SEVENTH FRAMEWORK PROGRAMME

THEME 5 - ENERGY

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Plan for exploitation and replication

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DELIVERABLE QUALITY REVIEW

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PARTICIPANT ORGANISATIONS

Participant organisation name	Short name	Country
ALSTOM HYDRO FRANCE	AHF	France
ELECTRICITE DE FRANCE S.A.	EDF	France
ELIA SYSTEM OPERATOR	ELI	Belgium
ALSTOM GRID SAS	AGR	France
IMPERIAL COLLEGE OF SCIENCE, TECHNOLOGY AND MEDICINE	ICL	United Kingdom
KEMA NEDERLAND B.V.	KEM	Netherlands
ALGOE	ALG	France

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1 INTRODUCTION

This report is part of the eStorage project funded by the European Commission with the objective to develop an economically viable solution supporting large-scale integration of intermittent renewable energy production into the EU electricity grid.

The goal of Work Package 4 “Exploitation” is to draft a plan to replicate the Variable Speed PSP technology throughout Europe.

The objective of Task 4.1.1 was to explore the potential existing PSP sites which could be upgraded to variable speed in the EU-15 countries, Switzerland and Norway. In Task 4.1.2 the total theoretical and realizable storage capacity potential (GWh) of PSPs has been estimated, providing the industry and governments with an overview of capacity and suitable locations, and enabling political and business decisions for development of new PSP projects.

In this report, the plan for exploitation and replication is described separately for Task 4.1.1 and Task 4.1.2.

2 TASK 4.1.1 POTENTIAL FOR CONVERSION TO THE VARIABLE SPEED TECHNOLOGY OF THE EUROPEAN PSP FLEET

This section proposes a plan for the exploitation of the task 4.1.1.

This plan relies on three major assumptions. First, a commercial approach based on product and technology is not fully efficient to promote the development of new or rehabilitation PSP projects. Secondly, the PSP market is highly depending on regulatory and market framework; the evolutions of these frameworks are consecutive to long-term promotions at both European and national levels. Finally, the exploitation of task 4.1.1 cannot be addressed in a stand-alone mode. Indeed, it is highly interconnected with the results of WP3 and WP4 dedicated to the development scenarios, the value of storage, the obstacles to its development and the inventory of potential new PSP sites. It is thus recommended to address all these topics jointly and built a complete communication package.

Two main directions should be considered for exploitation and replication:

1. Promote necessary updates in regulatory frameworks, at both EU and national level
2. Proactive PSP promotion towards electricity generation companies

Concerning the promotion of necessary updates in regulatory framework, first actions will be to build up recommendations for modifications in EU market rules to accommodate energy storage through European hydro and/or storage associations, and build up also a summary of the whole analysis: current barriers, value of storage, potential, recommendations. Then can be started the promotion of these documents at a European level, towards hydro, renewable and storage associations, and then towards EU authorities through hydro and/or storage associations.

Here is a list of potential tools that could be used in this promotion process:

- Press release announcing final results of eStorage Project
- Executive summaries for public deliverables for use by any stakeholder audience
- Briefings, meetings with partners executives, Government Affairs & Policy, Sales, Marketing and Communication teams
- Briefings meetings with like-minded industry bodies such as EASE
- Presentations at energy and/or renewable conferences

The same kind of process should also be implemented at a national level, with country-specific recommendations and summaries. The promotion will target first hydro, renewable and storage national associations, then national authorities (energy and renewable agencies) directly or through national associations, and also key national energy stakeholders (power producers, DSOs, TSOs). Operational action plan will be to work with the local media, create localized executive summaries for public deliverables, organize direct meetings with local policy makers and opinion formers, perform presentations at energy and/or renewable conferences when they occur in the country.

The second direction of the exploitation plan is a proactive PSP promotion towards power generation companies. This phase will be handled by GE sales and product management teams, as solution providers, supported by the other eStorage partners.

The keystone of this promotion phase will be business case studies specifically focused on prioritized sites. The prioritized sites will be selected from T4.1.1 and T4.1.2 respectively for upgrade and new PSP sites. These business cases will address both technical and economical stakes. They will be presented to the owners of the plant (in case of upgrade) or electricity generation companies targeting plant development (in case of new), focusing on the value of storage, the national context and dedicated economic case study. The technology is only addressed in a second time as a mean to reach value.

If the prospect is interested, an action plan will be jointly built to promote together PSP in their national environment. Would be investigated for example the opportunity to share these specific conclusions together with downstream players of the energy system and/or with national energy authorities, and the opportunity of a joint public communication (white paper, papers in energy and/or renewable conferences).

Finally, the global EU analysis and the communication tools will be enriched with the input of these new “partners”.

