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Power Storage

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Season's Greetings from the SETIS Team

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Editorial

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Energy Storage: Strengthening the backbone of modern society

Renewable energy sources are increasingly penetrating the European energy market; fossil fuel prices are projected to increase significantly in the coming years and decades. The patterns of energy supply and consumption are changing rapidly. The internal energy market is on the verge of becoming a reality.

Renewable energy sources are predominantly intermittent sources of generation, non-dispatchable and with wide seasonal variations, which increase the fluctuation of the power flows in - and reduce the stability of - the electric system. Higher variability of both power generation and consumption, combined with situations in which generation exceeds demand and vice versa, creates new challenges for the electrical system in general and puts a tremendous stress on transmission and distribution networks, thus leading to an ever increasing need for grid flexibility.

It is at this critical junction that the SET-Plan plays a vital role, focussing on those technologies that are needed to address the above challenges by helping them onto the market, making them cost competitive, resilient and able contenders on the international playing field. Energy storage - recognised as a “Strategic Energy Technology” - is one of them. Whilst the first of several cost-competitive solutions are already hitting the market today, there are still significant technical and financial challenges ahead, which the SET-Plan will help to address.

The changing energy landscape requires a large range of Energy Storage solutions, with varying storage capacities (from seconds, over hours, to days or even weeks) and both centralised and decentralised implementation patterns. Enabling European industry to bring this export technology to full maturity will definitely contribute to the global competitiveness of the EU. It is in this context that the pillars of Research, Development and Demonstration (RD&D) have to be reinforced, to guarantee that modern society takes full advantage of the benefits of renewable energies, avoiding curtailment and minimising additional grid and balancing infrastructure investments. Here, the SET-Plan becomes not only important, but vital for – as Commissioner Oettinger put it – the backbone of modern society: the energy system.

After all, transmission lines may bring energy from point A to point B, but storage will bring it from today to tomorrow.

The European Association for Storage of Energy (EASE) is the voice of the energy storage community, actively promoting the use of energy storage in Europe and worldwide. It actively supports the deployment of energy storage as an indispensable instrument within the framework of the European energy and climate policy to deliver services to, and improve the flexibility of, the European energy system. EASE seeks to build a European platform for sharing and disseminating energy storage-related information and supports the transition towards a sustainable, flexible and stable energy system in Europe. For more information please visit www.ease-storage.eu.

DECEMBER 2013

SET-Plan update

Energy Storage Focus

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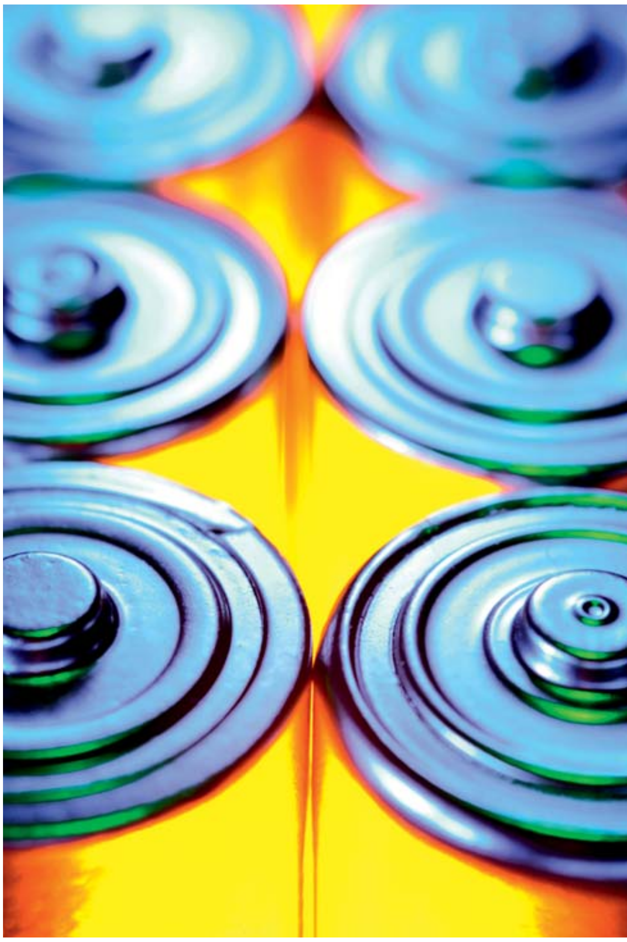
The European Strategic Energy Technology Plan (SET-Plan) aims to transform the way we produce and use energy in the EU with the goal of achieving EU leadership in the development of technological solutions capable of delivering 2020 and 2050 energy and climate targets.

Energy storage can supply more flexibility and balancing to the grid, thereby easing the market introduction of renewables and accelerating the decarbonisation of electricity supply. As such, it is a key element of the EU strategy to bring Europe closer to its renewable energy targets. The following is a chronological overview of some of the actions taken to promote the development and uptake of energy storage technology throughout the EU in support of SET-Plan objectives.

- In 2006, the **European Commission** issues a Directive on batteries and accumulators and waste batteries and accumulators (2006/66/EC), or the **EU Battery Directive** as it is more commonly known. This directive has the aim of minimising the negative impact of batteries on the environment and improving their overall environmental performance. This was followed by secondary legislation on batteries with, inter alia, Directives 2008/12/EC and 2008/103/EC amending the Battery Directive, Decision 2009/603/EC establishing requirements for the registration of battery producers, and Regulation No. 103/2010 establishing rules for capacity labelling of portable secondary (rechargeable) and automotive batteries and accumulators.
- Under its **Seventh Framework Programme (FP7)**, in 2006 the European Union finances a number of projects that aim to improve the regulatory environment and advance research into energy storage technologies in Europe, these projects include **HESCAP (New generation, High Energy and power density SuperCAPacitor based energy storage system) and NIGHT WIND (Grid Architecture for Wind Power Production with Energy Storage through load shifting in Refrigerated Warehouses) in 2006, in addition to the POWAIR, eStorage, STORAGE, and stoRE projects featured in this magazine, and others.**
- The European **SmartGrids Technology Platform** publishes a Vision and Strategy for Europe's Electricity Networks of the Future in 2006, which stresses the importance of energy storage in the grid of the future. It follows this with a **Strategic Research Agenda** (SRA) in 2007, in which it identifies innovative energy management strategies for large distributed generation penetration, storage and demand response as a strategic research task. In its SRA 2035, published in June 2013, widespread storage within the grid is listed as a high-priority research topic.
- The European Parliament's Economic and Scientific Policy Department published the study **Outlook of Energy Storage Technologies** (IP/A/ITRE/FWC/2006-087/Lot 4/C1/SC2) in February 2008, at the request of the European Parliament's committee on Industry, Research and Energy (ITRE).
- The **Fuel Cell and Hydrogen Joint Undertaking (FCH JU)** is created as a Community Body on 30 May 2008 and becomes autonomous in November 2010. Between May 2008 and November 2010 the Joint Undertaking is managed by the European Commission. The Commission publishes a First Interim Evaluation of the Fuel Cell & Hydrogen Joint Undertaking in May, 2010.
- In November 2009 the European Commission, through a SETIS workshop held in Brussels in the same month, encourages the European industrial and research community to set up a European Task Force on Energy Storage, working towards a shared European vision on the role of energy storage in power applications and aiming to identify measures to maximise the sector's contribution to the implementation of the SET-Plan.
- Following on from the Energy Storage Task Force launched by the European Commission in 2009, a group of European leading players in the energy sector, including manufacturers, utilities and academic bodies, found the **European Association for Storage of Energy (EASE)** in Brussels in September 2011. The creation of EASE results from a European Commission initiative,

looking for a consensual vision of the roles, technologies and potential applications of energy storage within the framework of EU Energy and Climate policy.

- The **European Energy Research Alliance** launched a joint programme on Energy Storage in 2011, with sub-programmes covering electrochemical storage, chemical storage, thermal storage, mechanical storage and superconducting magnetic energy storage. These programmes define individual work packages and milestones based on the diverse research and technological requirements of the different energy storage technologies.
- The European Commission holds an **Electricity Storage Expert Workshop** in February, 2012, and in April of the same year an **Expert Workshop on the Assessment of the Potential of Pumped Hydropower Storage** is organised on behalf of SETIS by the Energy Systems Evaluation Unit of the Joint Research Centre's Institute for Energy and Transport.
- **EURELECTRIC** organizes an energy storage workshop in April 2012 to discuss electricity storage from a policy-making, industrial and research point of view. The workshop focusses on the role of small-scale energy storage and the services and applications it brings to the electrical system to meet future needs, and examines the main regulatory challenges hampering the optimal operation of pumped storage.
- In April, 2012, the **European Association for Storage of Energy (EASE)** publishes a position on the European Commission's Energy Roadmap 2050, in which it commended the European Institutions for the work and progress achieved so far and provided industry feedback and offered expertise in a constructive dialogue with the European institutions concerned.
- The European Commission published its **Energy Roadmap 2050** in 2012, in which it noted the critical importance of storage technologies. According to the Roadmap, the EU should contribute directly to scientific projects and research and demonstration programmes, building on the SET-Plan, and invest in partnerships with industry and Member States to demonstrate and deploy new, highly-efficient energy technologies on a large scale. The Roadmap noted in particular that a new sense of urgency and collective responsibility must be brought to bear on the development of **new energy infrastructure and storage capacities** across Europe.
- In December, 2012, the **European Parliament** included an amendment on energy storage in Horizon 2020 legislation. This amendment acknowledges the importance of energy storage related research to the meeting of SET-Plan objectives.
- On 14 January 2013 the European Commission published the Working Paper "**The future role and challenges of Energy Storage"** identifying the need for a European strategy to advance energy storage development and deployment. With this document the Commission aimed to give more attention to the issues around energy storage with a view to addressing them more effectively in EU energy policy.



