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Technology Watch Newsletter

Electrical storage: enabler of the energy transition

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Technology Watch is the Elettricità Futura initiative to monitor global technology trends having the power sector at their heart. In our quarterly newsletter you will find an article with our analysis on a specific technology trend, an article by one of our partners and technology news from all over the world selected by Elettricità Futura.

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Electrical storage: key technologies for the energy transition

Author:

Reliable electricity supply is crucial for society at all times[1]. To ensure security of supply, there is a need for flexibility tools that can act when production sources or consumption vary in ways that cannot always be controlled. These flexibility needs have to be categorised following the purpose and time scale they act in[2] [1]. Different storage technologies can play an important role to support the energy transition and the integration of an higher share of Renewable Energy Sources (RES) in the energy mix, individually or in aggregate with other flexibility resources such as demand side response [1]. **Electrical storage** is intended here as forms of storage delivering electricity as "end product" for final use.

In Italy, the final version of the National Energy and Climate Plan (NECP), published at the beginning of 2020, defines a target of 10 GW of new storage systems, 4 of which in the form of small batteries and the rest divided between pumping and large electrochemical systems.

[1] There are three possible types of electricity deficit that could jeopardise supply reliability:
- Electric Energy deficit: For a longer time period it is not possible to produce enough electricity to fulfil demand (resource adequacy).
- Electric Power capacity deficit: At a given moment (hour, day) the available power is not sufficient to cover demand (operational security).
- Grid capacity deficit: There is enough energy and power available, but the grid cannot transfer the energy from the supply nodes to the demand nodes (grid adequacy).

[2] Eurelectric, Flexible generation: backing up renewables, October 2011. Eurelectric identified in this earlier report on flexibility four main types of flexibility needs within different time scales:
- Stable power system – continuously balancing variations in consumption and generation (seconds – hour)
- Ramping – take care of sudden deviations or disturbances (n-1 events, storm fronts, within hours)
- Correction and back-up – take care of deviations from plan (varying RES and load, within days)
- Planning – optimise use of power sources (varying load, complement non-dispatchable RES, day – year)

However, this numbers are set to grow in the Green Deal scenario with at least -55% overall emissions reduction in the EU with respect to 1990 [2] and an estimated increase of RES capacity by 65 GW (today there is an overall capacity of 55 GW) based on Elettricità Futura's data elaborations.

