TEXAS
The University of Texas at Austin

The Water-Energy Nexus:

Enabling Solar-Powered Water Purification Technology

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Objectives

Create a prototype for enhanced solar water purification using the hydrogel

Build and compare a prototype of a continuous flow solar still with and without the hydrogel

Scale prototype to test water quality, demonstrate potability, and encourage legitimacy

Develop an approach to evaluate adoption motivators and barriers

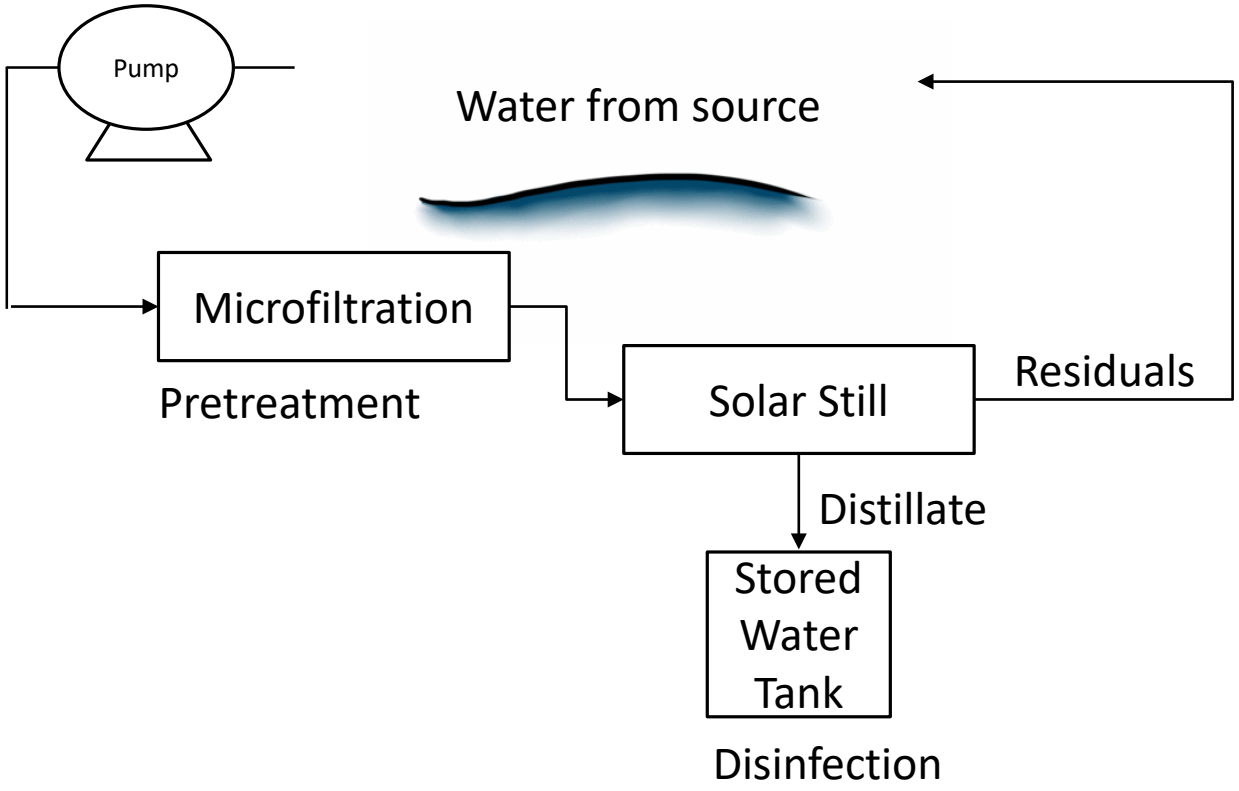
Process Design

Source: Brackish water/Seawater