3 TASK 4.1.2 OVERVIEW OF POTENTIAL LOCATIONS FOR NEW PUMPED STORAGE PLANTS IN EU 15, SWITZERLAND AND NORWAY

3.1. Overview

The results of the assessment of potential locations for new pumped storage plants in EU-15, Switzerland and Norway carried out in Task 4.1.2 have been documented in Deliverable 4.2. A dedicated Public Relations, communication and dissemination plan was executed, for which the details and outcomes are described in section 3.2. Because dissemination of results is deemed an essential part of the success of Task 4.1.2, the model for identifying potential sites needed to be refined. A description of the model refinement is presented in section 3.3. As the result of the PR campaign, many inquiries have been received. The inquiries are presented in section 3.4. In section 3.5, the next steps are presented for maximising the impact of the results of Task 4.1.2.

3.2. Public Relations Campaign

A Public Relations campaign has been set up in collaboration with GE, to disseminate the results and raise awareness of the results within a broad target group, consisting of PSP project developers, policy makers and utilities. A variety of communication channels have been used to this end, such as trade press, social media, the eStorage website and conferences. This is further elaborated below.

Trade press is used as an important communication channel. The press release, included in this report as Appendix 5.1, describes the main findings and the outputs of the eStorage model. The press release has had a total pickup of 267: it has been posted 241 times in full text online and in social media, also it was mentioned in 22 tweets and 4 retweets so far. Furthermore, the release generated 12 shares on social media. This release led to 100 views across all websites and networks. Also, it led visitors 82 times to the eStorage website.

In Figure 1 it can be seen that the release was mostly seen by people from Germany and from the energy industry.

In addition, a study of DNV GL showed that DNV GL spokespersons have been quoted approximately 175 times in articles.

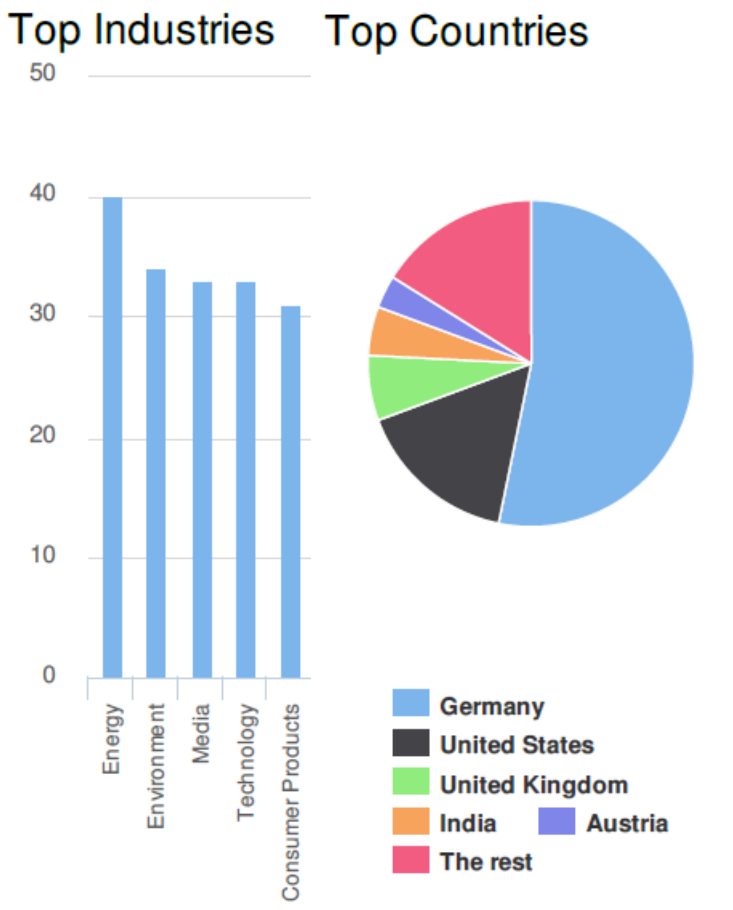

Figure 1: Industries and countries covered by the release

The publication led to coverage in the top 3 hydro trade publications: HydroWorld (includes Hydro Review Worldwide), Hydropower & Dams and International Water Power & Dam Construction Magazine.

Two interviews resulted from the press release, an interview with QualEnergia and Actu-environnement.

Several conferences have been visited where the results have been presented: ACI Paris Energy Storage Conference, EASE European Association for the Storage of Energy (TVAC – Technology Valuation & Assessment Committee) and Energy Storage Dusseldorf.

3.3. Requirements for model update

Although the model was able to create results for the countries in EU-15, Switzerland and Norway, the model had issues with stability and user-friendliness. This resulted in a time-consuming process to create new results, with a high chance of errors in iterations and tuning of the model. Given the wide interest in the model and the cumbersome handling of it, a new version of the model needed to be developed to overcome these problems.