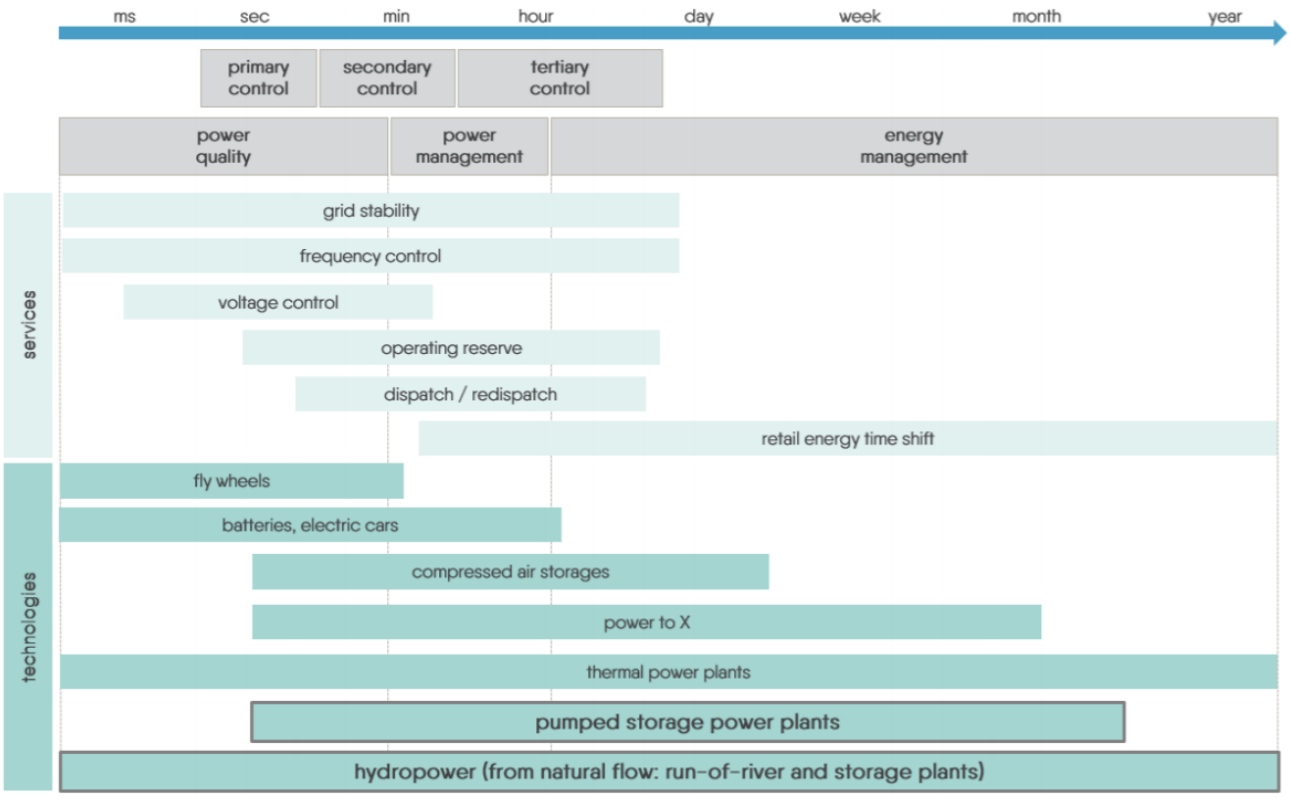

Fig. 1 - Flexibility services according to technologies and timescale. Source: Eurelectric/VGB, 2020 [1]

As described in Figure 1, several electrical storage technologies are available or are being developed. Among these, the following ones are described in the present Newsletter in more details:

- Pumped hydroelectric storage (PHS)
- Electrochemical Storage
- Power-to-X

Pumped hydroelectric storage (PHS) power plants may either have natural inflow in the upper reservoir or not. Typically, in case of excess power supply, e.g. by strong wind and/or solar generation, they pump water to a storage basin, the upper reservoir. This act of pumping is often

linked to the market opportunity of purchasing energy at very low prices to be redispatched later. Systems services of pumped hydro are mainly used to balance the grid or generation-driven fluctuations in supply (peak, off-peak). Typically, PHS plants without natural inflow store energy for several hours or days. The duration of their energy storage potential increases when being designed with natural inflow. PHS is a mature and efficient technology (around 80%). However, hydro resources are not available everywhere [1].

Batteries (**electrochemical storage**). Despite the high variety of different energy storage technologies, BESS (Battery Energy Storage System) using Lithium-Ion (Li-Ion) batteries have established themselves as the most versatile technology. The market convergence around this technology is driven by the growth of Electric Vehicles as well as Li-Ion's modularity, which makes them ideal also for the higher sizes required for stationary storage. Further, their stage of technology development shows the highest potential of cost reduction with a higher reliability as compared to other technologies still in demo phase. According to Bloomberg NEF, utility scale batteries are expected to make the majority of installations. These deployments can be either with a stand-alone configuration or co-located with power plants like Photovoltaics (PV) and wind farms to take the advantage of economies of scope (such as development, construction, infrastructure), and dispatch their production when the system needs it the most.

