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## Optimizing Membrane Distillation with Solar Thermal Collectors

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# ***Optimizing Membrane Distillation with Solar Thermal Collectors***



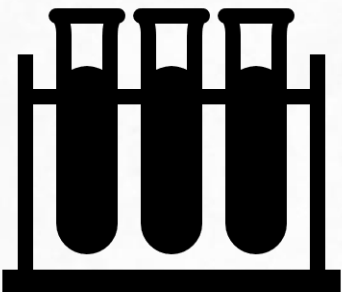
**Andy Mason**

***IN OUR GRIT, OUR GLORY™***





- Issue
- Method
- Technology
  - Membrane Distillation
  - Solar Thermal Collectors
- Product
- Applications
- Future Work
- Recognition





# 10 Billion Tons of Fresh Water Are Used Daily<sup>[1]</sup>



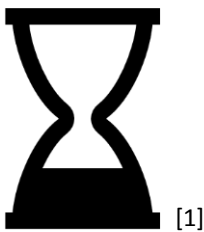
Human Population  
Agriculture/Manufacturing/Mining  
Water Usage



Reservoir Replenishment  
Fresh Water Availability



19y 104d 07h 42m 25s  
Time left till the world runs out of freshwater  
RIGHT NOW



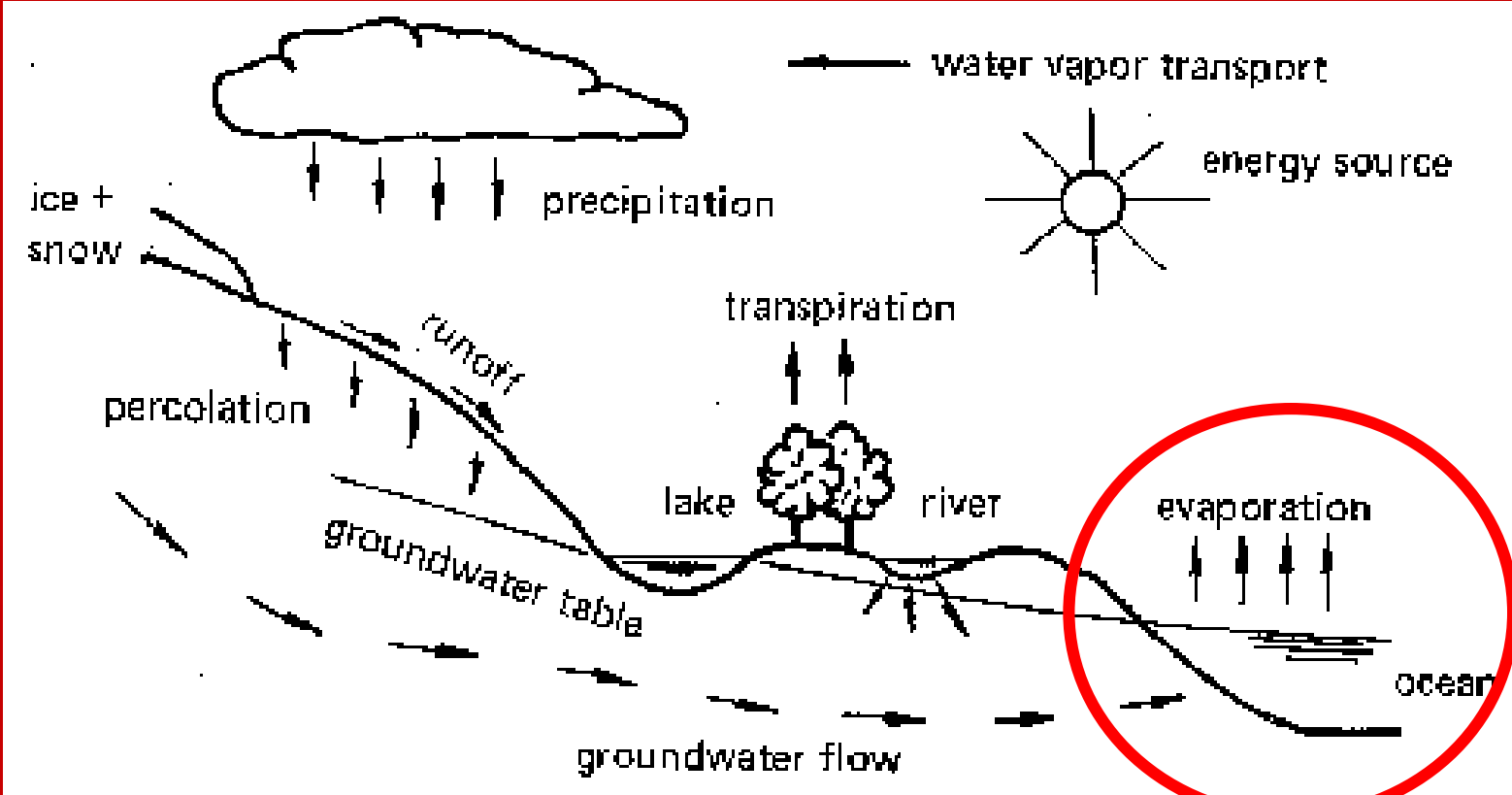
[1]



