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# An alternative hybrid concept combining seawater desalination, solar energy and reverse electrodialysis for a sustainable production of sweet water and electrical energy

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**ABSTRACT**

Fresh water and oil/gas based energy will become scarce since their actual (increase in) consumption rate is definitely unsustainable, when considering their restricted world reserves. Moreover, the large scale burning of such fuels for the production of electrical energy or in industry/transport results in a significant rising of the carbon dioxide concentration in the atmosphere and therefore a rising of global temperatures. Research and development regarding alternative energy sources such as e.g. nuclear fusion is proceeding but mankind also becomes more aware of the sun as being a giant fusion reactor, already at their free disposition and able to act as a lasting and sustainable energy source. The sun in fact delivers continuously about 89,000 TW of usable insolation (photons) power to our planet while the actual global power consumption is about 15 TW. From this point of view, the sun is thus able to provide about 6000 times the world's energy demand, thus highlighting the enormous potential of solar energy from such numbers in a very obvious way. A major disadvantage of insolation energy of course is its discontinuous and fluctuating availability during daytime. To circumvent such, a solution could eventually be found in the storage of solar power as osmotic energy in highly concentrated salt solutions. The development of salinity gradient power (SGP) based on reverse electrodialysis (SGP-RED) could therefore possibly become an important alternative approach. When combined with classic or solar power based seawater desalination technologies, the resulting hybrid system could well be a candidate for the simultaneous production of potable water and electrical energy. The concentration of the brine from the seawater desalination unit (SWDU) could be substantially increased by using solar energy while also producing additional sweet water (condensate). Electricity could then be produced from the mixing energy of the highly concentrated brine and seawater, by using the principle of reverse electrodialysis (RED). In this way the disadvantageous brine waste situation in seawater desalination could eventually be converted into an opportunity regarding the production of a large amount of additional fresh water, a significant amount of electrical energy and an answer to the brine disposal environmental problem. The theoretical simulation results from SGP-RED stack modeling using highly concentrated brine and seawater (brackish water) point to the absolute need of the development of a battery oriented SGP-RED stack configuration, requiring thin ion conductive membranes and thin spacers as to minimize the internal battery resistance and maximize the electrical power output.

*Keywords*: Salinity gradient power; Reverse electrodialysis; Brine; Solar; Desalination; Evaporation; Potable; Fresh; Sweet; Energy; Sustainable

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