- **Regulation (EU) No 347/2013 of the European Parliament and of the Council of 17 April 2013 on guidelines for trans-European energy infrastructure** is published. This is followed in May of the same year by the Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions [COM/2013/0253 final] **Energy Technologies and Innovation**.
- A conference on facilitating energy storage to allow fast growth of sustainable energy is held as part of **Sustainable Energy Week** in June 2013, to discuss policy issues and the regulatory framework required for the development of storage infrastructure, which is seen as crucial to allow the accommodation of the ambitious renewable energy targets in the EU.
- In July, 2013, **EASE** published its first annual **Activity Report**. Highlights in 2012 include the signing of Memoranda of Understanding with the Electricity Storage Association, based in Washington, EURELECTRIC, EUROBAT and Gas Storage Europe. The organization finished 2012 with 32 members.
- The Joint Research Centre, the EU's in-house science service, publishes the report **Assessing Storage Value in Electricity Markets**. Drafted in cooperation with the R&D department of Electricité de France (EDF), this report presents an overview of current research on the economic drivers or barriers for electricity storage.

SETIS TALKS TO:

Jean-Marie Bemtgen

Policy Officer, European Commission Energy Directorate (DG ENER)

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You recently said that storage is the 'weakest link' in Europe's electricity chain today. Could you explain why that is?

J.M.B.: "Our electricity chain, or indeed our whole energy chain, is integrated in a very complex way. Everybody treats it as if it were the sum of individual silos and nobody tries to build intelligent bridges or links between them. Storage could be a fantastic bridge, making sure we get higher efficiency at lower cost. It has huge potential. Having said this, we should never forget that storage – by definition – has negative efficiency and excessive costs. You don't want to store for the sake of storing. You only want to store if the alternative solution is even more expensive – for example expanding the grid. That holds both for large-scale and small-scale or local storage."

Why is storage important for the future development of the electricity grid?

J.M.B.: "We will see growth in the electricity demand up to 2050 – and the share of renewables will grow disproportionately. Also, the greatest growth will be in variable renewables. As the share of variable renewables grows, the need for storage will be zero at first, then minor and finally the need will grow exponentially. The situation will be very different in 2050 to what it is now, although it will vary from country to country. For example, we expect there to be major problems in Germany by 2030, due to the Energiewende - the Federal energy transition strategy. They are aiming for a high proportion of renewables in a very short time – anywhere between 85 % and 95 % before 2050, depending on how you calculate it. Other countries are aiming for 45 % – 65 %."

What role can small-scale, decentralised storage play in managing the grid?

J.M.B.: "For the moment we have a huge growth for local solar photovoltaic (PV) generation. A small part of what is produced is used in the home and the remainder is dumped into the electricity grid, as if it were a waste bin. Very few people ask if the grid can take it or if the grid needs it. Some people believe that everything can be solved with smart grids, smart meters and demand side management. A lot can be solved with those solutions. But at a certain moment, which is highly dependent on local circumstances, storage could be a cheaper or more efficient solution. However, there cannot be a 'one size fits all' rule for all of Europe.
The most foolish thing to do is store PV electricity in batteries

[1] http://ec.europa.eu/energy/infrastructure/doc/energy-storage/2013/energy_storage.pdf

and then use the batteries to heat domestic hot water. It's also stupid to use local batteries to drive air conditioning. We have to integrate the storage of electricity with the storage of heating and cooling. It is a hundred times cheaper to store heat or cold than to store electricity. It always makes most sense to store what is cheapest. We need to get rid of the politics and first make sure that the thermodynamics are right.

Regarding grid management, a huge amount of electricity is already used for heating homes and domestic hot water. The installed capacity in Europe is about 50 GW, which is exactly the same as the installed capacity of pumped hydro storage plants. Tapping those for free would make a huge amount of sense – and that is especially true in the UK, Ireland and France. That's why we should be talking about energy storage and not just electricity storage. It's an important distinction. ”

How does the notion of a smart grid affect the way storage will be used?

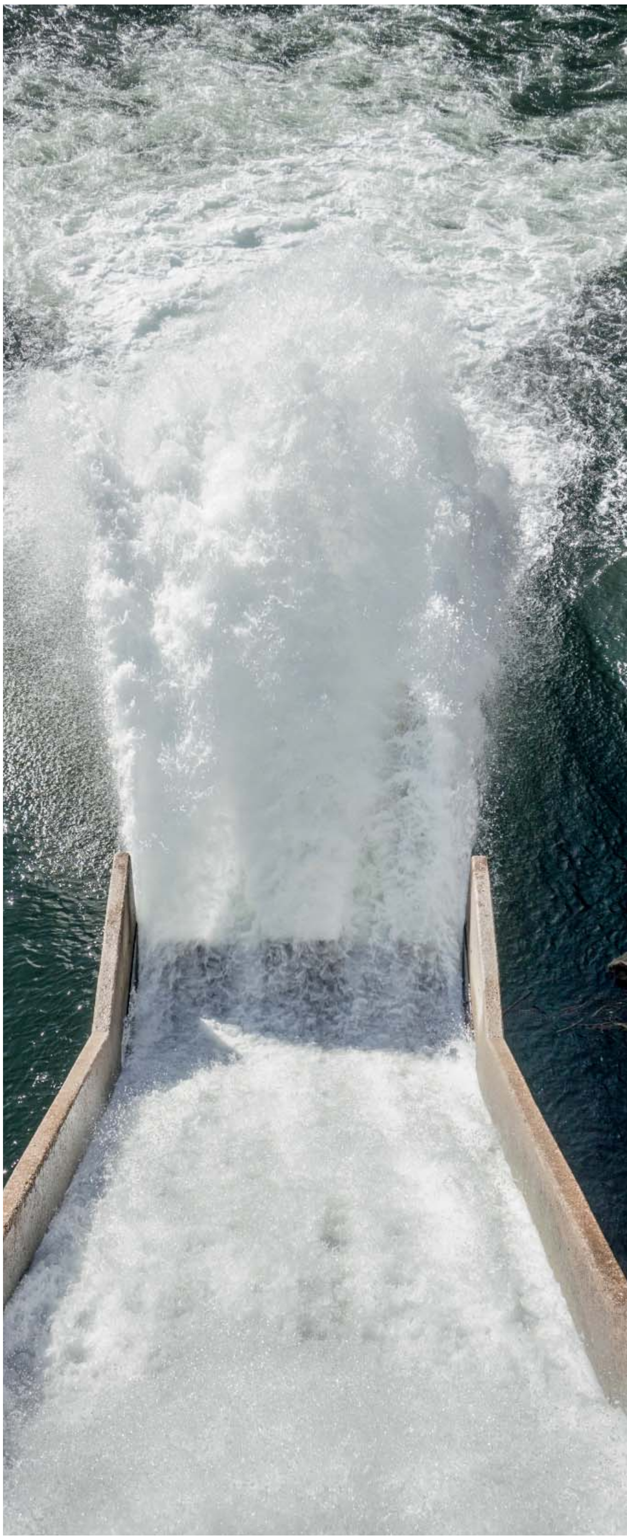
J.M.B.: “ The smart grid allows us to manage all the different elements in a more intelligent way. If you have a smart grid you want to have smart storage too. Or you can have 'stupid storage', but manage it in a smart way. An electric domestic hot water storage boiler is stupid. But if you link it in a smart way into the energy system, then the system becomes smart. ”

Is the technology in place for the widespread use of decentralised storage?

J.M.B.: “ For the moment a large share of electricity is used for heating hot water and space. And we are moving towards greater use of heat pumps that are electrically driven. Germany has started to promote battery storage, with mixed results. They've only spent one quarter of the subsidies that were foreseen for 2013. People were reluctant to buy. The payback is too long. At a recent conference I asked a simple question: if you have 1000 batteries and 1000 homes, do you put one battery in each home, or 1000 batteries in one place, close to the transformer station? Everybody agreed that the transformer station solution was better. This was true for government subsidies, Distribution System Operators (DSOs) and battery manufacturers. They all prefer the idea of batteries close to the power station. This however is the case for Germany – other locations may have different rules and regulations.

We know that in ten years we will have much more storage, but we don't know which type, which technology, or how to optimise the storage technologies in terms of performance and costs. We will have to learn by doing. ”

What more needs to be done in terms of policy and regulatory frameworks to encourage the private sector to help bring costs (of storage) down?



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[1] http://ec.europa.eu/energy/infrastructure/doc/energy-storage/2013/energy_storage.pdf

J.M.B.: “We are working very hard on that because batteries are not electricity generators – they have negative efficiencies. They are a tool to increase flexibility. But nobody rewards flexibility at the moment. As long as you are only buying and selling kilowatt-hours while you need flexibility, the market can never be right. We have to change the market rules. If you use batteries to stabilise the voltage of the grid or the frequency, for example, you won’t be paid for that service. How do you expect the benefit to be right if the market conditions are wrong?