As a starting point, a list of requirements for the updated model was developed. This list can be found in Appendix 5.2.

This new model is built in a Python environment, which is a GIS (Geographic Information System) tool. The Python environment allowed optimization in the code and therefore a faster runtime and lead to reproducible results. A Graphical User Interface was created to let the user easily change input datasets and parameters used in the estimation of the pumped hydro storage potential. Additionally, the tool can be used for further calculations, for instance in new countries, which might become relevant in follow up projects.

The eStorage model improvements did not change its functionality but rather the efficiency, accessibility, reproducibility and user friendliness. In this way it has become much easier to provide results for new areas or other specific purposes.

3.4. Received requests

As an outcome of the extensive Public Relations campaign, DNV GL received a large amount of queries concerning the model and its results. A list of the main queries can be found in Annex 5.3.

4 NEXT STEPS

The next steps are:

Adding results into ESTMAP (Energy Storage Mapping and Planning)

The objective of the ESTMAP project is to develop a geographical database with key characteristics of existing and potential future energy storage options in Europe. The database and corresponding GIS-maps delivered by this project will be made public and be continuously used and updated by the European Commission services. DNV GL is working with Ecofys and TNO to make sure the results of eStorage T4.1.2 are added to ESTMAP.

Solve questions from interested parties

DNV GL will continue solving the questions received concerning the model or the results in Deliverable 4.2.

Add countries to database where relevant

DNV GL will continue working with the model, where the addition of new countries to the model is an important development.

5 APPENDICES

5.1. Press release

Press Release
27 April 2016

eStorage Study Shows Huge Potential Capacity of Exploitable Pumped Hydro Energy Storage Sites in Europe

The eStorage Project, a European Commission-funded consortium of major European stakeholders from the entire electric power value chain, today announced the publication of a study that identifies a massive 2291 GWh of development-ready sites with existing reservoirs for new pumped hydro energy storage plants in the EU-15, Norway and Switzerland.

Southern Norway is the region with the most potential feasible pumped storage capacity with 1242 GWh or 54% of the study's total followed by the Alps with 303 GWh or 13% of the study's total (primarily Austria, France, Italy and Switzerland with 9 GWh in the German Alps). The Pyrenees in France and Spain have 118 GWh of feasible potential or five percent of the total realisable capacity in the study area.

The eStorage project has been tasked by the European Commission under its FP7 program to develop cost-effective solutions for the widespread deployment of flexible, reliable, GWh-scale energy storage across the EU and to enhance grid management systems to allow the integration of a large share of renewable energies. The 2291 GWh identified in the study is over seven times the current installed capacity of pumped hydro energy storage in Europe and more than enough to supply Malta's electricity consumption for a year.[1] It would require *95 million* lithium-ion batteries of the type found in most electric cars to provide equivalent energy storage.

Consortium partner DNV GL conducted the study, with the support of the eStorage members, and focused exclusively on existing water body pairs because of the cost advantages of connecting existing water bodies rather than building new reservoirs. This study is unique because it complemented multiple sources of quantitative data with a qualitative review by leading national hydro industry experts.

DNV GL developed a Geographic Information System (GIS) model using high-level non-country/region specific selection criteria to identify potential locations for new pumped storage plants. The potential locations from the model were further refined by national hydro experts using regional or country specific selection criteria. Following the national hydro expert review, DNV GL prepared a ranked list of potential sites by country with the total theoretical and realisable storage potential (TW, TWh) of each site, providing political and business leaders valuable information about the development of new potentially exploitable pumped storage plants.

"The qualitative review by leading national hydro experts is what really sets our study apart," said Haike van de Vegte, Senior Consultant at DNV GL. "For example, our Norwegian hydro expert called any reservoir below 2.5 GWh a low priority for Norway whereas for the rest of the study area, experts found reservoirs larger than 1 GWh very interesting. Also, the experts were able to provide country-specific requirements on usage of the water or environmental regulations, which could not have been integrated in the case of a desk study only. Consequently, the resulting database of pairs can be considered potentially realisable."

"eStorage is an ambitious project and these are some of the first results made public by the consortium," commented Maryse François, Technology Leader of GE's Hydro solutions. "Political and business leaders will be able to make better and more accurate decisions regarding the cost-effective implementation of energy storage in their countries or markets."

Pumped hydro energy storage plants are the only mature cost-effective and flexible means for GWh capacity storage of electricity. By transferring water between two reservoirs at different elevations, they can deliver electricity when the system needs it (for example on a calm day when there is little electricity produced from wind generation) and they can store electricity from excess generation of wind and solar plants.