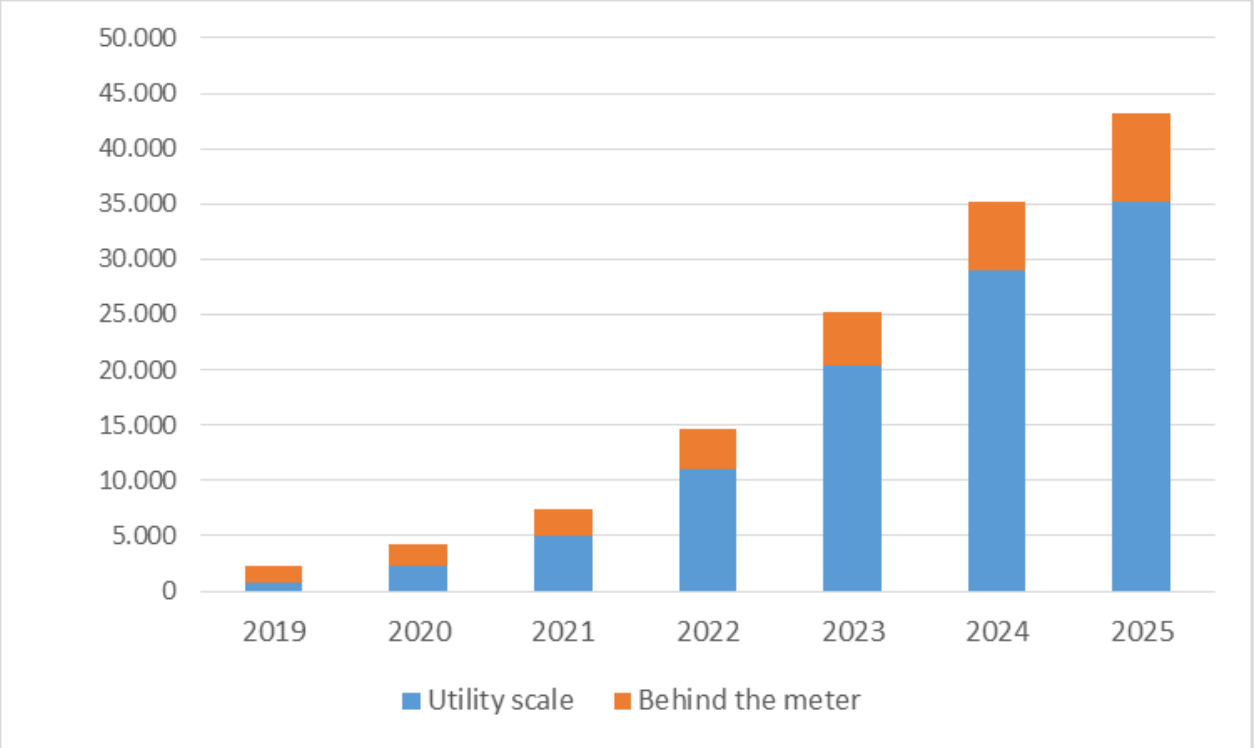

Fig. 2 - Cumulative battery storage installations in Europe (in MW): system level versus behind the meter. Source: Bloomberg NEF and Eurelectric [1].

Li-ion batteries are increasingly deployed behind the meter especially with electric vehicles. While it is difficult to assess how much capacity is connected at grid level, over 120,000 German households and small businesses have installed PVs and storage. Eurelectric estimates that in order to be on the right path to decarbonise the transport sector, 40 million electric cars need to hit the road by 2030. Larger li-ion batteries are also increasingly used at grid level. The potential for further cost reduction is considered high. The introduction of new chemistries (e.g. reduction of reliance on rare earths like cobalt), new cells and pack designs will positively contribute to the improvement of performance, leading to a lower cost of MWh delivered.
The price of lithium-ion batteries is indeed decreasing significantly (-80% between 2010 and 2017 and -89% in the last ten years according to BNEF). International projections indicate that the price in 2030 could reach $ 75-124 / kWh. The drop in the price of batteries will be a significant factor for the further spread of electric vehicles.

