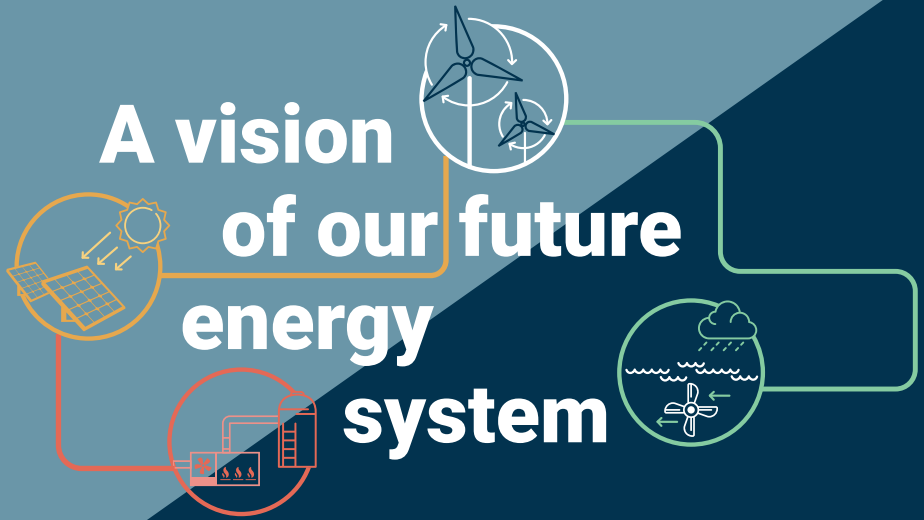
STORY

Added value of storage in distribution systems



STORY is a European project demonstrating and evaluating innovative approaches for energy storage systems in residential and industrial environments, with specific focus on their benefits in distribution systems.

This 5-year project started in May 2015, brings together 18 partners from 8 European countries and involves 8 demonstrations in 5 countries.

Aims of the STORY project

The main objective of STORY is to show the added value storage can bring for a flexible, secure and sustainable energy system. This will be achieved by showing the inter-relations between technologies and stakeholders as well as the potential and the impact of policy and regulatory framework. Eight demonstrations are set up to feed knowledge into the further analysis of large-scale impact assessment and on market models, policy & regulation. The eight demonstrations are located in five different member states (see map on the right) and cover industrial and residential environments, with the scales ranging from the individual building to the district. The demonstrations deliver input on technological performance, stakeholder acceptance and on the overall process of storage integration. An in-depth practice oriented analysis on grid challenges, hardware requirements and ICT delivers insights for the demonstrations that in turn support the deployment and impact analysis.

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The demonstration cases of STORY

		BE: Residential buildings	BE: Neighborhood multi-energy grid	ES: Storage in a factory	UK: Storage in a residental district	SI + DE: Large scale storage unit	BE: Private multi-energy grid
Type of storage	Thermal storage	■	■			■	■
	Battery	■	■	■	■	■	■
	Compressed air storage				■		
Technology	Combined heat and power					■	■
	Vacuum solar collectors	■	■				
	Heat pump	■	■				
	PV	■	■	■	■	■	■
	Wind power				■		
	Tidar power				■		
	Biogas				■		
	Fuel cell	■	■		■		
User sector	Residential	■	■		■	■	
	Industrial			■		■	■
Demo aims	Peak shifting and shaving	■		■			
	Load and generation control	■	■	■	■	■	■
	Grid support					■	
	Scheduling of flexbility	■	■			■	

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The STORY demos

The demos consider challenges to the grid infrastructure and management, the impact on the integration of local decentralized and large scale centralized renewable energy systems, but also possible opportunities and challenges of providing new forms of flexibility to the markets.

Demonstrations at residential building and neighborhood scale, Belgium

These two demonstrations show the value of storage for the end user, the distribution grid operator, the energy provider and a potential third party aggregating the flexibility. A dozen of houses in a residential street in Oud-Heverlee, Belgium, are equipped with a range of technologies that provide a maximum of load shifting potential: fuel cells, batteries, small scale thermal storage, seasonal thermal storage and improved monitoring and control. Interoperability receives considerable attention, in order to pave the way for cooperation between different technology providers and the move to plug and play solutions.

In a second step the goal is to take 13 houses in Oud-Heverlee off-grid by creating a microgrid at the end of the distribution line. The aim is to demonstrate the synergy of a neighborhood strategy for flexibility and grid balancing. So far, most of the equipment has been installed and data registration from the first step has started.

