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Renewables towards energy independence: key technologies to allow the transition

The proposal by Elettricità Futura to install 60 GW of new renewable capacity over the next three years is aimed to accelerate the energy transition and reduce gas imports by 20%. Such renewable energy capacity additions depend, on one hand, on the realization of new solar and wind plants; on the other, they rely on the development of new architectures, applications, or installation methods. In this respect, another key element is represented by storage technologies, which will make it possible to use renewables in a more flexible way during the day, to avoid unnecessary losses of energy produced – and not used – in the central hours of the day, and to guarantee services for the network.

The cost reduction of storage systems, the use of innovative systems such as new batteries, the role of Green Hydrogen and Vehicle-to-Grid technologies as additional storage systems will certainly contribute to the necessary acceleration of renewables in Italy over the next three years.

For example, the global trend in terms of solar photovoltaic additions is to have an average increase in terms of compound annual growth rate (CAGR) of 9% by 2040, with countries in the MENA region playing a big part in such increase. In this respect, CESI has been involved, in the last few months, in two large projects in Saudi Arabia and Qatar, in supporting local utilities National Grid / SEC and Kaharamaa, for the implementation of development plans for renewables, supporting TSOs in defining installation requirements, reviewing existing rules, also guaranteeing technical support for defining the technical specifications of these systems.

Indeed, to bring about a substantial increase in installed power in the short term, we will have to go beyond the so-called traditional installations on rooftops, especially in Italy. However, an increase in production in a short time cannot ignore the implementation of innovative systems. In addition to systems integrated into the facades of buildings, the most promising systems in Italy are both the installations of floating systems and the so-called *agrivoltaics* systems. The former allows installation when land availability is a constraint, helps to preserve water resources through reduced evaporation of the basins and guarantees an increase in production of about 5-10%, thanks to the water-cooling effect. In the latter, however, the photovoltaic systems merge with agricultural activities, sharing their areas, helping, where necessary, to reduce the temperature of the soil.

Other very promising systems, which would guarantee an increase in production of up to 20%, are represented by double-sided systems, which also guarantee production on the lower face of the panels, using diffused light, reflected from the ground. Furthermore, the improvement of monitoring systems through drones, cleaning through robotic systems, implementation of cooling systems of the panels to increase the yields at high temperatures, certainly represent interventions that, in the short term, would guarantee an increase of the available green power.

The same goes for wind energy production. Again, the global trend here is impressive, with a production forecast of 2 TW in 2040, with an annual growth of 5%. As for the wind turbines, the main technological trend is to increase the height and size of the rotor and, thus, their power: for instance, 40% of the projects in 2019 were made with turbines higher than 150 meters.

Certainly, a great contribution to the increase in capacity will be given by the development of offshore applications. Whilst onshore wind power will continue to play a crucial role in the global deployment of renewables, is the offshore wind energy which is destined to grow with an annual rate of around 17%, as it guarantees an increase in producibility (the wind is more stable and stronger compared to onshore installations) and it can be “politically acceptable”, as it minimizes the visual impact of turbines, which is something very important in the eyes of the Italian public opinion.

In this context, as a future development, the implementation of floating offshore wind turbines will certainly be important, as it will allow us to further move away from the coast, increasing producibility. Moving away from the coast, however, implies to find a feasible way to connect the wind farms to the existing power grid. The recent developments in high voltage direct current applications, the so-called Voltage Source Converters, will solve the problem of transporting large powers over long distances.

In this context, CESI has extensive experience in HVDC projects around the world and recently supported a developer in a tender for an offshore in Northern Europe, developing the technical tender documents for the HVDC part of this plant.

Moreover, the deployment of renewables cannot be separated from the development of storage systems. For example, according to our simulations to 2030, in Italy, without an adequate storage system, we would lose a considerable amount of energy from renewable sources in the central hours of the day. Storage systems can also guarantee important network services, such as frequency regulation, recovery from a black-out, support to the electricity system, avoidance of network congestions and several more.

Currently, over 90% of electrochemical storage systems are lithium-ion, thus the cost reduction trend of this type of storage will have a positive effect on the further expansion of such systems. However, the growth of renewables must be mirrored by the improvement of traditional lithium-ion systems through the use of cathodes with new materials, which are more stable at high voltages, and the optimization of the anode materials to increase the energy density.

Finally, green hydrogen can be an additional source of energy storage, and the ideal position and size of the electrolyzers should be studied to make the most of the renewable energy with which to power the electrolyzers themselves. Several areas can be identified in which renewable energy can be produced and where energy can be harnessed to produce green hydrogen, which can be used on site or transported by pipeline, as we pointed out in our recent study [*Italian Hydrogen Strategy: What Impact on the Power System?*](#). Green hydrogen can certainly contribute to the "security of supply" of the electricity grid and an increase in production from electrolyzers will certainly contribute significantly to decarbonization by reducing its production from natural gas.