Enabling PV integration by delivering flexibility to the energy market
Amsterdam, 26th September 2017

Value of Industrial Demand Flexibility for the European Power System and the Industrial Electricity Consumers

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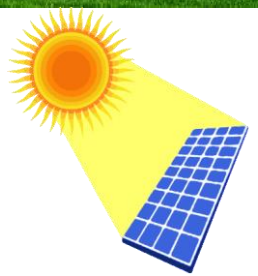
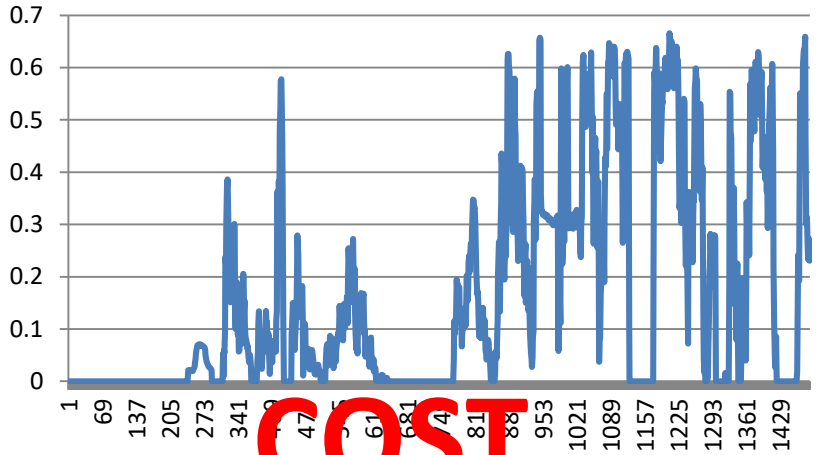
Challenges for European power system

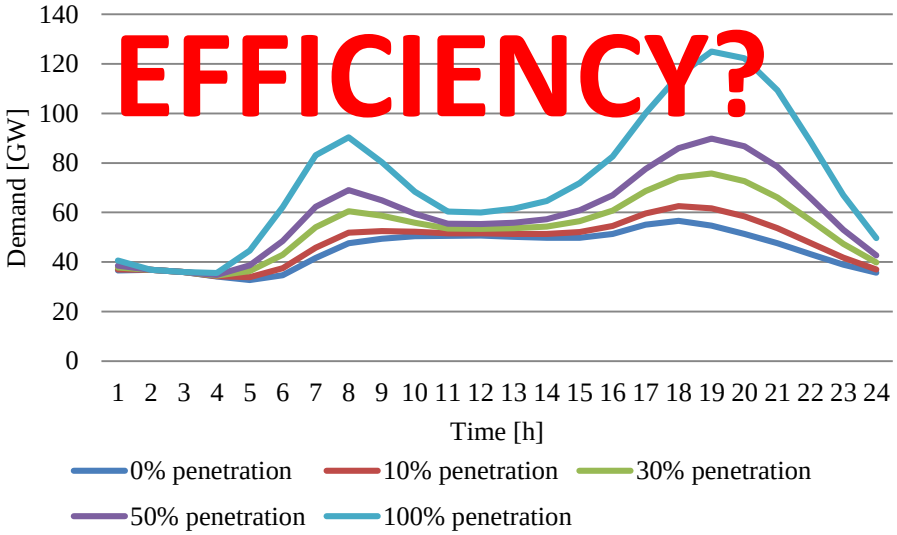




COST

- Under-utilized, inefficient generation units required to balance renewables' variability…or significant renewable power curtailment

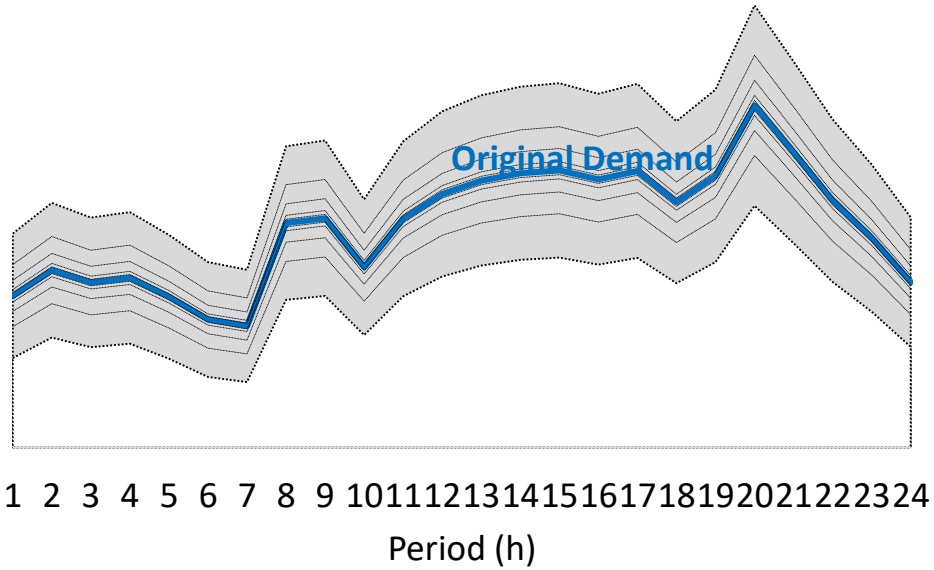
EFFICIENCY?