At the moment we are still trying to develop this kind of policy. We’re in a phase I call ‘n+1’, where ‘n’ is the number of people discussing and ‘n+1’ is the number of opinions. The market has been wrong for the past 40 years. So it’s not a question of gaining two weeks of time and making mistakes. It’s not important if it takes six months or two years to get it right. What matters is to get it right, to give the right signal to industry so that they go for large-scale implementation.

Most hydropower storage facilities are located near to national borders, because transporting electricity 20 km is easy. But the problem is that we have different and conflicting regulations in different countries. In Europe, you are allowed to sell kilowatt-hours on the wholesale market, but you are not allowed to sell dynamic storage services and other grid interventions across national borders. At the end of our strategy paper in DG-ENER[1] you will see a table with all the different regulations. No two countries are the same. And every country’s storage is regulated differently. This makes it doubly complex. Storage is very complex.”

Do you think we need to change these regulations?

J.M.B.: “If we don’t change the regulations we will stop the existing storage facilities, just when we need more. To save the market for local storage we also need to adapt local regulations to get local storage. If we don’t do that we will fail in our objectives for 2030-2050. It’s quite simple. No experts believe we can achieve 2050 targets with zero storage. Ten to fifteen years ago people believed that, but not today. There is an official statement from the German government that says: ‘no storage, no Energiewende’. They’re very firm about that and the French think the same: and that holds for the batteries in an iPhone, or an electric car, as well as pumped hydro storage.”

How can SETIS help to encourage these developments?

J.M.B.: “SETIS is absolutely necessary to ensure that we get the strategy and technology right, in a neutral and professional way, free from lobbying, industrial interests, national policy, etc. The subject is very important and I am so pleased that my colleagues working in SETIS take this task so seriously. Over the last two years we have succeeded in having a very dynamic dialogue with all industrial stakeholders. We hope that this positive cooperation will continue over the coming years, also with SETIS.”

Jean-Marie Bemtgen

Policy officer for new energy technologies and innovation, European Commission Energy Directorate (DG ENER)

Jean-Marie Bemtgen is a Project Officer responsible for new energy technologies, innovation and research coordination at the EC Directorate-General for Energy (Unit C2), which focuses on new energy technologies, innovation and clean coal.

Mapping of energy storage innovation in Europe

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In recent years, interest in buffering energy has surged and it has started appearing in more and more vision documents, energy policy papers and energy roadmaps all over Europe. At the same time people started realizing that there was little to no knowledge on the current state of development of this field. There are projects supported by the European Commission, but many efforts by the Member States did not show up on the radar screen. Furthermore, there was only limited organisation of the energy storage industry stakeholders, so there was no systematic source of information from that side either.

Back in September 2012, the SET-Plan European Electricity Grid Initiative (EEGI) recognised both the significance of storage and the lack of systematic understanding of the field. In 2011 it had already mapped demonstration projects for electricity distribution grids. It was therefore a logical development to start building a comprehensive overview of innovation activities in energy storage.

As a SET-Plan Industrial Initiative, the EEGI had access to the best expertise in industry, R&D and government. With major support from the Member States, an expert group was created consisting of people with strong insight into the development of storage innovation in their respective countries. This group collected a massive amount of data on ongoing storage research, development and deployment projects throughout Europe, which formed the basis for the work.

Europe is betting heavily on storage

A total of fourteen countries were covered, together with activities co-funded by the European Commission (e.g. through FP7). It turned out that - over the past five years - almost EUR 1 billion had been invested in this field spread over 391 distinct projects. This was significantly more than expected.

The mapping provides an overview by looking into the technological orientation of each project and by mapping at which level it is related to the electricity grid (from generation of transmission to distribution and end users). This approach will help inform further decisions on the role of storage in grid development and the interactions between both.

Globally speaking, national funding amounts to close to EUR 800 million; the EC's share is around 200 million and is thus very sizeable in comparison to the average share of European funding in R&D. The bulk of the budgets is spent on electrochemical storage (mostly batteries), power-to-gas and thermal storage.

The field of energy storage is clearly a fledgling one, with the exception of some of the technologies used in pumped hydropower. Most efforts in the field are therefore still at the research stage, with some of them reaching first pilots. Very few projects have advanced to the demonstration or pre-commercial stage. Those that have done so are considerably larger than the rest of the sample. It is worth exploring the link that seems to be present between financing schemes based on grid tariffs and the number of more advanced and large projects.

In terms of focus, most projects tend to be found at distribution level or with end users. As few very large developments/demonstrators are going on at the transmission and the generation level, the distribution is somewhat less skewed when considering the total amounts of investment involved.

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A diverse picture

Beneath the global analysis a wealth of insights on individual countries is presented. Overall there seems to be some tendency to regional specialization throughout Europe. Southern Europe is strongly focused on batteries. Countries like Italy are bringing large facilities online throughout the grid, but the tendency is also very clear in Spain and Portugal.

Mechanical storage, which is an umbrella for compressed air on the one hand and pumped hydro on the other, is concentrated in a few countries. As it could be expected, mountainous countries like Austria and – especially – Norway have strong contributions. We also see a relatively high contribution from Denmark with e.g. compressed air and unconventional pumped hydro storage. Power-to-gas and chemical storage, finally, are resurging. The most outspoken activity on this topic is found in Western Europe with Germany in the lead.

At the same time, the difference in pace between Western and Eastern Europe is remarkable. This may be something to pay attention to in the future. The risk is that there will be a Europe with two speeds on energy storage development.

The road forward

The mapping that the EEGI undertook was a pioneering piece of work. It can be a very valuable basis for strategic and policy work in the area of storage. The study provides a factual basis to build upon and offers a better understanding of the strengths and shortcomings of the storage landscape as it is today.

At the same time any mapping is - necessarily – a snapshot that is frozen in time. It needs to be updated from time to time to maintain its value and capture the most recent trends and developments. We also realise that a pioneering piece of work cannot possibly be complete. An update in this case would also mean improving the data set and expanding it to other countries. We managed to include 14 Member States this time; there are 14 more of them in the EU.

So let us look forward to autumn 2014, when the first update is planned. The field of storage will likely be more mature – and definitely a whole lot larger.

www.gridplus.eu/news/energy-storage

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Decentralised storage – the way forward for Europe's electricity grids?

Decentralised storage and renewable energies have been described as 'the perfect match'. Storage can smooth out the peaks and troughs of intermittent electricity supplies from renewable energies, essentially by storing energy when it is plentiful (e.g. during daylight hours for solar energy) and making it available for consumption when generation output is low. But relatively small storage facilities near to the point of production – in contrast to large, remote storage facilities such as hydropower – may also have more far-reaching implications for the design and operation of the electricity distribution grids of the future, not least smart grids.

A joint report published in April this year by the European Association for the Storage of Energy (EASE) and the European Energy Research Alliance (EERA), points out that storage solutions can have benefits at all levels of the electricity system. "At the central generation level," says the report, "they help in arbitrage, capacity firming or reducing curtailment. When it comes to transmission, they can play a role in frequency and voltage control and black starting [after a shut-down]. Distribution solutions support voltage control, and the reduction of curtailment. Finally at the customer level they are needed for peak shaving [shifting demand from peak to off-peak times], islanding [keeping a local network operational during a black-out] and general demand response." However, at an EASE policy briefing in March, Jean-Marie Bemtgen, Policy Officer at the EC's Energy Directorate (see also the interview in this issue), warned that storage is "the weakest link in our energy chain today," adding that, in the future, every new EC energy policy initiative will be considering potential opportunities for storage developments.

The stakes could indeed be high: a study by researchers at Imperial College, London, commissioned by the Carbon Trust,[1] found that "… in a 2050 high renewables scenario, the application of energy storage technologies could potentially generate total systems savings [for the U.K.] of GBP 10 billion per year, by avoiding distribution network reinforcements driven by electrification of the heat and transport sectors". Today, the grid is designed to cope with peak loads that usually occur for only a few hours on a few days a year. It has capacity far beyond its requirements most of the time. But, as a report by Eurelectric (the association representing the European electricity industry)[2] points out, in the future, decentralised smart and small-scale storage will make grid expansion less imperative, by enabling active grid management as part of a two-way process involving 'prosumers' – consumers who also feed electricity into the grid from their own solar panels, wind turbines or electric vehicles.

So long as renewable energy sources make up less than 25 % of the energy mix, conventional, centralised storage can balance out fluctuations in the grid, ensuring that supply matches demand on a second-by-second basis. This can be reinforced if necessary by back-up supply, e.g. from open cycle gas turbines, depending on how quickly and for how long the shortfall lasts, as well as by demand-side management, such as demand response, where consumers themselves modulate their electricity use to match supply – often driven by price incentives. But as the proportion of renewable energy sources in the electricity generation mix increases – with a target of 55 % under the EC's 2050 Energy Roadmap scenario and over 90 % expected in Germany – the corresponding increase

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in fluctuations, because of the intermittent nature of the supply, will challenge these existing stabilising capabilities.

