Distributed Renewable resources Exploitation in electric grids through Advanced heterarchical Management

Innovating Electricity Distribution in Europe
Enhance distributed market based approach to Distribution level with DSO aggregation & validation validate concepts and recommend regulation evolutions
Demonstrate that distributed “intelligence” combined with limited structural modifications is able to allow larger amounts of DER

Heterarchical approach: self-created and ever-changing distributed control depending on topology and current operational constraints within DSO advanced Remote Terminal Units

Provide access to flexibility on distributed markets

Develop a generic scenario for energy market at distribution level, synergic with national and international energy markets
• Get confident on DREAM benefits for your business • Assessing the expected advantages of individual DREAM solutions

Assess local flexibility during day-ahead and intraday markets
• Assess flexibility during day-ahead and intraday markets • Decide possible conflicting flexibility offers

Give access to national energy markets to every flexible end users with flexibility aggregation concepts
• Optimization of MV constraints management based on LV and MV flexibility opportunities • Operational planning: Determination of the MV available voltage range depending on the downstream LV flexibility opportunities because of the downstream LV flexibility opportunities

Extend distributed market based approach to distribution level with DSO validation & flexibility provision tools
• Validation and provision of end users flexibility opportunities (LV & MV levels) • Operational planning: calculation of energy offers for transmission to the national energy markets, and pre-emption of flexibility offers for DSO constraints management

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The DREAM software architecture for high DG-RES distribution grids

The DREAM framework
- Information and control architecture for commercial market and grid operation services
- Supports hierarchies for device coordination, multi-objective optimisation and self-healing scenarios for electricity grids
- First reference implementation (Java) now operational at DNV-GL lab in Groningen
- 22 use cases defined and to be built
  - Commercial
  - DISO operations support
  - Real-time reconfiguration and self-healing

Software package architecture

Supports fine-grained monitoring and control at the distribution level; interfaces to IEC-61850, CIM and IoT
- Enables distributed data storage and forecasting with flexible requirements as to duration, security and resilience
- Integrates physical grid and coordination topology to facilitate diverse Virtual Power Plant services
- Supports simulations and real-time operation
- Includes VPP-Flexibility bid model

Supports VPPs (e.g. PowerMatcher)
- Heterarchic approach:
  - Commercial (green) coordination via bid curves; (kW, €) pairs
  - Load shedding affected (red) via bid ladder (fast, light-weight publish subscribe protocol)

Results of a residential area simulation
- Transformer load with capacity constraints (> 7 days)
- Temperature heatpump frames (< 7 days)
- The charging strategy of batteries can be coordinated to relieve congestion
- Battery state of charge (> 7 days)

DREAM Real-time operations

Develop decentralized methods for real-time grid control through the dynamic aggregations and multi-objective coordination.

Introduction of self-defense capabilities and handle contingencies integrating traded flexibility. Address Voltage Control, Congestion Management and Frequency Support

Distributed Direct Approach for grid management:
- Agent-based implementation
- Peer-to-Peer communication

Distributed architecture of DER-based delivery of Frequency Containment Reserve

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