- Significant amount of under-utilized generation and network capacity required to cover demand peaks

Role of industrial demand flexibility

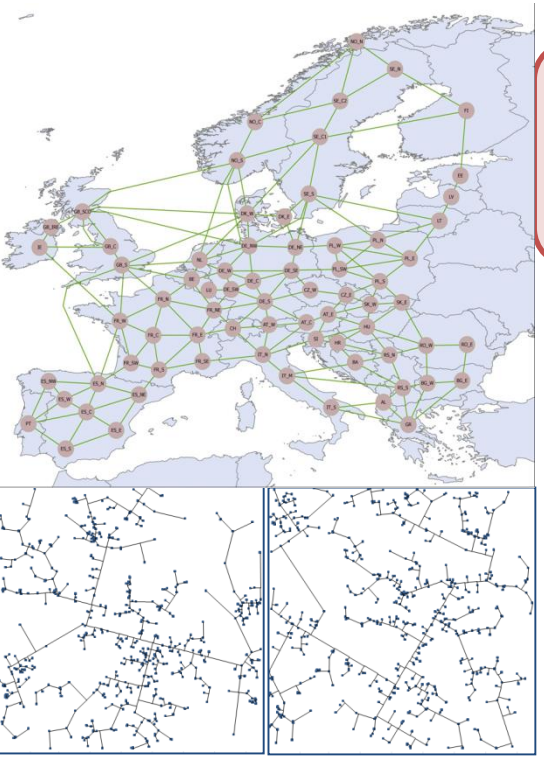
- Industrial demand flexibility:
  - ➢ ability of industrial consumers to
    consumption patterns
  - ➢ not reduction / increase of over
    redistribution of demand across
  - ➢ generic model: demand at each
    within a proportional limit **α**, as long as the daily consumption does
    not change



- Suitable coordination of industrial demand flexibility can:
  - ➢ Support system balancing
  - ➢ Limit peak demand levels
  - ➢ Enable cost-effective transition to low-carbon future

Whole electricity system model (WeSIM)

Interconnected EU system



Representative distribution networks in different countries

2030 development scenarios

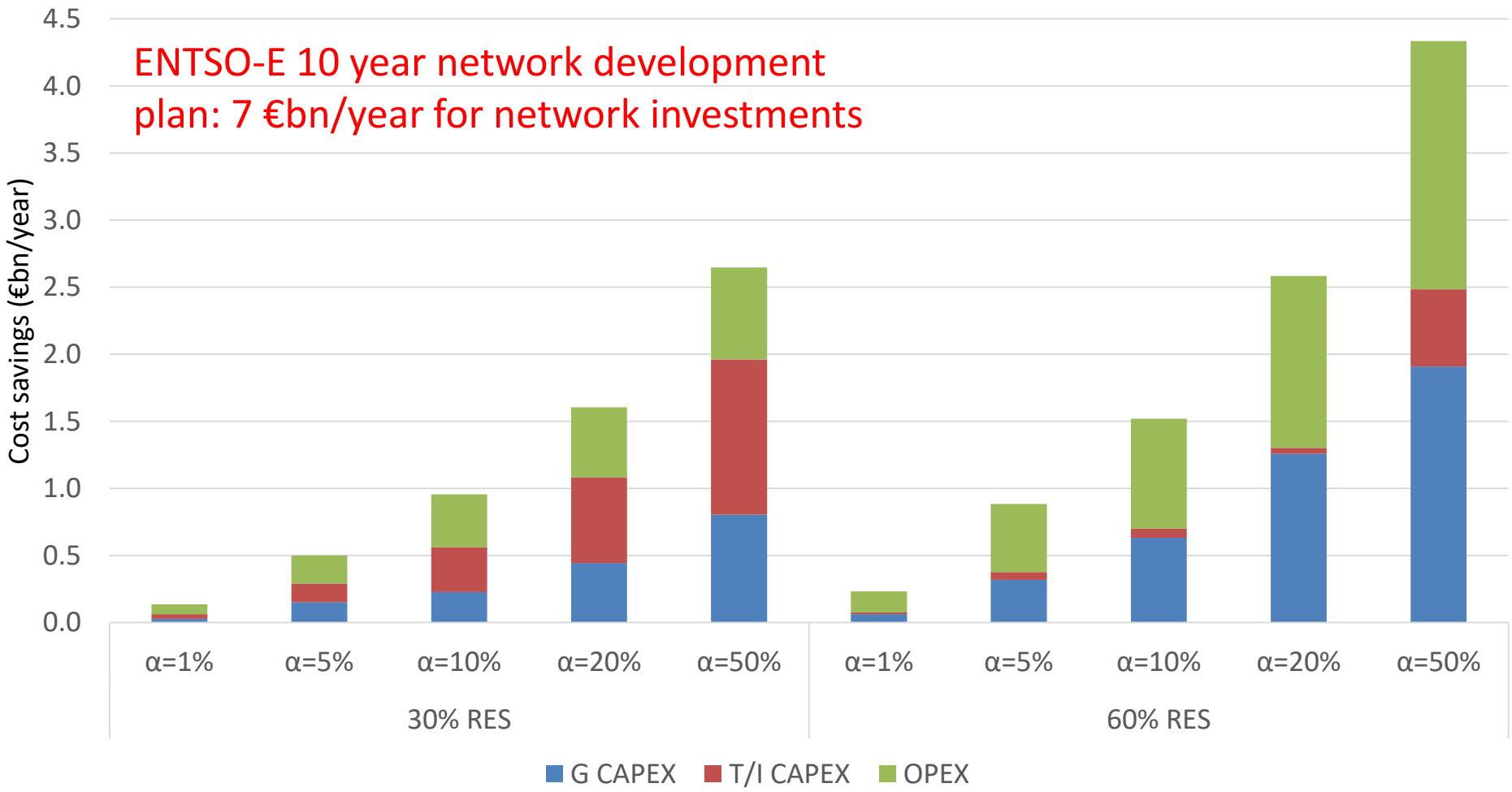
EU Electricity Demand, Generation and Network data

<u>WeSIM</u>: Minimise overall investment and operation costs of European power system

