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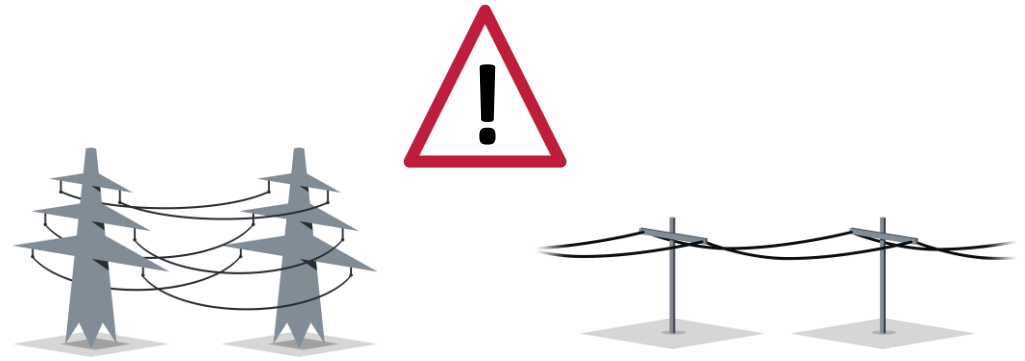


# Specific Product Characteristics of System Services and a Discussion of the joint market-based Procurement in a Single Product

Carsten Wegkamp, TU Braunschweig | Sebastian Buchholz, TU Clausthal | Paul Hendrik Tiemann, Uni Oldenburg | 27.09.2022

# Agenda

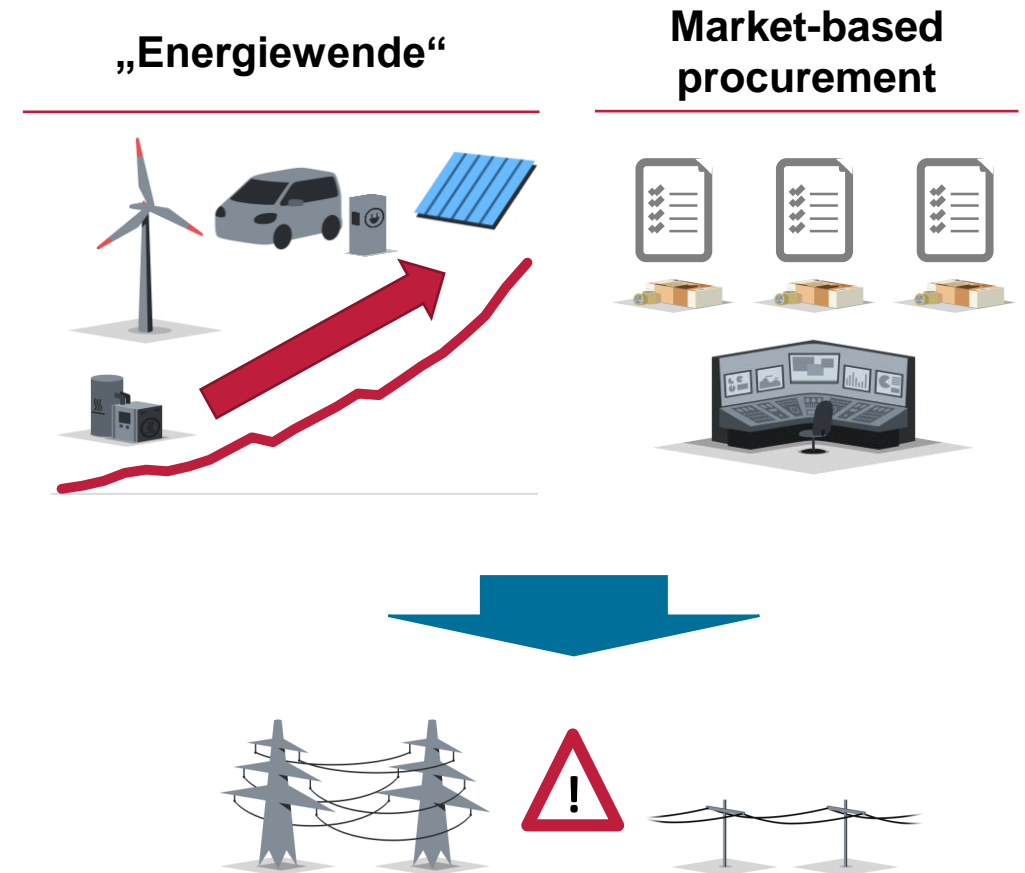
1. Introduction
2. Regulatory framework
3. Idea of a joint product for system services
4. Advantages and disadvantages
5. Product characteristics and analysis of a joint product
6. Conclusion and outlook



