Research Project Umbrella

Umbrella Project

Innovative operational security tools for the development of a stable pan-European grid

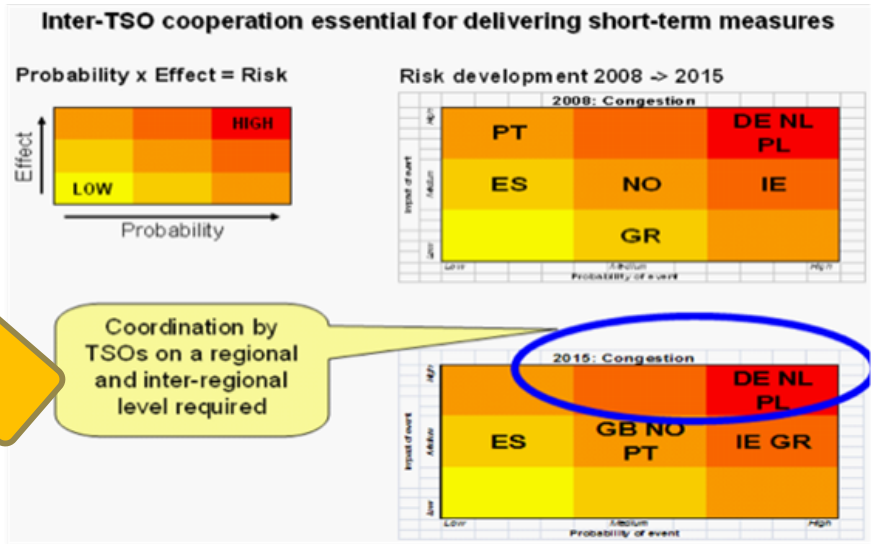
Zongyu Liu, Lou van der Sluis
Delft University of Technology, the Netherlands
on behalf of UMBRELLA project consortium

Outline

- Central European TSOs challenges
  - Current challenges
  - Expected future challenges
- Umbrella approach
  - Forecast including uncertainties
  - Enhanced Optimal Power Flow
  - Risk-based security assessment
- About Umbrella

Operational Challenges

- Challenges reported by TSOs concerning system operation with a significant contribution from RES relate to:
  - Coordination of Flow control devices
  - Coordination of System arrangement during faults
  - Development and utilization of Dynamic rating device
  - Forecast of Gen. load & RES infeed patterns
  - Deployment of Monitoring / control device
  - Using enhanced operational measures to maximize the benefits

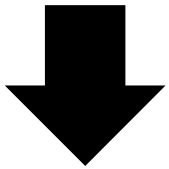


Source: EWIS Study www.wind-integration.eu

Expected Future Challenges

Umbrella Project

- Increasing uncertainties due to
  - growing share of intermittent renewable energy sources
  - increasing market-based cross border flows
- Enhance grid capability and grid flexibility
- New possibilities in network operation from
  - Newly planned interconnections including new technologies, devices for power flow control and FACTS for system
- Better system coordination and cooperation by using common tools



Further developments of common grid security tools

UMBRELLA's Vision

- New situation in transmission grid operation
  - Growing utilization and rising uncertainty
  - Additional operational degrees of freedom (HVDC, PST, …)

- UMBRELLA toolbox
  - Forecasts including uncertainty
  - Enhanced optimization algorithms
  - Risk-based security assessment