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Demonstration of storage in factory conditions, Spain

The site is located in an industrial zone in Navarra. This facility produces professional fridge rooms and uses equipment that requires a large amount of power (800 kW peak values) that represents a considerable financial burden. In addition to the existing 113 kWp PV on the site we added a battery to improve the cost savings and the business case.

Demonstration of a Compressed Air Energy Storage (CAES) in a residential district, Northern Ireland

The demonstration unit will take electricity from the grid that is produced by wind, PV and tidal generators to drive a compressor for storing compressed air in air storage cylinders (Compressed Air Energy Storage, CAES). The heat released in this process will be recovered and stored in molten salt tanks. When electricity is required for export, the compressed air is directed through an expander with heat injection from the heat store to drive a generator. The CAES plant can appear on the grid as either a controllable load or a controllable generator.

There will be times when the CAES unit will be restricted as a generator and times when the CAES unit will be restricted as a load, during the evening peak in consumption when thermal limits on heavily loaded lines may be reached.

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Demonstration of flexible and robust large scale storage unit in industrial and residential area, Germany and Slovenia.
In this demo, an 800kW storage unit will be built that provides a flexible and robust energy supply for diverse applications. The battery storage unit is designed to support substations at the medium voltage level in order to stabilize the grid, improve power quality and efficiency, moderate peak demand and integrate renewable energy sources (RES). The same unit is tested and demonstrated in 3 substantially different settings. The aim is to demonstrate the flexibility and robustness of the unit and its control management system, and the ease with which it can be integrated into the existing infrastructure. This battery storage unit will first operate behind the meter in the EnerSys Hawker factory, Hagen, Germany. In the next demonstration case, the storage will be connected to a residential grid operated by Elektro Gorenjska to supply energy to the village of Suha in Slovenia. In the last demo case, a storage unit will be connected to an low voltage industrial grid at Elektro Gorenjska headquarters in Kranj, Slovenia.

Demonstration of a private multi-energy grid in an industrial area, Belgium
The demo is located at the Beneens factory that manufactures wood-based products. At the demonstration, a new wood fired boiler (1.6 MW) with a heat delivery of 150°C has been built that is fueled by waste generated from the manufacturing process. This boiler is connected to an Organic Rankine Cycle (ORC) that can provide 90 kW of electric power. To increase the flexibility of the system, thermal energy storage based on a hot water storage tanks have been added. Within the demo there are efficiency enhancements and active controls of ORC using thermal storage. The aim is to increase the self-consumption of locally produced electricity in the new office building and diminish reliance on the grid for energy. The use of local batteries will reduce congestion and peak demand on the private grid.

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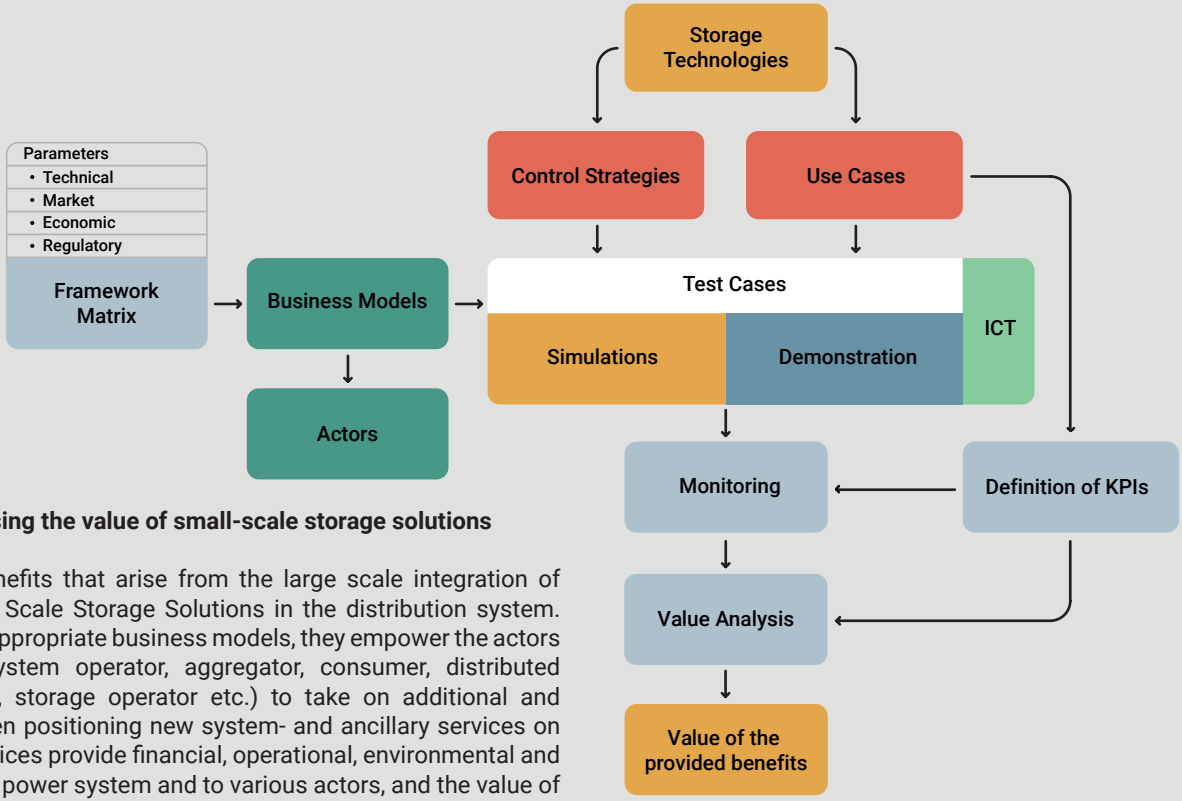

