

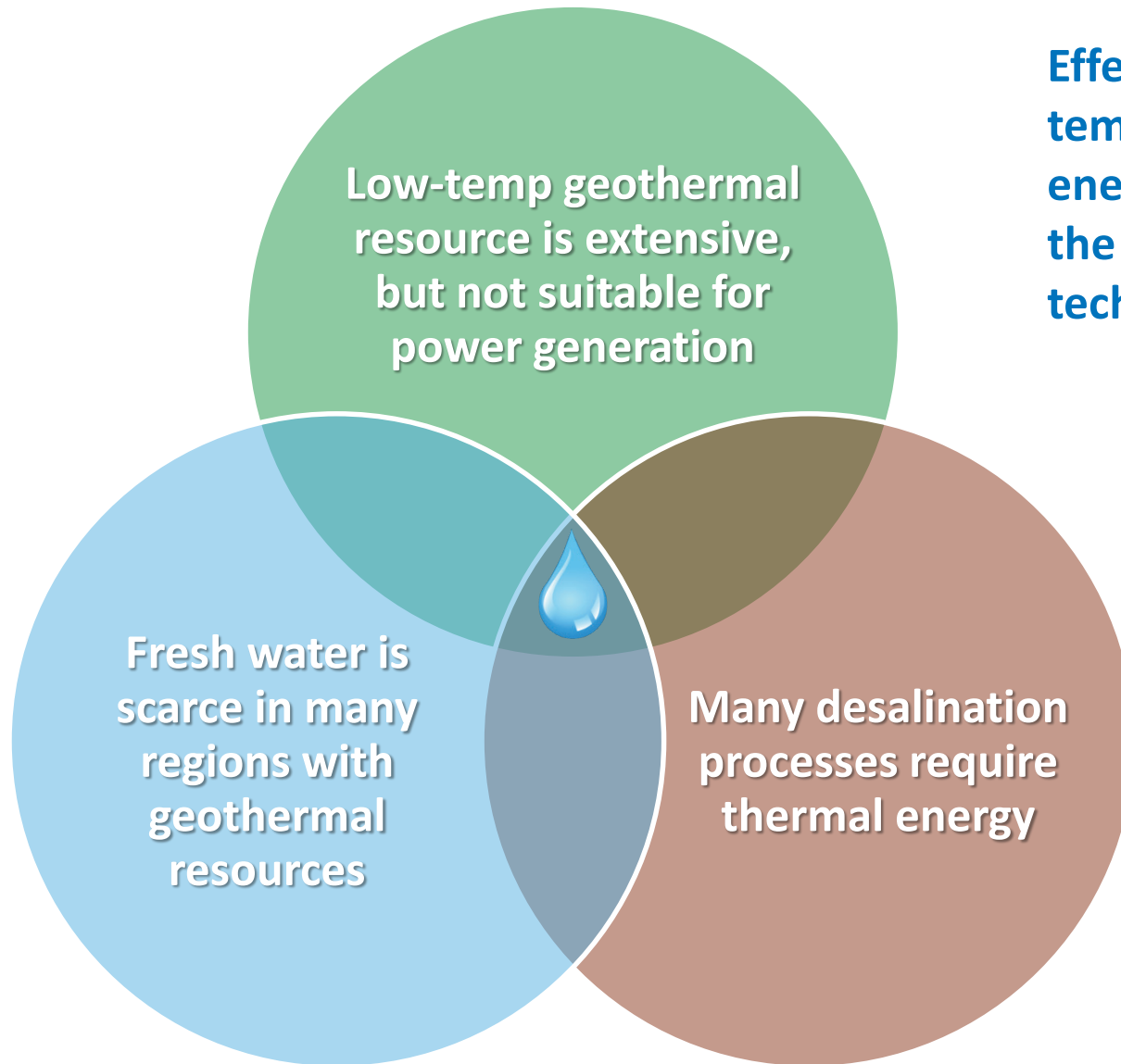
# Membrane Distillation Using Geothermal Energy



