



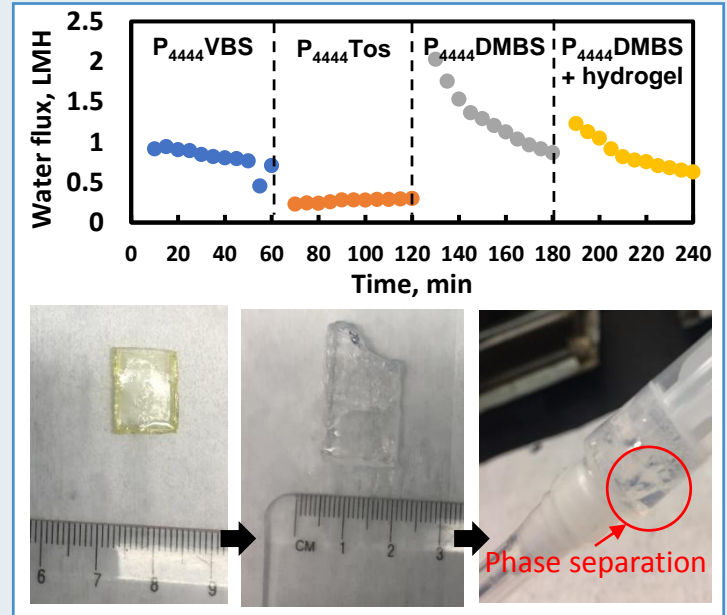
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## Motivation

Water resources are finite, whereas global population and energy consumption are annually expanding, the competitive balance between these resources has received renewed focus. Today, roughly 700 million people lack access to safe drinking water, and estimates show this figure rising to 1.8 billion in just 10 years. Since water and energy resources are heavily interconnected, developing technologies to enable a sustainable water and energy future is essential.

## Technological Challenges

Forward osmosis (FO) has the potential to overcome the limitation of reverse osmosis (RO), such as high salinity and directly utilizing waste heat or solar power. Thermo-responsive materials with high osmotic pressure need to be developed as draw agents for FO to utilize low-grade heat.



**Figure 2.** FO performance using [ionic liquid / Hydrogel] as draw solutions and the water recovery from hydrogel

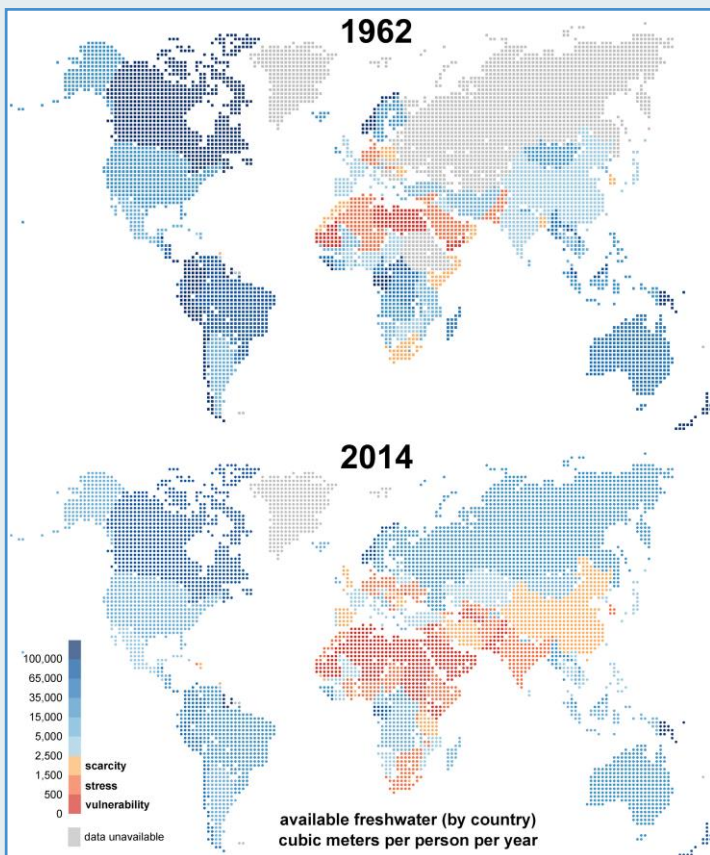
## Research

Ionic liquid (IL) and its hydrogel-form draw agents that exhibit lower critical solution temperature (LCST) phase behavior are a promising future direction. These ILs show a high osmotic pressure and low reverse diffusion, and the LCST phase behavior (*i.e.*, decreasing water miscibility with increasing temperature) allows these draw agents to be regenerated straightforwardly by integration with low-cost heat sources. A binary draw agent consists of IL small molecules and IL-based hydrogels allows us to extract water from hydrogels, which is purer than water recovered from ILs. The benefit from hydrogel can further decrease the energy demand for following water purifications.

## References

Urban J. J. "Emerging Scientific and Engineering Opportunities within the Water-Energy Nexus" *Joule* **2017**, 1, 665-688

## Acknowledgements



**Figure 1.** The Changing Landscape of Worldwide Renewable Internal Freshwater Resources from 1962 to 2014