

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 EU, and to enhance grid management systems to allow the integration of large share of renewable. The project will achieve this goal by developing Variable Speed PSP associated with an optimal dispatch and new market and regulatory framework as an economically viable solution supporting large scale integration of intermittent renewable energy production into the EU electricity grid

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 and PV.

Conventional Pumped Storage Hydro Plants (PSP) can only regulate their power in generation mode; variable speed technology for PSP can bring the additional 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 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 and 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, KEMA – 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)

The overall goals of the activity is to demonstrate the technical and economic feasibility of converting an existing PSP in France to variable speed technology and to develop and demonstrate the capability of IT systems to facilitate flexible balancing capabilities of energy storage by looking at closer to real-time market systems.

During the first period of the project, the main objectives are:

- Evaluation of market value of Le Cheylas power plant and comparison between its existing configuration with the foreseen one (task 1.1)
- Evaluate the likely economic benefits of such conversion.
- Assess the technico-economical feasibility of the conversion

Main achievements for this period are the following:

- Evaluation of market value of Le Cheylas power plant and by comparison between its existing configuration with the foreseen one (task 1.1) has been elaborated;
- Detailed specifications are ready for the conversion to variable speed of le Cheylas unit;
- A first scale model test of the upgraded turbine took place but the performances reached by the upgraded engine was not satisfactory. For this reason a second turbine design iteration and scale model test is being performed in the course of October/November, the results of which will be available at the end of November. This situation has been discussed and validated by the Project Officer as explained in section 3.2.1.4;
- The basic design for the set of modifications needed in the existing power plant to adapt it to the new turbine and motor / generator is almost achieved ;
- Basic design of the motor generator has been done in order to define its main characteristics.

As regards WP2, overall objectives for the 1st period are:

- Make a demonstration to participants of the software products that will be used and adapted to form the demonstrators for Energy Trading Market (T2.2) and Smart Dispatch Storage PSP (T2.3);
- Capture Participants & Market players needs, goals and constraints;
- Set-up a development platform and framework that will facilitate the development and integration of eStorage specific requirements into the base products.

Main achievements for the first reporting period are the following:

- Kick off meeting of the WP2 and demonstration to the participant of the e-terramarket and ISPO products that are the basis on which the future Demonstrator will be developed;
- Preparatory work made as regards the IT Tools for more continuous energy trading markets (Task 2.2);
- Good progress made in capturing the needs and constraints of the stakeholders for dispatch storage PSP.

2.2.2 RTD (WP3)

The overall goal of the activity is to quantify the benefits of flexible variable speed-based retrofit of PSP schemes, and propose changes to market and regulatory frameworks to support appropriate business models for flexible energy storage.

The objectives of the research and technical development activity for this P1 are :

- To execute a literature study on European policy and scenarios, on demand development, on technology development and on the development of fuel supply and fuel prices;
- To perform the analysis of the impact of storage on system operation and design ;
- To identify the main barriers posed by existing regulation and market frameworks ;
- To identify and analyse gaps in the existing regulatory that could represent barriers to cost-efficient deployment of storage in Europe.

WP3 was started with the kick-off meeting in March 2013 taking place in London.

The work progress was essentially based on the realization of different internal reports (on European policy and scenarios, on demand development, on technology development and on the development of fuel supply and fuel prices), several surveys of similar projects recently conducted.

2.2.3 Others (WP4/WP5)

The overall goal of the exploitation activity is to evaluate the deployment potential of new PSP and of PSP upgrade into variable speed.

The Kick-off Meeting took place on April 2013.

The WP4 objectives for the P1 are:

- To provide a comprehensive overview and segmentation of all existing PSP sites which are eligible for variable speed conversion in the EU15 + Norway + Switzerland and to develop a set of business cases efficiently representing the existing PSP installed base and providing the basis for feasible investments plans for variable speed conversion;
- To realize a feasibility and technical cost-benchmark of existing large PSPs sites in Europe.

To achieve these tasks, an inventory of suitable new (variable speed) PSP locations in Europe was performed through the selection and analyze of specific criteria and the development of a data map. In parallel, criteria for the selection of potential for new VS-PSP have been selected based on interviews, literature review and inputs from the WP4 Steering Group.

As regard to the communication on the project, overall WP5 objective for the period was to raise awareness about the project and storage and energy management systems in Europe in general.

In this context, a communication plan has been set up and went through the realization of eStorage own communication materials (project leaflets, creation of the project visual identity through a eStorage logo, specific templates and a website).

In parallel, press release presenting the project was distributed and disseminated in different languages. The coordinator was interviewed by specialized press

Another important objective was to enable the project management and collaboration among partners, through the creation of an online portal (D5.2).

Finally, the organization of the first annual workshop (D5.4) at KEMA was the third deliverable that could help raising awareness about eStorage.

The coordinator and partners attended several conferences in Europe focused on the energy storage technologies. It was the occasion to present the eStorage project.

2.2.4 Management (WP6)

The objectives of the first period, in terms of management activities, are to develop all the tools that will help to successfully implement the project and monitor its progress and results.

The work performed by the management activity essentially consisted to set up the general framework of the project that will be used until the end.

The project officially started with the organisation of the Kick-off Meeting held in Grenoble in October 2012. During the meeting, documents and deliverables regarding the general project management (PMP, PQP, Risk Register and Action List) were presented. .

In parallel, the contractual documents – Grant Agreement and Consortium Agreement – were finalised, signed and officially delivered to the EC.

For project monitoring and management, Core group meetings were held by teleconference. It was the occasion to have a general overview of the progress made per WP.

Regular contacts have been kept with the project officer, through emails, in order to inform him about the project progress, risks and problems and to present and discuss ways on how to solve them.

A collaborative tool – that already existed and used by the project coordinator – was officially designed and is now used for documents exchange, meetings organisation and communication between partners.

At the end of the period, the Steering Committee, the General Assembly and the Workshop of the project were started to be organised. They will occur during the P2 in Oct 2013.

In the meantime, all partners were informed and prepared to take part to the annual periodic report.

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 cost-effective way to disseminate this technology all through Europe.

The eStorage project will indeed 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 will allow 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 will it make 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 reaction time amongst the transmission scale generation resource.

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

A public website for the project has been created: <http://estorage-project.eu/>