



Flexibility Operation in Nordic Demand Response Markets

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The Energy System – Flexibility or Rigid Structures?

- What is the role of the current energy system that connects energy resources and acts as the base for liberalized energy markets?
- What do we face in transition and what do we need when future energy resources take over?

Change Drivers in the Energy System

- **Emissions**
 - Current emission levels are not sustainable
- **Resource dependency vs. self-sufficiency**
 - Local resources do not get used
 - Large networks are needed to distribute and operate resources
- **Generation technology**
 - New resources with smaller ecological footprint
- **Control technology**
 - Resource use can be optimized in real time
- **Management system technology**
 - Large amounts of information can be aggregated and managed easily

Basic Technical Balance Requirements

- An electricity network can only function correctly if it is in balance
 - Consumption and production are equal at all times
 - Otherwise physical characteristics like frequency and voltage change
- When physical delivery limits are not met, the network shuts down

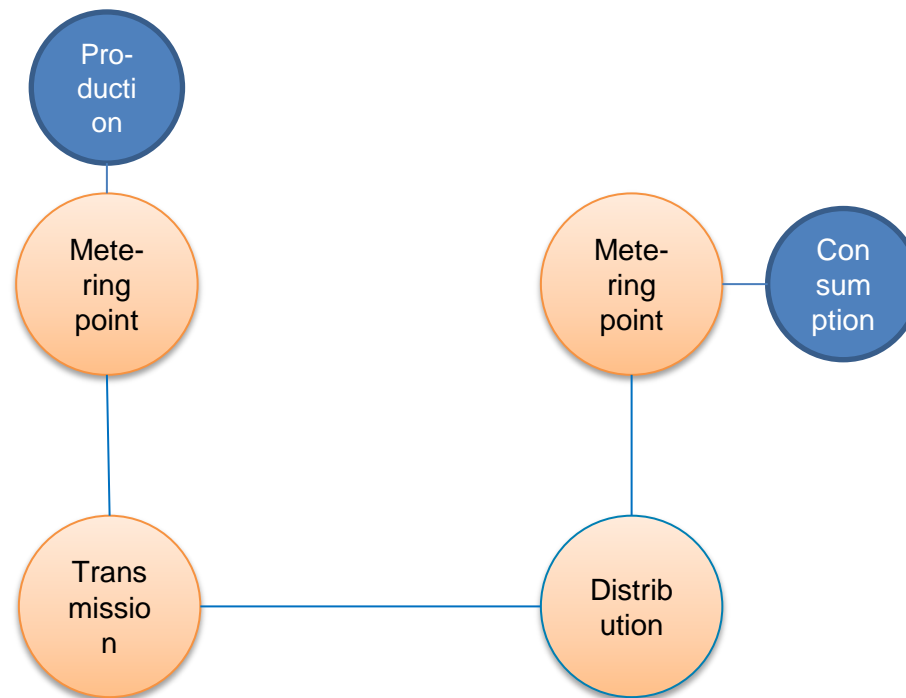
Basic Commercial Balance Requirements

- A trade can only be consummated if
 - The quantity and price has been agreed
 - The delivery is according to the quantity and price
- When any of these are changed, the trade is no longer valid
 - The party responsible for the trade needs to be able to control the components of the trade