A number of technological solutions are already available to provide electricity storage, depending on how quickly and for how long the stored power is required. The choice of storage – from existing massive remote hydropower down to transportable batteries in smart cars – also depends on how much space is required and where in the distribution and transmission chain, from high voltage to medium and low voltage networks, it is required.[3] Apart from space, the main obstacle is cost, as the technology is still young and incentives are still required to attract investors to back research and development. But, as the Eurelectric report points out, "where a storage solution proves to be competitive against the cost of expanding network capacity, it should be preferred, as it reduces the overall cost for ratepayers (consumers), improves the utilization of distribution assets and, in the end offers DSOs (distribution systems operators) a better use of capital for other projects."

A number of demonstration projects are already underway or being planned in Europe to test the contribution of alternative forms of large-scale storage on the running of the electricity grid. One of the most recent, and largest, is a 6 MW capacity lithium manganese battery installation in Leighton Buzzard (U.K.), costing €22.4 million, mostly funded by the U.K. government, and being built by a consortium of S&C Electric Europe, Samsung SDI and Younicos. The project is expected to come on-stream in 2016.

Distributed generation technologies, combined with local storage, can also have much higher efficiencies than large centralised facilities and also have greatly reduced, even negligible transmission infrastructure costs. Indeed, in the future, with a high proportion of small-scale renewable energy sources connected to local storage, most of the grid could consist of local, low voltage lines, with high voltage transmission lines only used to link large wind farms, solar arrays and conventional power stations with urban areas.

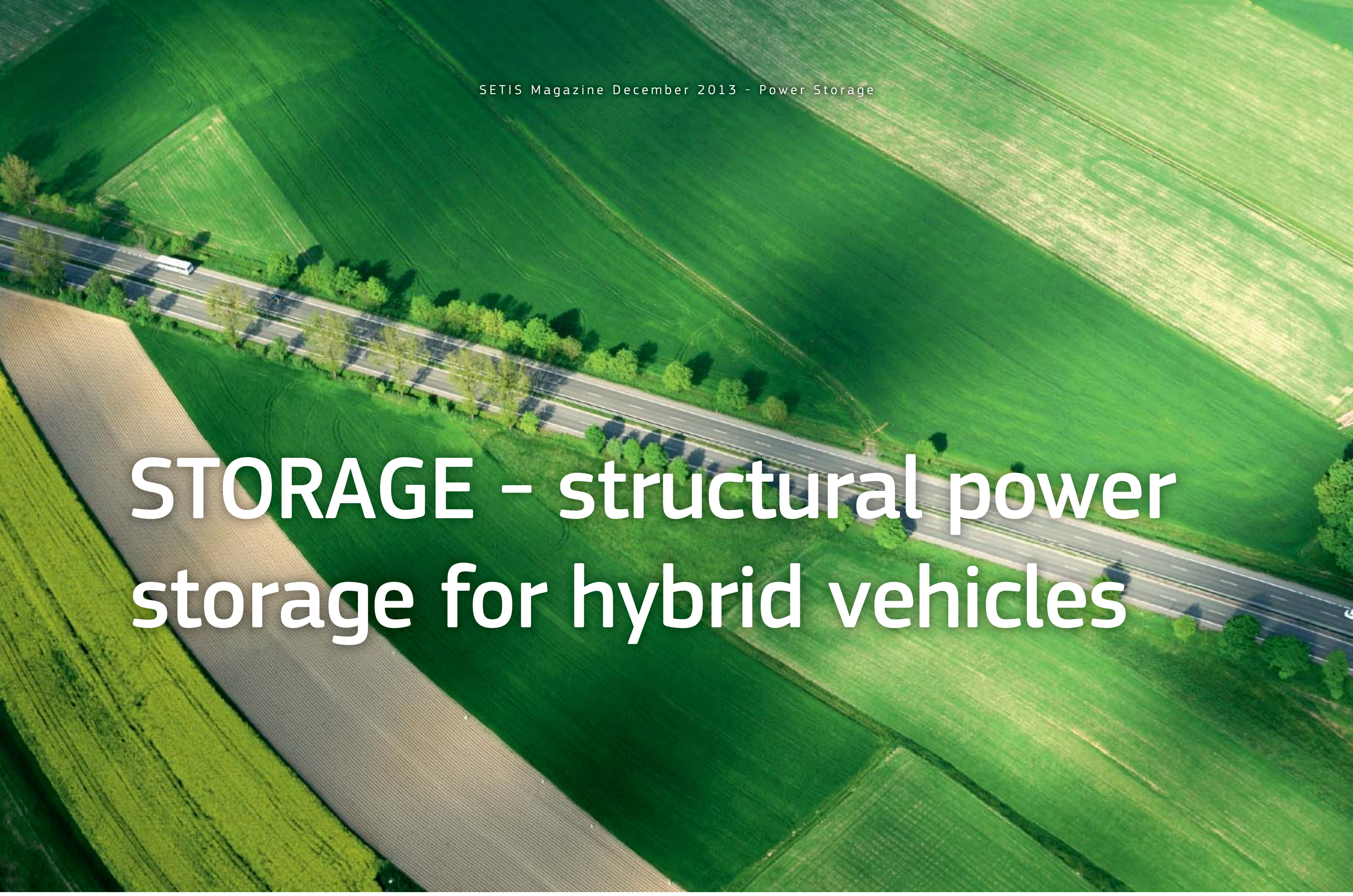
But much of the potential for decentralised storage in the future could be via the smart grid. Unlike the conventional grid, the smart grid is two-way, with consumers also supplying electricity. As the Eurelectric report puts it, "a future smart grid without decentralised electricity storage could be like a computer without a hard drive: seriously limited." Decentralised storage can help to balance out unacceptable voltages or currents from intermittent sources, allow renewable sources to continue producing electricity, rather than be curtailed, when they would otherwise lead to grid congestion. It can also overcome short-duration voltage sags and interruptions, help DSOs postpone grid expansion by making more efficient use of existing capacity and improve the reliability of local supply.

Decentralised storage may also have a longer-term role to play in energy management, by decoupling electricity production from its instantaneous consumption (i.e. arbitrage). As small-scale storage technology close to the point of production becomes more affordable, it will help renewable energy to move away from a subsidised system of feed-in tariffs towards a market-driven approach, by increasing the availability and reliability of the energy supply from intermittent sources and creating a more solid business case.

EERA report
http://tiny.cc/EERA_Smart_Grids

1 http://www3.imperial.ac.uk/newsandeventspggrp/imperialcollege/administration/energyfutureslab/newssummary/news_5-7-2012-14-8-41
2 http://www.eurelectric.org/media/53340/eurelectric_decentralized_storage_finalcover_dcopy-2012-030-0574-01-e.pdf
3 For more information, see: http://setis.ec.europa.eu/newsroom-items-folder/eera-smart-grids-programme-looks-at-state-of-the-art-on-storage

STORAGE - structural power storage for hybrid vehicles



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The EU-funded research project Composite Structural Power Storage for Hybrid Vehicles (STORAGE) was set up to develop new concepts for lightweight energy storage to radically improve the efficiency of hybrid vehicles by using parts of a car's structure as power sources.

With an award of €3.37 million under the 'Transport' theme of the EU's Seventh Framework Programme (FP7), the project is focusing on research into materials that simultaneously carry mechanical loads whilst storing electrical energy. These materials are resilient, strong and lightweight, making them well suited to the manufacture of car parts, while at the same time having crossover applications for information and communications technology.

Essentially, the heavier a vehicle is the more energy it requires to move. Consequently, the weight of existing batteries is a factor that reduces the environmental benefits of hybrid vehicles. This is the main problem that the STORAGE project seeks to address and, by focusing on innovative composite materials that lower the weight of the vehicles by integrating the energy storage systems into the structure of the vehicle itself, the aim is to improve the efficiency of the hybrid cars and make them a more viable alternative to conventional vehicles.

Materials used in the construction of a vehicle that do not contribute to its load-carrying capacity are structurally parasitic in that they contribute to the power drain on the vehicle. While the standard approach to maximizing the efficiency of hybrid vehicles has been to examine the efficiency of individual subcomponents, this project differs in that it aims to create new materials that simultaneously perform more than one function, thereby offering significant savings in mass and volume, in addition to performance benefits.

The project's novel concepts include composite structural capacitors and batteries, which reduce the need for traditional batteries, allowing for an associated reduction in the total weight of the vehicle. According to the researchers working on the project, using the composite material to replace the wheel well for the spare wheel alone could reduce a car's overall weight by 15% and significantly improve its driving range. Furthermore, the composite material will be able to store and discharge large amounts of energy, and can simply be recharged by plugging a hybrid car into the driver's home power supply.

One of the priorities of Horizon 2020 will be to promote research leading to the market rollout and consumer uptake of technologies that achieve the twin goals of helping Europe reach its SET-Plan targets, while at the same time ensuring Europe's place at the cutting edge of innovation. The STORAGE project addresses the 'competitive industrial processes' research area identified in the FP7 call for proposals, and involves work on innovative product concepts that will strengthen the competitiveness of European industry in emerging green technologies, while at the same time providing a means to significantly reduce CO2 emissions from surface transport.

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The STORAGE consortium, which sees the UK's Imperial College London (ICL) collaborating with teams from Belgium, Germany, Greece and Sweden, will provide innovative products and concepts which will strengthen the competitiveness of European industry. ICL's Dr Emile Greenhalgh said: "We think the car of the future could be drawing power from its roof, its bonnet or even the door, thanks to our new composite material. Even the Sat Nav could be powered by its own casing."