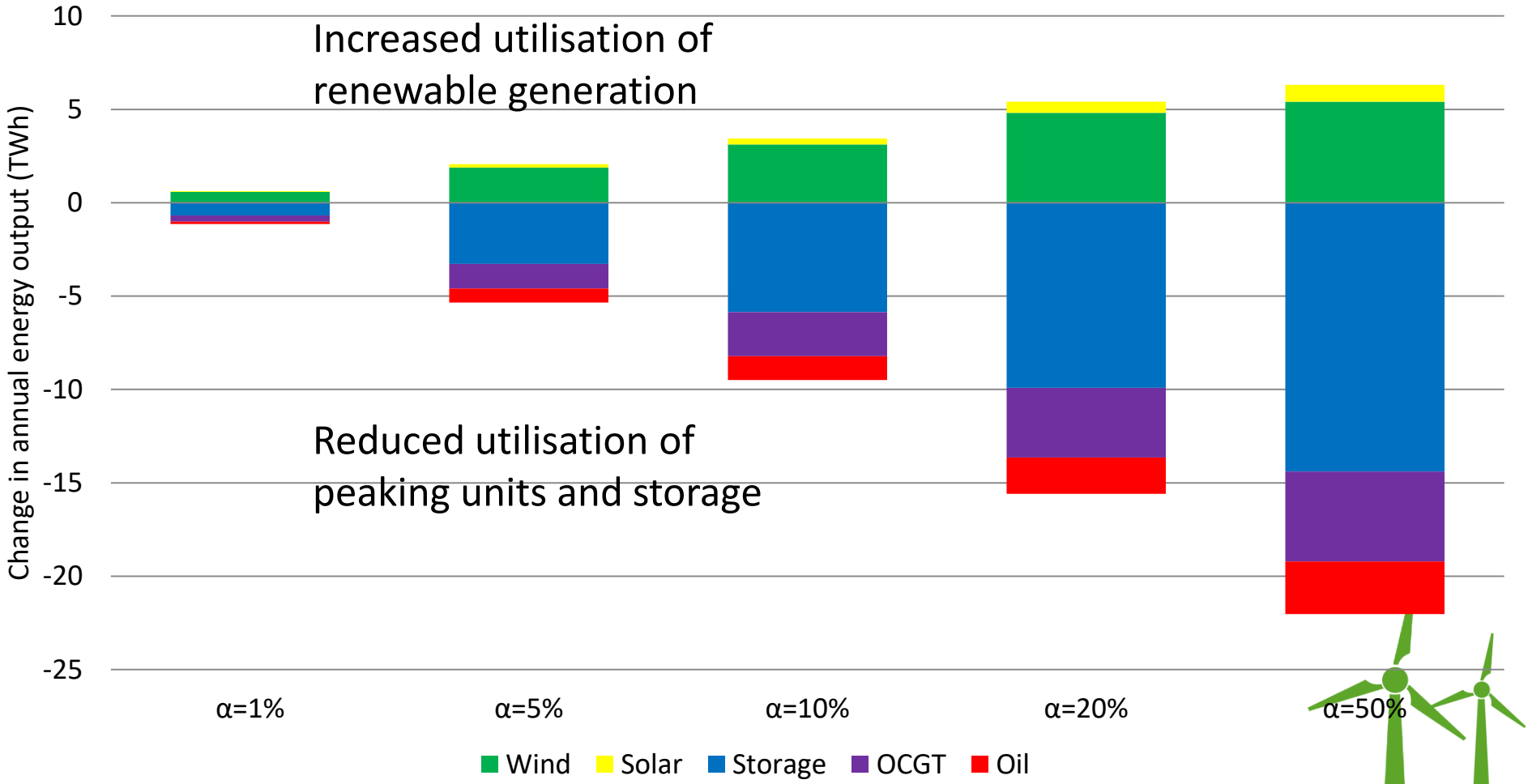
Renewable generation targets and system security constraints

- Investment in network assets
- Investment in generation assets
- Operation scheduling of generation, storage and flexible demand

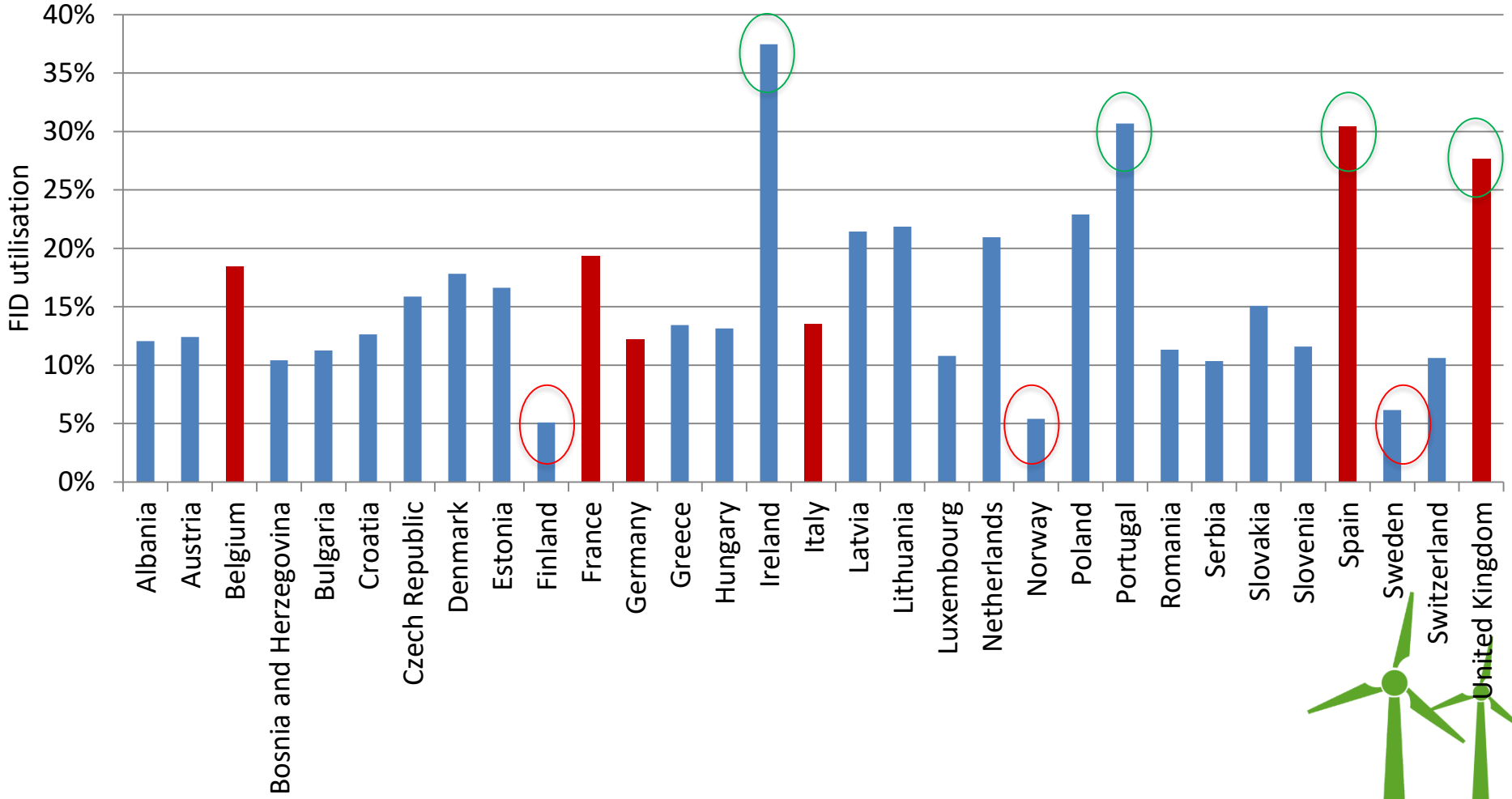
Benefits for European generation / transmission system