Creating and assessing the value of small-scale storage solutions

There are many benefits that arise from the large scale integration of Small- and Medium Scale Storage Solutions in the distribution system. Combined with the appropriate business models, they empower the actors (e.g. distribution system operator, aggregator, consumer, distributed generation operator, storage operator etc.) to take on additional and innovative roles when positioning new system- and ancillary services on the market. The services provide financial, operational, environmental and other benefits to the power system and to various actors, and the value of these benefits will be assessed.

In STORY, we have defined the STORY Value Analysis Framework to be able to measure these benefits.

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The STORY Value Analysis Framework rests on the following concepts:

- The benefits are realized as value to the actors, when services are exchanged among them.
- Services are provided by actors controlling storage technologies, network resources, Distributed Renewable Energy Sources (DRES) and Demand Response (DR) units.
- The control strategies for the storage and other resources are structured in three control layers: Primary or Device Layer, Secondary or Network layer, and Tertiary or Service layer.
- The actors cooperate through Business Models developed in STORY that describe the nature of exchange of services. Each actor has a different portfolio of benefits.
- By controlling the storage units using control strategies and algorithms, value is realized also with broader societal and environmental benefits (e.g. increased RES consumption reduced emissions and losses in the system).

In STORY, we aim to illustrate the benefits through the demonstration cases and through simulations. They are defined in a Framework Matrix, that describes the technical, economic, market and regulatory aspects of the business models.

To determine whether the STORY goals have been achieved or not, Monitoring process employs a set of quantitative Acceptance Criteria defined for each goal. They are expressed as Key Performance Indicators (KPIs), defined as quantities either directly measurable or calculated from the measured data.

For evaluation, several Test Cases are either demonstrated in the field or simulated. Test Case scenarios cover various parameters that influence the operation of storage.

From the Monitoring results, we can use a Value Analysis process to assess the value of the provided benefits.

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Scenario building and simulations

The main aim of adding any storage units to the grid is to improve grid operation optimise investments in the grid. This is why STORY aims to evaluate the impact of a large-scale integration of small-scale storage units in the European distribution networks and influences on the transmission network. The demonstrations represent a good mix of market driven and regulated (grid driven) implementation of storage. These cases will now be embedded in a larger model of the grid. To evaluate markets & prices in our (simplified) calculations, the market prices will be treated as exogenous, rather than endogenous parameters.

To build a set of future development scenarios we combine a set of grid and RES development scenarios with the scenarios for storage technology development. This combination of development scenarios is the then put into the scenario framework matrix in order to get a full set of future development scenarios that serve as an input for simulations and evaluation analysis. The simulations will provide an indication of costs, benefits and how sensitive they are to the main technology, market price settings, policy, and regulatory factors in order to derive robust policy conclusions.

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STORY is a part of the H2020 Low Carbon Economy family of projects, working on a common BRIDGE initiative

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