# Introduction into system services

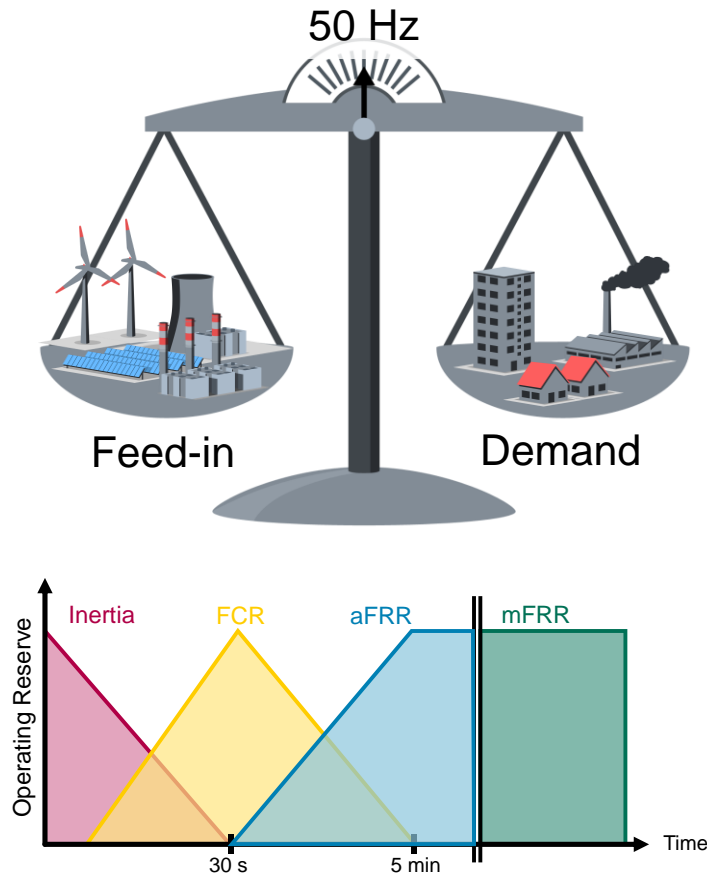
## Rising need for system services and integration of market-based procedures add complexity

- System services shall maintain a safe and reliable operation by keeping electrical power grid within all operating limits
  - Balance generation and consumption on a global level
  - Keep voltage amplitude of local grid sections in the permitted voltage band
  - Prevent thermal overload of lines or transformers
- Procurement of system services becomes increasingly complicated
  - Rising need due to “Energiewende” with increase in decentralized, and volatile electricity generation as well as sector coupling
  - Requirement of market-procedures by EU 2019/944&943
- In this assessment we don't presume specific products for the system services
  - E. g. FCR, Redispatch
  - Rather the methodology itself



# Frequency Control

Balance generation and consumption on a global level

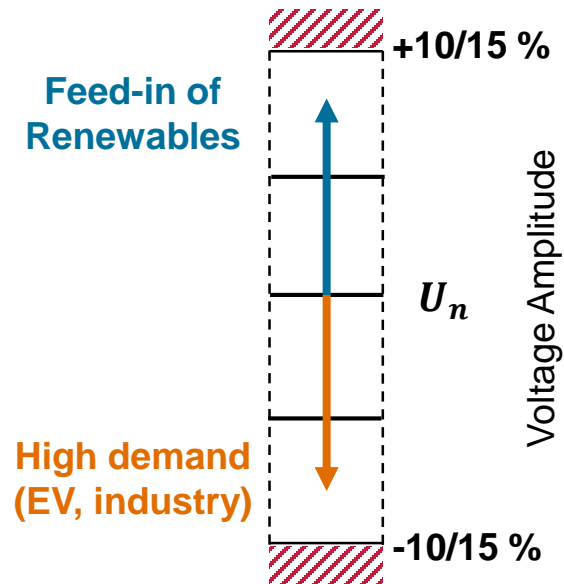


Frequency Control	
Product	Active power
Basic Methodology	Balance for generation and load of electrical energy in the interconnected power grid

