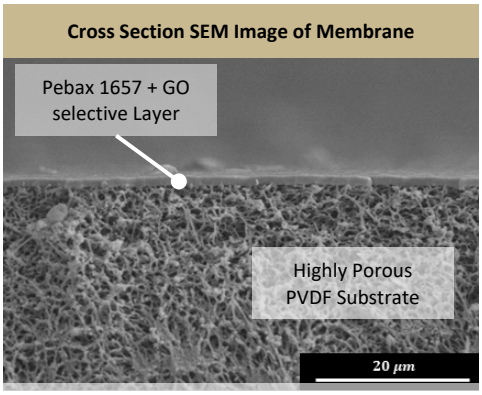
Positions Available: MemDry: Vapor Selective Membranes for Drying and HVAC

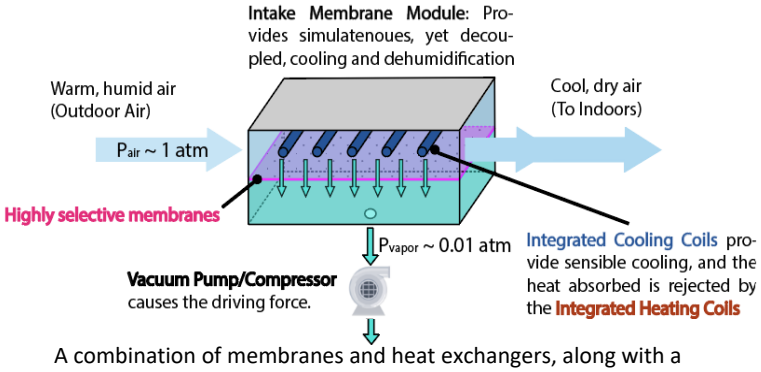
We are recruiting PhD students and PostDoc(s) at Purdue, including mechanical, materials, and civil engineering disciplines.



Prelimary work: membranes, made of Pebax-Graphene Oxide pass 10,000 molecules of vapor for every molecule of air

The project: It aims to use new materials that selectively remove water vapor and block air transport while avoiding heat loss, combined with a clever and flexible process design. It will achieve 50-80% energy savings by avoiding condensing of water, reducing temperature differences, a passive mode, and pumping only small amounts of vapor via a dual membrane design. The approach combines novel membrane materials, enhanced thermal transport, a novel system, and a new compressor design. Our past work [1, 2] shows its potential in HVAC applications. Preliminary results show extraordinary potential in other applications including industrial drying processes.

Positions: The total amount of funding from the DOE Advanced Manufacturing Office (AMO) is $2.4M and we are **hiring at least 3 grad students** and **PostDoc(s)**. Those who join may also contribute to other projects on membrane materials[3], water treatment[4, 5], atmospheric water harvesting[6], and HVAC component design. There will be experimental work, modeling work, patenting, journal papers, graphic design, conference presentations, and internship opportunities. Applicants should be comfortable working collaboratively in a large diverse team with substantial mentorship of grad and undergrad students.



A combination of membranes and heat exchangers, along with a recirculating air stream, will enable ultra-efficient drying.

The team and facilities: The work will be centered between Purdue's Birck Nanotechnology Center (which has the second largest cleanroom of a US university) and Herrick Labs (which is the world's largest academic HVAC facility). Purdue is also ranked 4th for engineering. The students will be mentored by a combination of Prof. Warsinger (PI), a specialist in separations processes, water technologies, nanomaterials, and thermal transport, and Co-PI Prof. Davide Ziviani, a specialist in HVAC equipment, compressors, and thermal management. Prof. Jim Braun will also have a mentoring role.

Prospective grad students and **PostDocs** should message dwarsing@purdue.edu and **fill out** this **survey**.

References

[1] A. J. Fix, J. E. Braun, and D. M. Warsinger, "Vapor-selective active membrane energy exchanger for high efficiency outdoor air treatment," *Applied Energy*, vol. 295, p. 116950, 2021.

[2] A. J. Fix, B. C. Pamintuan, J. E. Braun, and D. M. Warsinger, "Vapor-selective active membrane energy exchanger with mechanical ventilation and indoor air recirculation," *Applied Energy*, vol. 312, p. 118768, 2022.

[3] D. M. Warsinger, S. Chakraborty, E. W. Tow, M. H. Plumlee, C. Bellona, S. Loutatidou, L. Karimi, A. M. Mikelonis, A. Achilli, A. Ghassemi, P. P. Lokesh, S. A. Snyder, S. Curcio, C. Vecitis, H. A. Arafat, and J. H. Lienhard, "Review of polymeric membranes for potable water reuse," *Progress in Polymer Science*, 2018.

[4] H. B. Parmar, H. F. Juybari, Y. S. Yogi, S. Nejati, R. M. Jacob, P. S. Menon, and D. M. Warsinger, "Nanofluids improve energy efficiency of membrane distillation," *Nano Energy*, vol. 88, p. 106235, 2021.

[5] A. Deshmukh, C. Boo, S. Lin, A. Straub, T. Tong, D. Warsinger, and M. Elimelech, "Membrane distillation at the water-energy nexus: Limits, opportunities, and challenges," *Energy and Environmental Science*, vol. 11, no. 5, pp. 1177–1196, 2018.

[6] A. K. Rao, A. J. Fix, Y. C. Yang, and D. M. Warsinger, "Thermodynamic limits of atmospheric water harvesting," *Energy & Environmental Science*, accepted, 2022.