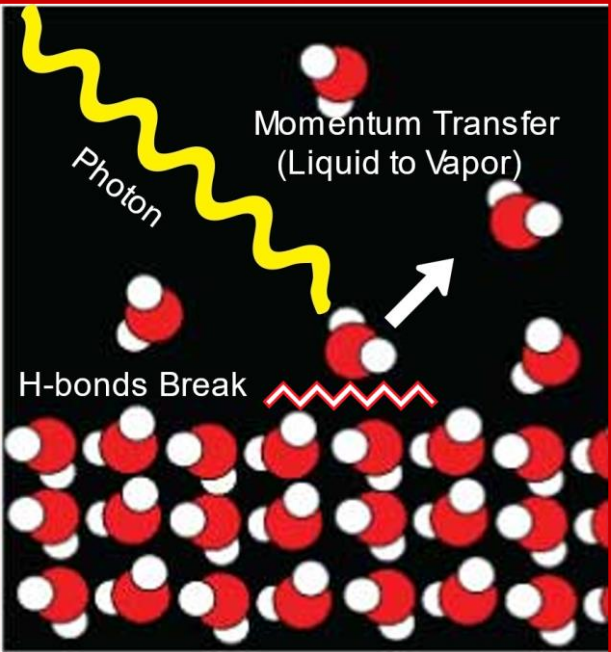
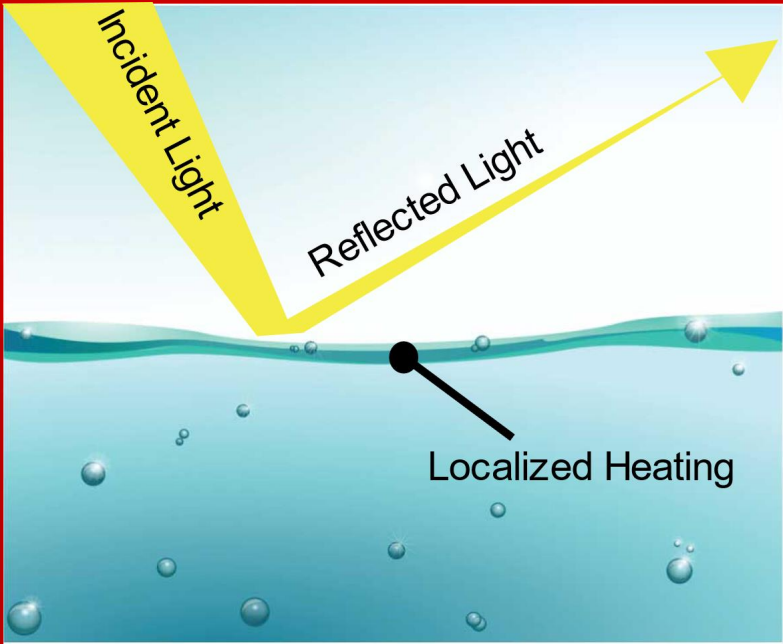




# Water Cycle

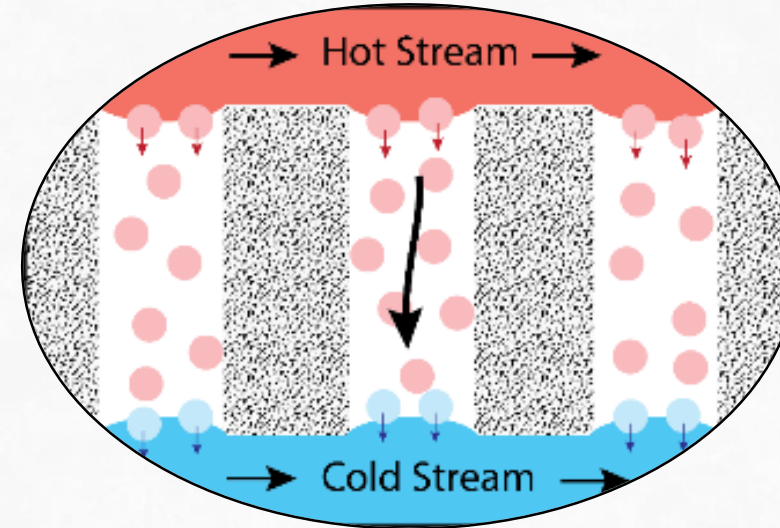
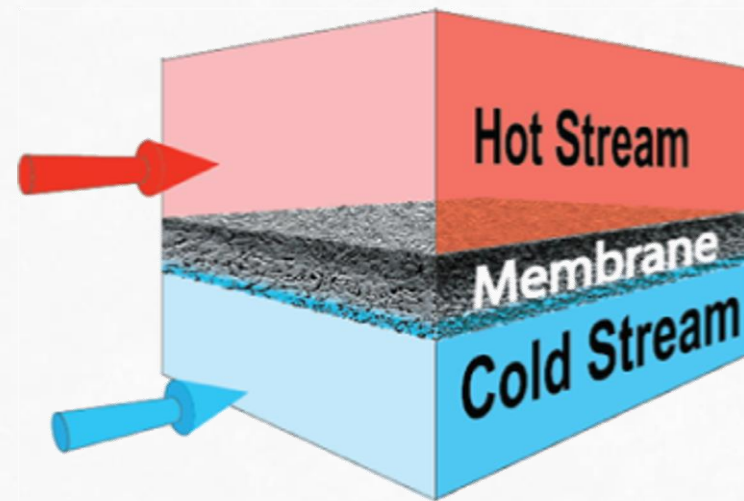