- Harmonization of frequency control in Europe
  - Based on the System Operation Guideline EU 2017/1485
- Several market-based products: FCR, aFRR, mFRR
  - Procurement via capacity auctions and the balancing energy market
  - Harmonized activation procedure

# Voltage Control

Keep voltage amplitude of local grid sections in the permitted voltage band

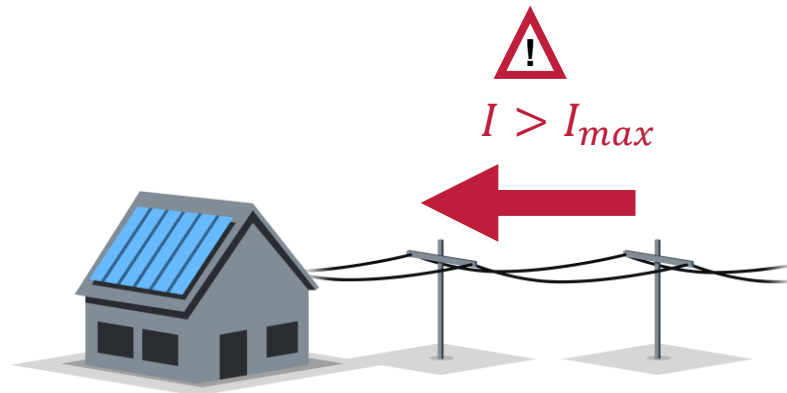


Voltage Control	
Product	Active or reactive power
Basic Methodology	Influence of injection of power to the voltage at grid nodes

- In Germany: Limits and permitted influence by generation/consumption devices are regulated by Technical Connection Rules (TAR) and Conditions (TAB)
- Market-based procurement instructed
  - Cf. Art. 31 (7), Art. 32 (1), Art. 40 (4) and (5) Directive (EU) 2019/944, Art. 13 (1) and (2) Regulation (EU) 2019/943
- In Germany: Excluded due to efficiency issues