Continuous Operation

Potentially fully operational from solar energy

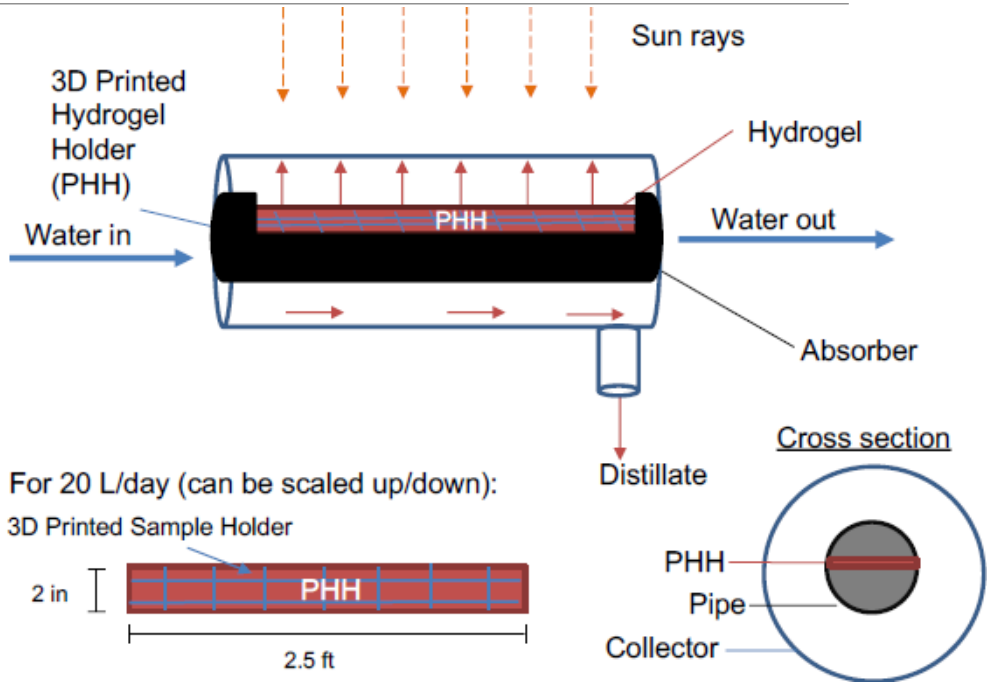
Tubular solar still

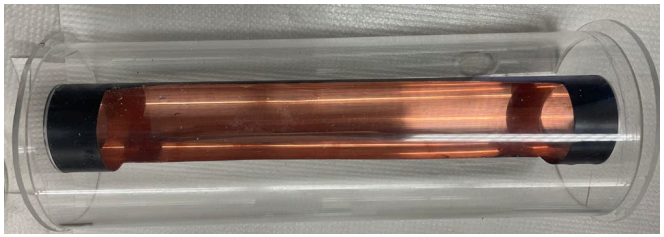


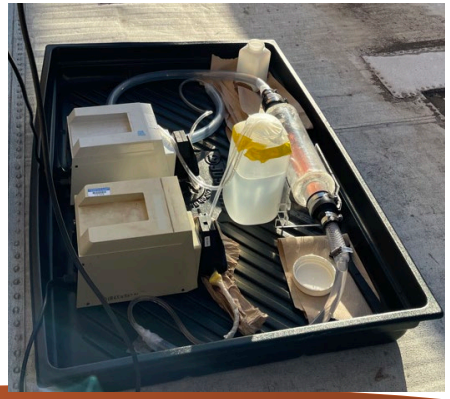
Gif courtesy: clipart-library.com

Continuous Flow Prototype Design

- **Source: Aransas Bay**
- 1 L/day continuous flow system (daylight hours)
- Easily scalable to ≥ 20 L/day
- Potential for full solar power operation
- Design accommodates varying hydrogel sizes
- Adsorber fit for 3D- hydrogel holder
- **Allow** water quality testing
- Setup on roof of UT- ECJ Building







