2 Publishable summary

2.1 Summary description of project context and objectives

The objective of eStorage is to develop cost-effective solutions for the widespread deployment of flexible, reliable, GWh-scale storage across the EU, and to enhance grid management systems to allow the integration of large share of renewable.

The key issue we plan to address is the need for power regulation during low demand periods, when only inflexible baseload generation and intermittent renewable generation are operating. In contrast to conventional generation, a storage plant able to regulate its consumption could help to avoid curtailing wind.

Conventional Pumped Storage Hydro Plants (PSP) can only regulate their power in generation mode; variable speed technology for PSP can bring flexibility in pumping mode as well. Developing technically and economically feasible solutions in eStorage will allow upgrading a significant part of European PSP capacity to variable speed, providing up to 10 GW of additional regulation capability with no environmental impact and little administrative burden, all at a much lower cost than required for developing new plants.

We will also develop and demonstrate solutions for coupling the dispatch of storage plants with renewable generation using advanced Energy Management Systems. This will enable storage plants to maximise their value in the balancing markets. From simulation studies, demonstration results and storage potential analysis we will evaluate the system-level benefits of storage. We will also identify development barriers in order to draw recommendations for efficient market and regulatory framework to maximise the impact of project outcomes.

eStorage gathers major stakeholders from the entire value chain across EU (Elia – TSO, EDF – Generation Company, Imperial College – Academic Institution, DNV GL - Energy Consultancy and Alstom – Equipment Manufacturer).

2.2 Description of the work performed since the beginning of the project and the main results achieved

2.2.1 Demonstration (WP1/WP2)

Main achievements for this period of WP1 are the following:

- Finalise the detailed design of new unit and launch of the necessary procurements.
- Mould the new turbine and deliver it in Grenoble for assembling and final manufacturing.
- Launch the reflexion on future maintenance process for the new unit.

Main achievements of the WP2 for the second reporting period are the following:

- Define Market model and associated clearing rules to be implemented in the Balancing Market tool.
- Write-up Balancing Market tool System Specifications.
- Write-up and validate a new version of PSP high-level specification document.
- Develop and test new version of smart dispatch.

2.2.2 RTD (WP3)

Main achievements in WP3 during Year 3 include:

- Work on setting up the models with the scenario data from Task 3.1, analysing the European system in the 2020-2050 time horizon.
- Develop preliminary studies to evaluate the system benefits of variable-speed against fixed-speed PSP.
- Develop the business case analysis approach, studying a new storage technology from a market perspective.
- Initiate interaction with other WPs.
- Allocated different countries to partners for the regulatory analysis (including and European-level regulation).
- Developed outline structure of D3.3 report to facilitate the compilation of partners' contributions.
- Distributed a skeleton document analysing the regulatory situation in the UK, to be used by partners as a template for other European countries.

2.2.3 Others (WP4/WP5)

Main achievements in WP4 during Year 3 include:

- Finalise the first business case.
- Perform the detailed analysis of the 5 remaining business case.
- Prepare the deliverable 4.1.
- Prepare the expert selection process with stakeholders in EU 15 plus Norway and Switzerland by shaping a clear and attractive presentation of the results of the model.
- Analyse the results from the manual check.
- Develop deliverable 4.2.

Main achievements in WP5 during Year 3 include:

- The organisation of the second annual workshop in London.
- Gaining awareness about the project and storage and energy management systems in Europe.
- Educating pan-European and European national decision makers and influencers on the role of energy storage in integrating variable renewable energy into the electrical grid.
- The participation in various significant conferences and presentation of the technical co-works, which exhibits the professional expertise in energy storage as well as the friendly partnership within the organisation.

2.2.4 Management (WP6)

Main achievements in WP6 during the 3rd period of the project :

- Participation to the Steering Committee and General Assembly in London and the presentation of the work achieved in the 2nd Period and the pending issues.
- Regular monitoring meetings and completion of follow-up documents.
- Realisation and submission to the EC of the 2nd periodic reporting.
- Preparation and submission to the EC of the amendment n°2.
- Review and submission of Deliverables in line with the process and due dates agreed in the contractual documents.
- Organisation of the Periodic review.
- Regular updates (every 3 months) of the Monitoring and Action Management board and of the Action list to address work progress and actions to be done.

- Update of the Risk register at the beginning of the period.
- Cost control and resources management to ensure a coherence between both prevision and real achievements.

2.3 The expected final results and their potential impact and use

The general project scope is to develop a global system solution by connecting the intermittent generation to the storage resources through an efficient electricity market, and by maximising the bulk storage resources flexibility. By optimising the global chain value and making recommendations to adapt the regulatory framework to incentivise the adequate bulk storage development maximising the global system value, one expect to maximise the end consumer value and minimise the electricity cost and/or minimise the intermittent generation integration cost impact.

With a typical availability factor above 90% and response time below the minute Hydro-Electric plants are amongst the most reliable generation resources to provide base load or peak power. The variable speed technology applied on Pumped Hydro Storage Plants pushes the flexibility of such plants one step further. With their flywheel capability and a reaction time for large power variation below the second, variable speed PSP can provide power quality service as well as frequency regulation in pumping and generation mode and time shift. They are the ideal partner of intermittent generation. However the investment cost for new plants and the topology constraints limit the diffusion of the technology. By developing solutions to upgrade existing plants we provide less expensive way to disseminate this technology all through Europe.

The eStorage project objective is indeed to demonstrate in WP1 the economic and technical feasibility to upgrade existing conventional Pumped Hydro storage plants into variable speed ones by upgrading a 240 MW PSP. This upgrade objective is to increase the plant frequency regulation capacity and to improve its cycle efficiency and therefore provide economic benefit to the plant owner. The project includes also a R&D phase whose objective is to develop solutions that aims to make it possible and economically viable to upgrade in variable speed more than 75% of the 40,000 MW installed base.

IT tools encompassing new market regulatory framework geared to closer to intraday and real-time capabilities and dealing with network congestion management will help reducing the impact of disturbances introduced by ever growing penetration of variable energy resources like wind. Studying and assessing new market design will likely help both system operators and Balance Responsible Parties to achieve system and portfolio balancing by introducing closer to real-time products and opportunities to trade energy and reserves. New IT tools will not only consider the point of view of the central grid or market operator but will also help other actors such as generation companies to adjust and optimize their revenue streams by having new energy or reserves trading opportunities.

Several international studies indicate that bulk storage can provide many benefits to electricity grids and markets in addition to facilitating the integration of renewable energy. These include increased efficiency of existing plant and of the transmission system as a whole, enhanced security of energy supply. Thus, PSP can contribute to a reduction of overall generation and transmission system costs and electricity prices.
Variable speed Hydro Storage probably has the shortest response time amongst the transmission scale generation resources.
Bulk storage will reduce the need to curtail wind. Curtailment is already occurring in grid systems having integrated large intermittent generation (Ireland, Spain,…) and predicted levels of wind congestion on transmission lines are of concern to System Operators. Thus PSP could provide valuable wind management services to the TSO and command a new payment consistent with market consultation by the Regulators for “new ancillary services” to reward such grid services.
PSP have the potential to provide ancillary services, including operating reserve, reactive power, black start, automatic generation control and system support services. The challenge of integrating increased renewables onto the grid adds greater complexity to balancing of the system and introduces greater risks (e.g. frequency fluctuations) and costs for all stakeholders - existing plants, utilities, the system operator,

potential investors and the consumer. PSP have the potential to provide what may be termed Advanced Ancillary Services in providing a powerful and flexible balancing component for systems with high wind penetration.

2.4 The address of the project public website

http://estorage-project.eu/