# Congestion management

Prevent thermal overload of lines or transformers



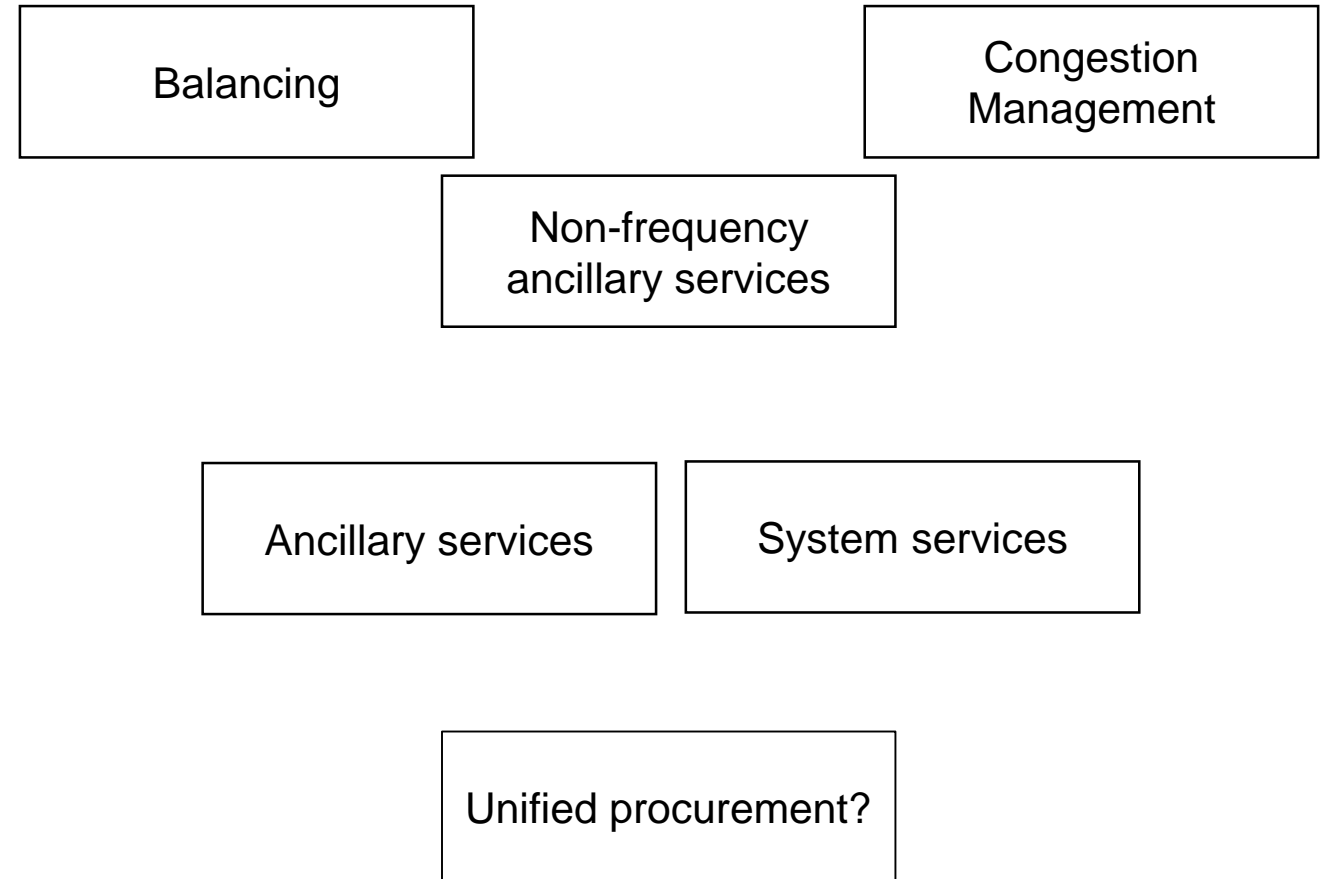
## Congestion Management

Product	Active or reactive power
Basic Methodology	Reduction of current flow over grid lines

- Impact of structural congestions on electricity price only for borders in the European zonal system, not within zones
- Market-based procurement instructed
  - Cf. Art. 31 (7), Art. 32 (1), Art. 40 (4) and (5) Directive (EU) 2019/944, Art. 13 (1) and (2) Regulation (EU) 2019/943
- In Germany: Redispatch 2.0 in effect since 10/2021
  - Not market-based, but cost-based procurement