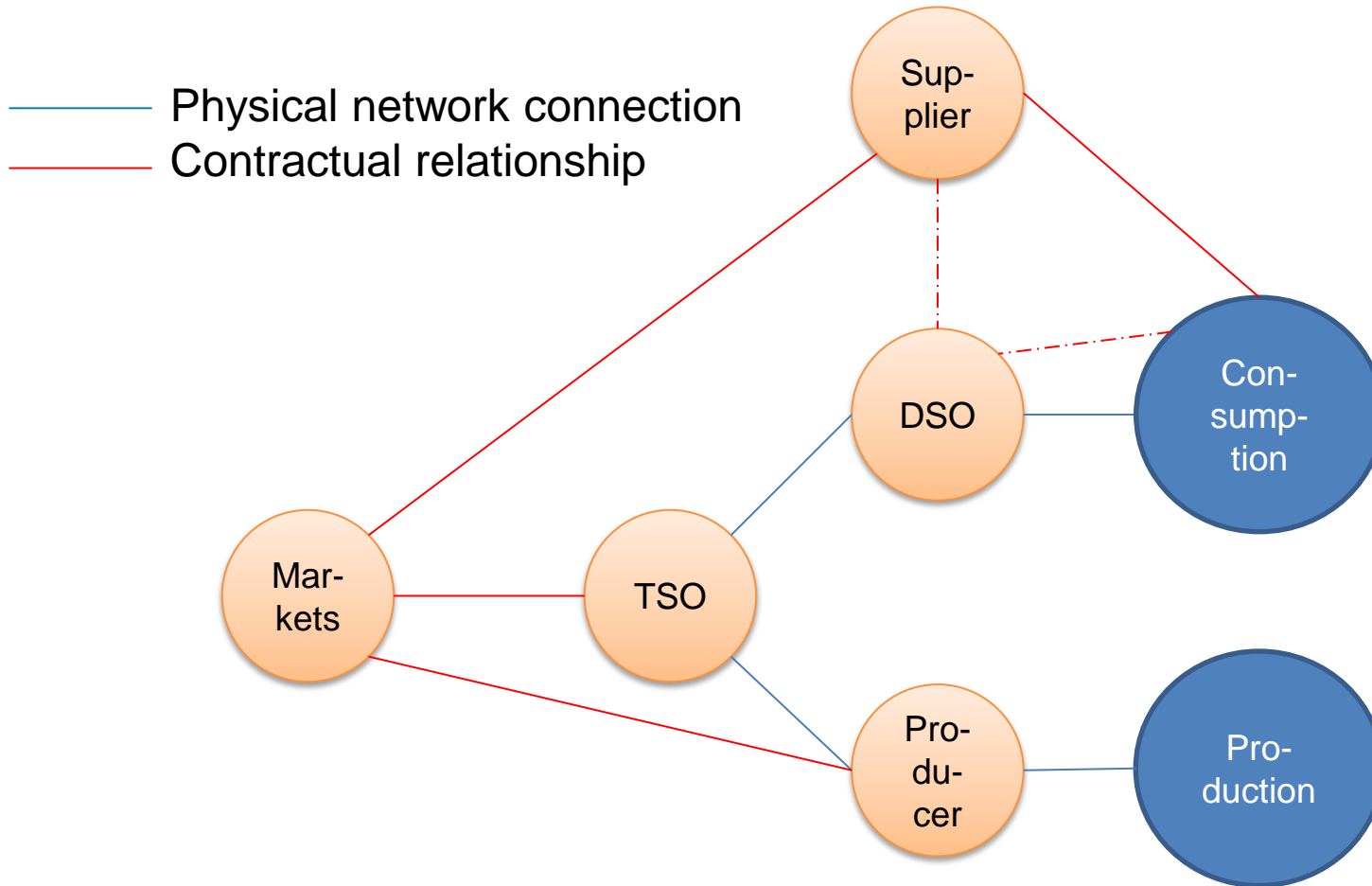
Markets as facilitators

- The role of electricity markets is to facilitate electricity trading between partners
 - The structure is designed to create balance in order to allow physical delivery to happen
- The tradable commodity should have
 - Value to the end customer
 - Properties that allow for safe and reliable delivery