Impact on utilisation of energy sources (60% RES scenario)



Utilisation of industrial demand flexibility (α=20%, 60% RES scenario)



Flexible industrial consumer market model

Quantification of system benefits

Operational constraints of flexible industrial consumer

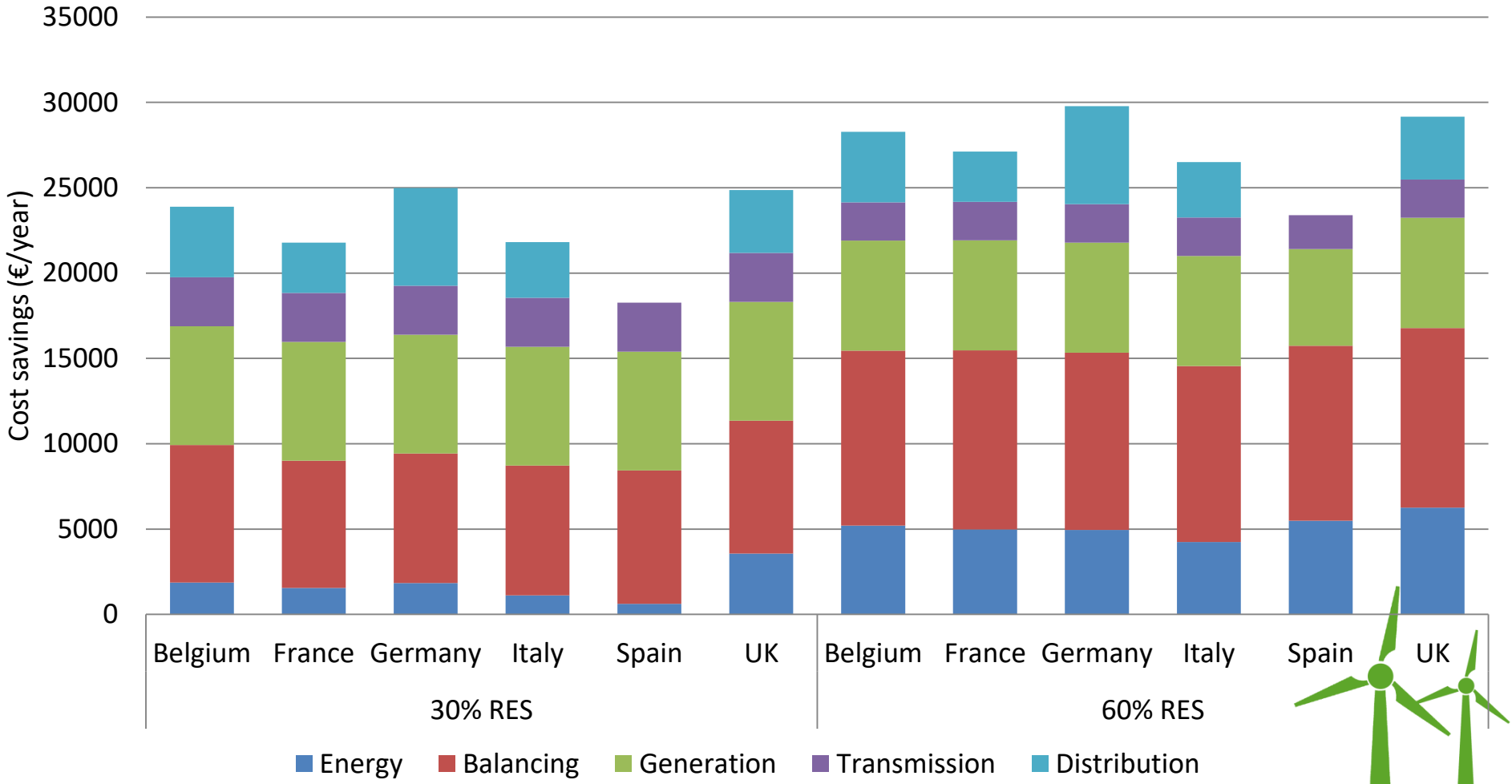
<u>Objective function</u>: Minimise overall electricity cost of flexible industrial consumer