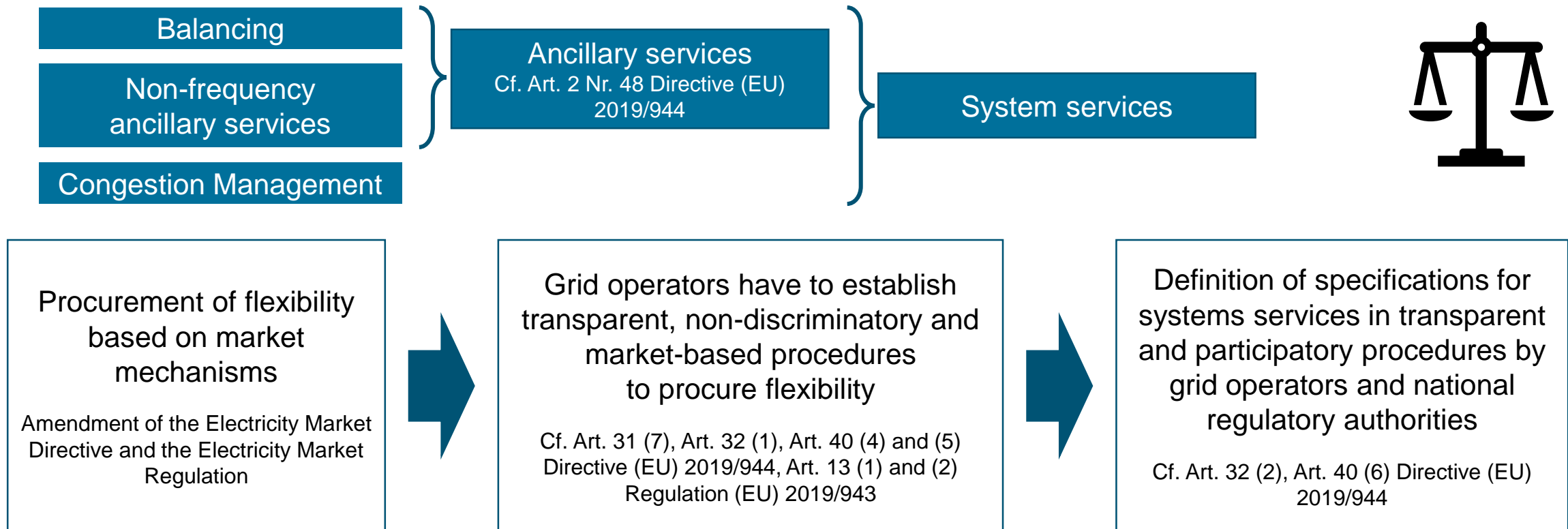
# Agenda

1. Introduction
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# Regulatory framework

The legal framework is open for of a joint procurement through a single system service product

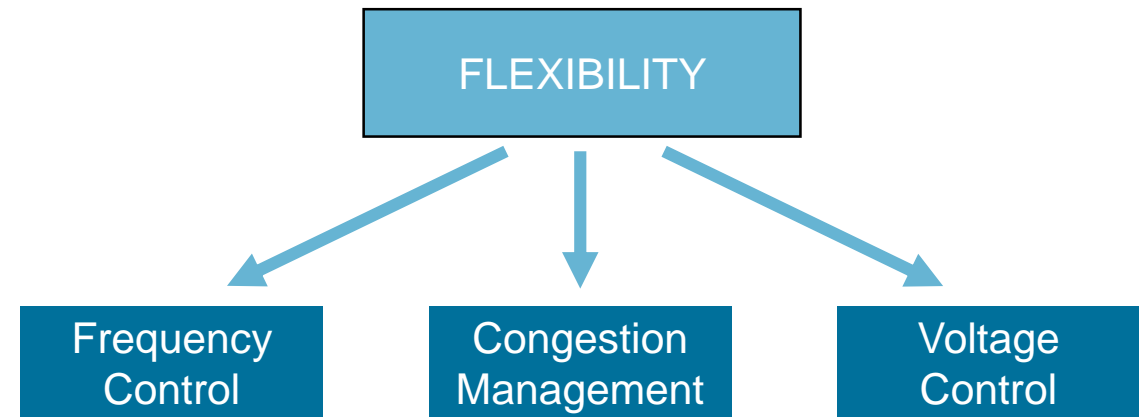


➤ Are uniform procurement procedures possible and should they be implemented?



# Agenda

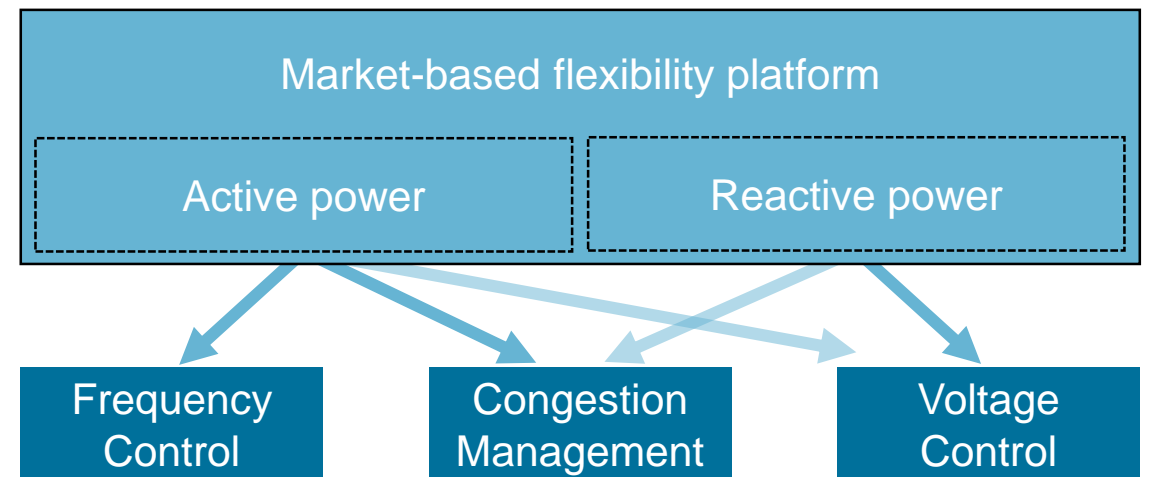
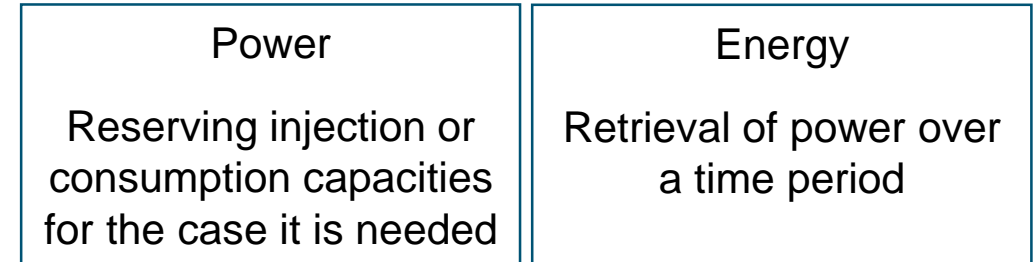
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2. Regulatory framework
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# Idea of a joint product for system services