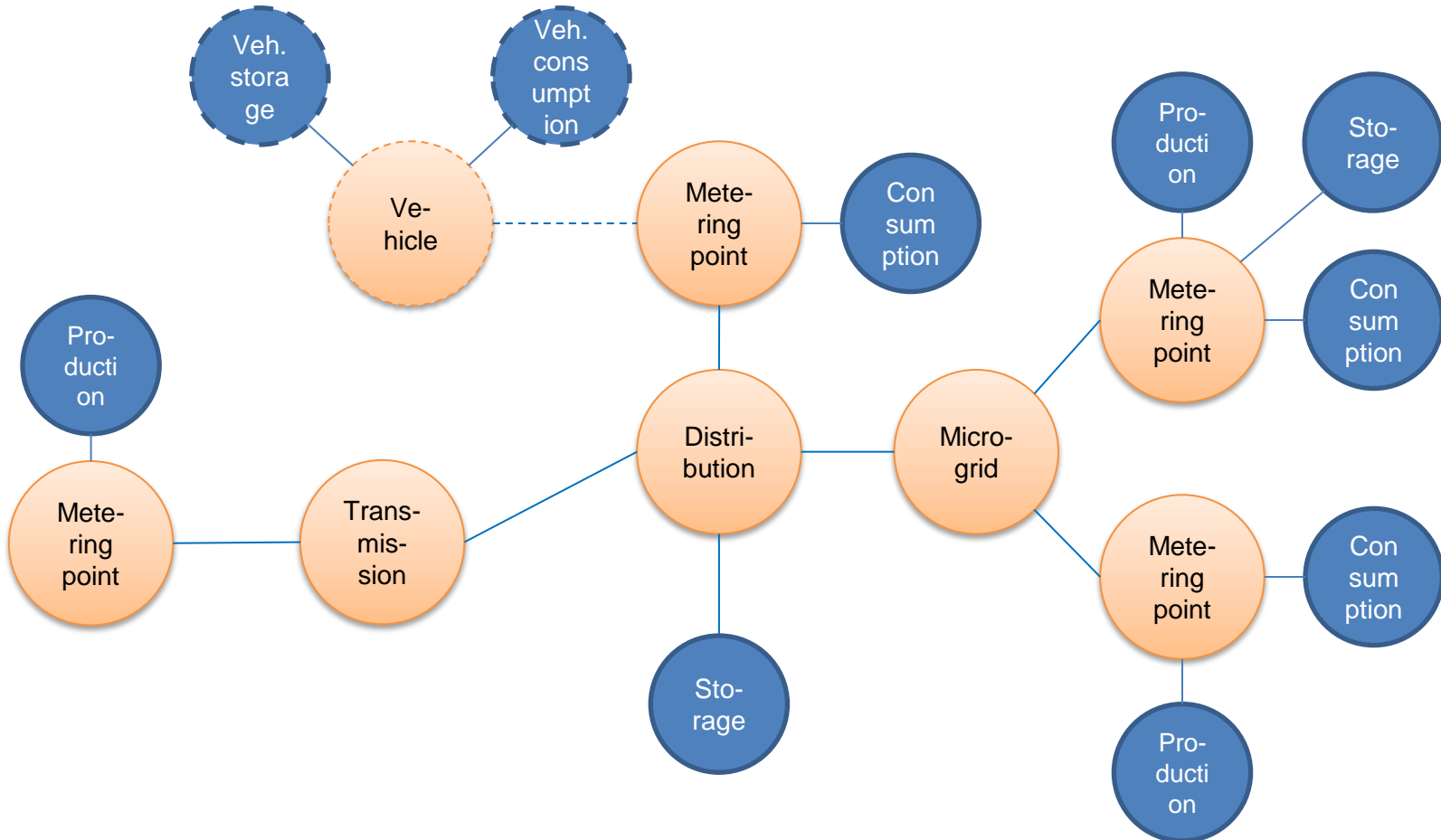
A Simplified Energy System



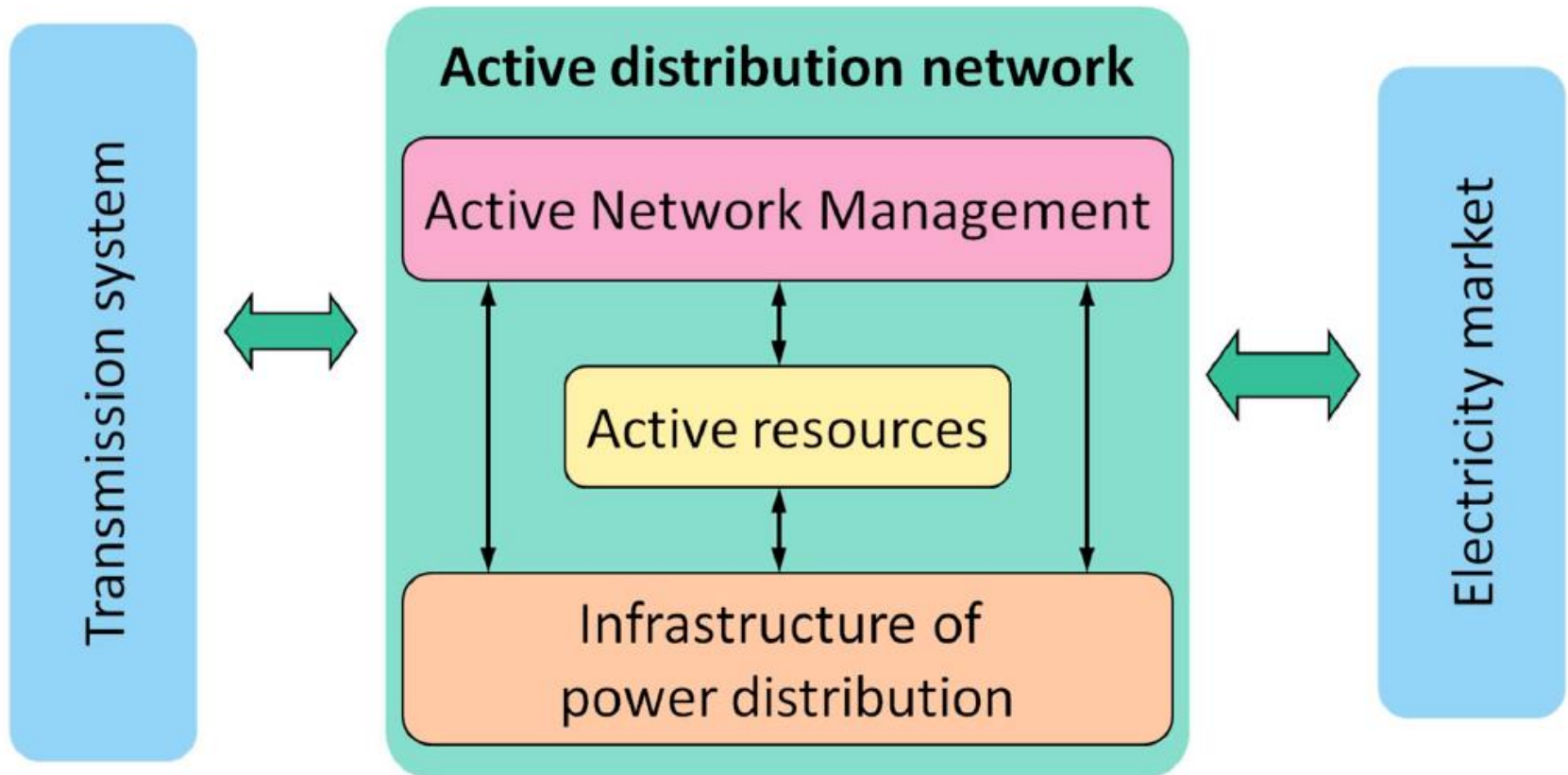
The Energy System Today



System parts in the future

