Technology integration and interoperability

Sustainable places 2019, Cagliari, Sardegna

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Introduction

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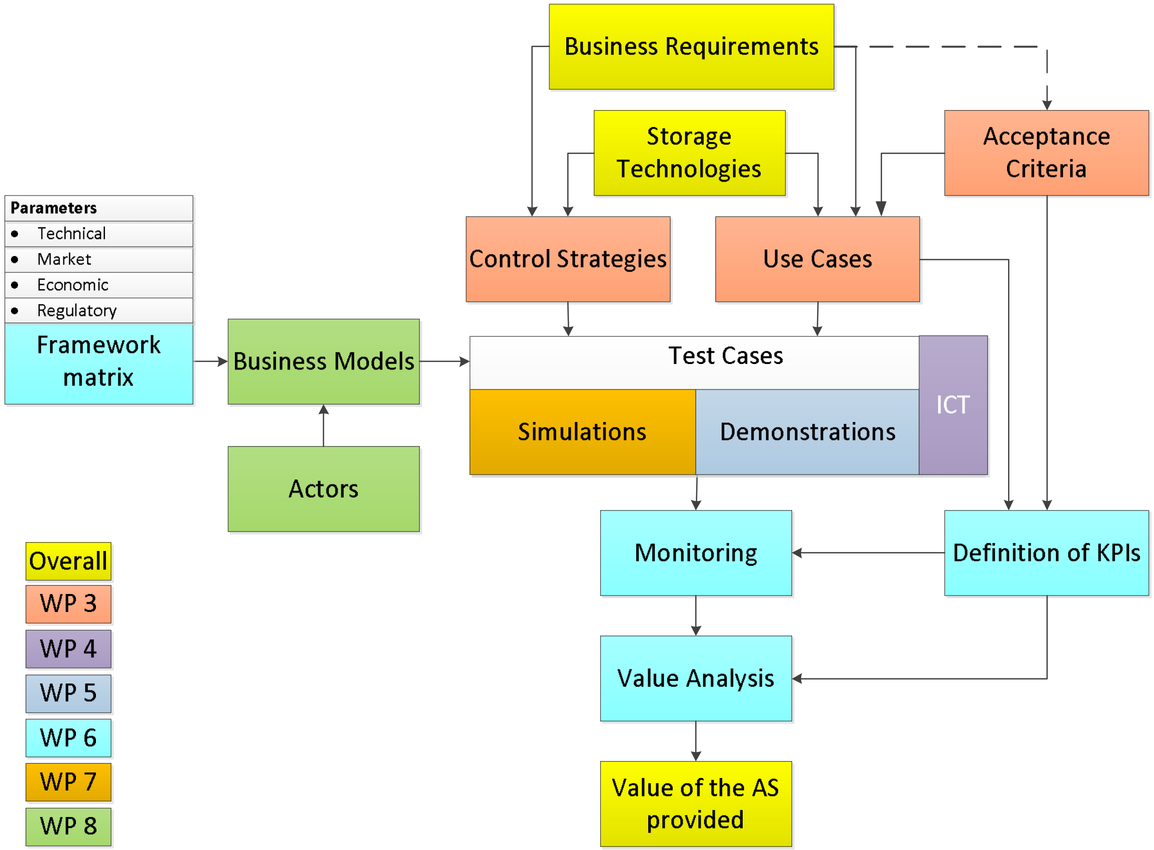
This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 646426

The STORY project

- Added value of storage
- Connection of several technologies and actors
- Impact on regulatory development
- Business model development
- New actors integration on electricity markets
- New ancillary services
- Analysis of mass rollout of storage technologies