There are several reasons why a joint procurement seems obvious and logical

- System services at hand are all based on active and/or reactive power/energy
- Need for justification of non-uniform procurement due to coherent categorization
- Possibility to rethink existing processes in implementation of transparent and participatory procedures
  - Superordinate platform for the procurement of system services
- Idea: Joint procurement in a single product "flexibility"
  - Flexibility may be used for multiple purposes
  - Could improve the efficiency



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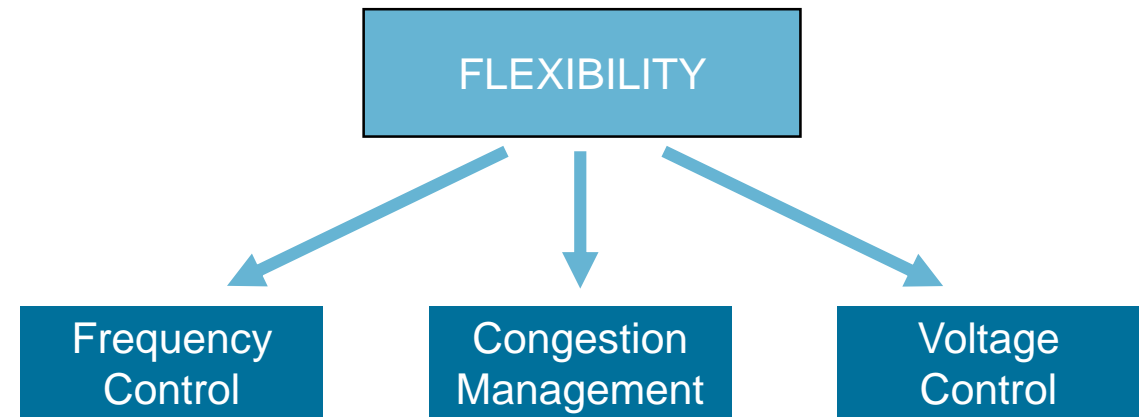
# Advantages and Disadvantages

## Unified conditions and common processes vs potential loss of efficiency

- ✓ **Efficient allocation of existing resources** due to shift of liquidity
  - Especially if the new market was to be set up in addition to the existing ones
- ✓ **Easier mutual recognition of flexibility activations** for grid operators
- ✓ **Increased transparency** and promotion of **acceptance** among flexibility providers due to uniform procurement conditions
- ✓ **Only one common prequalification procedure**, making the participation for flexibility providers easier, thus enabling **increased participation**
- **Potential efficiency losses** for system services by ignoring ...
  - ... the specific technical requirements and
  - ... relevant differences in the economic value (of specific services or in different regions)

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# Product characteristics and analysis of a joint product

**Key question: Are uniform procurement procedures of different system services possible?**

- System services at hand are based on active and/or reactive power
- But they have very different methodologies
  - And while frequency control is a global problem, the others always refer to a specific grid component

	Frequency Control	Voltage Control	Congestion Management
Product	Active power	Active or reactive power	Active or reactive power
Basic Methodology	Balance for generation and load of electrical energy in the interconnected power grid	Influence of injection of power to the voltage at grid nodes	Reduction of thermal load/current flow over grid lines
Location	Global – Location irrelevant	Local – Location significant	

- On the following slides various characteristics are examined
  - Focus is on whether the characteristic requires a differentiation in the procurement
  - We do not presume specific products but just examine the system services' methodologies