## Solar Evaporation

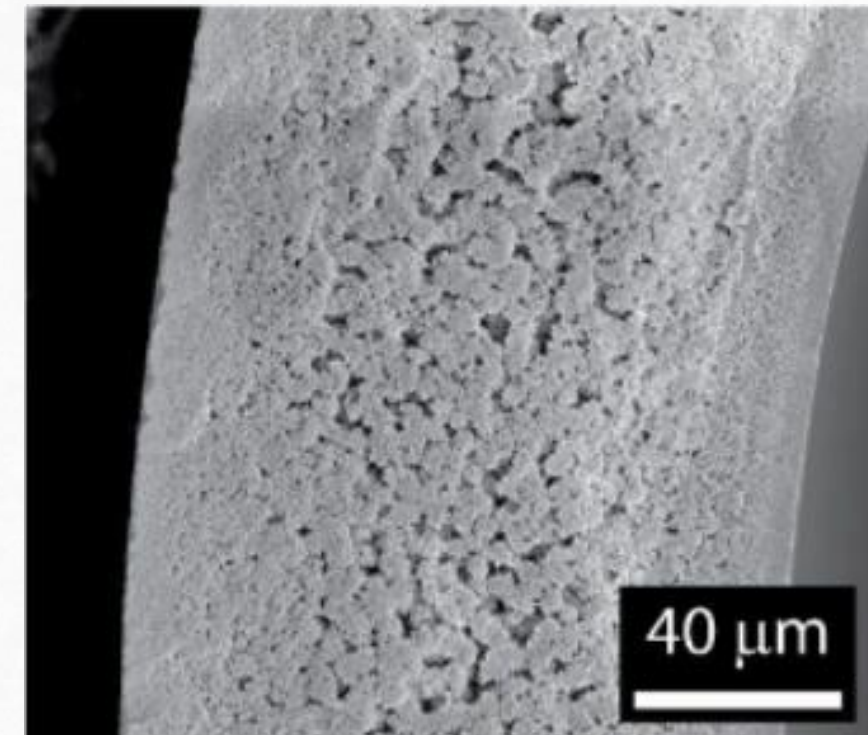
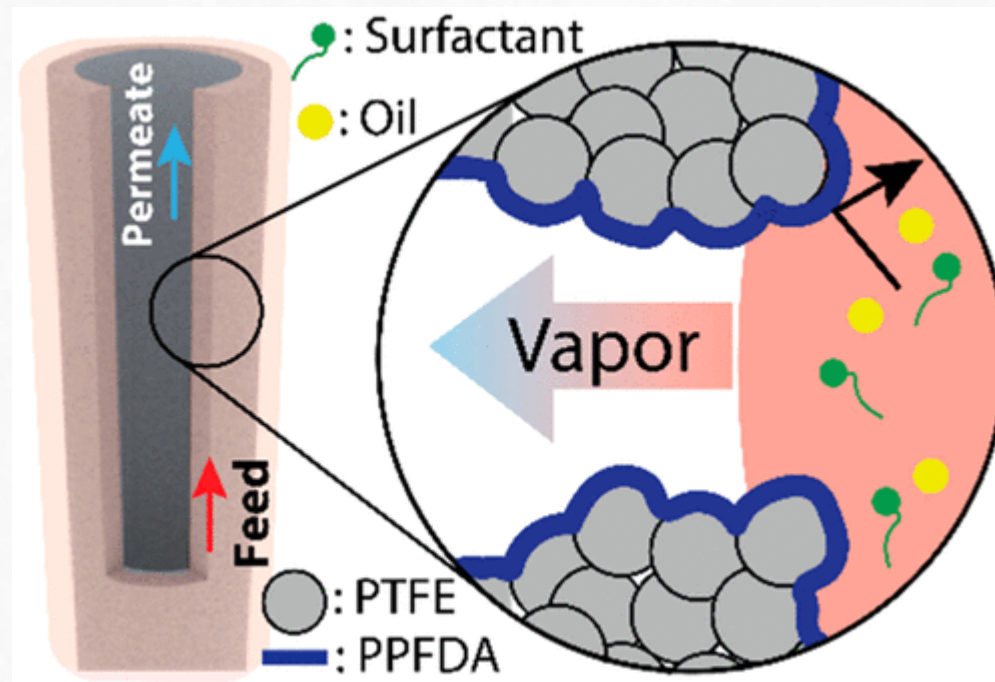




# Membrane = Filter For Liquid/Vapor



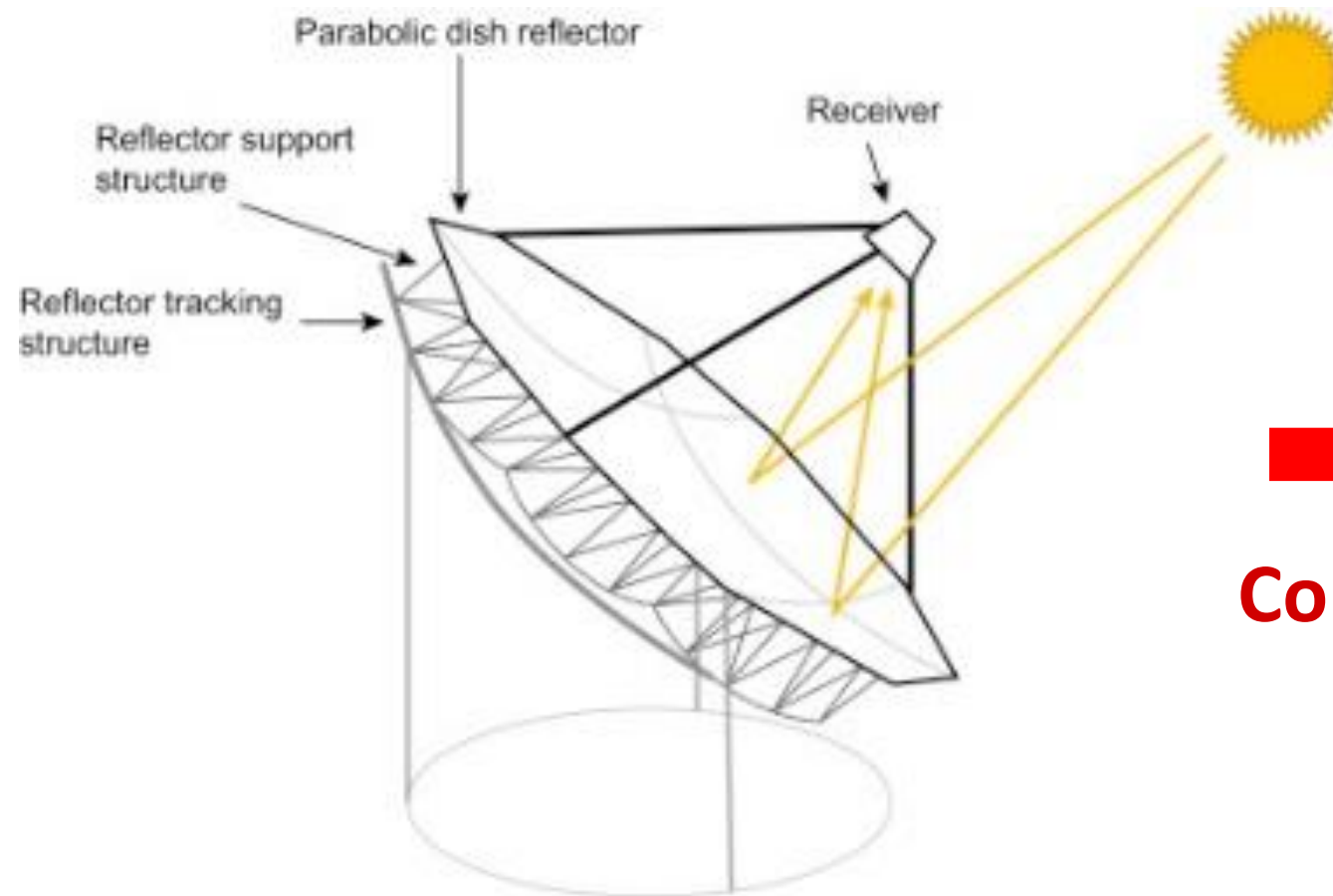
Omniphobic Hollowfiber Polyvinylidene Fluoride (PVDF) Membrane  
Coated with Polytetrafluoroethylene (PTFE-Teflon) and Poly(1H,1H,2H,2H-perfluorodecyl acrylate) (PPFDA)