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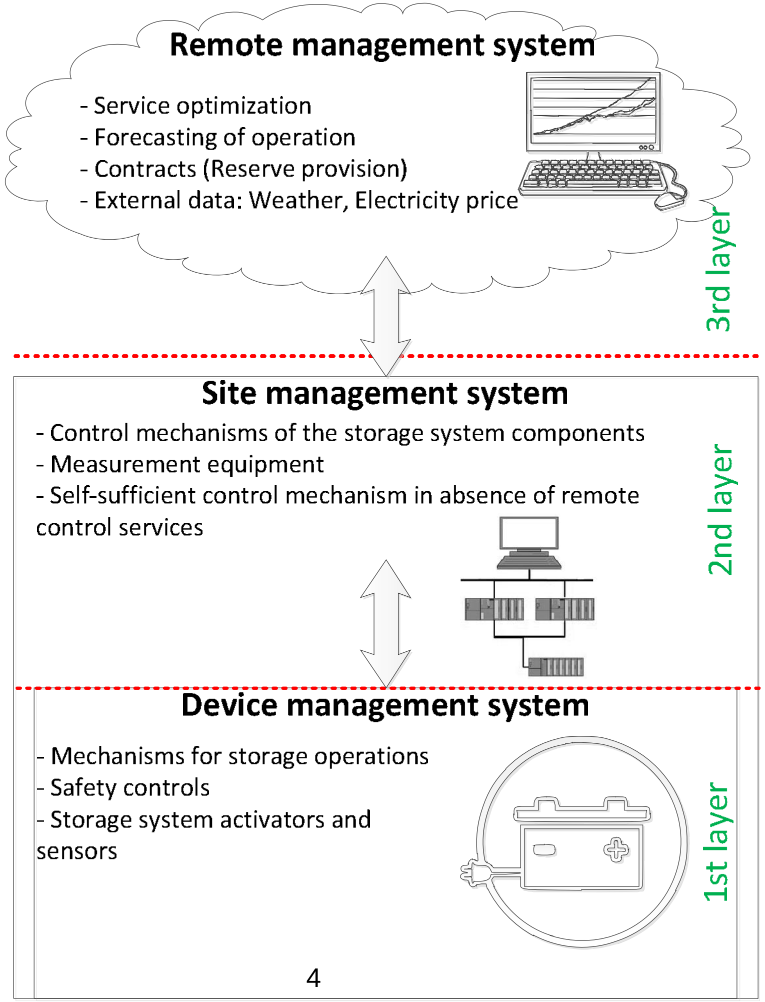
3 layered control strategy approach

STORY

- Device
- Site level
- Cloud



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The demonstration sites

Existing technologies and new assets

Case Studies

- Residential - building scale (Belgium)
- Residential – neighbourhood scale
- Storage in factory setting (Spain)
- Residential district (N. Ireland)
- Grid BESS (Slovenia)
- Multi energy grid,
  industrial area (Belgium)

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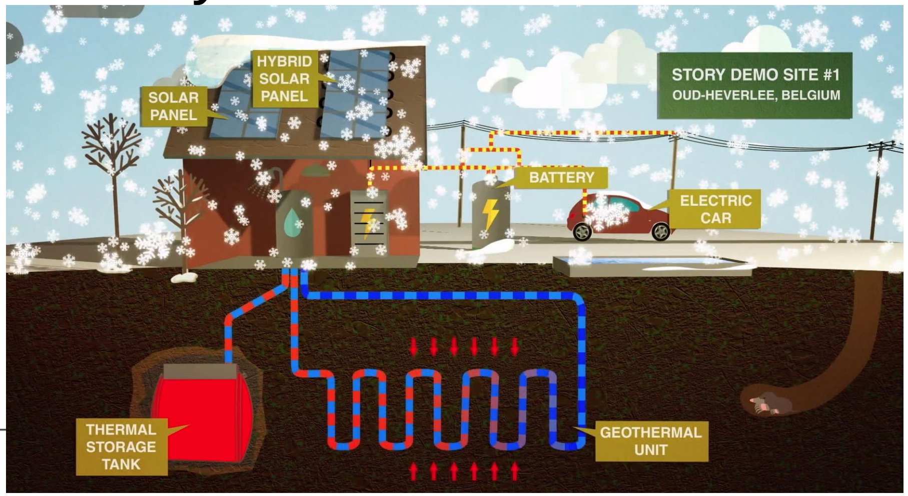
Case study 1 and 2

Neighbourhood

- Thermal, seasonal thermal and battery storage
- Working with PVT (cooled), EVs, heat pumps, fuel cells and smart home appliances
- Market oriented heat pump control
- Grid energy exchange minimization
- Advanced monitoring and control system needed to maintain operation:
  - Thermal sensors
  - Communication equipment
  - Control platfrom and server
  - Smart plugs



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Key insights

STORY

- Installation of measurement equipment: main power meters, thermal sensors, smart plugs
- Setting up the stable connection
- Quality of sent data must be at sufficient level
- External services: weather forecast, market prices
- **Comfort of the Residents**
- Cycling of the storage, proper technology selection
- Proper ‚customer support' and fast trouble shooting