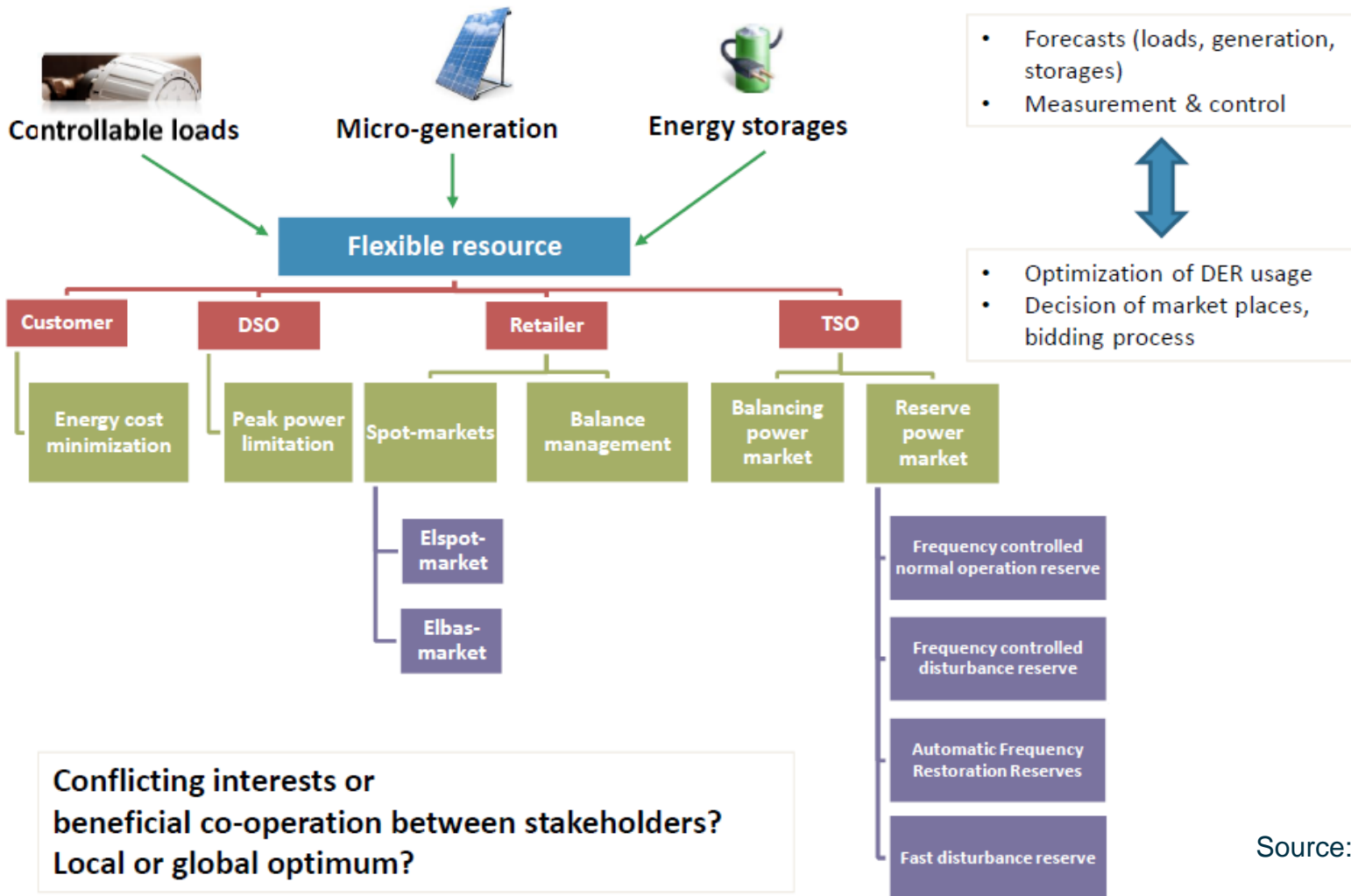


Future DSO Network Vision



Source: TUT

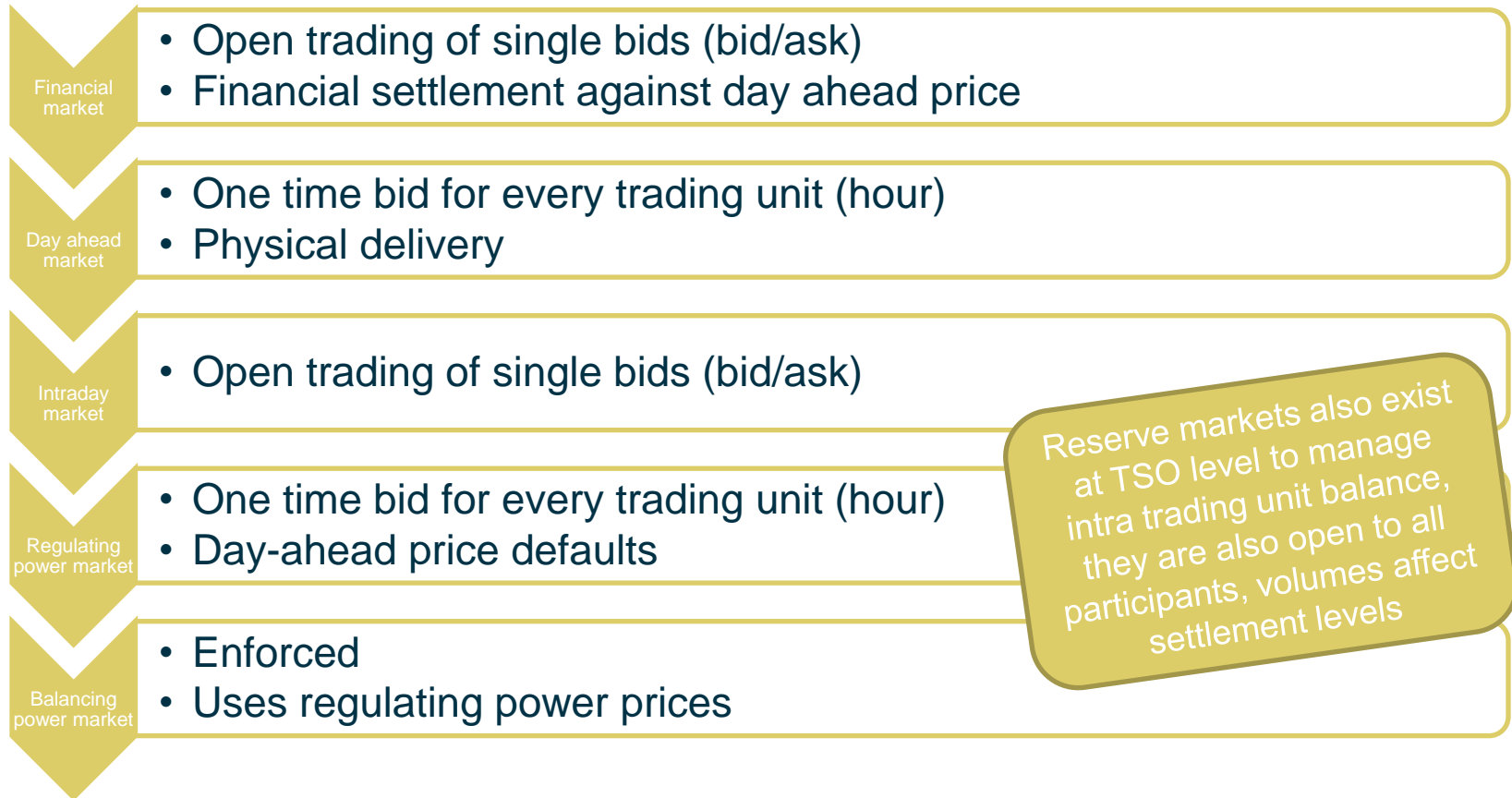