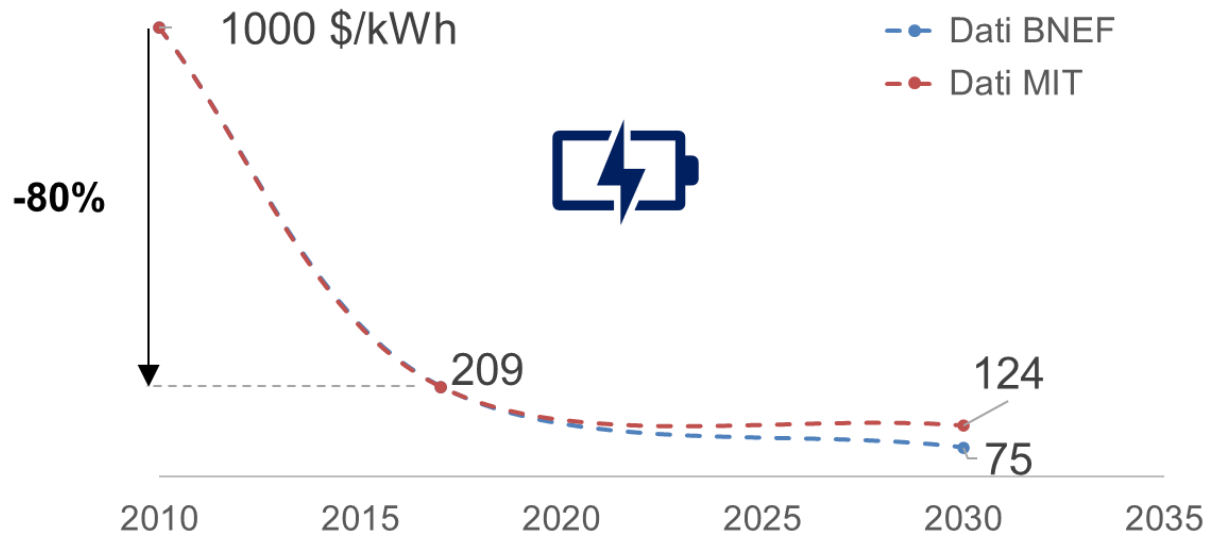

Fig. 3 - Price evolution of the battery pack for electric cars (Lithium Ion technology) [$ / kWh] [3].

On the other hand, several doubts have been casted about the sustainability of Li-Ion batteries, especially in view of the expected significant increase in volumes of electric vehicles in the coming years (with for example a target of 6 million electric vehicles by 2030 according to the Italian NECP). A recent report published by IVL [4] also admits that the best practices for recycling have not yet been defined, but various technologies exist and are being refined. Furthermore, advanced

electronic control systems can optimally manage the batteries to extend. “New lives” batteries and their reuse for other applications will also play a fundamental role.

The average life of batteries in electric vehicles is estimated, according to the manufacturers, to be around 15 years. At the end of their life cycle, some batteries may still be able to store renewable energy (for example coupled with small photovoltaic systems). Others could be used as backup power systems for buildings. According to Motus-E estimates, the launch of a national chain of companies engaged in the recycling of electric car batteries would create about 70,000 jobs in Italy alone [5].

The IEA foresees that lithium-ion batteries will remain the dominant technology by 2030 [6]. However, other technologies could become competitive in 2030 (or even earlier, in the event of technological leaps that are not entirely predictable today), such as Lithium-Air and Lithium-Sulfur and more generally Solid State batteries (based on solid electrolyte instead of liquid ones). The latter could lead to a "revolution" in the storage sector, increasing power density and potentially improving significantly the level of sustainability compared to current ones. Solid State batteries have limited commercial applications today but major players like Toyota have announced that their plans to introduce them in the market are en route for 2021 [7].

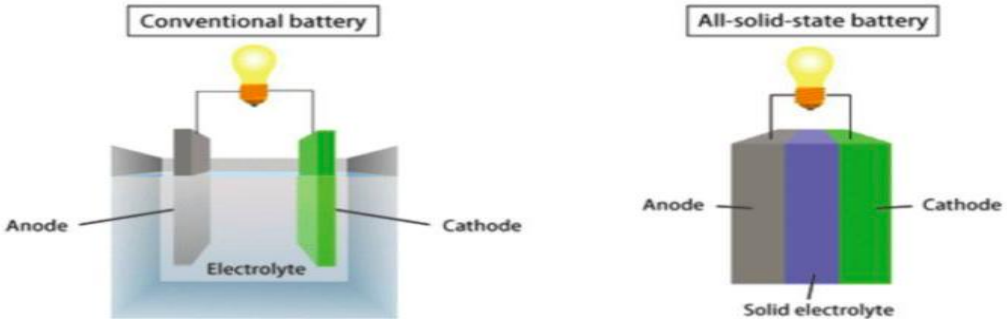

Fig. 4 – Schematics depicting the difference between conventional and solid state batteries.