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# Motivation



**Effective integration of low-temperature geothermal energy requires selecting the right desalination technology.**

# Desalination Decision Support Tool



Inputs

Source-water composition

Geothermal resource

Product-water targets

Treatment Selection Module

Beneficial Use Screening Module

Beneficial Use Economic Module

Outputs

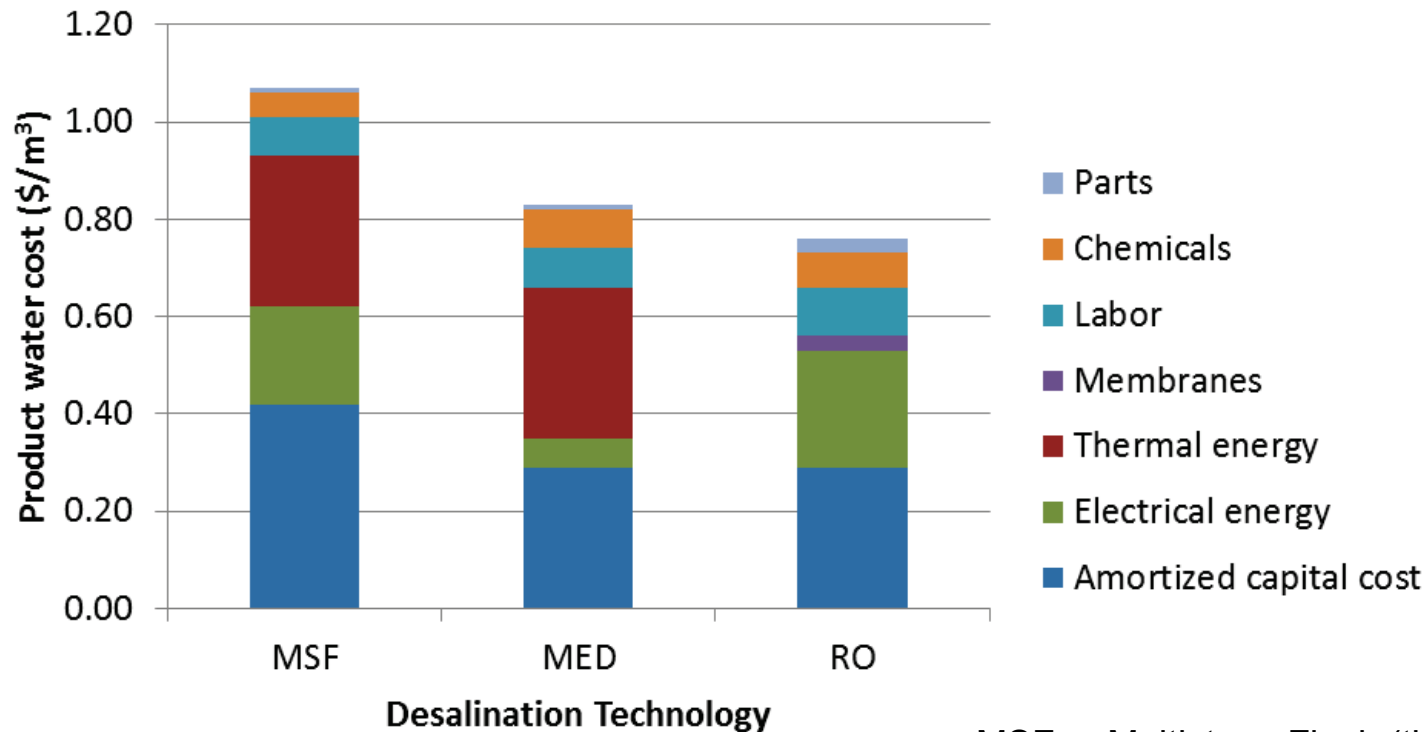
Conceptual design of suitable treatment train(s) with energy demand and estimated cost



# Cost of Desalination

Distribution of cost by category for the three most common desalination technologies. Energy cost and consumption is key.