The versatility of the polymer composites being examined means they provide an ideal opportunity to develop novel multifunctional materials which can store the electrical energy required to power systems, while simultaneously meeting structural demands. Carbon fibre composites are attractive as they are commonly used as both electrodes and high performance reinforcements. Previous work has demonstrated that these multifunctional materials can be synthesised in a laboratory, and the technology is ready to be taken up by industry.

Initial work for the project focused on two techniques for developing the innovative materials: 'reinforcing and grafting' and 'multifunctional resin'. Cost-benefit analyses helped to identify the most promising constituents, which were then combined into composites. Samples of these innovative materials were then manufactured and tested for their mechanical and electrical performance, with a view to showing that they provide an efficiency improvement of at least 15% compared to conventional materials.

The researchers have identified several novel technologies which improved performance. These include carbon aerogel reinforcement, matrix development based on a mixture of existing epoxy resins and liquid electrolyte, and improved composition of multifunctional resins for super-capacitors. The STORAGE researchers also looked at system issues associated with structural power sources such as power management, packaging and connectivity. Demonstrators using the new composites were built and tested on a small scale.

The STORAGE project has laid the groundwork for revolutionary developments in efficient vehicles for the future. These technologies will help implement more sustainable transport solutions and, by developing revolutionary lightweight energy storage concepts for future vehicles, they will not only make a significant contribution to the meeting of greenhouse gas reduction goals for 2020 and beyond, they will also serve to keep the EU at the cutting edge of high-tech research and development.

For more information:
http://cordis.europa.eu/result/brief/rcn/11648_en.html
http://cordis.europa.eu/fetch?CALLER=EN_NEWS&ACTION=D&RCN=31737
http://www3.imperial.ac.uk/structuralpowerstorage

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SETIS TALKS TO:

Alfons Westgeest

EUROBAT Executive Director

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How significant a role will batteries play in helping Europe achieve its energy and climate goals?

A.W.: “Batteries of all technologies (lead-based, lithium-based, nickel-based and sodium-based batteries) are already playing a significant role in helping Europe achieve its energy and climate goals. For example, advanced lead-based batteries are already providing micro hybrid functionality in around 75% of new car models placed on the market by European car manufacturers in 2013. This results in fuel efficiency savings of 8-10%, with technology still being improved year-on-year. In hybrid, plug-in hybrid and full electric vehicles (including buses, trams, boats and bikes), lithium, nickel and sodium-based batteries provide varying levels of full electric propulsion, paving the way for a decarbonised European transport sector in the future.

In relation to the establishment of an EU Smart Grid, battery energy storage (BES) technology will continue its development as an important means for homeowners and businesses to increase their percentage of self-consumed electricity from PV panels from a maximum of 30% without storage to around 70%, reducing the amount of additional power needed from the grid. This is already being encouraged on a national level, as demonstrated in Germany’s recent storage subsidy scheme. In the longer term, residential BES also has the further potential to be aggregated and provide active grid support.

The market for medium and larger scale grid-connected energy storage (decentralised and centralised) also has high potential for rapid development between now and 2020, due to a combination of ambitious EU climate policies, the successful integration of renewable energy sources across Member States, and a shared determination to achieve security of power supply. Although still at the initial phase, real progress is already being made, for example, with Italy’s TSO Terna committing to implement 130MW of battery energy storage in the next 3 years, and the UK testing the impacts of a single 6MW battery installation (the biggest in Europe) in an £18.7m project.[1] ”

What are the main drivers behind investment in storage technologies? Is there anything that can be done at a policy level to ensure that these drivers create a sufficient level of investment?

A.W.: “ From a purely technical point of view, investments into storage technologies are already encouraged by the high penetration of renewable energy sources in certain EU countries. In such situations, Transmission and Distribution Service operators are faced with high peak loads, more balancing of severe requirements, and the challenge to continue matching supply and demand.

BES has already been targeted through demonstration projects and real installations as a solution to maintain grid stability and flexibility in spite of these challenges. Although demand is there for their implementation, the main current obstacles to their wider take-up are mostly related to the lack of a clear regulatory framework for storage.

In the current pre-competitive phase, regulatory authorities can promote market take-up and investment through supportive incentive schemes. This approach has already been followed by Germany, whose EUR 25 million storage subsidy programme provides financial support to all systems containing battery energy storage installed in Germany in 2013 (with a maximum capacity of 30kW).

EUROBAT welcomes the introduction of harmonized storage incentive schemes in Europe as a short-term stimulus to encourage the take-up of battery energy storage at distribution and customer levels. However, in the longer-term electricity from batteries (such as for battery-integrated PV systems) must become fully market competitive in its own right. Here, a supportive regulatory environment will be important (see below). ”

Storage is seen as key to the efficient inclusion of energy from renewable sources into the grid. What are the main barriers to be overcome in order to create a smart grid in which renewables are fully integrated?

A.W.: “ As I have mentioned, the implementation of renewable energies into different levels of the European grid creates significant challenges for grid operators at all levels to retain generation adequacy. While the proliferation of large-scale renewable generation sources such as offshore wind parks will need to be supported by investments into strengthening the transmission grid, Europe’s low and medium-voltage distribution networks will also be required to accommodate an increasing number of small- or medium-scale RE sources, decoupling supply from demand.

BES technologies have the ability to act fast and are modular to meet power and energy requirements and have therefore been identified as key balancing technologies to support DSOs (and TSOs) in maintaining grid stability and flexibility. However, they will still need to be implemented alongside a host of other options, including demand-side participation and increased back-up generation.

The role of DSOs will also have to change in line with these developments, as they become responsible for the smart management of the electricity flowing in their grids, by dynamically managing distributed generation and demand. Consumers must also increasingly be encouraged to actively manage their energy demand through demand response mechanisms. ”

A recent EC working paper on the future role and challenges of energy storage[2] stipulates that the regulatory framework should be technology neutral. Is this a valid approach in your view, or are there some clear technological winners that should be the focus of R&D?

A.W.: “ EUROBAT agrees that the regulatory framework should be technology neutral, in order to allow for free and fair competition between all technologies. The expected demand for storage technologies is significant, with RWTH Aachen for example projecting that an optimised European electricity system with close to 100% renewable generation will require short-term hourly storage of 2000 GWh. This demand can best be met by a portfolio of different storage technologies providing a range of different functionalities to meet the specific demands of each installation.

However, it should also be highlighted that batteries are at present one of the technologies of choice to be installed in this capacity. A lot of other (non-PHS) storage technologies being discussed are still in the development phase, while batteries of all technologies – lead, lithium, nickel and sodium – are already available on the market, ready as a mobile and scalable solution to resolve specific problems raised by RES integration at the distribution level, or to create interest and momentum at the customer level for end-users.

In this context, EUROBAT considers that R&I into mature storage technologies should prioritise technological improvements to facilitate the integration of those existing and commercialised storage technologies into the different levels of the grid (both cell- and systems-level research, including demonstration projects). This will improve the immediate business case for storage at each level, and help ensure that the demand for storage is met as quickly as possible. In addition, this would also help maintain EU industrial leadership, increase our energy independency and boost Europe's economy. At present, there are already considerable battery production facilities in Europe employing over 30,000 people who are directly involved in battery manufacturing on the continent, but more production facilities could be created. ”

How important has the SET-Plan been in creating a framework to promote the development and market uptake of power storage technologies?

A.W.: “ The European Industrial Initiatives on Solar, Wind and Electricity Grids from the SET-Plan have been successful in accelerating the overall knowledge development and boosting technology up-take. The key European Technology platforms - PV TP, TPWind, SmartGrids and EPoSS - have all recognized the importance of research and innovation to improve energy storage (and battery energy storage in particular) to accelerate the deployment of the SET-Plan and a further technology transfer to a low-carbon economy in Europe.

As for the next steps in promoting BES, we still need a strong basis for basic research but additional efforts will also be needed to foster public-private partnerships and to ensure real market uptake to help to get the low-carbon business to take off. Europe has a strong and well-established battery manufacturing basis. The European battery industry is ready to respond to SET-Plan goals but requires further harmonised support schemes to ensure security and guaranteed investment returns.

What changes in the regulatory framework, in your view, would facilitate the better integration of power storage in the supply chain?

A.W.: “ At a political level, it will be crucial for EU and national regulators to establish a supportive and comprehensive market framework for storage technologies within the electricity sector. For example, due to the liberalisation of the European and national energy markets, we still need to establish energy storage as a separate asset from generation and consumption, and afterwards decide how this asset should be defined. A better defined market framework will increase certainty and improve conditions for investing in storage technologies.