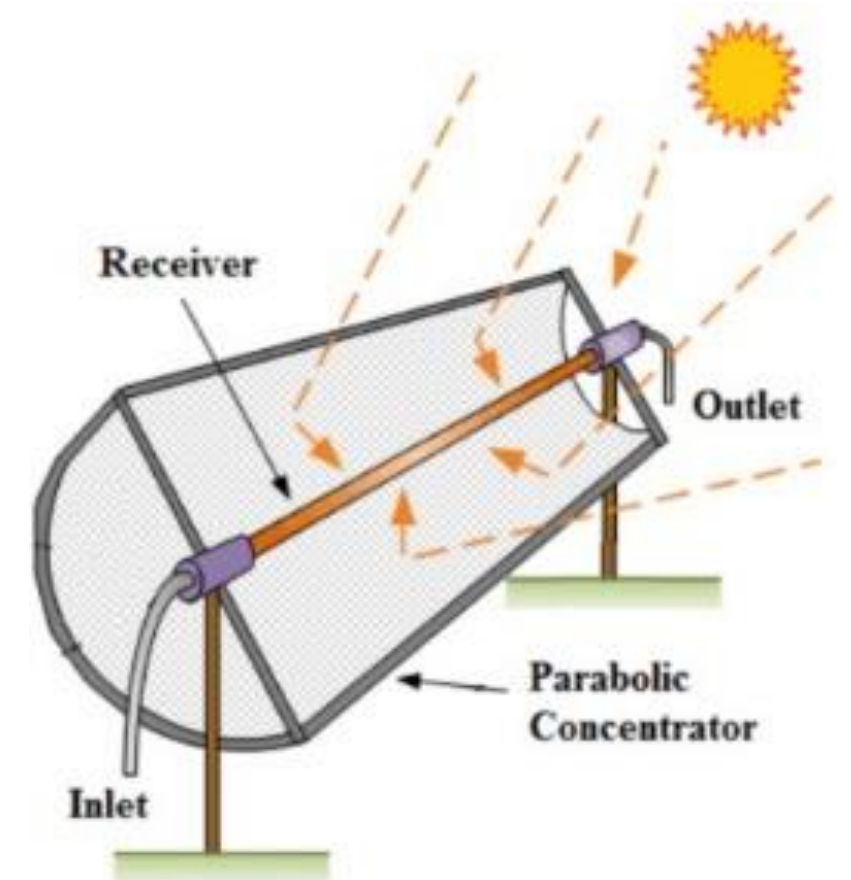




# Solar Collectors



Continuous Flow



Breakdown

Issue

Method

Tech

Application

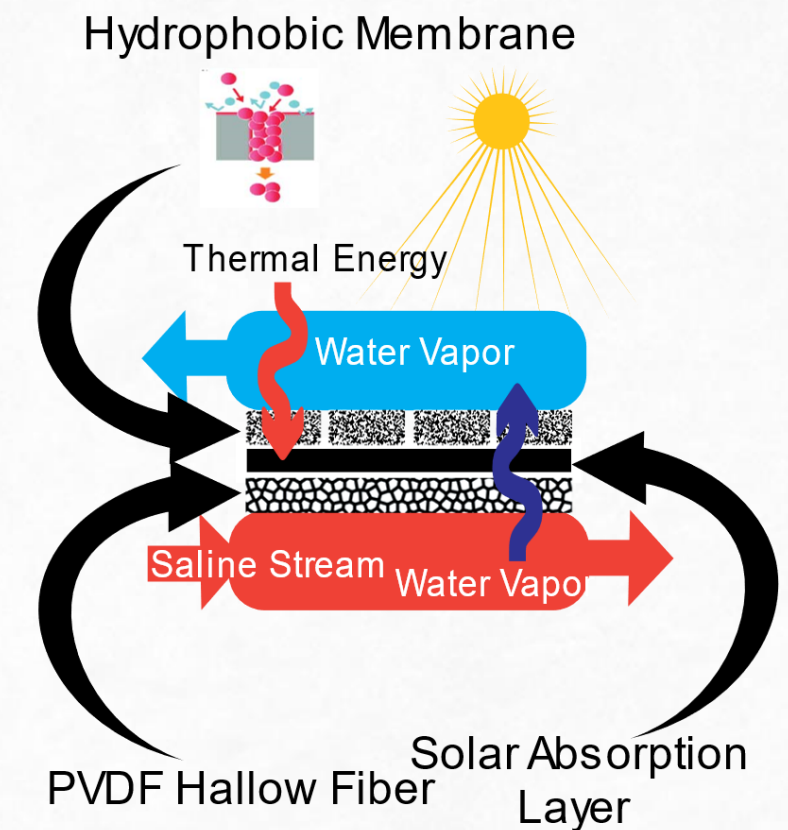
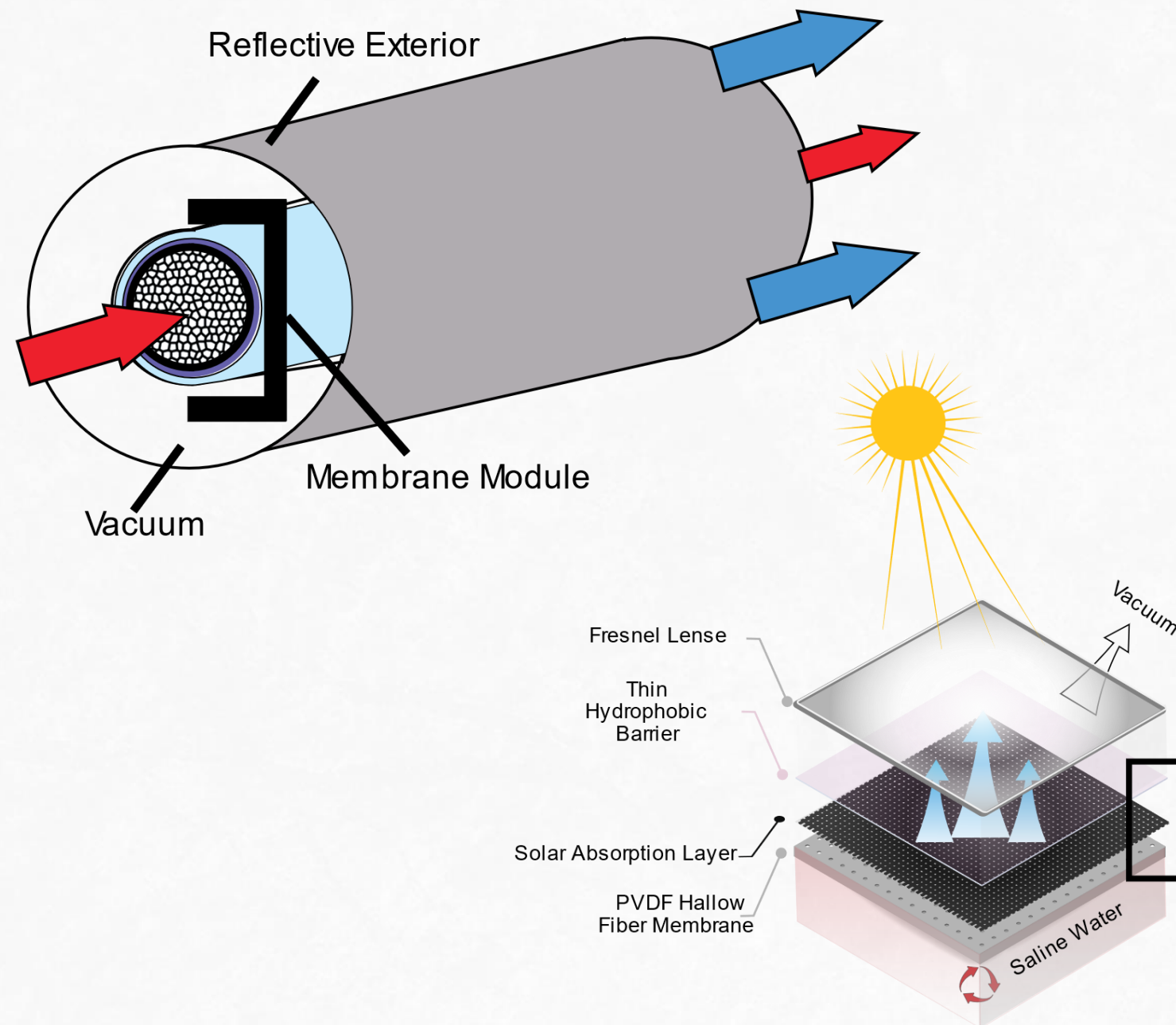
Future

