



## HEDNO

### Study Committee C5

Electricity Markets & Regulation

Paper ID 707

## Deployment and Evaluation of TSO-DSO-Consumer Coordination in a Market Environment

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### Introduction

The EU funded CoordiNet project, aims to examine collaboration schemes among TSOs, DSOs and consumers for a smart, secure and more resilient energy system.

#### Key Objectives

- Demonstrate activation and provision of services through TSO-DSO coordination
- Define and test standard products that provide services to network operators
- Develop a TSO-DSO-consumer collaboration platform for interoperable development of a pan-European market

### Greek Demonstration

- Two demonstration areas: Kefalonia island and Mesogia Area.
- Grid services: congestion management and voltage control.
- Flexibility Products: Capacity and Energy products (active and reactive power).
- Coordination schemes: Multi-Level vs Fragmented Market

Service	Product	Coordination Scheme
Congestion management	Network Congestion Management, Congestion, Capacity	High Level Coordination, High Level Coordination, High Level Coordination
Voltage control	Multi-Stage Reactive Power, Active	High Level Coordination, High Level Coordination, High Level Coordination



### Local Market Schemes



#### Optimizing Local Market operation:

- Mixed Integer Linear Programming for Day-ahead and Intraday market.
- Non-Linear Programming for Real Time.

In day-ahead and intraday market, flexibility is reserved based on forecasts. In real-time, local market can procure additional flexibility, if reserves cannot satisfy requirements.

#### Two coordination schemes are tested:

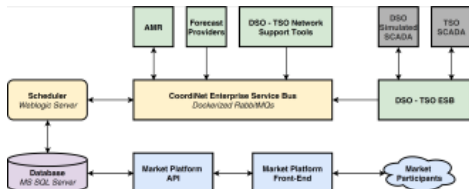
- Multi-level market model: TSO has access to DER flexibility indirectly, DSO clears the local market for local congestion management and forwards the remaining bids to the TSO market.
- Fragmented market model: TSO has no access to DER flexibility; DSO runs a local market for both local congestion management and energy balancing.

### Communication Platform

Service-oriented architecture through an Enterprise Service Bus (ESB). Key advantages:

- Point to point connection is avoided
- Overall architecture of software projects more maintainable and scalable

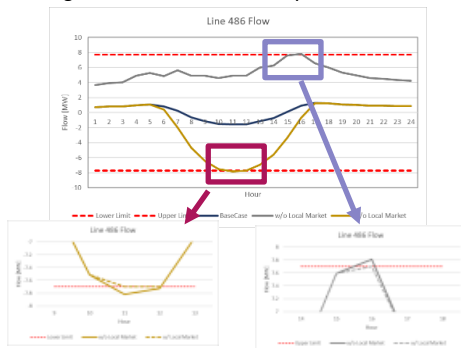
A scheduler, handles dynamically communication between services and is responsible for data handling and parsing between the database and the ESB.



### Test Case

Future scenarios with increased DER considered: Reverse flows in the base case scenario, HEDNO (DSO) guarantees security margin between forecasted line flow and line thermal rating in a preventive way.

Local market in future scenarios, gives DSO the ability to operate closer to limits, while managing congestions in a corrective way



### Discussion & Conclusion

- Local markets could benefit DSO by eliminating network issues, and local market participants by increasing revenues.
- New types of loads and flexibility service providers (batteries, EVs), will increase the benefits of local markets.



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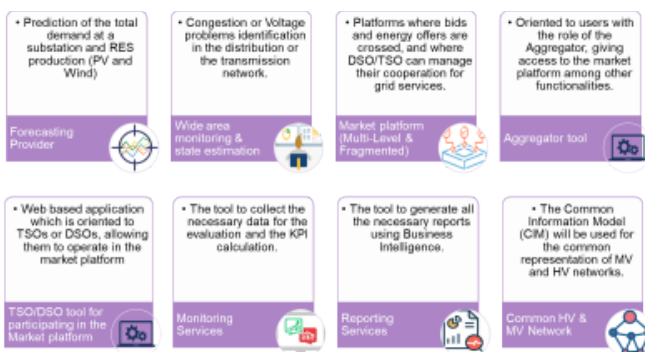
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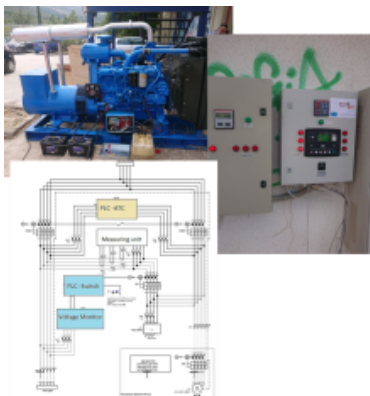
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#### Software Tools



#### FSP experience

- Back-up Generators



- Irrigation Pumps



#### Lessons learned – Products & services

- Bid location crucial due to distribution network radiality
- TSO experience shows that location of the bid is important to the impact of the served flexibility
- Each feeder is considered as a separate local market
- DSO should be always aware of the network current topology. Bids might be transferred to another local market when reconfiguration of the network is applied.
- Reactive power products are required for voltage control (Currently few resources can offer this type of product in the distribution network)

#### Lessons learned - Market timing

- No interaction and bids exchange between local market and TSO market in the DA and ID timeframe

Increase the liquidity of the local market.

Decrease the liquidity of the TSO market.

Avoid potential network issues due to the activation of flexibility by the TSO.

Less incentives for FSPs to participate in the market.

- Integrate congestion and voltage market with balancing market.

Reduced balancing cost.

Increased participation of FSPs in the market

Challenges: Market solution and data exchange handling