Flexible Resource Optimization



Nordic Market Structure

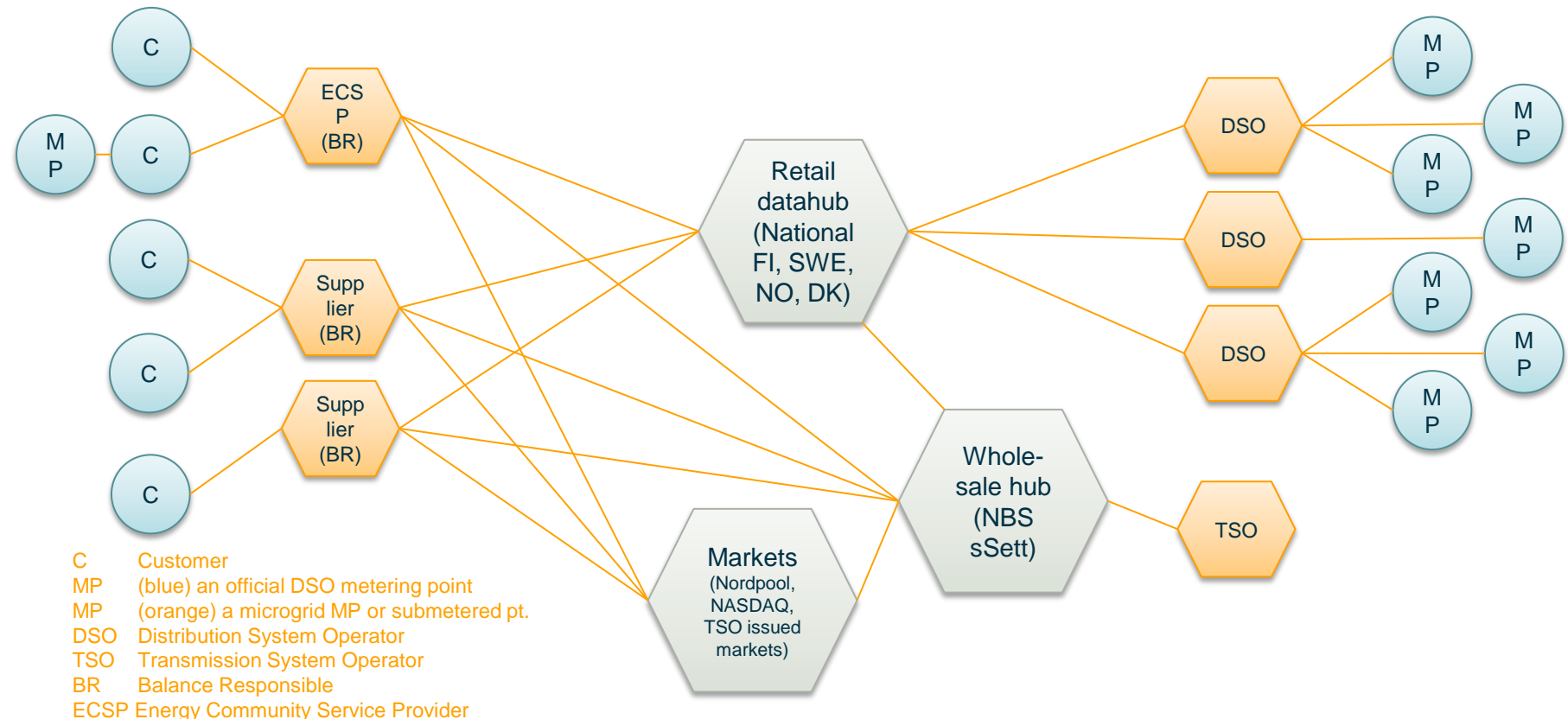
- One market area over four countries
- All physical connections are 100% market controlled by implicit auction
 - Price areas manage physical constraints
 - Financial CfD products provide protection for area price volatility