Power-to-X, with particular reference to Power-to-gas and Power-to-Hydrogen, they can be a key element towards the indirect electrification of hard-to-abate sectors (such as maritime, aviation and heavy industry), where direct electrification is not completely technically and economically viable yet. Hydrogen can be used as a feedstock, a fuel or an energy carrier and storage. The European Commission has set out its Hydrogen Strategy for a climate neutral Europe, and the declared priority is to develop renewable hydrogen, produced using mainly wind and solar energy. However, in the short- and medium-term other forms of low-carbon hydrogen are needed to rapidly reduce emissions and support the development of a viable market, according to the EC. The strategy also highlights hydrogen as an investment priority to boost economic growth and resilience, create local jobs and consolidate the EU’s global leadership [8].

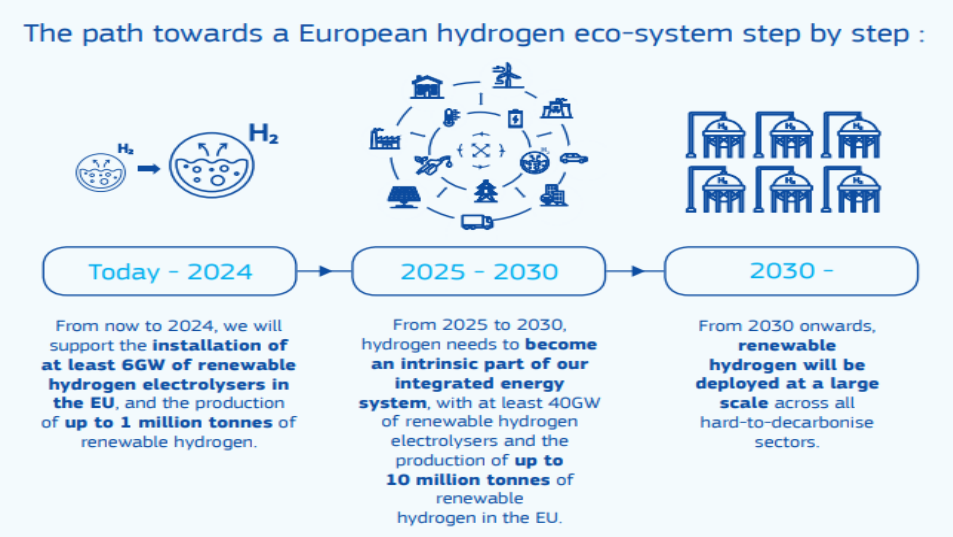

Fig. 5 - The path towards a European hydrogen eco-system step by step, according to the European Commission [8]

In general, Long Duration Energy Storage can be a game changer to help making Non-Programmable Renewables totally dispatchable in the future and hence they are expected to have a strong impact on resilience and circularity dimensions.

References:

[1] Eurelectric, “Charge! Deploying secure & flexible energy storage”, 2020

[2] RSE-ANIE, “LIBRO BIANCO ACCUMULI 3.0”, 2020

[3] Elettricità Futura elaborations on Massachusetts Institute of Technology (MIT) data and BNEF Energy Storage Outlook 2019, 2020

[4] IVL, “Lithium-Ion Vehicle Battery Production, Status 2019 on Energy Use, CO2 Emissions, Use of Metals, Products Environmental Footprint, and Recycling”, 2019

[5] Motus-E, https://www.motus-e.org/news/una-seconda-chance-per-le-batterie-delle-auto-elettriche-2, 2019

[6] IEA, Global EV Outlook, 2018

[7] Nikkei Asia, https://asia.nikkei.com/Business/Technology/Toyota-s-game-changing-solid-state-battery-en-route-for-2021-debut, December 2020

[8] EU, Hydrogen Strategy factsheet, 2020
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Note: weblinks last accessed in February 2021

Energy Storage in the Context of the EU Green Deal: Will Policymakers Deliver?

