Third Generation Redox Flow Battery

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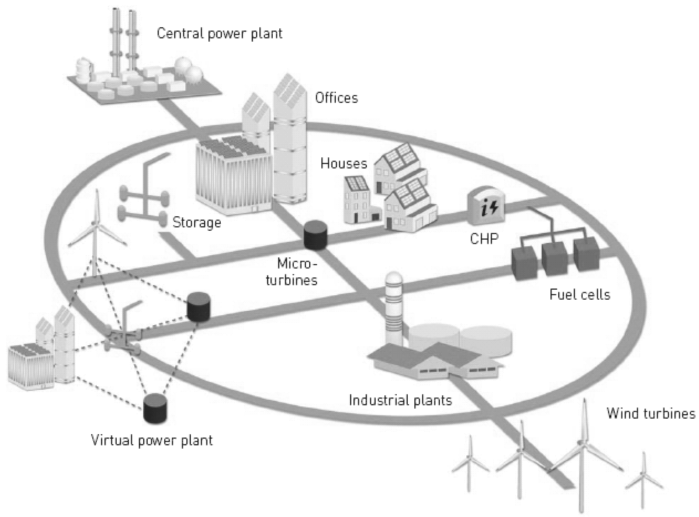
Future electricity supply shall contain more and more decentralized generation units. The amount of renewable energy, generated by solar, wind and water, will increase. The power production of these units is hard to control and match with electricity demand, which influences the stability and power quality of the electricity network.

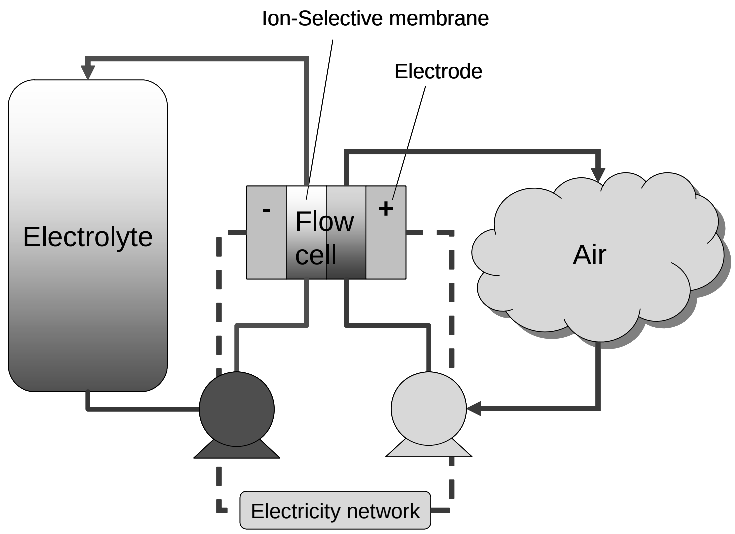


Courtesy of European SmartGrids Technology Platform

It is possible to overcome these problems by introducing electricity storage systems into the network. For local, small-scale storage systems, several technologies are commercially available or in advanced state of development. Examples are lead-acid and Li-ion batteries.
For middle and large scale developments (>100MW, >100MWh) the most obvious storage systems at this moment are compressed air and pumped Hydro storage. However these technologies require specific geography, like a storage reservoirs (lakes) or (salt) caverns. These have only limited availability in the Netherlands. Therefore Redox Flow batteries are an interesting alternative for middle and large scale electricity storage.

Two generations of the Redox Flow system have been developed. The "first generation" is the "Regenesys™ system, based on the polysulfide-bromide redox-couple. The "second generation" Redox Flow systems are the currently available "All Vanadium" and "Zinc-Bromine" systems. Both these generations contain two large vessels containing electrolyte and a stack in which the actual redox reaction occurs. The "Regenesys™ has never reached the phase of commercial implementation. The "All Vanadium" system consists of two vessels of expensive electrolyte and expensive membranes.

The "third generation" Redox Flow system, currently being developed, will contain one electrolyte vessel. The second vessel will be replaced by an air electrode. The Dutch Research Institute TNO has proven this concept. However for this proof of principle expensive membrane electrode assemblies (MEA) were used. The costs for this MEA have to decrease drastically, before such a "third generation" system will be economically feasible. Therefore within this project both existing and new electrolytes will be investigated on performance and price, new membranes will be developed and implemented. The complete system, with only one vessel containing the optimal electrolyte, will cost less and will be smaller than existing systems.



Third generation redox flow system

KEMA (Netherlands), University of Twente (Netherlands) and MAGNETO (Netherlands) are developing a "third generation" system, with a reversible air electrode. The objectives for this project are to enable oxygen from air to act as a reactant for the electrolyte and to develop membranes which are simple and cost-effectively produced on a large scale. Within the project membranes, electrodes and catalysts applicable for the air electrode will be developed. Depending on the investigation on interesting electrolytes, new electrolytes will be developed or existing electrolytes will be used. Finally these separate components will be integrated and an operational system will be developed.

By the development and application of the "third generation" redox flow battery it is possible to integrate more small-scale, sustainable generation units in the distribution network without decreasing the quality of electricity. Electricity storage systems are enabling technologies for implementation of renewable energy sources on a large scale.

This project is executed within the Long Term Energy Research Scheme of the Dutch Ministry of Economic Affairs.