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Case study 3

Factory Storage implementation

- Battery storage implementation to improve local RES
- Reduction of peak demand, lowering the operation costs
- Pre-implementation activities:
- Study of battery system dimensioning
- Definition of factory baseline consumption
- Testing of the system
- Legal constraints: no storage grid interaction allowed

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Key insights

CS3

- Legal constraints: restricted storage operation
- Delays in commissioning due to change of production location, lack of producer‘s personnel on the field
- Change of factory production: extension from peak demand reduction to additional load shifting
- Regulatory changes: registration of storage possible – grid interaction enabled
- Demo becomes role model for regulatory development
- Stability of the system was impacted by the contactor‘s sensibility, causing shut down of the system
- *Many factors and technologies apart from the energy storage system itself have an impact in the operation and reliability of these plants*

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Case study 4

Residential district

- Implementation of CAES in weak section of the grid zone
- Supporting local PV, Wind generation
- Reinforcement of the grid
- Provision of ancillary services, capacity allocation and load on demand services
- First out-of-the-lab, large scale implementation

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Crucial steps

Case Study 4

- Design of LP and MP systems
- Site preparation and tenders for CAES equipment, development of service agreements to enable revenue streams
- Single tender response, no agreement reached, move to separate technical solution (lower cost, faster build time)
- Design of the system, modelling and simulations performed
- LP system operational
- MP system: components designed, build and installed, certification ongoing

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Case study 5

Medium scale storage unit in residential and industrial area

- Demonstration of robustness and flexibility of the BESS
- Location 1: residential village in Slovenia
  - Supporting local PV generation
  - Peak shaving, island operation, reserve provision
- Location 2: industrial DSO's headquarters
  - Operating with PV, CHP, Ice bank and Diesel aggregators
  - Reduction of the peak demand curve, ancillary services

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Key insights

CS5

- Design of the demo control strategies, algorithms
- Definition of BESS functionalities, alarms outputs/inputs, interaction with the PLC
- Waiting for the delivery/delays, problems with BESS in the manufacturing process
- BESS not delivered, switched to other supplier
- Redesign of the system, adaptation of the control strategies, revision of the time plans
- New delays with cell delivery: factory acceptance test of the equipment (inverters and communication)
- After cells were delivered, the whole system assembled: final FAT

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Important lessons learned

CS5

- BESS production process from design to final commissioning revealed the complexity of the system
- First of a kind installation in Slovenia attracted a lot of attention
  - Slovenian distribution companies,
  - Slovenian Energy regulatory Agency,
  - Slovenian TSO,
  - EG control board members and private companies
- Different demo sites aims and needs brought high technical challenges
- Modular structure is a must
- Technology providers could not foreseen all problems: high noises, PCU unit processing and communication abilities, harmonics pollution
- *The batteries are not available to the extent that is generally assumed and marketed. This is a similar learning as in Navarra.*
- *The grid environment is different in each case, and the systems have to be designed separately for each case, although some advantage can be gained from the flexibility*

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Case study 6

Multi energy industrial site

- Thermal storage
- Enhancement of ORC operation
- ORC provides heat to the facility and produces electricity
- Site goals:
  - Efficiency enhancement and active control of ORC through the use of thermal storage
  - State of charge estimation of thermal energy storage with limited sensors
  - Potential optimization of the thermal grid through double use in intervals
  - Use of the local batteries to reduce congestion and peak demand on the private grid

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Key insights

CS6

- The system is stable and operational, however the full output was not achieved (850kW, although designed for 1600kW)
- Tests were carried out on varying supply temperature, flow rates and boiler parameters such as the primary and the secondary air fractions
- Lower thermal power has resulted in multiple start/stop sequences of the ORC combined with limited hours of operation. This has several times resulted in a broken shaft sealing.
- Boiler is in the mean time used for heating purposes, while ORC adaptations are investigated: high temperature circle did experience uncoordinated way of power flows
- A major issue in effectively implementing the valve control is the lack of a flow information. Only the total flow and the flow towards the ORC are measured. The flow over the bypass and towards the high-temperature circuit are not measured.
- Disrepancies in energy balance, still investigated

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Summary

- Time plan
- Parallel activities
- Reserve options, mitigation measures
- Equipment compatibility
- Not off-the-shelf solution will bring unforeseen challenges

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THANK YOU!

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