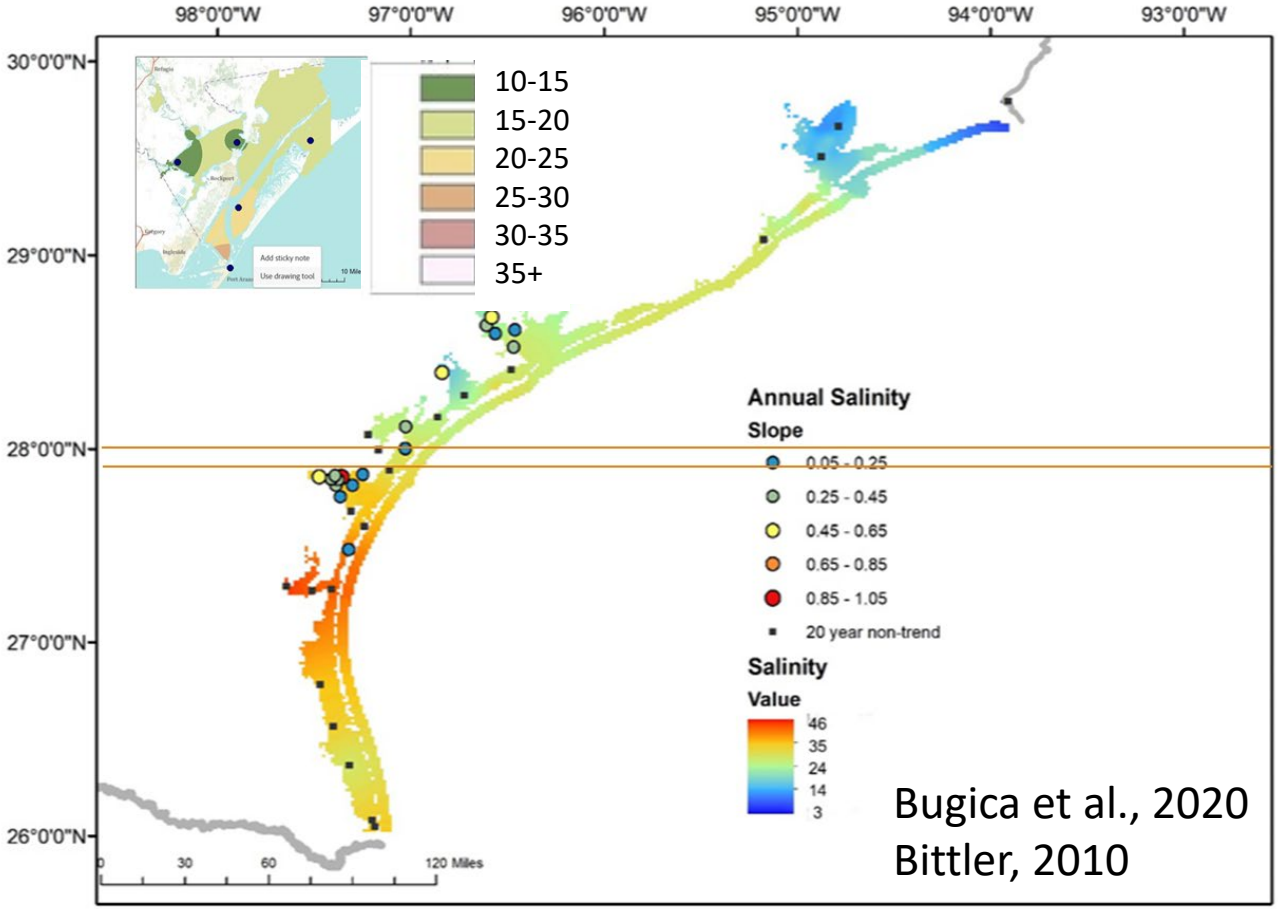
Water Quality Analyses

General water quality (pH, conductivity, alkalinity, nutrients)

Cation & anion concentrations (ICP-OES/IC)

Organic Carbon (TOC)

Trace Orgnics Disinfection By-Products (GC/MS)