Prices of energy, balancing and capacity services

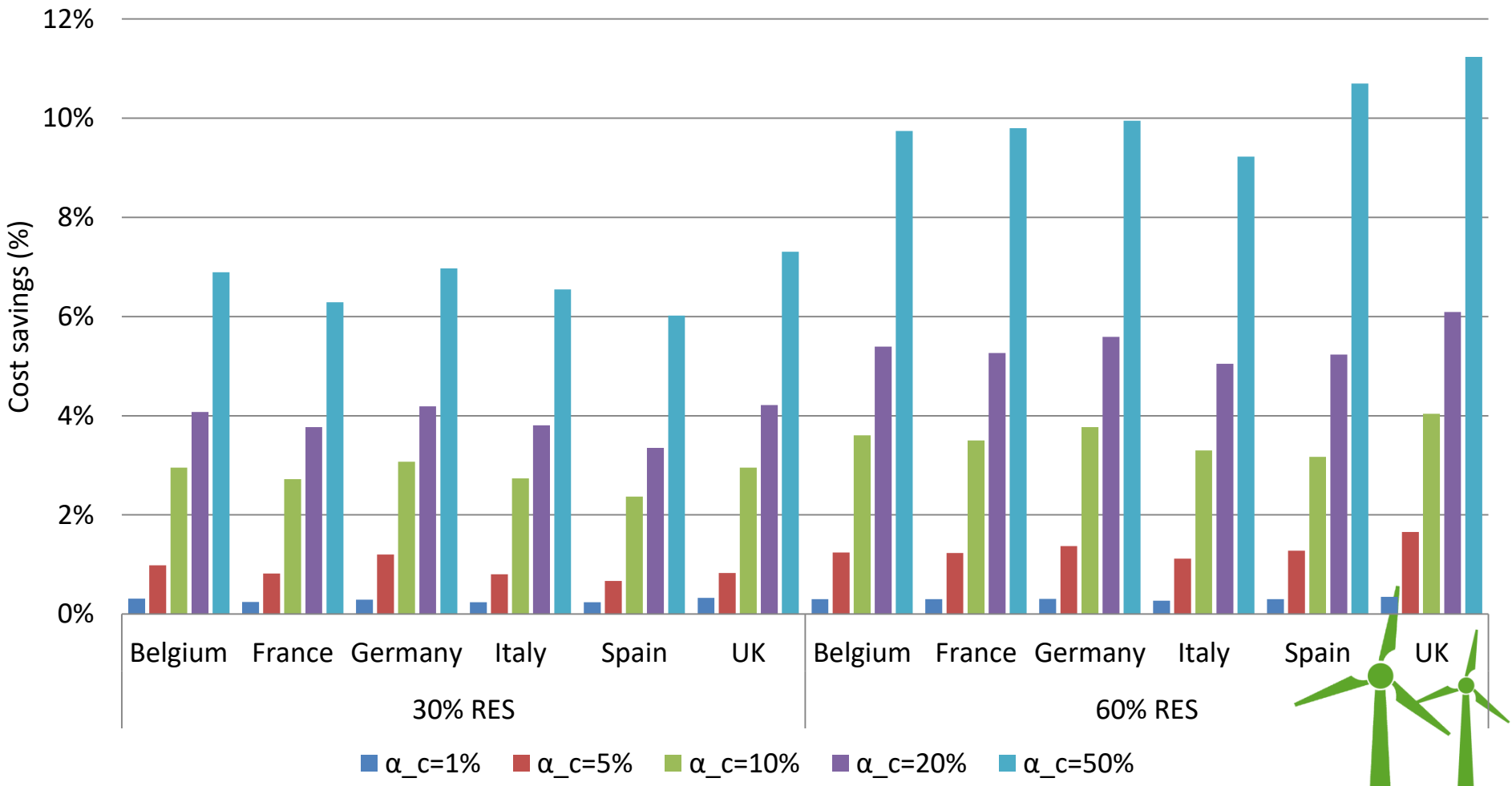
- Energy procured by the consumer in the energy market
- Volume of balancing services offered by the consumer
- Peak demand of consumer in the examined horizon

Case study: Steel plant with actual yearly demand profile

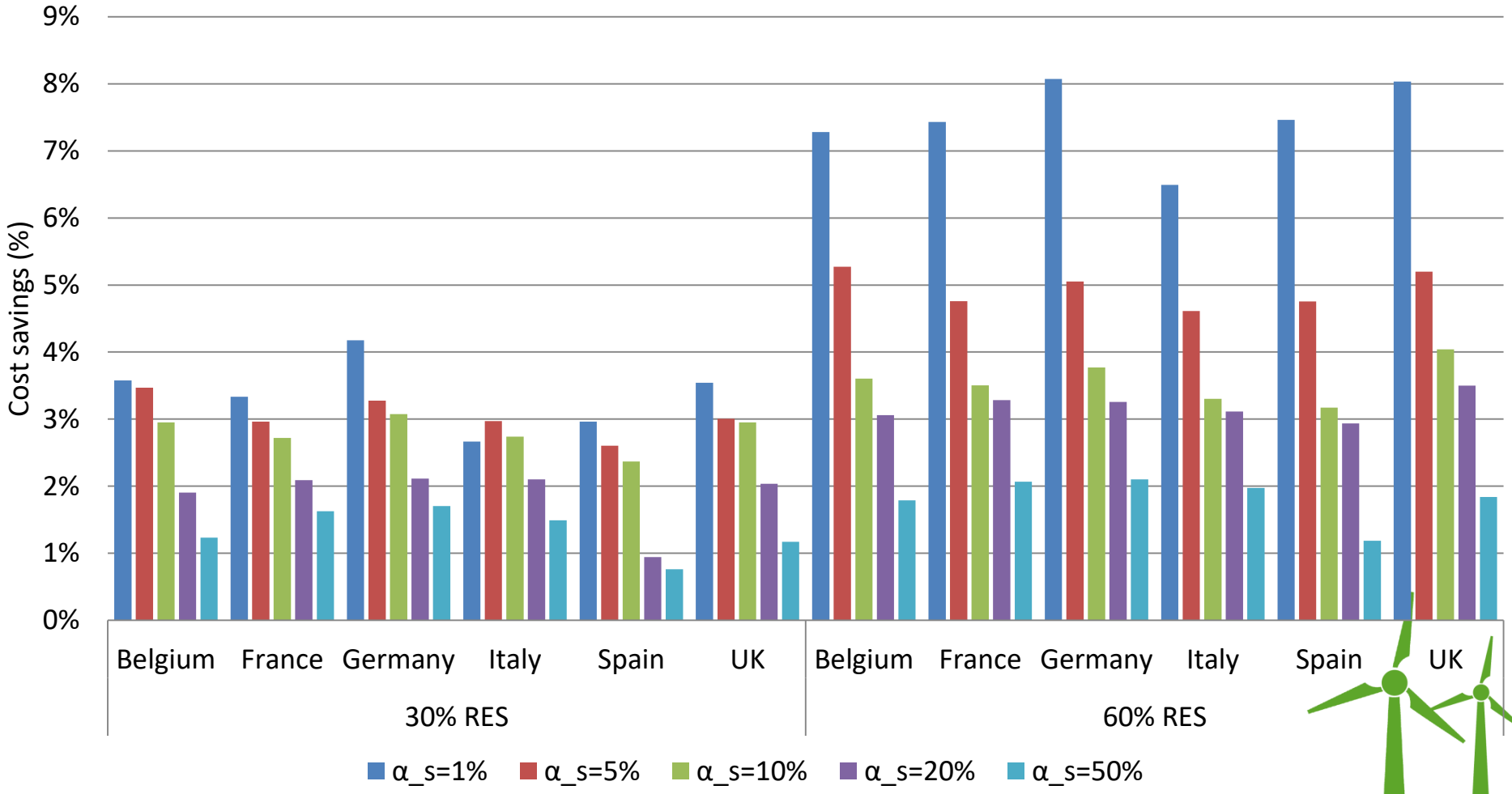
Benefits for flexible industrial consumer (α=10% scenario)