Recognize



# Membrane Distillation Module

Product



Breakdown

Issue

Method

Tech

Application

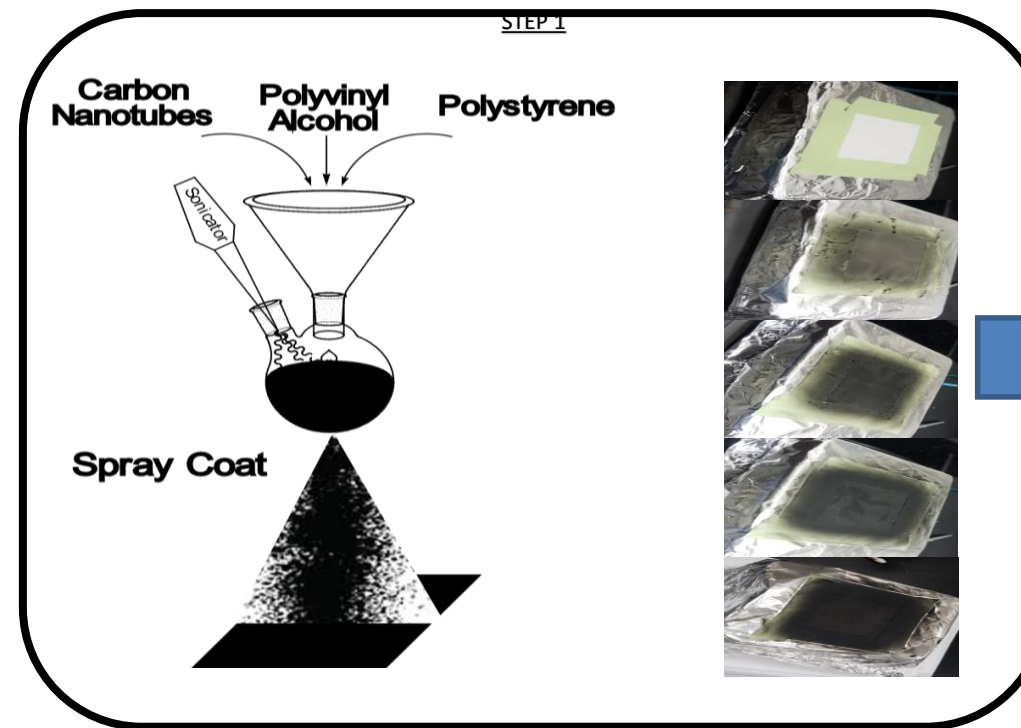
Future

Recognize

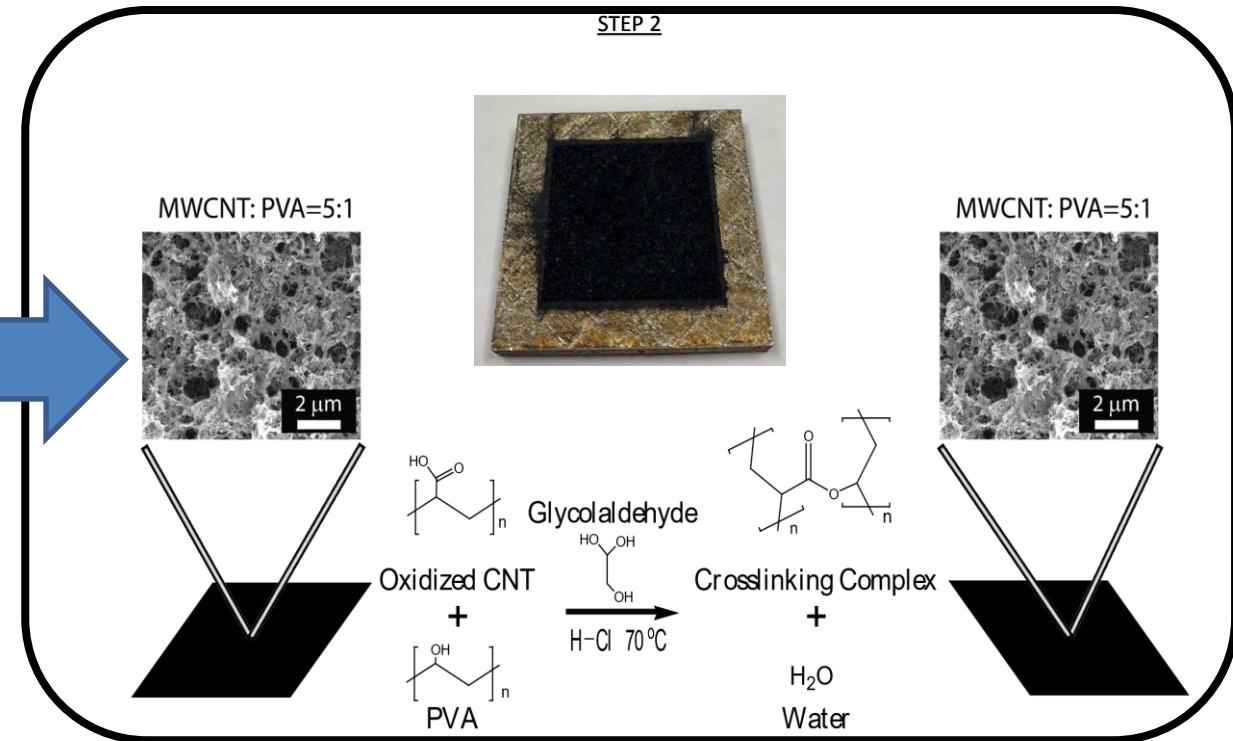