⇨ Early identification of critical system states

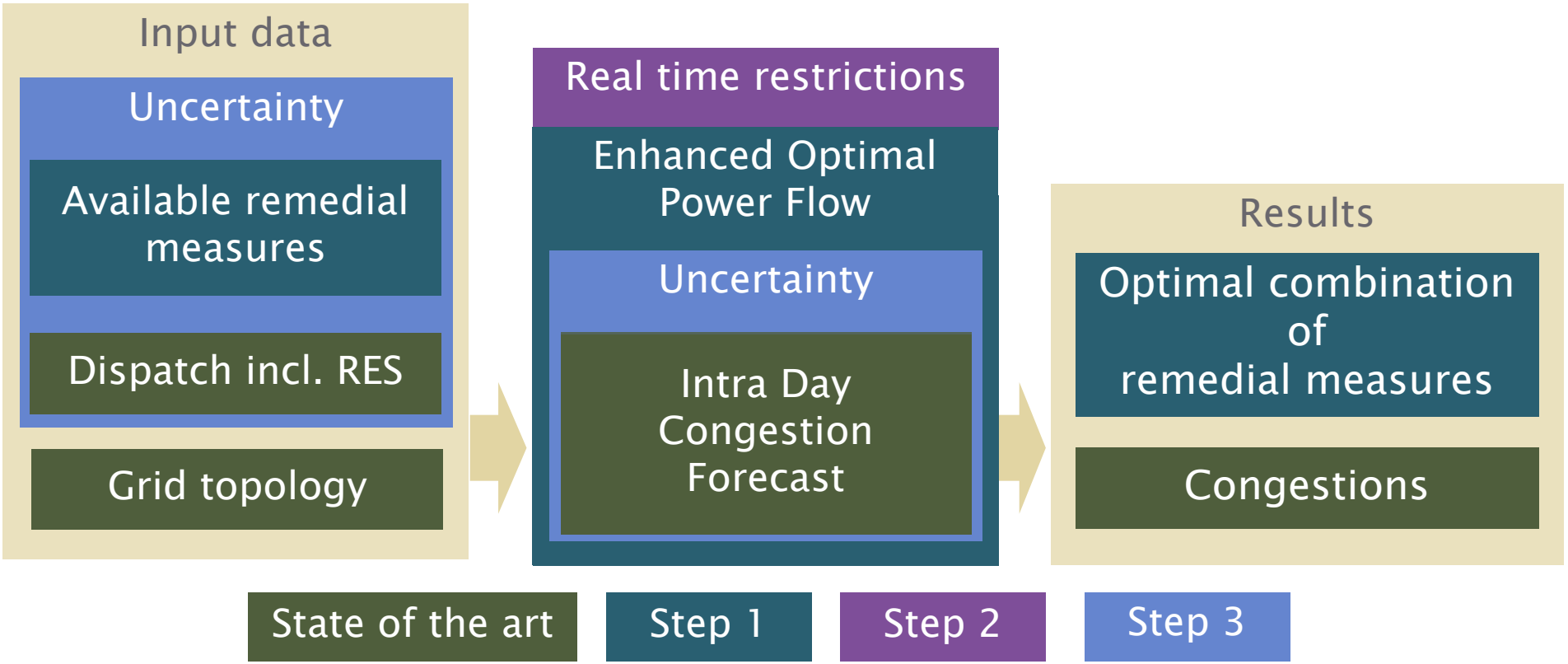
⇨ Maximize power transits and limit impact of disturbances

Uncertainty assessment

Umbrella Project

- Identify the uncertainties
  - Analysis of uncertainties in transmission grid operation
- Forecast scope
  - Feed-ins from renewable energy sources
  - Load
  - Intraday trading
  - Power plant outages