Impact of higher individual flexibility



Impact of higher system flexibility



Main findings

- Numerous value streams of industrial demand flexibility:
  - Reduction of system operation costs by enabling higher utilisation of renewable and cheaper energy sources and providing balancing services (reserves, frequency response)
  - Reduction of generation and network investments by limiting peak demand levels and limiting the required generation flexibility

- Synergy between renewable generation and industrial demand flexibility:
  - Industrial demand flexibility increases the utilisation of renewable generation
  - System cost and industrial consumers' cost savings are more significant under higher renewable generation levels

Relevant deliverable report (5.1)

IndustRE

"Innovative Business Models for Market Uptake of Renewable Electricity unlocking the potential for flexibility in the Industrial Electricity Use"

Quantifying the Economic Benefits of Flexible Industrial Demand

Deliverable 5.1
May 2017

http://www.industre.eu/downloads/category/project-results

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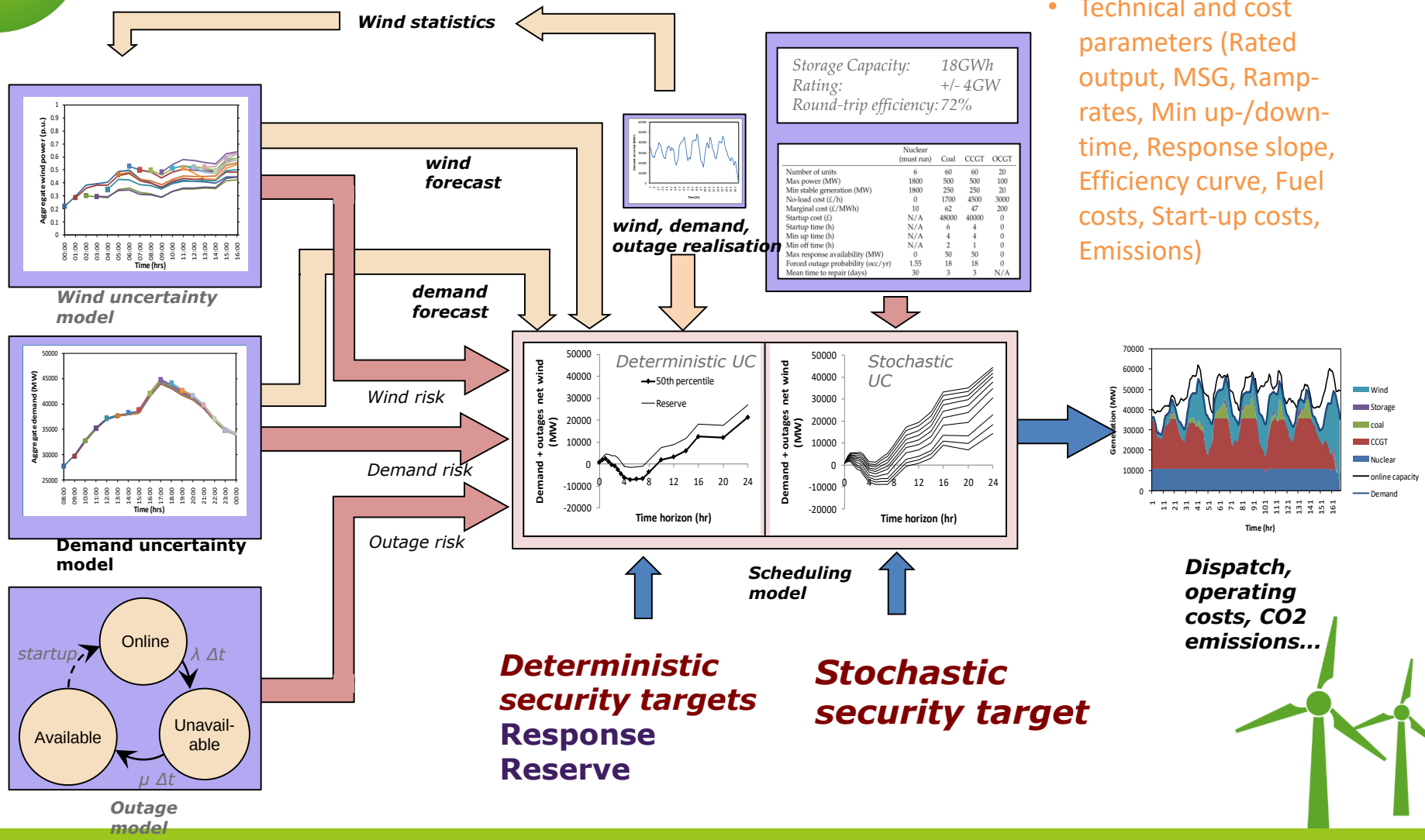
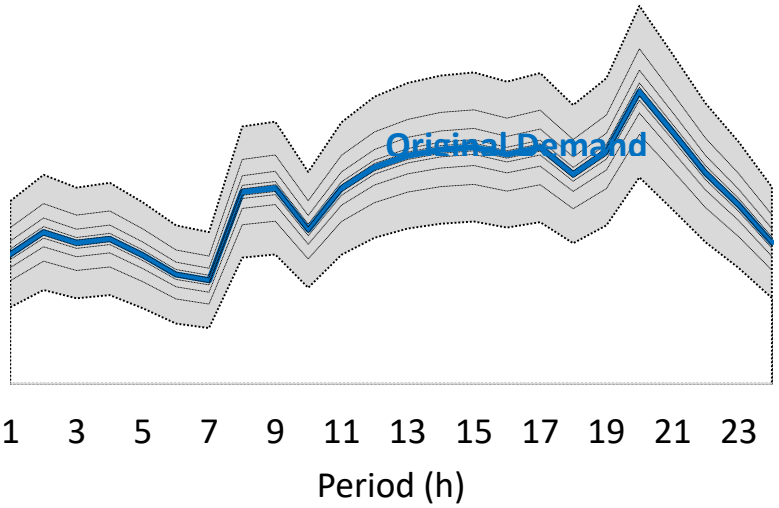
Stochastic unit commitment model (SUCM)