Author: Brittney Elzarei, EASE Policy Manager

In just a few years, the energy storage industry has seen significant progress in terms of its role in the EU energy policy agenda. The Third Energy Package, finalised in 2009, made no mention of energy storage at all. It was some time before energy storage began appearing on policymakers' radar. The European Commission published its first working paper on energy storage in 2013, outlining the future role and challenges for energy storage[3]. By the time the 'Clean Energy for all Europeans' package proposals were issued in 2016, energy storage was starting to be recognised as a key technology for the transition.

Today, energy storage has very clearly risen to the top of the EU policy agenda; recognised by the European Commission, Member States, and European Parliament alike as an essential enabling technology to achieve the bloc's ambitious 2030 and 2050 targets. This shift has become especially clear with the proposal of the European Green Deal, the ambitious plan from EU Commission President Ursula von der Leyen to accelerate the transition to a net-zero emissions energy system by 2050.

With many EU Green Deal files being proposed in the coming year, the launch of the Horizon Europe research programme with dedicated funding for storage projects, and the ambitious 'Next Generation EU' COVID-19 recovery plan setting aside funding for clean energy technologies, 2021 has many positive developments in store for the industry.

The EU Green Deal has become the flagship initiative of the European Commission. It started with decarbonisation targets, setting a clear pathway and high level of ambition for the EU. In March 2020 the European Commission proposed the European Climate Law, setting the objective for the EU to become climate-neutral by 2050. In September 2020, the Commission updated its

[3] https://ec.europa.eu/energy/sites/ener/files/energy_storage.pdf

2030 climate target to a net reduction of at least 55% of the EU's greenhouse gas (GHG) emissions compared to 1990 levels, which was agreed by the Member States in December.
Achieving these targets requires coordinated and well-executed policy planning. The European Commission has already issued many policy proposals aimed at making the Green Deal a reality, many of which were highly encouraging for storage, and many more policy proposals are expected in 2021.

Among the Commission's most eagerly awaited policy proposals were the **Energy System Integration Strategy and Hydrogen Strategy**, released in July 2020. Both strategies are positive for energy storage, supporting the deployment of all types of energy storage projects across the EU, including power-to-x and thermal storage. Energy storage can link different energy and economic sectors – electricity, gas, heating and cooling, transport, and industry - and this is clearly recognised by the Commission. Integrating these sectors can increase the efficiency of the whole system while contributing positively to energy security.
In October 2020 the European Commission published the **Renovation Wave**, a strategy to accelerate building renovation while reducing Europe's GHG emissions. Energy storage installed in residential homes or commercial and industrial facilities can increase the integration of renewable and surplus energy into buildings. Furthermore, behind-the-meter storage can provide flexibility at low cost, also supporting smart-charging and vehicle-to-grid services. Energy storage can facilitate the decarbonisation of the heating and cooling sectors which currently are heavily dependent on fossil fuels. The Renovation Wave, by unlocking investments and encouraging deployment of smart energy technologies, can boost deployment of behind-the-meter storage, especially in the context of the COVID-19 economic recovery.
Other Green Deal policies – including the Energy Taxation Directive, the TEN-E revision, the smart mobility strategy, and the Batteries Regulation – continue this positive trend of addressing the different barriers to energy storage deployment. Taken together, they represent a real change in how storage is addressed – rather than a nice technology at the periphery of EU policy, energy storage is now addressed across all major EU energy policies.
Public funding is also essential to bring more innovative energy storage projects to fruition. In January 2020 the European Commission presented the European Green Deal Investment Plan and the Just Transition Mechanism. The Just Transition Mechanism provides targeted support to help mobilise over €150 billion from 2021 to 2027 to alleviate the socio-economic impact of the transition in the most affected regions.

On 16 September 2020 the European Parliament plenary approved its position on the Just Transition Fund (JTF) and called for significantly higher funding than the Council and the Commission. The Parliament's amendments added energy storage technologies to the scope of support of the Just Transition Fund. This will unlock funding for energy storage, a valuable tool that can help islands, industrial, coal and energy intensive regions transition to a more sustainable energy system.

In addition, policymakers in 2020 agreed on a new Multi-annual Financial Framework and Next Generation EU recovery plan of €1.8 trillion, which clearly recognises the important role of supporting investments in clean energy technologies such as storage through programmes including Horizon Europe, the Recovery and Resilience Facility, InvestEU, and others. A significant portion of this funding must be spent on climate change adaptation. This means that hundreds of billions of euros will be made available in the coming years for energy storage projects.