Optimization Framework



Step 1: Optimization algorithms supporting operational planning process

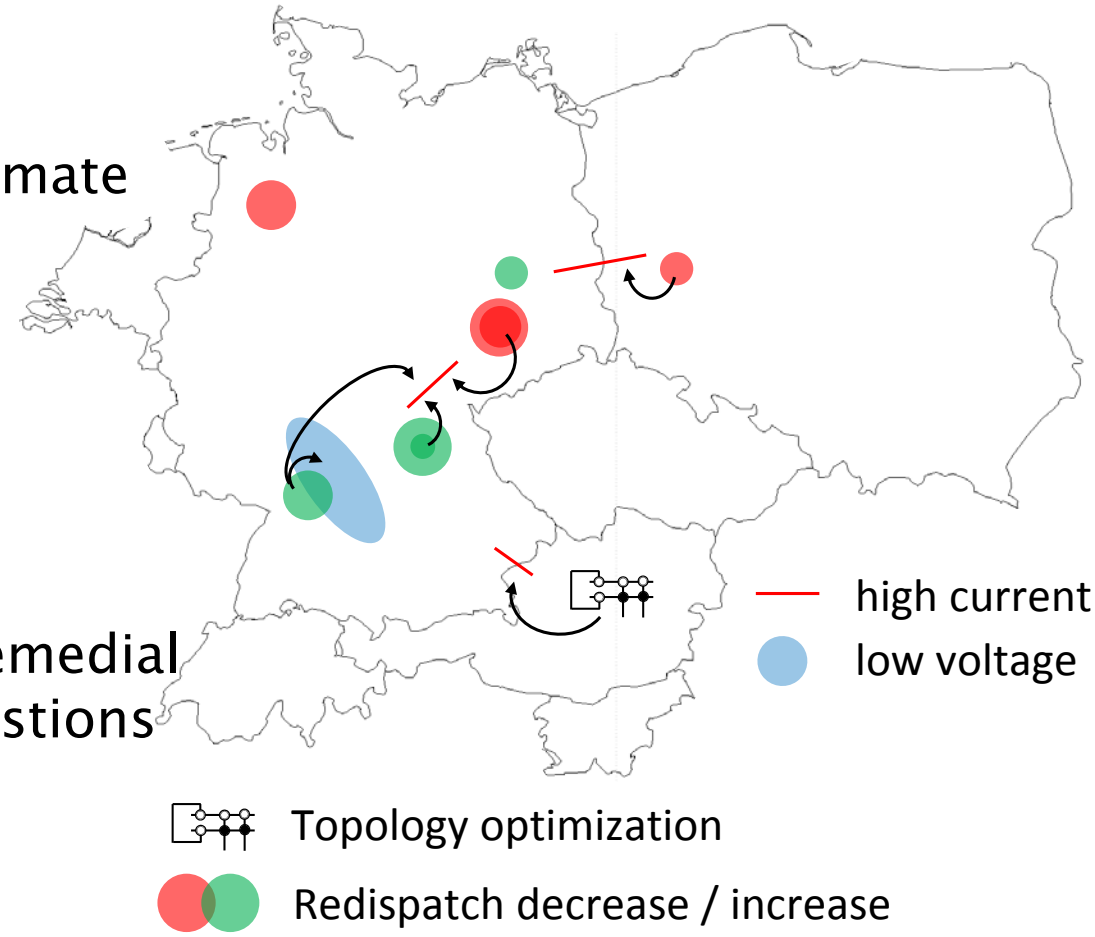
Step 2: Short term optimization methods for real time grid operation

Step 3: Optimized uncertainty accounting in operational planning

Intended Outcomes

- Congestion forecast methods provide (DACF, IDCF, …)
  - Expected congestions
  - Critical faults
- Optimization algorithms estimate
  - Switching state
  - (Phase Shifting) Transformer tap position
  - Redispatch

  In base case & per outage
- Combined optimization of remedial measures for multiple congestions
- Assignment of congestions to remedial measure



Risk-based Security Assessment

Umbrella Project

Risk = probability · severity

- Advantages
  - Quantitative formulation of risk
  - Explicit formulation of acceptable risk level
  - Direct trade-off between security and cost
  - Incorporation of different sources of uncertainty

- Challenges
  - Modeling (e.g. definition of outage probability and severity)
  - Computational requirements
  - Visualization (for interpretation in control center applications)