In parallel, it's also imperative that European industry is provided with continued opportunities to demonstrate the performance and competitiveness of different storage technologies as a flexibility option within the European grid. Demonstration projects will validate the combination of services that batteries can provide in this capacity, and as well as resulting in faster market deployment, and will be valuable in bringing together the range of different stakeholders necessary for their full implementation. ”

For more information:
http://www.eurobat.org/

Alfons Westgeest

EUROBAT Executive Director

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1 http://www.energyswitcheroo.com/switcheroo-news/largest-battery-in-europe-that-has-the-potential-to-help-power-britain
2 http://ec.europa.eu/energy/infrastructure/doc/energy-storage/2013/energy_storage.pdf

stoRE - unlocking Europe's storage potential

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The stoRE project, which is co-funded by the European Union's Intelligent Energy Europe Programme, aims to unlock potential for energy storage infrastructure in Europe in order to facilitate the integration of energy from renewable sources into the grid and bring Europe closer to achieving its 2020 energy and climate goals.

stoRE is examining non-technological barriers to energy storage with a view to creating the right regulatory and market conditions to incentivise the development of energy storage infrastructure to the extent necessary to accommodate planned renewable energy installations in the electricity grid. The three-year project began in April 2011 and has a total budget of €1.6 million, of which the European Union is contributing 75%.

Energy storage helps accommodate higher percentages of variable renewable energy by balancing supply and demand and improving power quality. The stoRE project aims to fully examine the environmental performance of energy storage installations with a view to removing unnecessary regulatory barriers while at the same time ensuring that the environment is fully protected. To this end, it will assess, together with key stakeholders, the regulatory and market framework conditions in Europe in general, and in the specific target countries of Germany, Spain, Denmark, Greece, Ireland and Austria.

Based on this assessment, the project's stakeholders will engage key actors at European and national level, especially policymakers, in order to implement action plans for regulatory reform, thereby paving the way for increased energy storage capacity and renewable energy penetration. To further promote these objectives, the project also aims to improve awareness among stakeholders and the general public about the role energy storage can play in a sustainable energy future.

The possible positive and negative impacts of the different energy storage options on the environment are also being assessed and consultation processes will ensure that the project is open to all key actors and target groups and that their opinions are taken into account. A consensus will be reached among all the key actors to bring about improvements in policies, legislation and market mechanisms in the targeted Member States.

The project began with a technology and needs overview, which involved collecting and evaluating information about the status and potential of energy storage technologies, followed by an assessment of storage potential and needs, setting the foundations for the next phases of the project. These included an analysis of the European regulatory and market framework for their effect on energy storage infrastructure and use. The next stage deals with the environmental considerations relevant to the development and operation of energy storage facilities, particularly pumped hydro and compressed air storage, followed by an analysis of the target countries to identify regulatory and market barriers to the development and operation of energy storage.

The overall aim of the project is to help Europe achieve its ambitious renewable energy targets for 2020 and beyond and to create framework conditions that will allow energy storage infrastructure to be developed. To date, the project has resulted in the publication of a number of reports including, in May 2013, a list of Recommendations for Furthering the Sustainable Development of Bulk Energy Storage Facilities. These recommendations were made to both the Member States targeted in the project and to the European Commission, and covered areas such as identifying storage needs, developing plans and programmes, sourcing viable sites and preparing guidelines and best practice documents.

Review and assessment work already carried out has led the stakeholders to conclude that the need for new energy storage capacity should be recognized in both EU and national policy in order to facilitate project development. It was also recommended that the Commission establish clear guidelines, especially regarding the relationship with European environmental legislation and best practice. It has been found that conditions such as deployment level, untapped potential, market operation, regulatory framework, environmental constraints and so on, can vary significantly from one Member State to another. The assessment work has also revealed a lack of widespread acceptance of the need for storage, a limited understanding of the challenges faced, and no common vision for the future of energy storage among the relevant stakeholders.

For the targeted Member States, it was recommended that when the need for energy storage is acknowledged in their NREAPs, then this technology should also be considered at the strategic planning level and sustainable plans and programmes should be developed to facilitate the national and regional deployment of bulk energy storage technologies. It was also recommended that physically viable storage sites be identified and tested at a strategic level and that clear Member State guidelines for sustainable project development, best practice and planning be drawn up. Finally, it was recommended that the efficiency and speed at which bulk energy storage projects are considered during the planning approval stage be improved, including by legislating to accelerate planning approval or by appointing a dedicated competent authority to process these applications.

In general, it was found that without a clear policy for bulk storage of electricity, it will not be possible to adopt any strategic plans or programmes, which will make project development more difficult. Consequently, the main recommendation from the report is that, in order to facilitate the further sustainable development of pumped hydro and compressed air storage, or indeed any power storage project, the appropriate policy and strategic plans and programmes should first be put in place.

For more information:
http://www.store-project.eu/
http://www.store-project.eu/en_GB/project-results

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POWAIR: zinc-air flow batteries for electrical power distribution networks

The Powair project, which is funded under the EU's Seventh Framework programme (FP7), aims to create a low-cost modular and environmentally sustainable electrical energy storage system with high energy density and fast response by radically extending the performance of zinc–air batteries.

There are currently only a few technologies available for large-scale energy storage systems of MW-scale. These include pumped storage systems and Compressed Air Energy Storage (CAES). However, use of these technologies is restricted by the fact that they require geographical features: large water reservoirs or salt caverns. The attractiveness of conventional battery systems such as lead-acid, nickel-cadmium and lithium-ion batteries for large-scale energy storage systems is reduced by their limited number of cycles, poor efficiency, often high costs per kWh, and system complexity.

The Powair project aims to compensate for these shortcomings by developing a technology that permits large capacities of electrical energy to be stored indefinitely, to be transmitted or distributed as and when required. The battery system being developed can be charged directly from the grid, for peak shaving applications, or from renewable energy installations, thereby providing stability and flexibility to the grid and eliminating the need for fossil fuel powered peaking plants.

To achieve these aims, the project will extend the performance of zinc–air batteries from small-scale single primary cells to rechargeable redox flow battery modules, which at production scale can be stacked to give powers of 20 kW to MWs with several hours of storage. In tandem with the battery system, a novel distributed power converter will be developed to enable the disconnection, replacement and reconnection of a single battery without interrupting the energy storage system's performance.

This collaborative project is funded under the FP7 energy call "Energy storage systems for power distribution networks." The project, which began in November 2010, will last for a period of four years. The total project budget is just over €5.13 million, of which the EU will provide €3.56 million. The objective of energy research under FP7 is to aid the creation and establishment of the technologies required to make the European energy system more sustainable, competitive and secure. This project fits the FP7 remit perfectly, as it will also help reduce power system dependence on imported fuels and facilitate the diversification of energy sources.

As regards the technology, zinc-air batteries use oxygen from the atmosphere rather than a metal-dissolved electrolyte, which is more usual. Air reaches the cathode surface, where an active electrocatalyst promotes the reduction of oxygen. Metallic zinc is oxidised on the opposite side of the cell, usually in an alkaline electrolyte. As the cathodic reactant is not packaged within, zinc-air batteries have a higher energy-to-weight ratio than other types, and also since the cathode is very thin, the anode compartment can be packed with more zinc, resulting in a very high energy density. Due to their scalability, flow batteries have a wide power range, from a few kWs to many MWs, and much higher capacity ratings than static batteries. Eliminating the need for a positive electrolyte effectively doubles the energy density of the system. The project takes advantage of the knowledge of electrochemical technologies that exists within the consortium to develop a flow battery that will compete with systems currently under development.

Some of the advantages of zinc-air flow batteries include a much higher power and energy density than vanadium redox flow batteries (VRFB). Their high alkali content and flow prevents zinc passivation and reduces dendrite formation and they have a well-known chemistry with fast kinetics. Furthermore, there are additive systems already available from the electroplating industry that can be used to control deposit morphology, which also reduces dendrites. The fact that the batteries contain a liquid electrolyte means they are unlikely to dry out, reducing the need for humidity control. Moreover, thermal management issues are minimal due to the recirculated electrolyte and the air electrode. Finally, production of the batteries involves the use of low-cost, benign and widely available materials.

According to the technology roadmap for the project, the project should currently be at the stage of demonstrating a prototype in a test environment, with prototype demonstration in an operational environment planned for year four. There are major challenges ahead if wholesale centralised and decentralised renewable power generation is to be implemented. That said, Powair's contribution to grid flexibility and the integration of intermittent renewable energy sources means that it will be a valuable component in the technology basket underpinning the large-scale energy storage installations needed to off-set periods of restricted generation, and is therefore likely to play an ever-increasing role in facilitating the integration of renewables into the European grid.