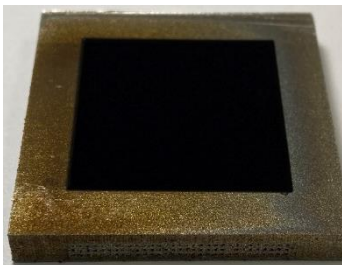
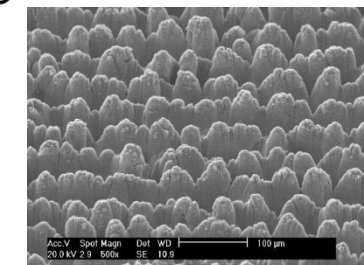
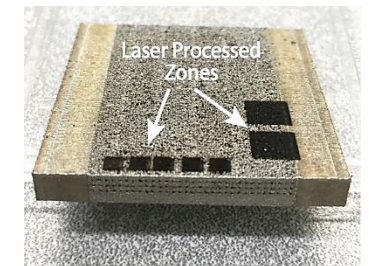
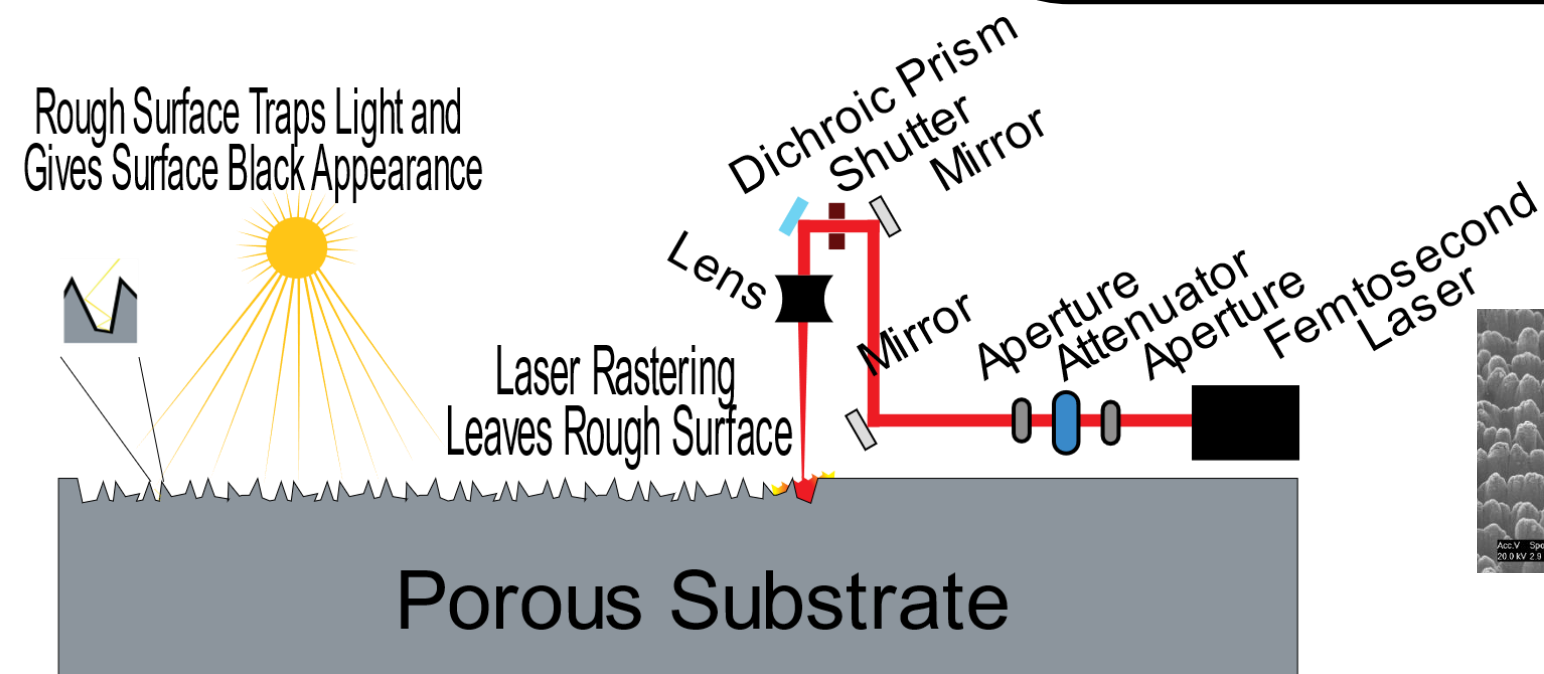
## Spray Coated Carbon Nanotubes