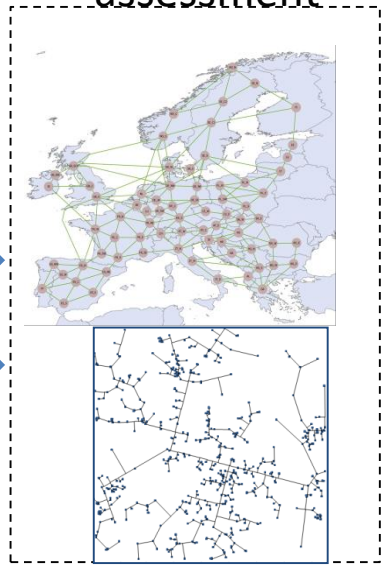
- Technical and cost parameters (Rated output, MSG, Ramp-rates, Min up-/down-time, Response slope, Efficiency curve, Fuel costs, Start-up costs, Emissions)

Overall modelling app



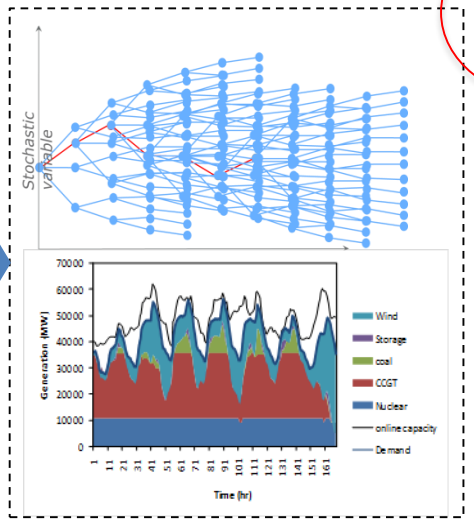
Future scenarios
2030 horizon

G+T+D infrastructure assessment



Generation, Transmission and Distribution Investment Optimisation