# Product characteristics: Design of the offerings

	Frequency Control	Voltage Control	Congestion Management	
Product size and aggregation	<ul style="list-style-type: none"> <li>Too small offers not reasonable, but <b>no specific bounds</b> for offers necessary</li> <li>➤ Differentiation not required for product size</li> </ul>			✓
	<ul style="list-style-type: none"> <li>Aggregation possible</li> </ul>	<ul style="list-style-type: none"> <li>Aggregation only partly possible due to <b>relevance of plant location</b></li> </ul>		
Product duration	<ul style="list-style-type: none"> <li><b>No clear need for specific time periods</b> of offerings</li> <li>Smaller periods more reasonable as longer ones favor some (conventional) technologies</li> <li>➤ Differentiation not required for duration of offerings</li> </ul>			✓
Recuperation	<ul style="list-style-type: none"> <li><b>Fixed requirement</b> for recuperation periods <b>important</b> to ensure continuous availability of procured services</li> <li>➤ Differentiation not required for recuperation periods</li> </ul>			✓

➤ No need for differentiation into separate products for the offerings' design

# Product characteristics: Access by grid operator

	Frequency Control	Voltage Control	Congestion Management
Controlling	<ul style="list-style-type: none"> <li>▪ <b>Entitlement of control</b> (by grid operator) <b>needs to be resolved</b> <ul style="list-style-type: none"> <li>– Direct control via control signals</li> <li>– Indirect control via characteristic lines etc.</li> </ul> </li> <li>➤ Differentiation not required for controlling by grid operator</li> </ul>		✓
Measurement requirements	<ul style="list-style-type: none"> <li>▪ Provision of services has to be <b>measured accurately</b> for verification</li> <li>➤ Differentiation not required for measurement</li> </ul>		✓
Penalties for non-availability	<ul style="list-style-type: none"> <li>▪ Might be <b>higher for global services</b>, as they concern the whole interconnected power grid</li> <li>▪ <b>Design:</b> Fixed or dependend on offer size or time span</li> <li>➤ Differentiation not required for penalties</li> </ul>		✓

➤ No need for differentiation into separate products due to grid operators' access



# Product characteristics: Economics

	Frequency Control	Voltage Control	Congestion Management	
Divisibility	<ul style="list-style-type: none"> <li>▪ Procurement of a part of the offer and utilization of a part of the procured offer                             <ul style="list-style-type: none"> <li>– Should both be possible → <b>Reduction of inefficiency</b></li> </ul> </li> <li>➤ Differentiation not required for divisibility</li> </ul>			✓
Energy price, capacity fee	<ul style="list-style-type: none"> <li>▪ Utilization of <b>prices for both power and energy possible</b></li> <li>▪ Capacity fee probably not needed for local services, as procurement could indicate the need for retrieval</li> <li>➤ Differentiation not required for divisibility</li> </ul>			✓

➤ No need for differentiation into separate products because of economic reasons

# Product characteristics: Temporal aspects

	Frequency Control	Voltage Control	Congestion Management
Reaction time	<ul style="list-style-type: none"> <li>Rather <b>unpredictable</b> and short-term events</li> <li>Fast reaction on signals very important → automatic control</li> </ul>	<ul style="list-style-type: none"> <li>Demand <b>mainly foreseeable</b> by market results, only slightly affected by short-term events, e. g. volatility of DER</li> <li><b>Short-time overload acceptable</b>, reasonable response time – manual and/or automatic control possible</li> </ul>	



- Need for differentiation into separate products due to predictability
- Frequency control is rather short-term while local system services are fairly well forecastable
- Results in different requirements regarding the modelling of the system services and the retrieval of the power bid

# Analysis of a joint product: Different requirements

Predictability and temporal aspects require differentiation in retrieval of the subsidized power

## Local system services

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Voltage Control, Congestion Management

- Demand mainly results from day-ahead and intraday market
- Offerings can be subsidized early
  - Utilized power is determined thereby
- Adjustments only need to be made due to short-term events
  - E. g. volatility of DER leads to replacement by other generating sources
  - Reaction time in the range of a few minutes