Nordic Market Levels



Hub Market Facilitation in the Nordic Energy Market

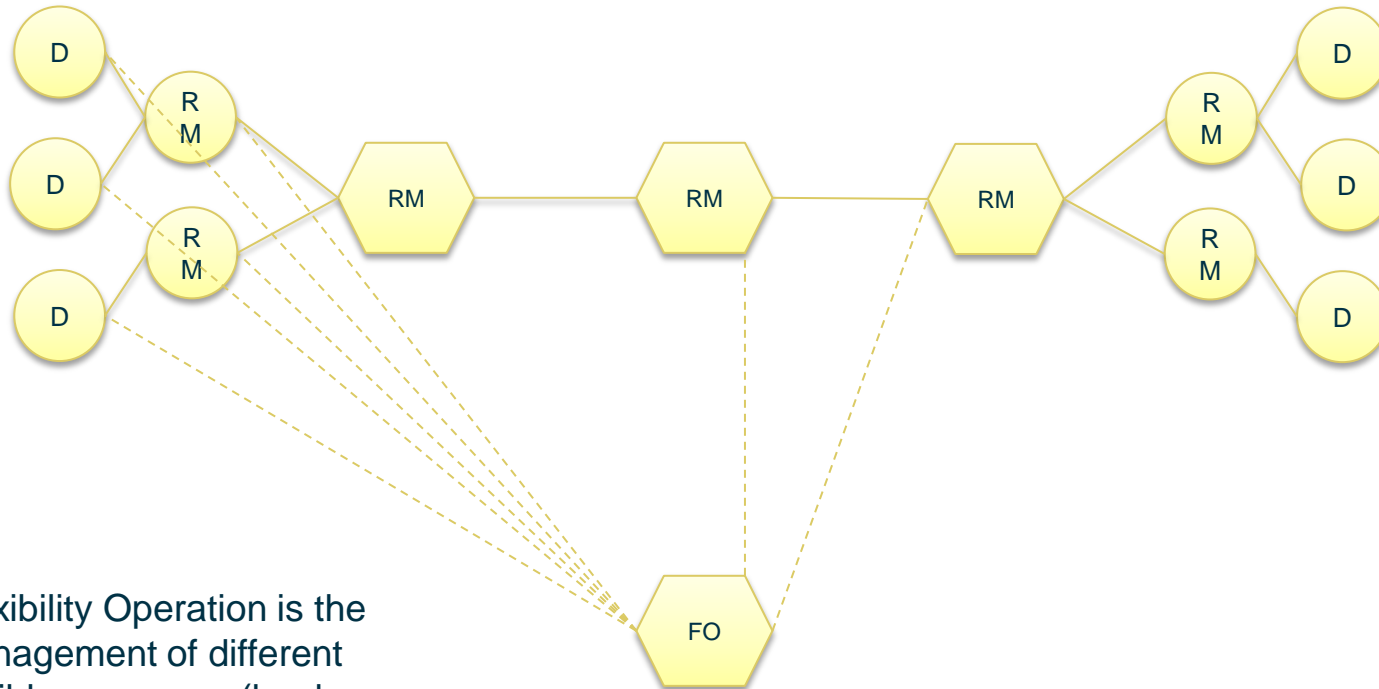
Markets are converging into hub enabled and marketplace driven models
 Energy Community Service Providers serve Microgrids and traditional customers



Flexibility, why and what?