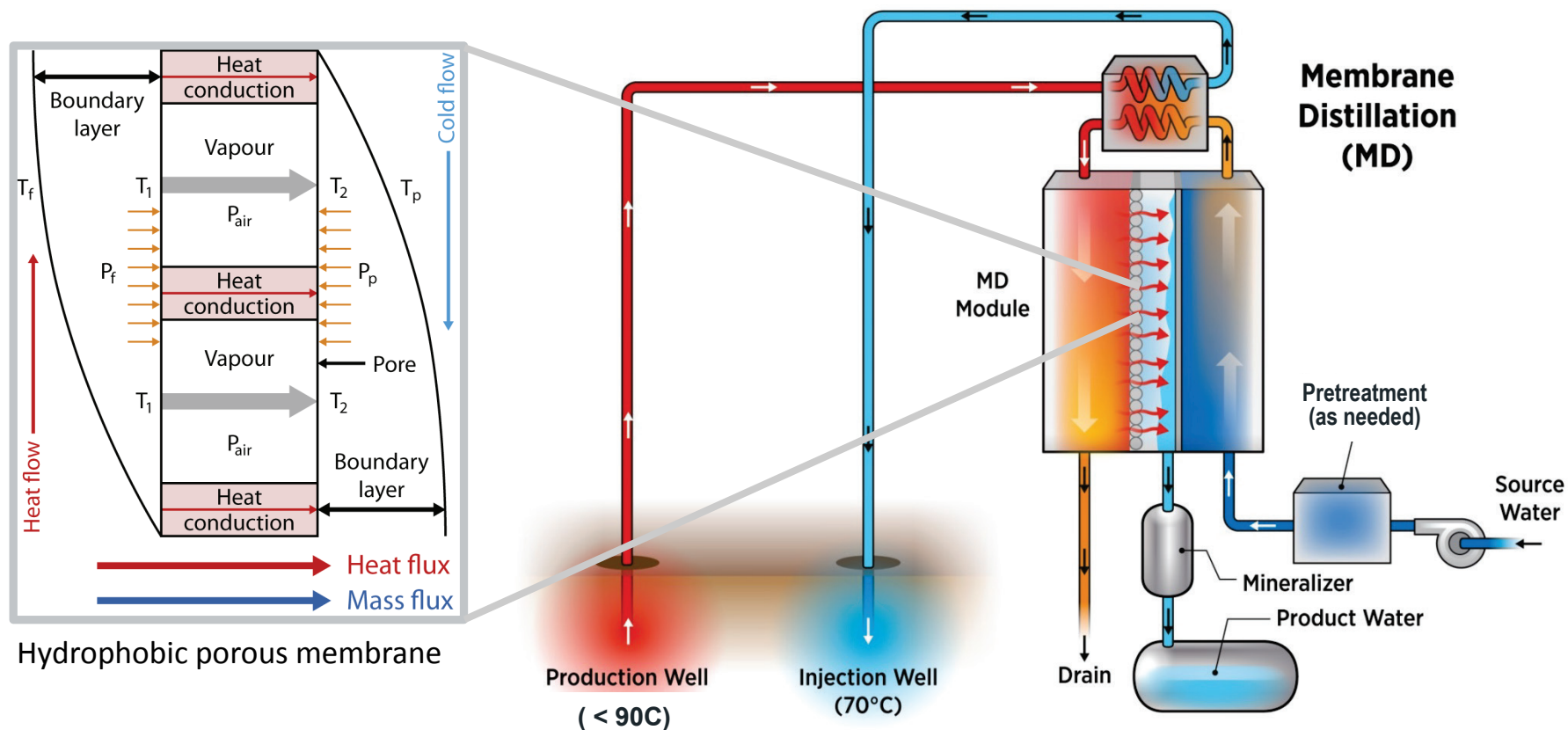
Values are based on a large seawater desalination plant. [Ziolkowska, 2015]



MSF = Multistage Flash (thermal)  
MED = Multi-effect Distillation (thermal)  
RO = Reverse Osmosis (electrical)