## Global system services

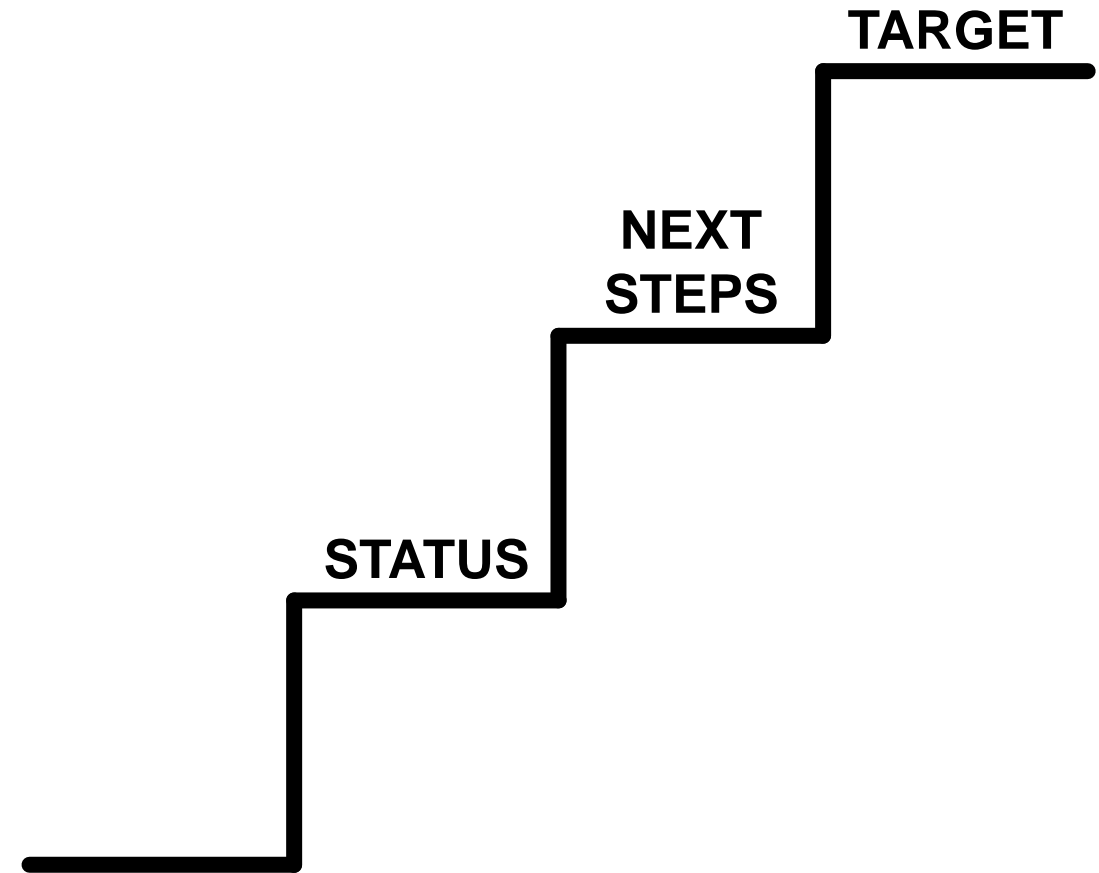
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Frequency Control

- Have to react to short-term and unpredictable problems in the grid, e. g. failure of generation units
- Offerings have to be procured beforehand
  - Utilization of procured power is determined in the short-term based on events in the grid
- Automatic reaction (in a matter of ms) needed to maintain reliable system operating point

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# Conclusion and Outlook

**Uniform procurement procedures are not be reasonable, the focus should be on how to implement procedures for local system services**

- System services aim at a reliable grid operation by respecting all operating limits
  - But while they have different methodologies, the ones examined here are all based on active and/or reactive power
    - A joint procurement seems logical and possible by the existing legal framework
  - Examination of various characteristics focusing on whether uniform procurement procedures are possible
    - No need for differentiation into separate products for the offerings' design and due to grid operator involvement
    - Need for differentiation into separate products because of predictability and its impact in the retrieval of the subsidized power
- No further potential to integrate system services for a complexity reduction

How can transparent and participatory procedures for local system services be implemented?

Integration of all system services into single platform without inclusion into a uniform product?

- Transparency and uniformity
- “Systemmarkt Amprion“

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Research Project: [SiNED](#)

Ancillary Services for  
Reliable Power Grids in  
Times of Progressive  
German Energiewende  
and Digital Transformation