Op assessment



Stochastic Optimisation

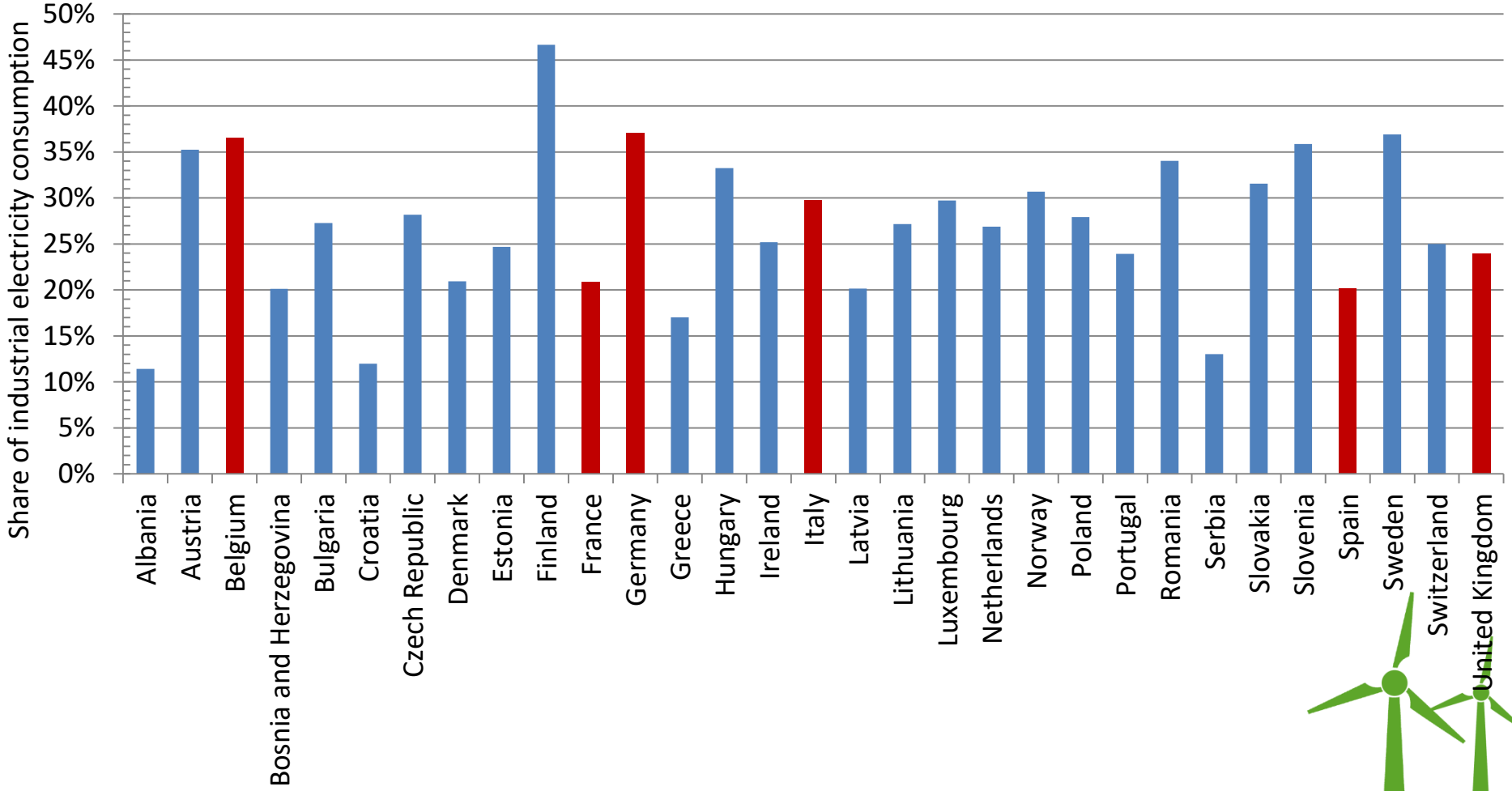
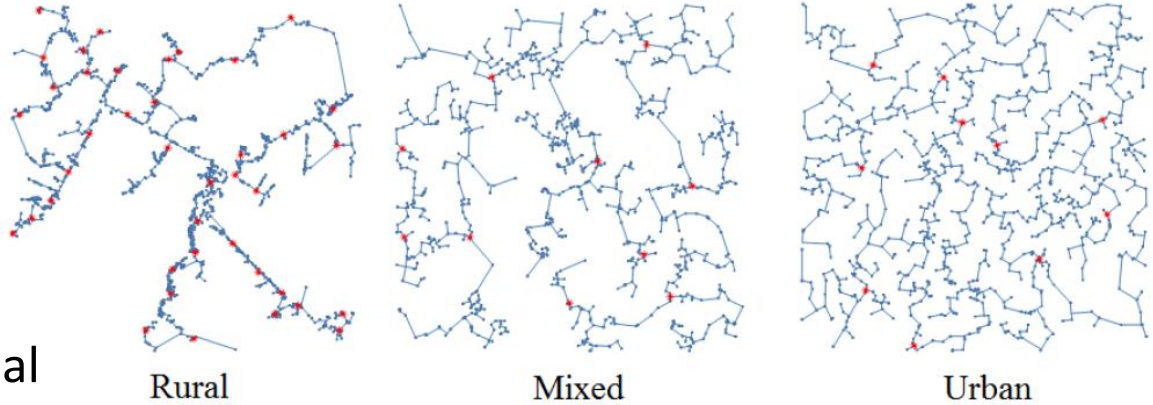
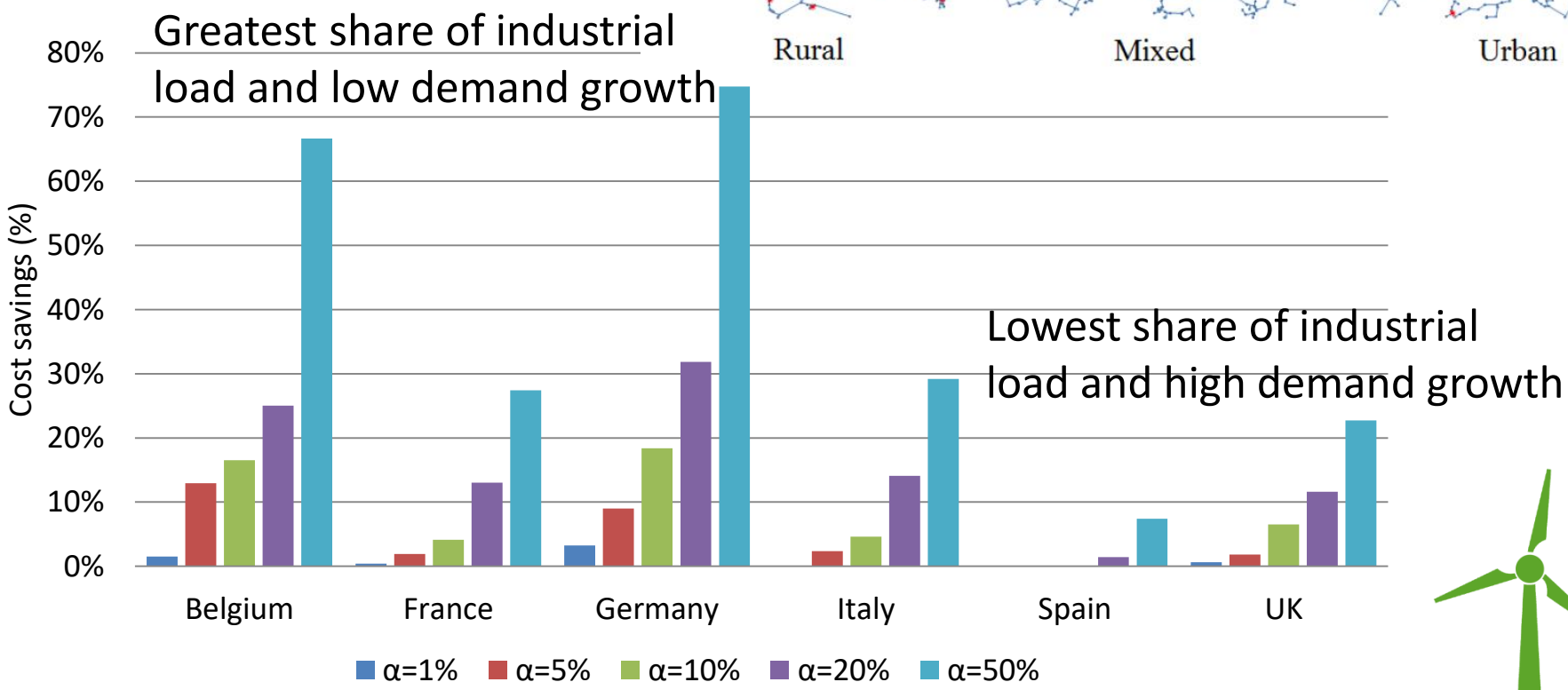
Flexible Industrial demand

Inflexible Industrial Demand

System benefits of industrial demand response

Sensitivity studies

Share of industrial demand per country



Benefits for European distribution networks