Bugica et al., 2020
Bittler, 2010

Evaluate Motivators and Barriers for Regional (Community Specific) Adoption

Methods: Semi-structured Interviews

Protocol based on framework is ready for deployment

- Tailored to solar still prototype to understand motivators and barriers
- Targeting coastal communities

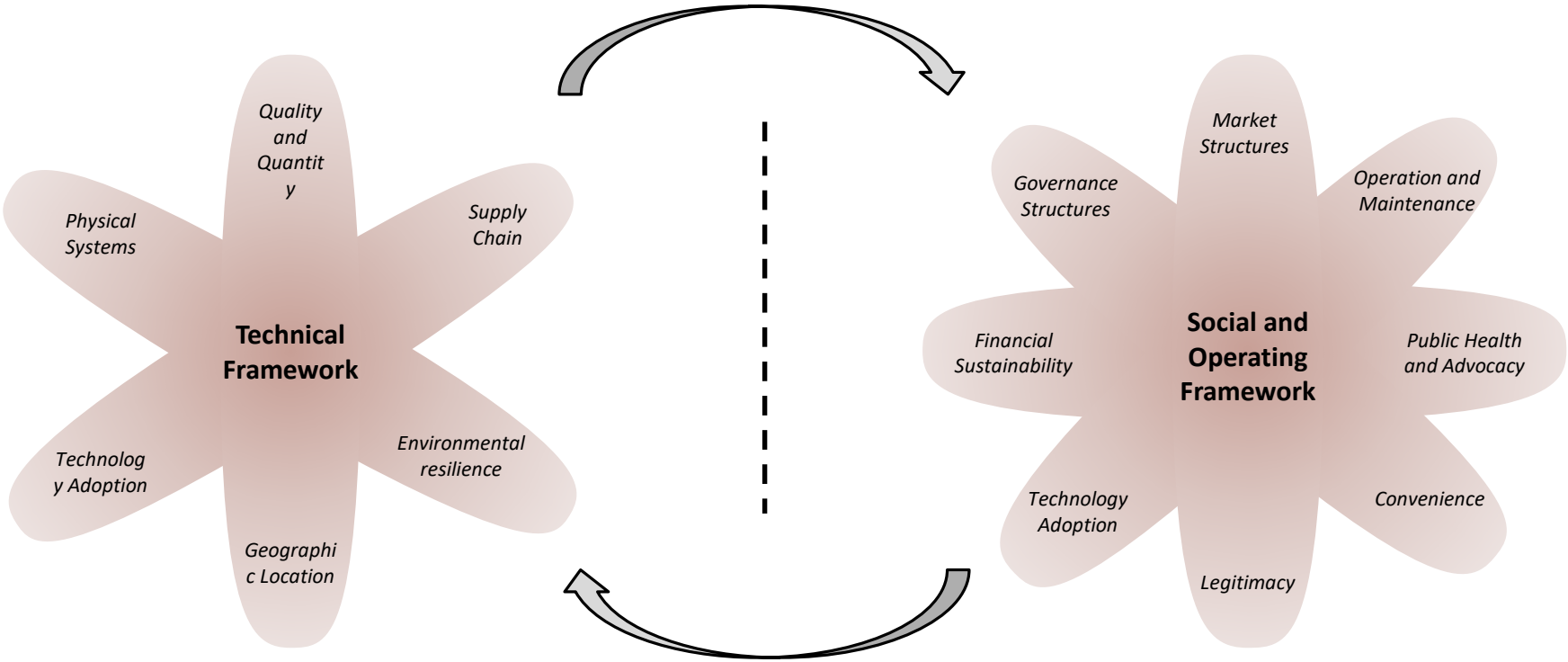
Impact beyond this project

Applying protocol based on framework to other technologies

- Desalination technologies
- Agriculture communities

Sociotechnical Framework for Decision Making

