Vincent Rious[1]

WHAT TYPES OF SUPPORT FOR STORAGE DEVICES IN ISLAND POWER SYSTEM?

[1] Supélec, France, 0033 169 85 1531, vincent.rious@supelec.fr

OVERVIEW

The integration of massive photovoltaic and wind power raises problems in some island power systems in Europe because of the intermittency of these Renewable Energy Sources (RES), from 2012-2013 for some systems. Indeed, beyond a certain amount of intermittent renewable power, two alternatives are possible to balance load and generation. The first solution is to cut some conventional thermal plants when there is excess intermittent renewable energy. But these thermal power plants can then no more provide the necessary reserve margin to balance instantaneously the power system [1]. So this solution is not technically feasible because the power system will then not be reliable enough. The second solution consists in curtailing intermittent RES production surplus to maintain the balance between generation and load. But this solution limits the integration of more renewable energy in island power systems and makes more difficult the achievement of objectives of energy independence and reduction of GHG emissions for these isolated systems.

The only solution to deal with this limitation that is CO2-free and that can be quickly be implemented is to rely on the storage of electricity. Considering the constraints of available space in these small power systems, the electrochemical storage devices seem to emerge as the most suited solutions for the island power systems. The different technologies of electrochemical energy storage (batteries – lead acid, lithium or sodium-sulfur – flow batteries or fuel cells) are mostly still in the infancy of industrialization with a small level of deployment, even worldwide[1]. This is because their cost is prohibitive.

Nevertheless, we think that a public support should be implemented for electrochemical storage in island power system because the integration of electrochemical storage in the power system is facing fourfold market failures. 1° The electrochemical storage promotes the development of intermittent RES and reduces CO2 emissions from other power plants by flattening the load demand curve. And the pricing of CO2 does not alone internalize this positive externality (yet?). 2° The scientific and technological efforts associated with R & D and demonstration pilot for the development of these technologies have a public good character. 3° Innovations in the power system such as electrochemical storage face technological entry barriers due to the pre-existence of mature solutions (such as oil power plants) that can provide a similar level of flexibility required for an island power system with a big amount of intermittent RES. This limits their practical adoption and learning effects which would be associated. 4° A country that would develop an innovative technology as a special electrochemical storage technology has a genuine interest to accelerate the deployment of this technology with public support to make the related industry in order to position this industry as an international leader.

[1] NGK Insulator Ltd, the Japan leader of the Sodium-sulfur (NaS) technology, announces 200 operating megawatts and 450 MW signed for future installations. The market for batteries connected to the power network around 2018 would be only 4 billion dollars (www.pikeresearch.com).

METHOD

To propose a form of public support for storage in island power systems, we will first recall the various forms of public support for the development of clean technologies in the electrical system [3]. We can then link the various stages of technological and industrial development of new technologies [2] with the adequate support instruments. In a second part, we will identify the services that the storage could provide to island power systems to facilitate the integration of intermittent RES. We then establish the electrochemical storage technologies that can deliver these services. In the last section, we will recommend the form of adequate support for these technologies given their technical and economic maturity and their association with the development of intermittent renewables.

RESULTS

We come up with recommendations on the adequate support schemes for the electrochemical storage devices. The fuel cell technology is still in a R&D phase. So it should be placed outside of the power market with the constitution of a niche market. Technologies like flow battery still in the beginning of the phase of precommercial development should receive a support for investment while being exposed to some extent to market risks. Battery technologies are at the end of precommercial phase and should then be supported by a feed-in premium above locational hourly market price. In the absence of locational market signals, a feed-in tariff should be applied for coupled storage and intermittent renewable devices.

CONCLUSION

Considering the horizon where the electricity storage must be extended to ease the continuing development of intermittent renewable generation in the island power systems, we conclude a feed-in tariff scheme with a price level that varies with time of day must be implemented. It will focus in particular on battery technologies. Finally, to further promote European industry, the tariff should be designed to encourage the adoption lithium-ion-based and nickel-based technologies in order to avoid NaS technologies where the Japanese industry is currently the leader.

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