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The potential for microfluidics in electrochemical energy systems

(Supporting Information)

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1. Generalized scaling strategy for energy microsystem

The flow-diagram presented in Figure S1, describes a general strategy for the assessment of the potential implementation of a microfluidic system in the energy domain. First, (1) the requirements of the electrochemical energy conversion systems need to be understood; this can involve current densities, potentials, form factors and application intended. Then, (2) collecting the data related to the physical properties of the species or materials involved and (3) information regarding existing processes (micro and macroscale) can allow for a better understanding on (4) what scaling strategy to follow (e.g. reactor design, limiting phenomena, critical device parameters). With the information in hand and following the discussion presented in Section 4 of this manuscript, a scaling strategy can be assessed. In all likelihood, parallelization strategies would only be useful if the application intended requires low amounts of energy and is to be implemented in a high-margin industry. Otherwise, it is critical to envision a way to areally scale the microdevice in question. At this point it is important (5) to identify the appropriate materials set to manufacture the device, including the compatibility with the chemical transformations that take place, the structural stability and desired durability of the device, as well as the allowable costs. This will inform the decision on (6) what manufacturing approaches can be used based on the intended final applications. Once a strategy to fabricate the devices has been envision, the last steps involve carrying out a life-cycle analysis (7) to determine if the devices can produce more energy than the one required to manufacture them, as well as a technoeconomic analysis to understand the economic viability of the product. Lastly, (8) social aspects regarding the deployment of the technology should be consider to assure the successful adoption of the energy solution; this can include understanding the regulatory framework, the societal needs, and other opportunities for clean-energy technologies.

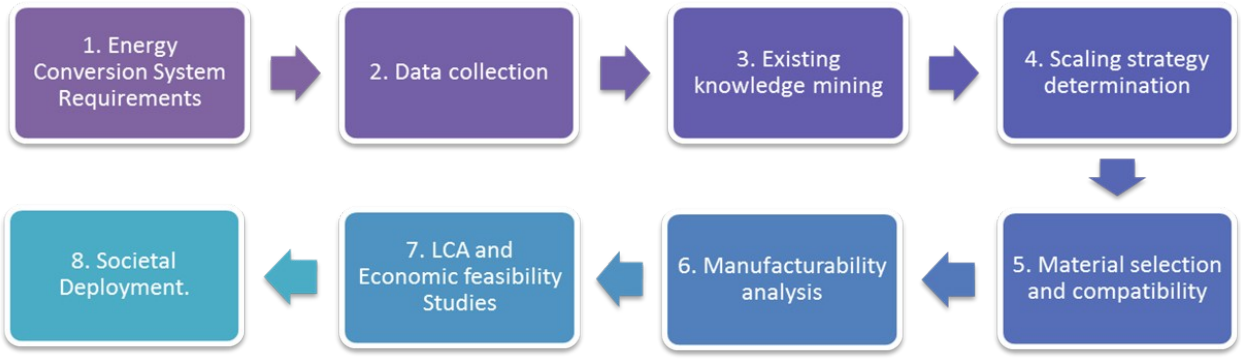

Figure S1. Flow-diagram describing the steps to follow for the deployment of microscale energy technologies.