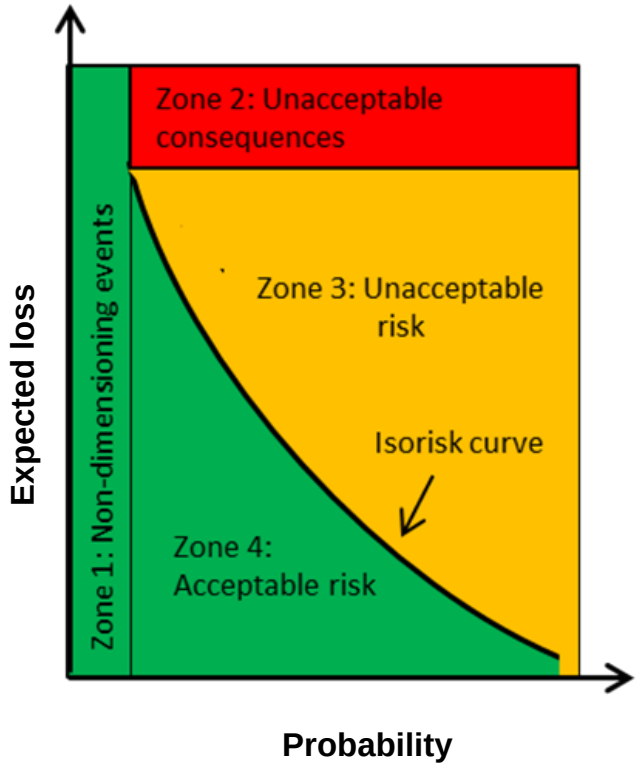
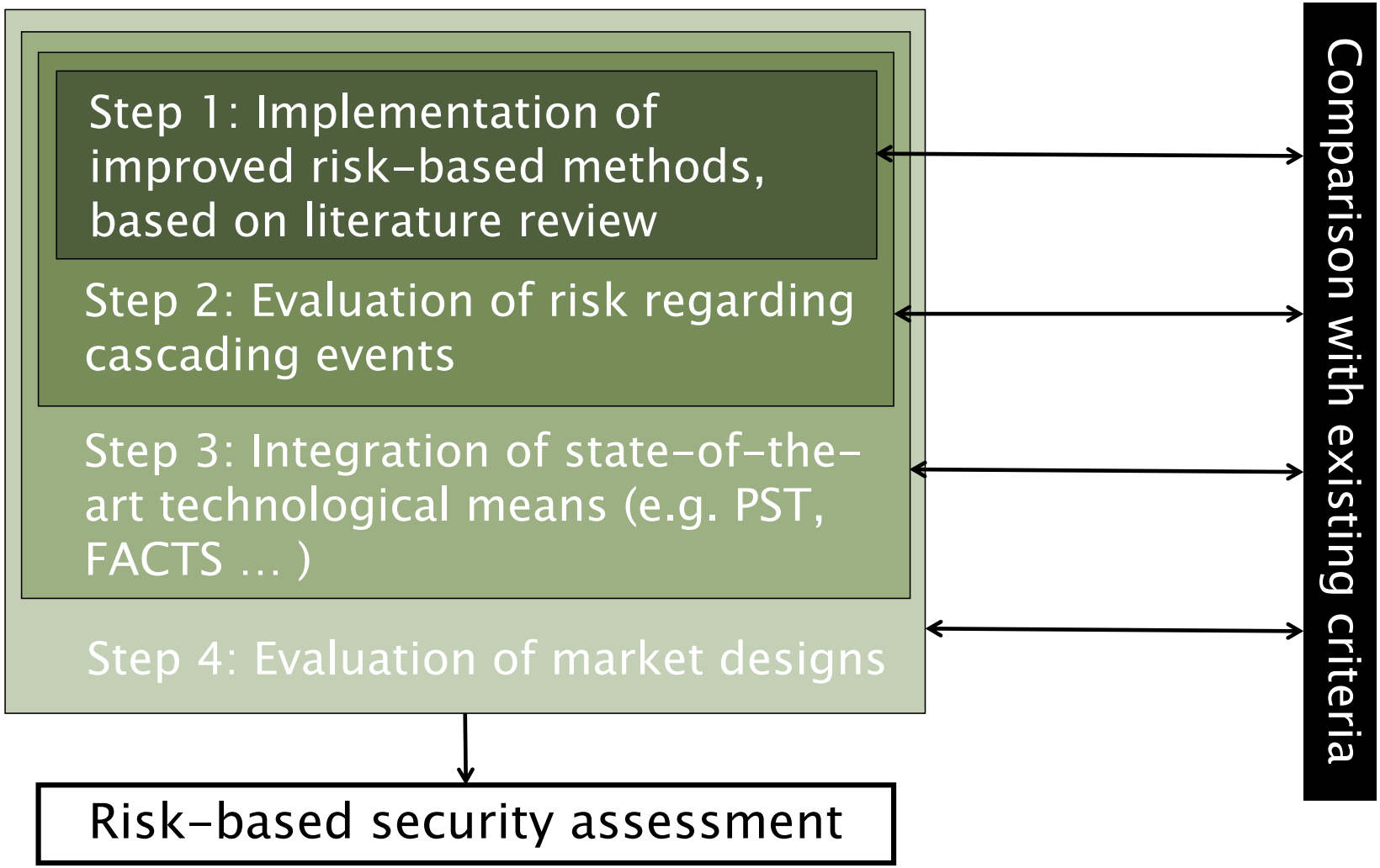
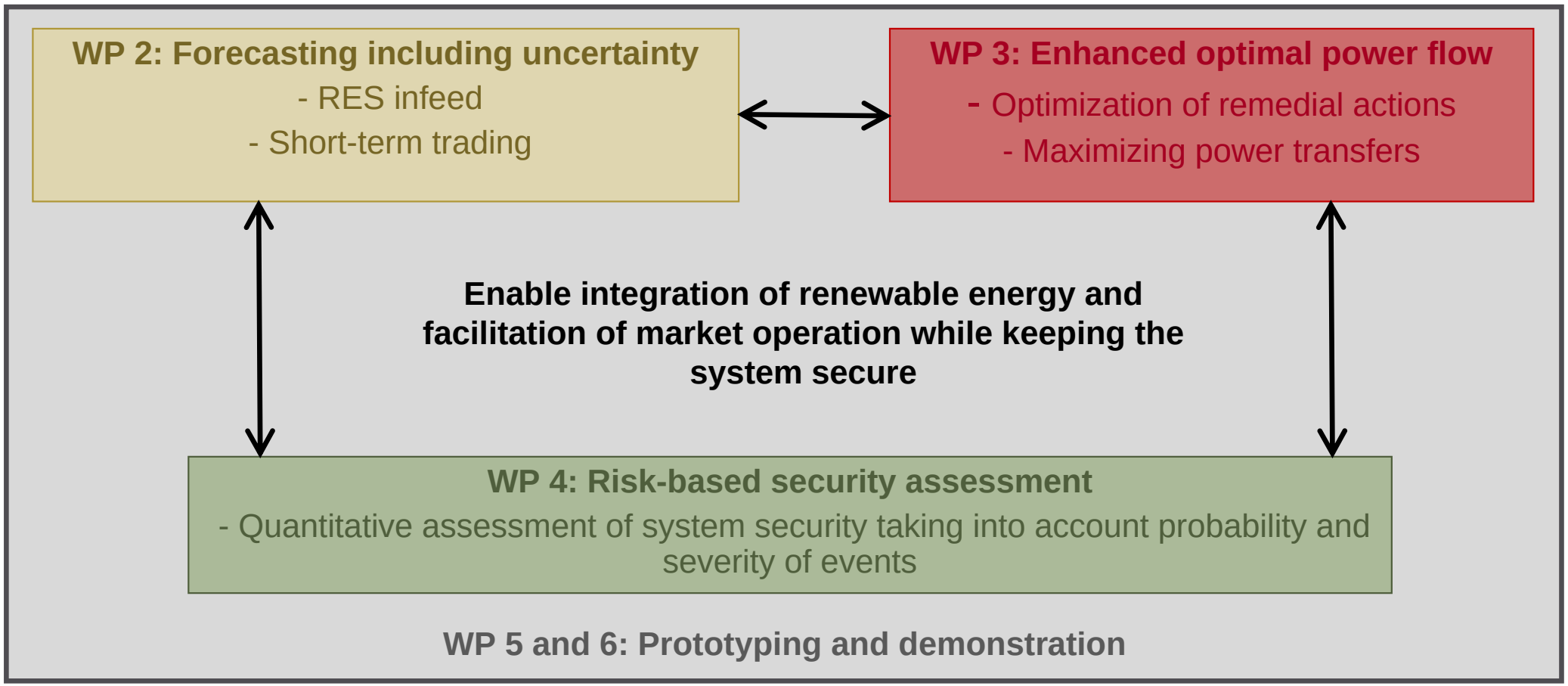


Figure 1: Risk zones in operation based on different risk levels. [UCTE OH]

Steps and Outcomes



Work Package Interaction



About UMBRELLA

- Innovative tools for the future coordinated and stable operation of the pan-European electricity transmission system (Acronym: UMBRELLA)
  - EU Research Framework Programme 7 (FP7)
- Duration: Jan 2012 – Dec 2015
- Consortium: 9 TSOs, 5 Universities, 1 Research institute
- Objective :
  - Develop a dedicated innovative toolbox to support the decentralised grid security approach of TSOs
    - simulation of uncertainties due to market activities and renewables on different time scales
    - optimisation of corrective actions in reaction to simulated risks on different time scales according to total costs and transmission capacities.
    - development of risk based assessment concepts for anticipated system states with and without corrective actions
  - Demonstrate the enhancement of existing and running procedures by utilisation of the developed toolbox
  - Provide a scientifically sound basis to support common TSO decisions.

Thank you

Umbrella Project

- Comments & Questions?

- Contact information
  - Official site: www.e-umbrella.eu
  - Email: info@e-umbrella.eu