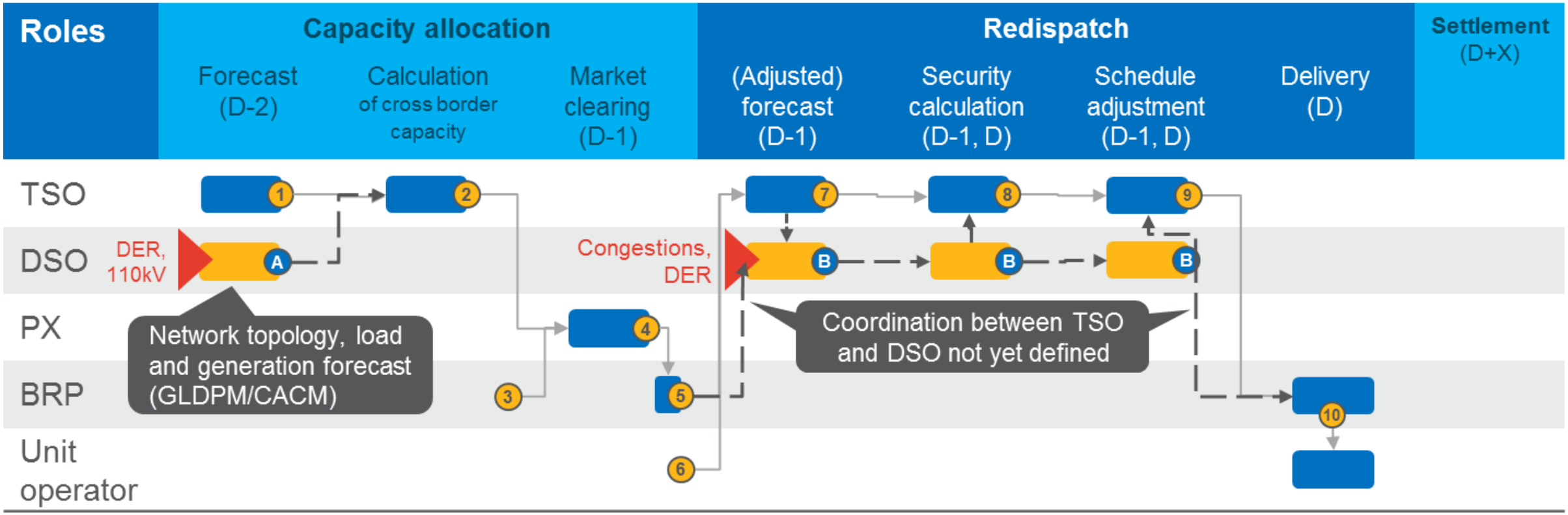
# Example: Capacity Allocation & Redispatch

## Current Process



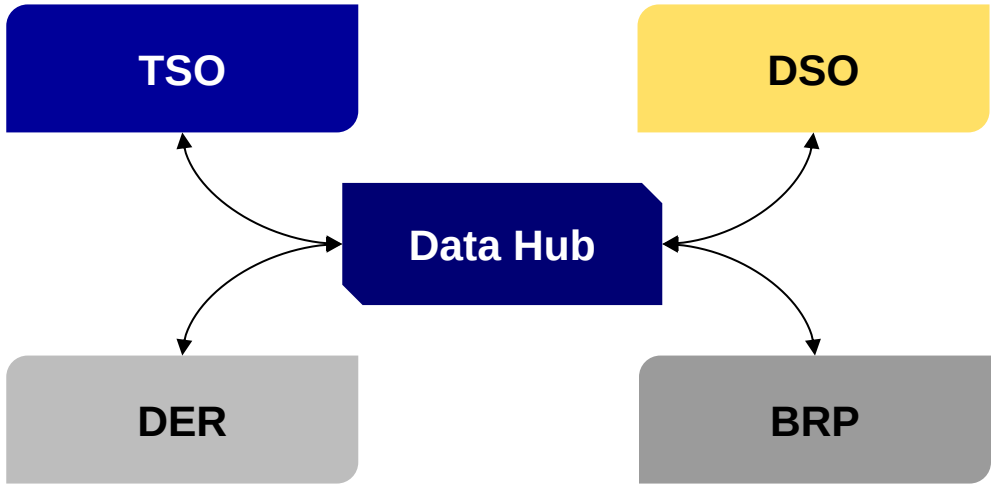
# Example: Capacity Allocation & Redispatch