For more information, including consortium partners: http://www.powair.eu/

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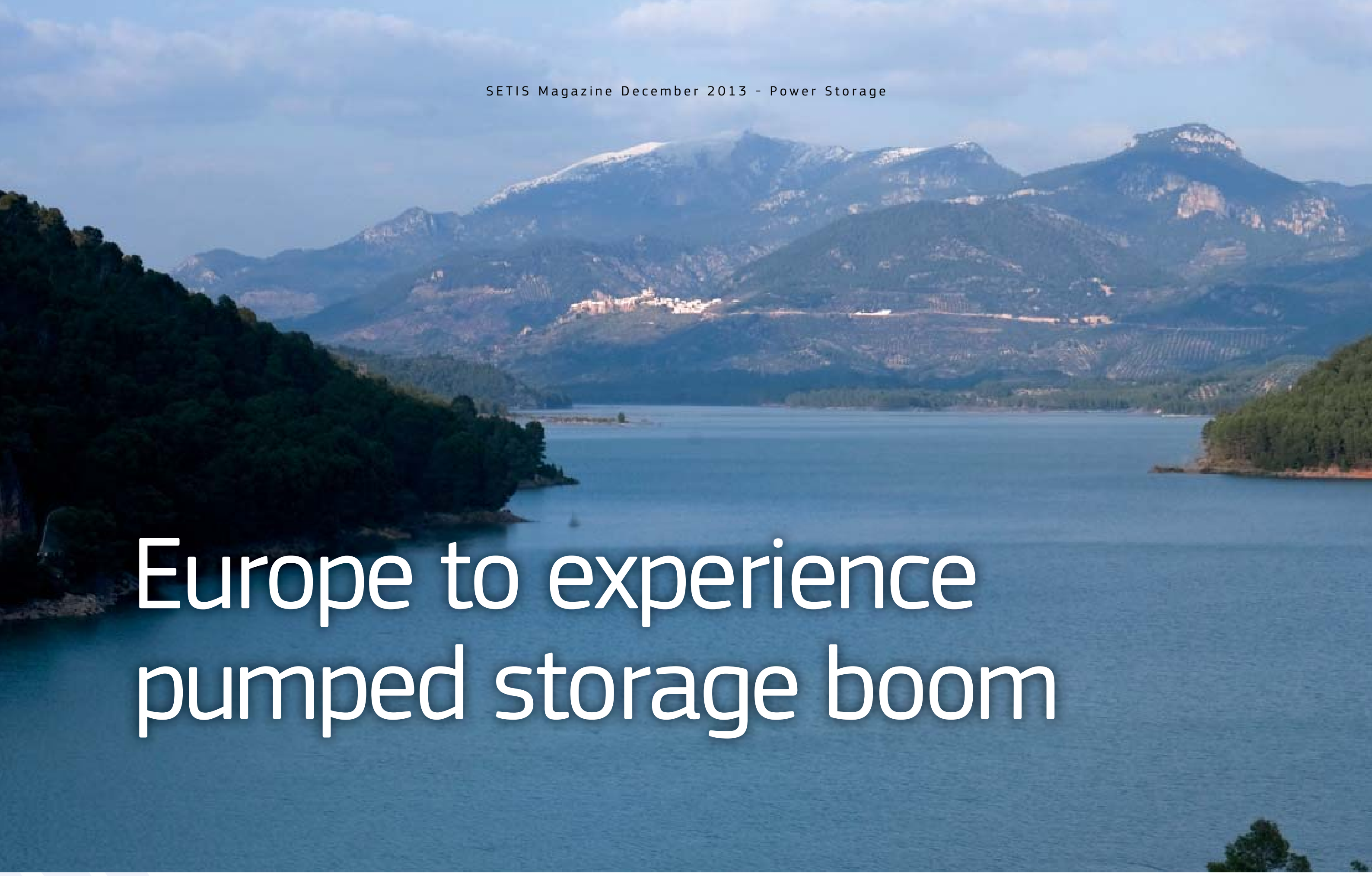

Europe to experience pumped storage boom

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The increased penetration of renewables into the European energy mix will see a surge in demand in Europe for power storage solutions, particularly pumped hydro storage.

Europe's 2020 target of 20% of final energy from renewables will entail an even higher penetration of renewable energy in the electricity mix, which some estimates put at between 35 and 40%, of which intermittent renewables such as wind and solar energy will account for a large share. This share will be increased even further by the European Union's proposed 2050 greenhouse gas emission reduction targets. In order to accommodate this high level of intermittency, electricity systems will have to become more flexible, so they can balance generation and consumption. One way to introduce this flexibility into the grid is through pumped hydro storage (PHS) and some estimates suggest that more than 60 new pumped storage plants with a total capacity of about 27 GW will be built in Europe by 2020. This represents about 50% of the capacity of existing plants and reflects an investment volume of almost €26 billion.[1]

Pumped storage hydroelectric plants are the most flexible and widespread means for the large-scale storage of electricity. By transferring water between two reservoirs at different elevations it is possible to supply electricity during peak demand and store excess electricity during periods of low demand. Pumped storage technology has a very good overall yield of about 80%, which means that 100 MWh of excess energy stored will enable the production of around 80 MWh of energy during the next peak in energy consumption. This storage system enables electricity to be produced rapidly. The pump turbine can go from stop mode to full power in less than 2 minutes, providing a sound complement to a gas turbine (the most flexible in the energy mix) which requires 15 minutes to reach its maximum output.

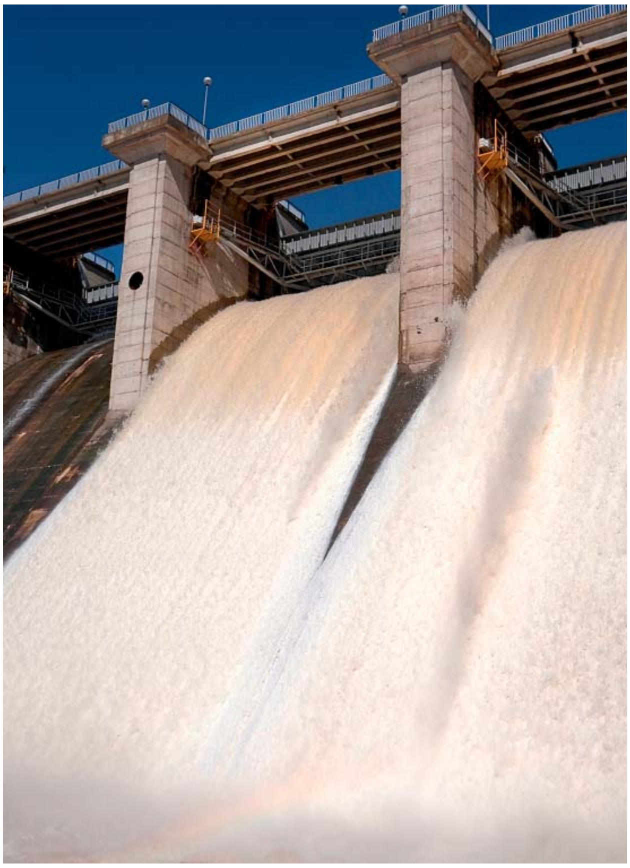
Although there are no official figures reported to Eurostat for existing pumped storage capacities in Europe, some sources[2] put total capacity at the beginning of 2011 at almost 45 GW, with about 170 pumped storage plants operating in Europe, over 37% of which are concentrated in Italy, Germany, France and Spain. This is due to the fact that the largest European energy industries need the largest capacities for storing electricity. Throughout Europe, the average capacity of a pumped storage plant is about 300 MW. The largest plants are in the countries that also have the most overall pumped storage capacity (the UK bucks this trend - the few pumped storage plants it has are among the largest in Europe). On average, European pumped storage plants are more than 30 years old, with two-thirds of them built between 1970 and 1990. It would seem that the conditions are ripe for the forecast boom in capacity construction.

A report on the European potential for pumped hydropower energy storage prepared in 2013 by the Joint Research Centre, the European Commission's in-house science service, assessed European PHS potential based on two topologies: one where two reservoirs already exist and are close enough to be linked (T1), and one requiring the construction of a second reservoir (T2). This assessment revealed that the theoretical potential in Europe is significant under both topologies, with potential energy storage capacity of 54 TWh under T1, of which 11 TWh is located in the EU and 37 TWh in candidate countries. Under T2, the European theoretical potential reaches 123 TWh, of which 50% lies within the EU.

However, the construction of storage facilities will bring other problems to the fore, as the stored energy still needs to be distributed. This will require an increase in the capacity of interconnectors in Europe and new techniques to enable non-dissipative long-distance transportation of huge quantities of electricity. Therefore, a prerequisite for the forecast construction boom is the development of the grid system, as the existing grid structure is not up to the task of absorbing and transporting the necessary amount of electricity to and from its storage locations. To tap Europe's storage potential, improvements will also be required in the reservoir database which, according to the JRC report, could be expanded to include the topology of lakes. As a way of achieving this, the JRC suggests that the European Environmental Agency's European Catchments and Rivers Network System (ECRINS) database be expanded, for example by adding Norwegian reservoirs, and that its new dataset be used. Other recommendations arising from the JRC assessment include the inclusion of existing reservoirs smaller than 100 000 m^3 which have hydropower exploitation above 1 MW and changing the basis on which searches for a suitable site are performed from the current 'single point' model to an 'area or polygon' model, which would require an update of the reservoir database from points to polygons. It was also suggested that it would be useful for individual countries to perform analyses of their potential storage versus population density, surface area, solar and wind resources, and projections for electricity consumption and RES generation by 2030.

The conclusions and recommendations reached based on the assessment should prove useful to agencies in charge of planning future electricity system development as well as to spatial planning authorities and to developers of hydropower schemes. If the forecasts for a boom in pumped storage prove to be accurate these recommendations are likely to be put into practice across the EU, as the European grid strives to smarten and to achieve the flexibility required to integrate the levels of renewables needed to see Europe reach its energy and climate goals for 2020 and beyond.