Pumped storage also plays an essential role in power regulation which is the capability for generating units to rapidly adapt their output to keep generation and consumption balanced at all times. Electrical production and consumption need to be balanced to ensure the stability and continuous operation of electrical networks. Variable speed pumped storage units offer the added advantage of providing power regulation in generation *and* pump mode, e.g. 24 hours per day.

To download the complete report, visit www.estorage-project.eu

About eStorage

eStorage is a European Commission-backed consortium dedicated to developing a solution for cost-effective integration of intermittent renewable energies, such as wind, into the electrical grid. It includes major European players from the entire electric power "ecosystem," including Algoé, a management consultancy; DNV GL, a business and technical consultancy for the energy market; EDF, an energy company, active in all major electricity businesses; Elia, one of Europe's leading transmission system operators; GE, a leading power generation and distribution equipment and solution provider and Imperial College London, a science, engineering and business university, consistently ranked amongst the world's best.

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5.2. Model requirements

		REQUIREMENT	STATUS	CATEGORY
1	B1	The model should be able to run a complex country such as Norway		BASIC FUNCTIONALITY
2	B2	Model should be usable / easy to adapt for any country or region		BASIC FUNCTIONALITY
3	B3	Model needs to identify appropriate water bodies		BASIC FUNCTIONALITY
4	B4	Model need to pair waterbodies		BASIC FUNCTIONALITY
5	B5	Model needs to give a good estimation of elevation		BASIC FUNCTIONALITY
6	B6	Model needs to give a good estimation of volume		BASIC FUNCTIONALITY
7	B7	Model needs to give a good estimation of distance between waterbodies		BASIC FUNCTIONALITY
8	B8	Model needs to "avoid" duplicates		BASIC FUNCTIONALITY
9	B9	Model needs to exclude pairs / water bodies based on criteria.		BASIC FUNCTIONALITY
10	B10	Model need to derive parameters such as slope, GWh storage…		BASIC FUNCTIONALITY
11	B11	Models needs to deliver results and they should be replicable		BASIC FUNCTIONALITY
12	B12	Model should be as fast as possible		BASIC FUNCTIONALITY
13	E1	user should be able to change ranges for exclution criteria		EXCLUSION CRITERIA
14	E2	user should be able to include new criteria		EXCLUSION CRITERIA
15	D1	Model should be set up to take in updated and new datasets		DATA INPUT
16	D2	The model needs to include the possibility to improve the calculation of storage volume and overwrite calculation with actual data if this is available		DATA INPUT/
17	D3	If several "conflicting" datasets, the model needs to know which to use - secure best possible results and avoid duplicates		DATA INPUT/
18	U1	Model need to limit need for manual corrections		USER INTERFACE / FRIEND.
19	U2	The user of the model is somebody within the organization and should have basic understanding of (Arc)GIS		USER INTERFACE / FRIEND.
20	U3	There should be a user manual		USER INTERFACE / FRIEND.
21	U4	Somebody with expert understanding (not the developer of the first version) should be able to adjust the model		USER INTERFACE / FRIEND.
22	U5	The software should be usable by several people within the organization (either with license or without (open source), but no specific requirements for the type of software		USER INTERFACE / FRIEND.
23	U6	Model results should be easy to link with geographical location data - for instance name of water body		USER INTERFACE / FRIEND.
24	U7	Model need to be able to present and report results in format that is easy to work		USER INTERFACE / FRIEND.

5.3. Queries resulting from the PR Campaign

Prospect Id	First Name	Last Name	Email	Company
	Mathis	Rogner		International Hydropower Association
	Michael	Darke		University of South Wales
	Rianne	Cunningham		University of Leeds
	Abu	Bakar		KIT
	Carlo	Ricciardi		Consiglio superiore lavori pubblici
	Alfredo	Scherngell		EKZ
	Odd	Ã˜ygarden		E-CO Energi
	ranc	nathan		serhy
	Jan	Tnnessen		Agder Energi
	Jungwan	Park		KHNP
	Anders	Holm		HOLM.as
	Per	Henriksen		VE-BYG
	Michael	Rieley		Scottish Renewables
	Jacques	MOEGLEN		AXTER
	Jan	Barton		ARCADIS CZ a.s.
	Alex	Shepard		Amec Foster Wheeler
	onder	nalbant		Guris
	William	Steel		Renewable Energy World
	Markku	Hagstrm		Gaia Consulting Oy
	Krutarth	Mengde		Pendharkar Consultants
	Jukka	Kuuskoski		Kuuskoski Consulting Oy
	Erik	YstgÃ¥rd		University of Bergen
	Jose	Rebollo Pericot		Pentaedro, S.L.
	Teuvo	RAESALMI		Solved