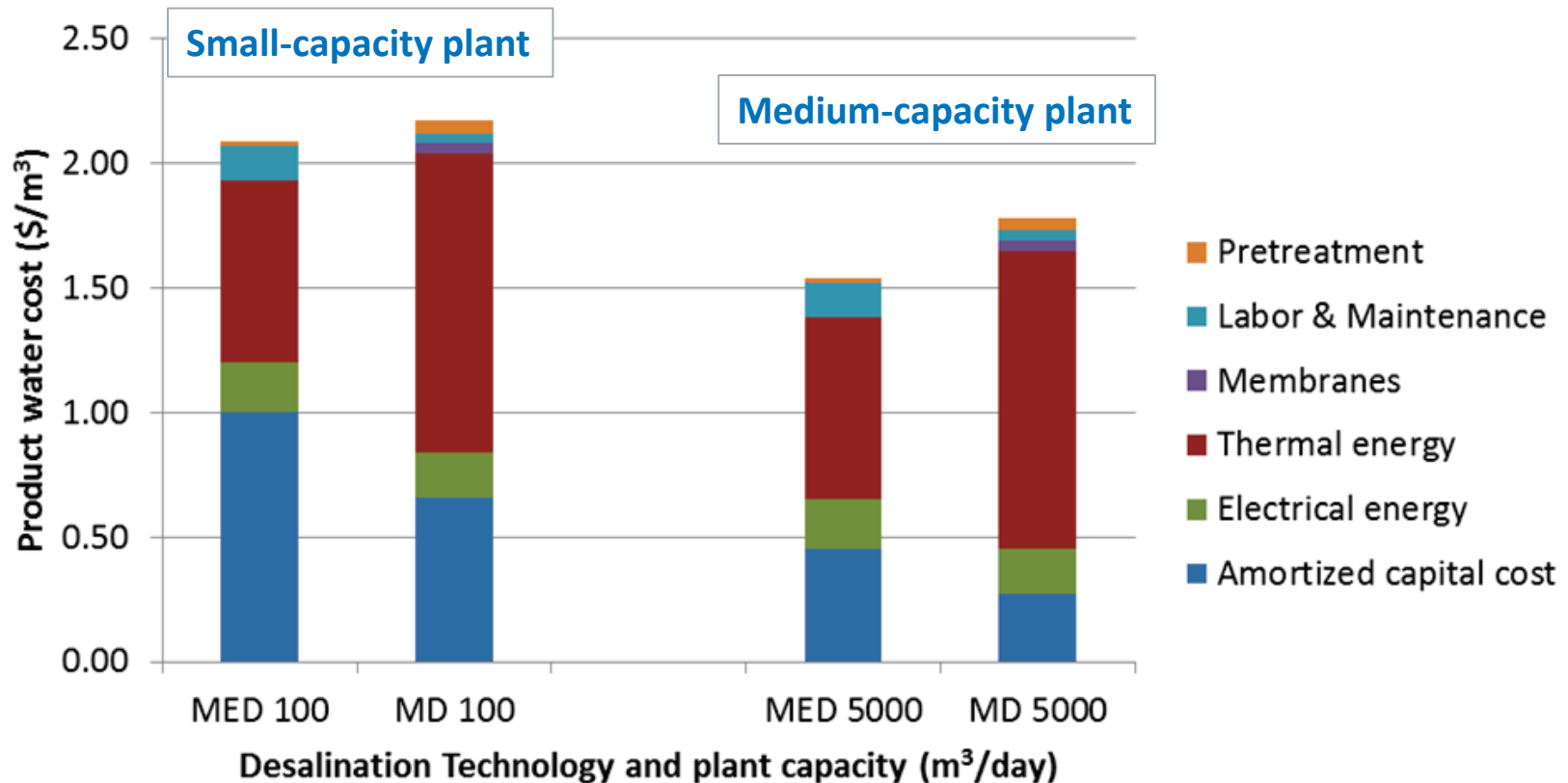
# Desalination Technology Choice

The emerging technology of Membrane Distillation (MD) was selected as the best match for small-capacity systems powered by low-grade heat.



# Membrane Distillation Cost

MD advantages are more apparent at small scale. Lower thermal energy costs could allow MD to undercut MED costs.



Kesieme et al., 2013.