## Solar Absorption Layer



## Laser Rastering



Breakdown

Issue

Method

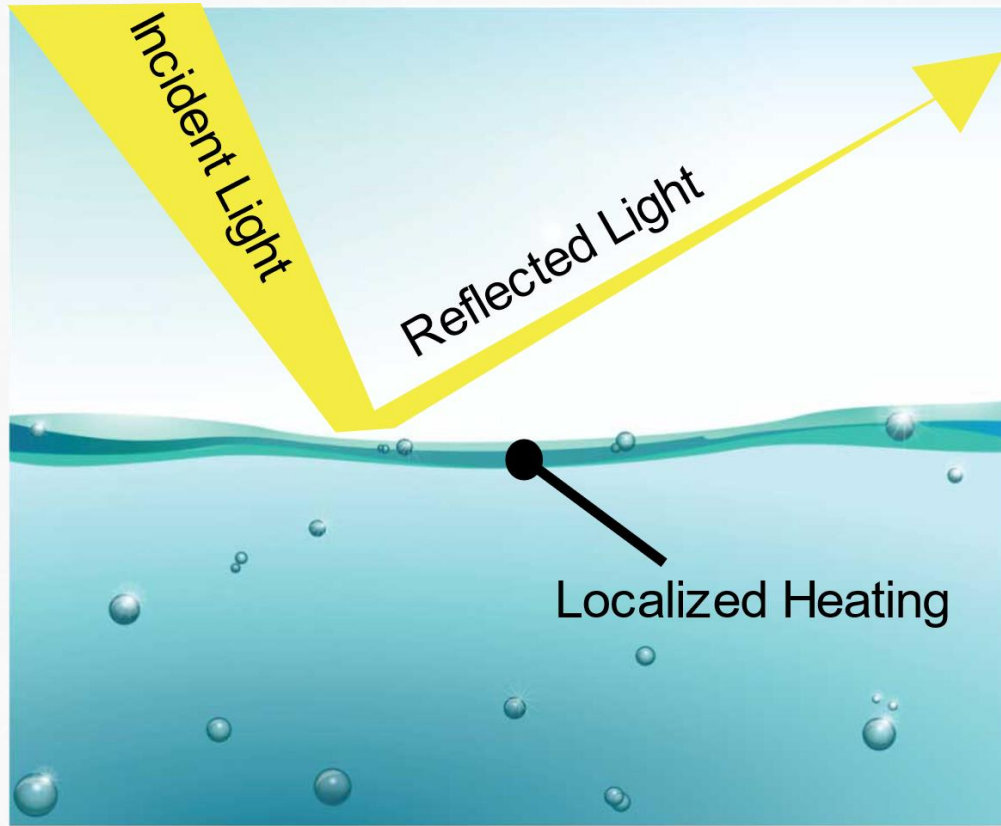
Tech

Application

Future

Recognize

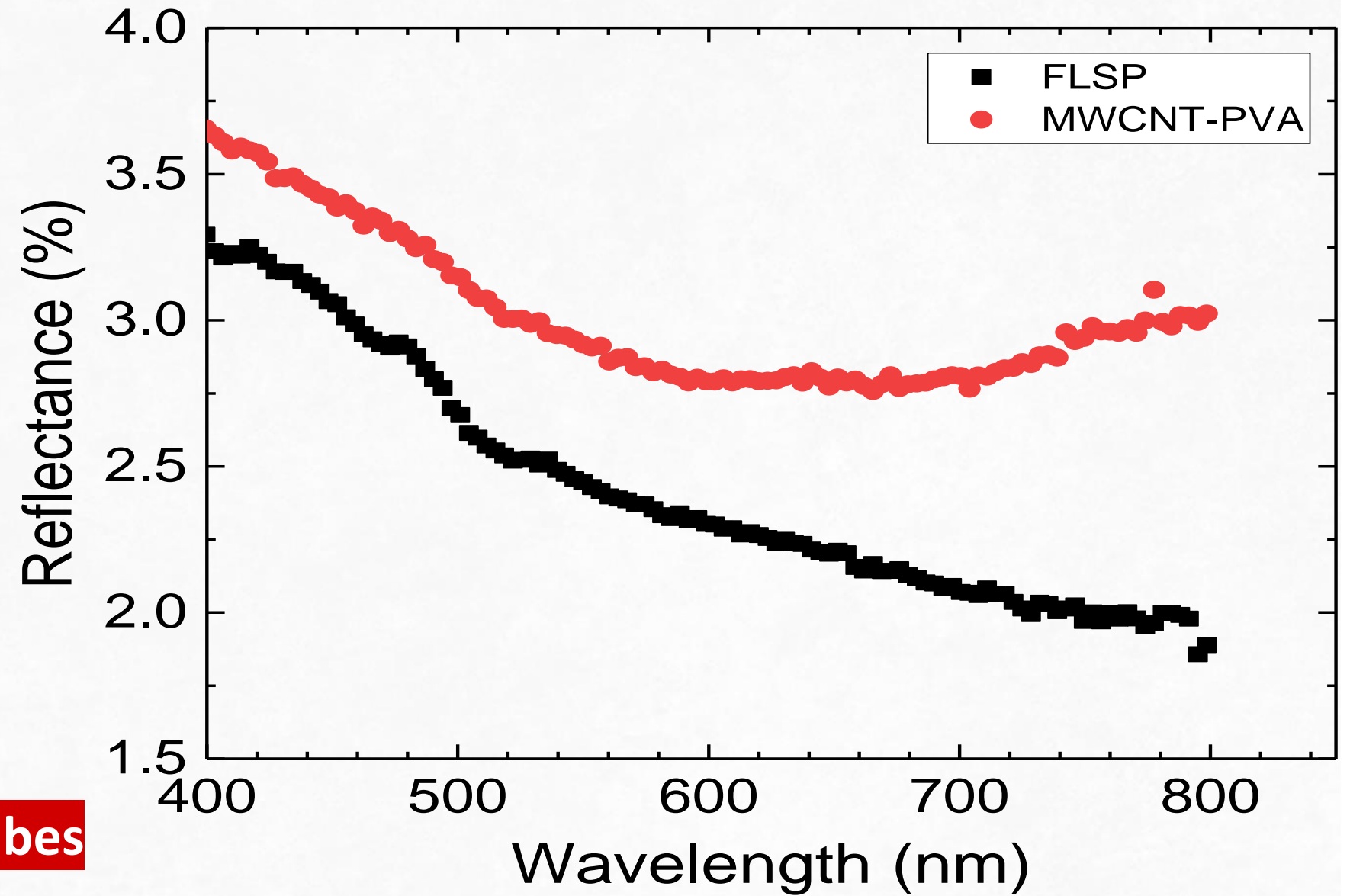




**Laser Rastering > Carbon Nanotubes**

## Solar Absorption Evaluation

### Reflectance Data



Breakdown

Issue

Method

Tech

Application

Future

Recognize



## Desalination Plants

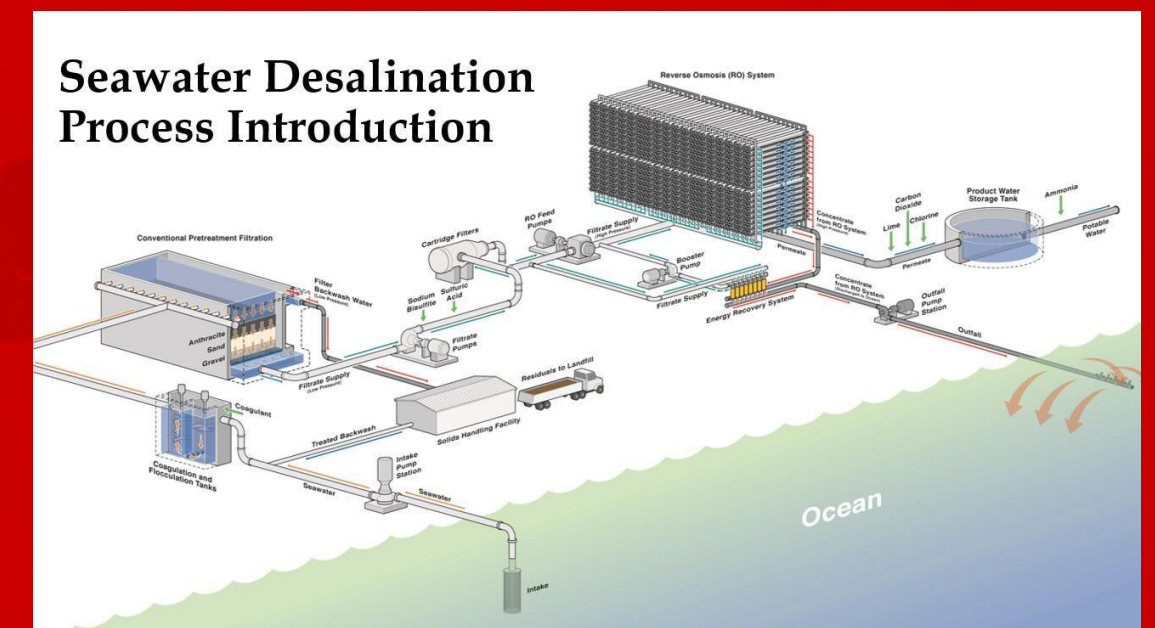
Replace RO Systems ( $\sim 2.2$  to  $6.3 \text{ kWh/m}^3 \text{ water}$ )<sup>[5]</sup>

More Energy Efficient ( $\sim 2.0 \text{ kWh/m}^3 \text{ water}$ )<sup>[4]</sup>

100% Rejection of Solute

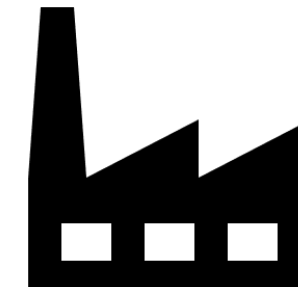
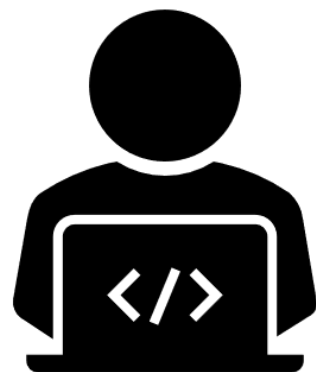
Reduction in Salt Scaling

Mergeable with other energy sources  
(geothermal/friction)





**Continue Developing Flow Models**  
**Prototyping**  
**Integrating Solar Collectors**  
**Testing Energy Efficiency on Large Scale**







NEJATI RESEARCH  
GROUP  
Transformative Coatings  
and Interfaces



Center for Electro Optics  
and Functionalized  
Surfaces



Breakdown	Issue	Method	Tech	Application	Future	Recognize
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# References

- [1] <https://www.theworldcounts.com/stories/average-daily-water-usage>
- [3] Ghaleni, Mahdi Mohammadi, et al. "Model-Guided Design of High-Performance Membrane Distillation Modules for Water Desalination." Journal of Membrane Science, Elsevier, 28 June 2018, [www.sciencedirect.com/science/article/abs/pii/S0376738818306835](http://www.sciencedirect.com/science/article/abs/pii/S0376738818306835).
- [4] Mahdi Mohammadi Ghaleni, Design, Synthesis, and Fabrication of Membranes and Modules for Water Desalination: Porous Materials with Special Wettability for Membrane Distillation, Ph.D. Dissertation, University of Nebraska-Lincoln, 2020.
- [5] <https://www.irena.org/DocumentDownloads/Publications/IRENA-ETSAP%20Tech%20Brief%2012%20Water-Desalination.pdf>



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**What Questions Do You Have?**