It is highly encouraging that policymakers emphasised that any economic recovery must be a 'green recovery' – clearly making the case that investments in clean energy technologies are not only important to address climate change, but they also make sense from the perspective of jobs, socio-economic welfare, and competitiveness of EU economies.

The European Green Deal is an ambitious roadmap with numerous policies aimed at transforming Europe's economy and society. For years, the challenge for the storage sector has been raising awareness and understanding of the role of storage for the system. Now, energy storage is clearly front and centre for policymakers – the challenge is to ensure that the policies, and their implementation, fully support the implementation of energy storage projects across the EU.

There are still a few key barriers to storage deployment. First of all, there is a lack of a comprehensive and holistic EU strategy to address energy storage. While various aspects related to storage are addressed in many different policy files, there is a risk of policy coordination falling short. The European Parliament has therefore called on the Commission to develop a comprehensive strategy to address all aspects of energy storage deployment, ensuring cohesive technology-neutral policies. At Member State level there is also a similar issue, with most National Energy and Climate Plans for instance mentioning storage only in passing, rather than proposing clear targets and strategies for storage deployment.

Secondly, there is a tendency among policymakers to choose several winning technologies. Batteries and power-to-gas are receiving significant attention from EU policymakers, while technologies such as pumped hydro storage, thermal storage, flywheels, liquid air, and others are neglected. Energy storage policy at EU level must be technology neutral to enable the whole

toolbox of storage technologies to support the energy transition, enabling sector integration, supporting a diverse energy mix across the EU, and enhancing competition.

Finally, many of the barriers to energy storage deployment persist as long as the Clean Energy Package provisions are not adequately implemented in each EU Member State. National authorities must now take an active role in updating their policy frameworks to clearly define energy storage in national law, ensure market access, empower ‘prosumers’, and address the challenge of double charging and grid fees.

EU policymakers are paying attention to storage now more than ever before. We must take advantage of this momentum to advocate for ambitious and comprehensive EU energy storage policy that can take our industry to the next level.

Technology News Worldwide

HIGHLIGHT:

UN Climate Change Conference of the Parties (COP26) in partnership between UK and Italy

The United Kingdom will take over the Presidency of COP26, in partnership with Italy. The UK will host the 26th Conference of the Parties linked to the UN Convention on Climate Change (COP26) in Glasgow on 1 – 12 November 2021, while Italy will host the preparatory events, including a youth event and the Pre-COP Summit, to be held in Milan from 28 September to 2 October 2021.

Fully in line with the principles of the United Nations, the partnership will focus on promoting tangible actions to create the radical changes needed to realise the full "potential" of the Paris Agreement.
LINK

- **#Storage:** New class of cobalt-free cathodes could enhance energy density of next-gen lithium-ion batteries. Researchers of the DOE/Oak Ridge National Laboratory have developed a new family of cathodes with the potential to replace the costly cobalt-based cathodes typically found in today's lithium-ion batteries that power electric vehicles and consumer electronics.
  Link

- **#Solar:** New blended solar cells yield high power conversion efficiencies. Researchers of the Hiroshima University have blended together various polymer and molecular semiconductors as photo-absorbers to create a solar cell with increased power efficiencies and electricity generation.
  Link

- **#Artificial Intelligence:** Breakthrough optical sensor mimics human eye, a key step toward better Artificial Intelligence. Researchers of the Oregon State University are making key advances with a new type of optical sensor that more closely mimics the human eye's ability to perceive changes in its visual field. Artificial intelligence con be a power tool for the energy sector too.
  Link

- **#Wind Energy:** An innovative tiny device can scavenge wind energy from the breeze you make when you walk. Most of the wind available on land is too gentle to push commercial wind turbine blades, but now researchers have designed a kind of 'tiny wind turbine' that can scavenge wind energy from breezes as little as those created by a brisk walk. The method is a low-cost and efficient way of collecting light breezes as a micro-energy source.
  Link

Note: weblinks last accessed in February 2021

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