For more information:
http://tiny.cc/Pumped-Hydro
http://tiny.cc/Hydro-Article



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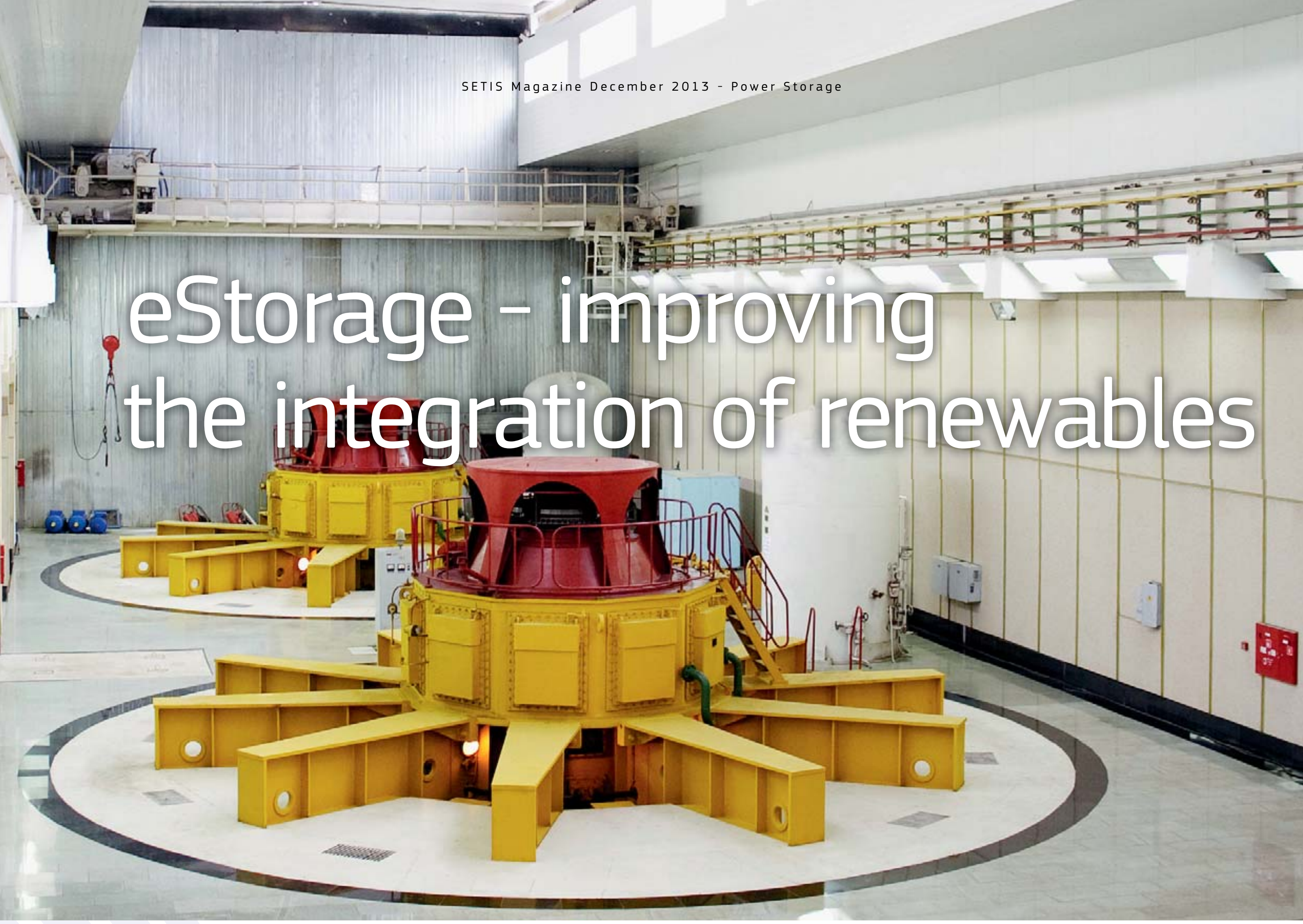
1 The European Market for Pumped Storage Power Plants, Ecoprog, April 2011.
2 Ecoprog

eStorage - improving the integration of renewables



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eStorage is a European consortium that is working to develop a solution based on variable-speed technology to increase the operational flexibility of hydro power plants and enable the cost-effective integration of intermittent renewable energy generation, such as wind, into the electrical grid, in support of SET-Plan objectives.

Backed by the European Commission with a grant of 13.3 million euros under FP7, the eStorage consortium, which is made up of major European stakeholders from the energy value chain, aims to improve energy management by developing 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 energy.

The consortium consists of a multidisciplinary team, bringing together major European players from the entire electricity value chain, such as Algoé, Alstom, EDF, Elia, Imperial College London and DNV KEMA, with expertise covering electricity generation and transmission, research activities and impact studies, state-of-the-art hydro and grid technologies and project management. The project team is supported by an advisory board including the European Association for Storage of Energy (EASE).

The project's objectives include demonstrating the technical and economic feasibility of upgrading an existing fixed-speed pumped hydro storage facility to variable-speed technology, which offers several advantages, including frequency regulation in generation and pumping modes. The technology also provides more operational flexibility for plant operators and makes flexible ancillary services available to grid companies. Furthermore, eStorage aims to enhance IT functionalities and to develop grid management solutions in line with real-time market systems and to quantify the benefits of an EU-wide rollout of variable-speed pumped hydro storage under alternative scenarios. The project also aims to propose changes to market and regulatory frameworks, to support appropriate business models for flexible energy storage in the EU and to develop and assess technology solutions allowing the upgrade of 75% of European pumped hydro storage to variable speed, in order to obtain additional capacity for flexible load balancing. The consortium will also develop and demonstrate solutions for coupling the dispatch of storage plants with renewable generation using advanced energy and market management systems, which will enable storage plants to maximise their value in the balancing markets.

"Variable-speed technology provides power regulation capabilities to utilities 24 hours per day which is critical for integrating intermittent renewables into the grid," eStorage Project Coordinator Olivier Teller told SETIS. "Furthermore, upgrading an existing pumped hydro plant to variable speed is less expensive and faster to implement than constructing a new site. However, the upgrade can be complex because the variable-speed generator is larger than a fixed-speed generator. The eStorage project will demonstrate the feasibility of upgrading European pumped hydro energy storage plants to variable speed which could provide up to 10 GW of additional regulation capability should a significant portion be converted," he said.

The cornerstone of the eStorage project will be upgrading EDF's Le Cheylas fixed-speed pumped storage hydroelectric plant (PSP) to a variable-speed pumped storage plant. Once completed, Le Cheylas will provide 70 MW of additional night time regulation capability which will allow the integration of several hundred MW of intermittent renewable generation. This will demonstrate that a significant portion of European PSP capacity can be upgraded to variable speed, providing up to 10 GW of additional regulation capability with no environmental impact and at a much lower cost than developing new plants. The lessons learned from the Le Cheylas upgrade will help to enable the conversion of over 75% of European fixed-speed pumped hydro storage.

PSPs play an essential role in power regulation, allowing 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. However, fixed-speed PSP plants can only provide power regulation in generation mode while variable-speed units can regulate power in both generation and pump mode. Virtually all existing PSPs in Europe are fixed-speed units. Adding variable-speed technology to pumped hydro storage power plants increases plant efficiency and flexibility by allowing power regulation in both turbine and pumping mode. It also enables electric utilities to harness surplus power from intermittent sources, like wind, to fill pumped hydro storage plants' upper reservoirs faster, storing the surplus energy for later use when demand is high or when no wind energy is available. Coupled with improved IT systems, variable-speed technology will facilitate grid management for better real-time balancing of supply and demand.

From simulation studies, demonstration results and storage potential analysis, the eStorage consortium will evaluate the system-level benefits of storage and identify development barriers in order to draw recommendations for an efficient market and regulatory framework to maximise the impact of projects. The eStorage project will demonstrate the feasibility of upgrading to variable-speed technology, develop new IT systems for smarter grid management, put forward market and regulatory recommendations for energy storage, and develop scenarios for the rollout of energy storage across the EU.

For more information:
http://estorage-project.eu/


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Assessing storage value in electricity markets

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Spurred by a renewed interest in power storage the European Commission's in-house science service the Joint Research Centre (JRC) has provided several recommendations on how to improve assessment of the economic value of storing electricity, in a recently published report. Drafted in cooperation with the R&D Department of Electricité de France (EDF), the report presents an overview of the current research into the economic drivers and barriers for electricity storage.

The researchers advise, for example, to study more systematically how storage might simultaneously provide services to different actors in the power system and how future technological and economic improvements might influence the business case for storage. These proposals are meant to be used as guidance for further research and as a discussion base for policymakers.

The researchers reviewed more than 200 publications from academia, consultants and industry. They looked into the methodologies used to assess storage value and profitability, and also defined the regulatory possibilities that might address the current challenges for electricity storage.

The JRC report differentiates between two broad categories of studies. Engineering studies aim to assess the value of an investment without modelling the whole system, while system studies represent the effect of storage on the entire energy supply system. Recent engineering studies seem pessimistic about the possibility of earning sufficient revenues to recover significant investments in power and reserve markets, although some additional value pools have been identified. System studies identified storage value in many cases, but a negative impact is possible if the deployment of storage requires additional investment in grid or generation infrastructure.

Evaluating the economic value of future electricity storage requires making assumptions about storage regulations. These may range from fees and technical instructions, ownership questions or fundamental market regulation. Minor technical rules may have a large impact on the viability of storage. In fact, any change in regulations will have an impact on electricity storage as the current frameworks for large-scale storage are not centrally regulated. New developments in the power system, such as the integration of renewable energy sources, will influence discussions on storage and issues such as the ownership and operation of storage devices.

For the full JRC report, see:
http://tiny.cc/Power-Storage

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