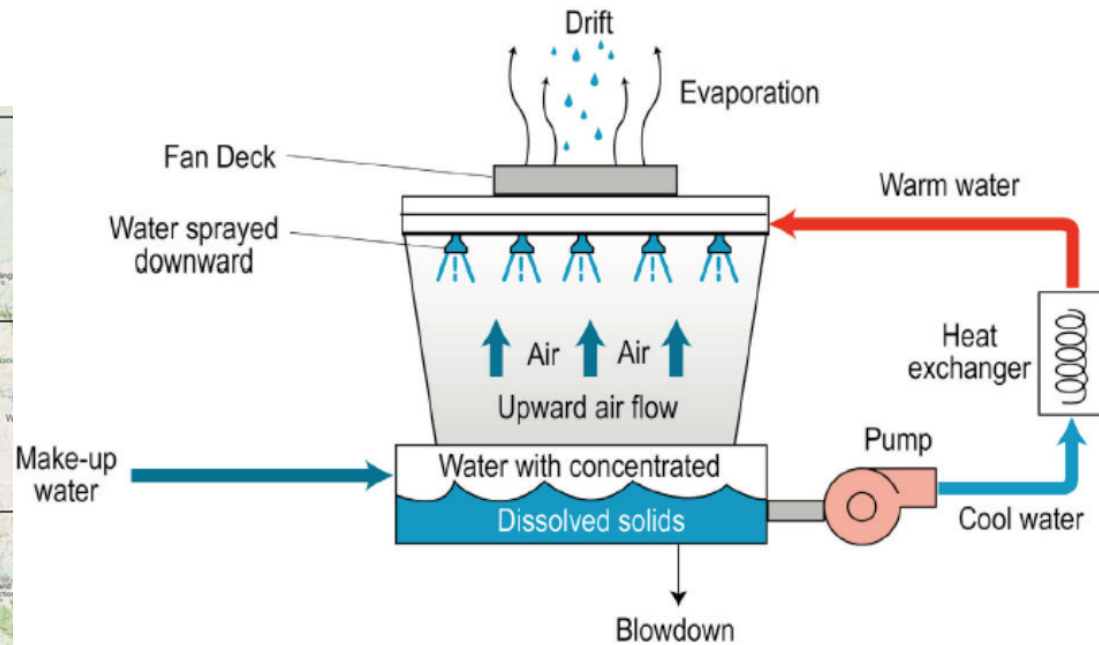
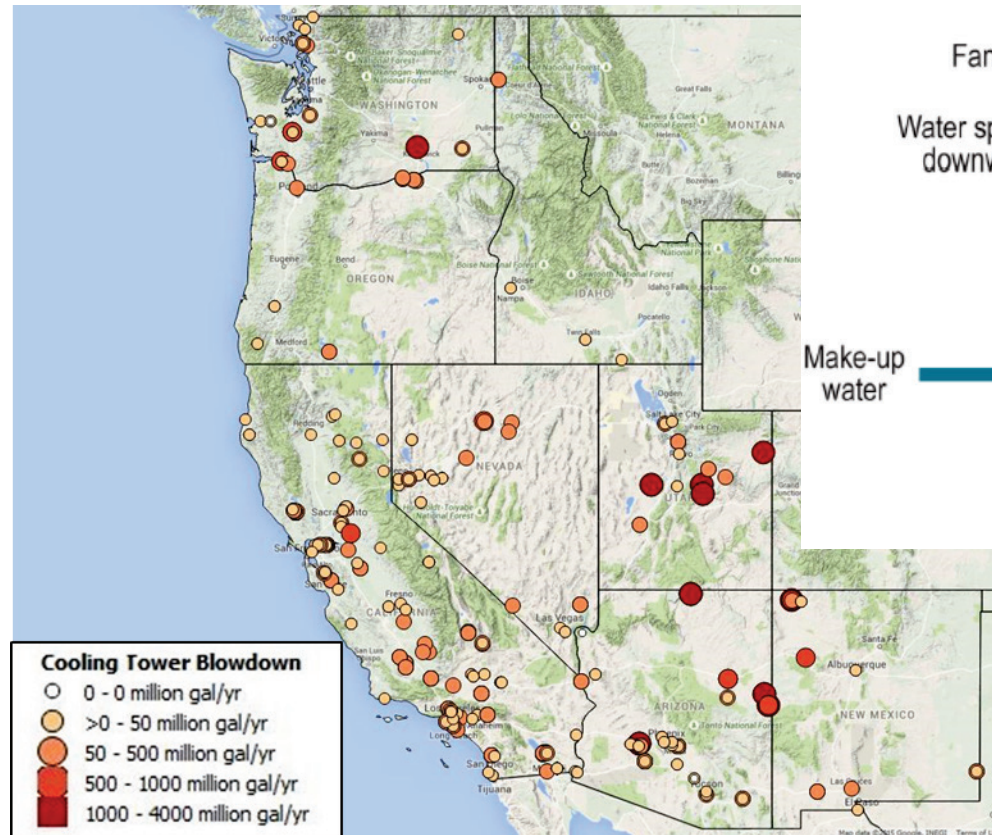
# Advantages of Membrane Distillation (MD)

- Produces high-quality product water,
- Can treat higher-salinity brines than RO and can be used for enhanced recovery from RO systems,
- Uses low-grade heat for primary energy input (50 to 90 °C),
- Accommodates sensible (e.g., hot water) heat input,
- Operates at near-ambient pressure,
- Uses membranes that can be made of low-cost polymers due to modest pressure and temperature conditions and a pore size that is larger than required for RO membranes, and
- Provides a modular design that is amenable to small-scale facilities



# Target Applications

Best applications are where the source water is a wastewater disposal issue and the site has need for fresh water, e.g., cooling tower blowdown, **oil & gas field water (e.g., fracking flowback)**, agricultural drainage water.