- Flexibility is the new commodity of electricity markets
 - Electricity Markets and grids require constant balance to operate properly
 - The marginal cost of new renewable resources is zero, creating a value for any operational energy flow without any control incentive
- The specific characteristics of electricity distribution create a value for flexibility in supply and consumption
 - Renewables and their support schemes create an intermittent influx of energy into the market and the grids
 - Flexibility needs to be aggregated, operated and traded upon to achieve a working electricity market

Flexibility Operation

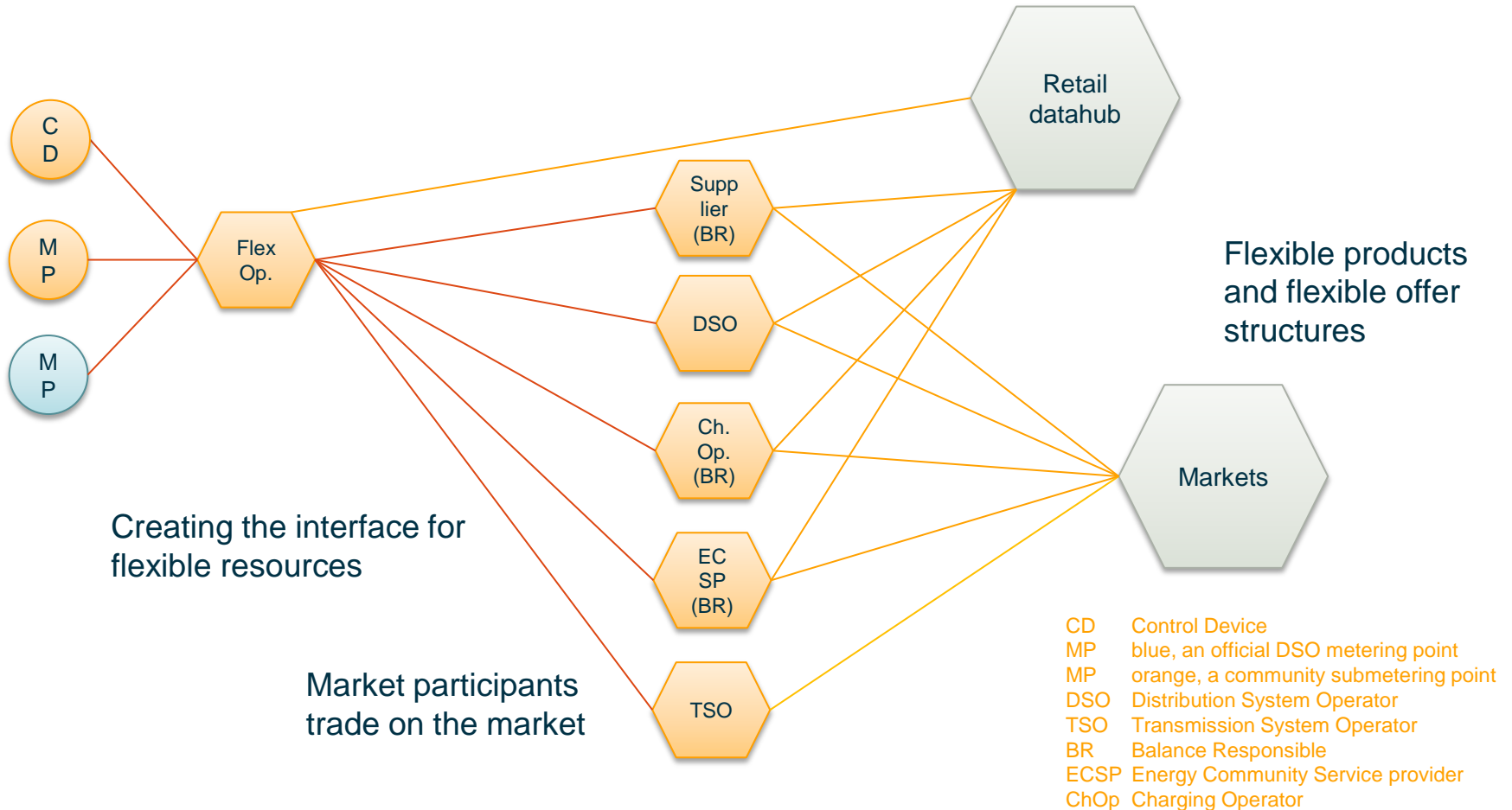


Flexibility Operation is the management of different flexible resources (loads, production, storage) on multiple aggregation levels and bringing their capabilities in aggregate to market participants

Flexibility Operation is not trading energy or assuming balance responsibility

D Device/Resource
RM Resource Manager
FO Flexibility Operator

Flexibility Operation in an Energy Market Environment



The Future Flexible Energy System

- Allows smooth entry and exit of all energy
- Allows free transactions between all parties
- Opens up new topologies in connecting resources
- Leverages the value of flexibility

- Facilitates safe and reliable delivery of electricity between parties
- Makes use of and encourages new technologies

Thank You for your attention

Empower IM
Your partner in the
Future Energy System

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