## Example of Potential Future Process – Curative Approach

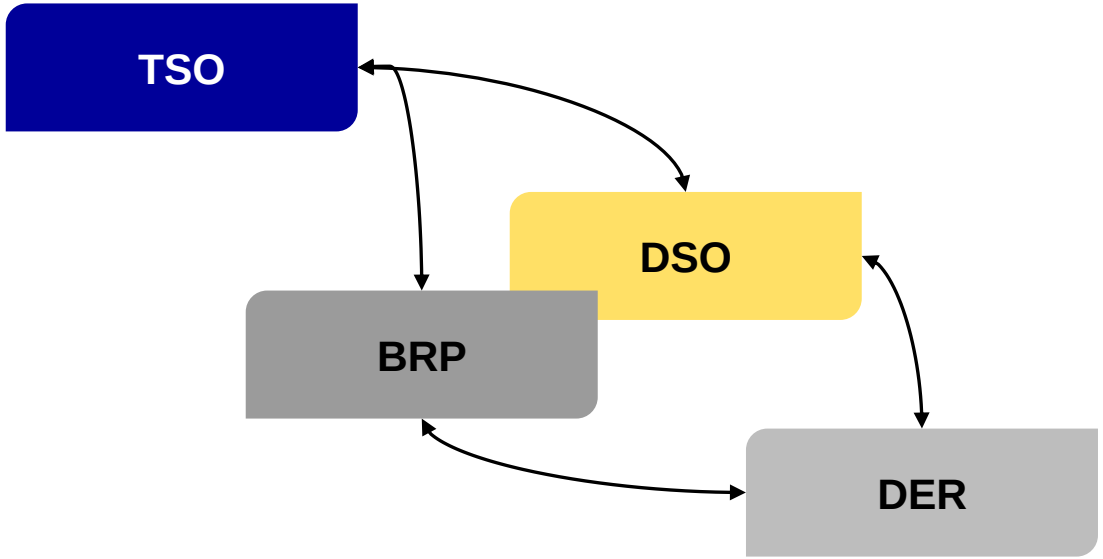


# Data Exchange: Main Options Under Consideration

## Centralised Data Hub




## Cascade Data Flow




## Key Considerations:

- Data Exchange Requirements
- Comms. & IT Hardware
- Data Protection & Cyber Security
- Business models
- Data Types

# Example: Long Term Data Objects

| Data Object | Required By | For Function | At Resolution | When DER Reaches |
|---|---|---|---|---|
| **DER Capacity Forecast** | TSO, DSO, BRP | All | Hourly by primary substation | DER Capacity > size of peaking plant |
| **DER Production Forecast** | TSO, DSO, BRP | All | Hourly by primary substation | DER Capacity > size of peaking plant |
| **DER Type** | TSO, DSO, BRP | All | | DER Capacity > size of peaking plant |
| **DER Settings Configuration** | TSO, DSO | Network Adequacy, Connection Studies, Protection, Harmonics & Special Studies | | DER Capacity > size of mid merit plant |
| **Demand Forecast** | TSO, DSO, BRP | All | Hourly by primary substation | |
| **DER Location** | TSO, DSO, BRP | All | | DER Capacity > size of peaking plant |
| **DER Controllability** | TSO, DSO, BRP | Future Operational Studies, Flexibility Assessment, Network Adequacy | | DER providing ancillary services or redispatch |
| **DER Electrical Properties** | TSO, DSO | Network Adequacy | | DER Capacity > size of mid merit plant |
| **DER Voltage Control Capability** | TSO, DSO | Network Adequacy, Connection Studies, | | DER Capacity > size of mid merit plant |
| **DER Dispatch Limits** | TSO, DSO | Future Operational Studies, Flexibility Assessment | | DER providing ancillary services or redispatch |
| **DER Reserve Capability** | TSO | Future Operational Studies, Flexibility Assessment | | DER providing ancillary services or redispatch |

# Forthcoming Deliverables

- US work
  - Interim report Q4 2018
  - Final report Q1 2019
- European work
  - Whitepaper Q1 2019

# Together…Shaping the Future of Electricity