# Project Goal and Objectives

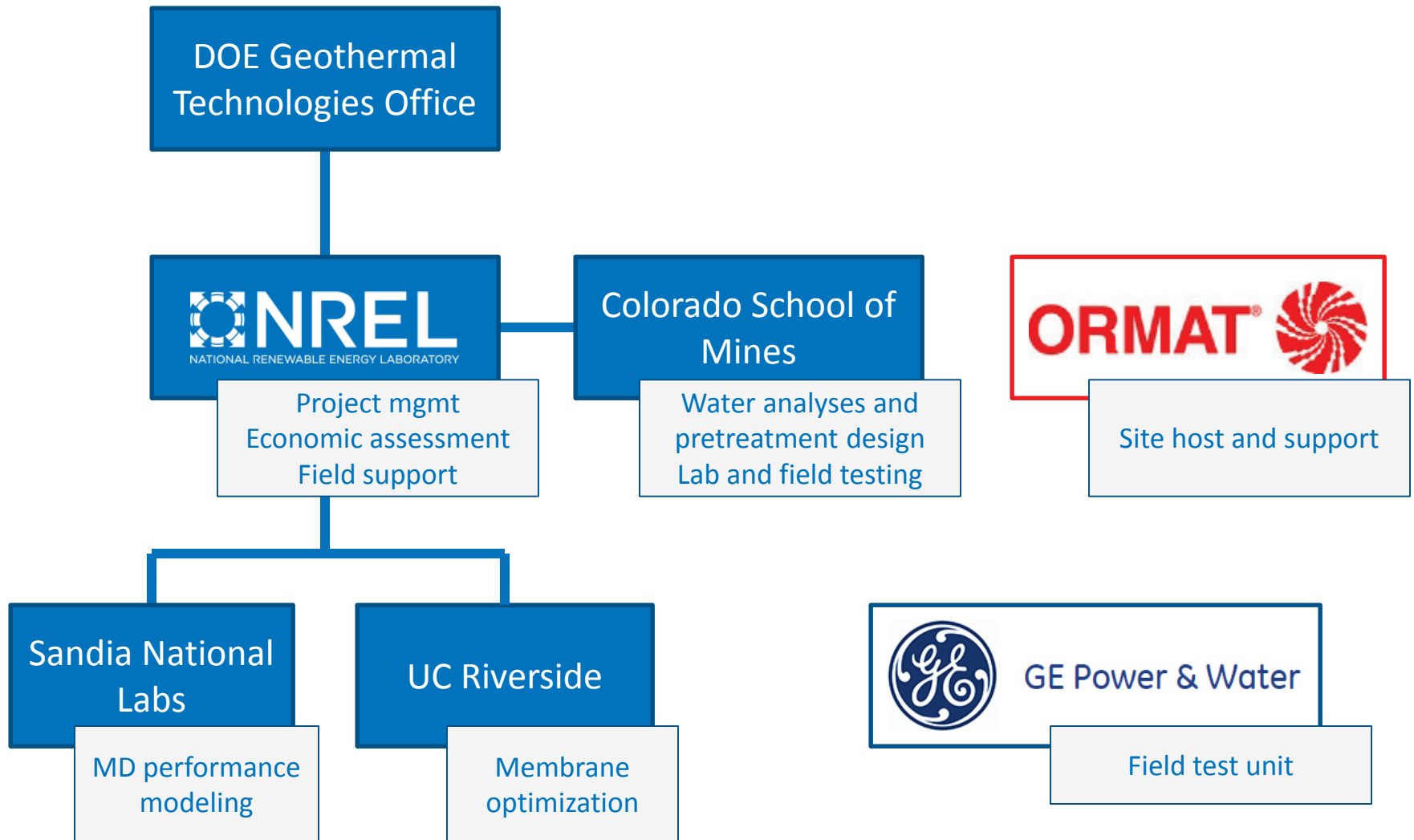
## Goal:

- Expand the use of underutilized, low-temp geothermal resources

## Objectives:

- Demonstrate the integration of MD with geothermal energy,
- Develop a performance model and validate membrane flux estimates with commercial-scale modules under field conditions at different operating conditions,
- Test and evaluate antiscaling and/or antifouling coatings applied to commercial membranes, and
- Define conditions that lead to costs of  $< \$1.5/\text{m}^3$  or otherwise provide economic viability. Describe and quantify applications beneficial to the geothermal industry.

# Project Partners & Roles



# Project Status

- **Site identified and characterized**
- **Lab-scale testing underway**
- **Opportunity space being defined:**
  - Power plant cooling tower blowdown
  - Underutilized geothermal resources
  - Oil & Gas waters

Project Activity	FY16	FY17	FY18
Site selection and characterization	XX		
Lab testing	XX	X	
Membrane optimization; performance modeling	X	XXXX	X
Field testing		XXXX	XX
Cost analysis and documentation			XXX

# Contact information

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MD test unit (Memsys/GE)