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Abstract: Capacitive deionization (CDI), an electrochemical desalination technology, was numerically coupled with pressure-retarded osmosis (PRO), a salinity gradient power generation technology, for water and energy production. A novel multi-pass desorption process was employed for CDI, result in a high freshwater recovery and highly concentrated desorption effluent. The high and low concentrated streams produced by the electrochemical CDI system were used in PRO as continuous draw and feed solutions, respectively. The integrated CDI-PRO system performance was mathematically assessed in terms of water recovery (WR), concentrated gain ratio (CGR), PRO power generation, and overall power consumption for different desorption flow rates, applied currents, and number of desorption passes. The WR and CGR values in the electrochemical