Technical and Social Interdependent Frameworks

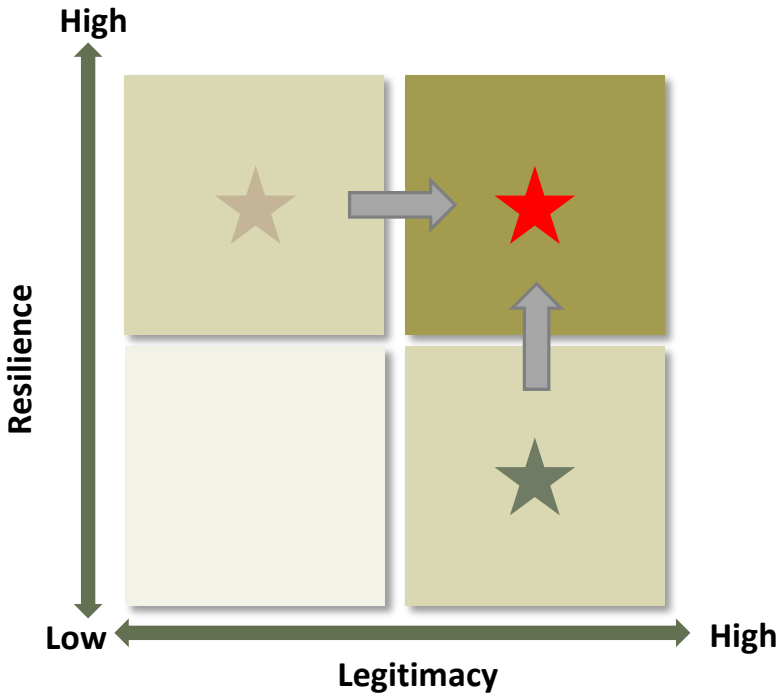


Decentralized Water Failures – Why?

Engineered designs succeed in short-term, controlled environments

Why are they failing in communities long-term?

What motivates and creates barriers of adoption for potable water technologies at the community level?



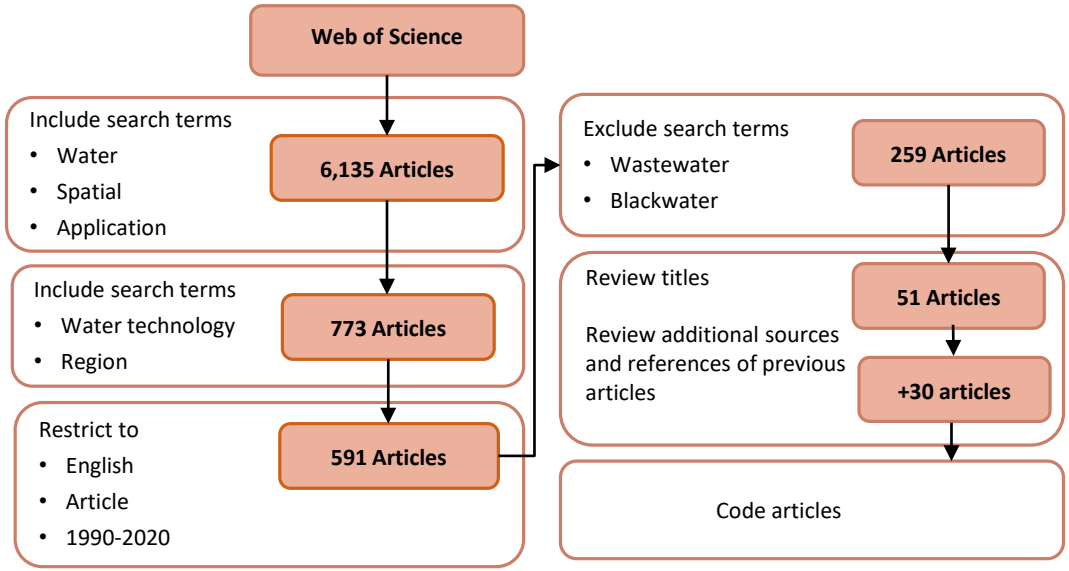
Identifying Technical and Social Barriers and Motivators for Adoption of Novel Technologies

Methods: Literature Review

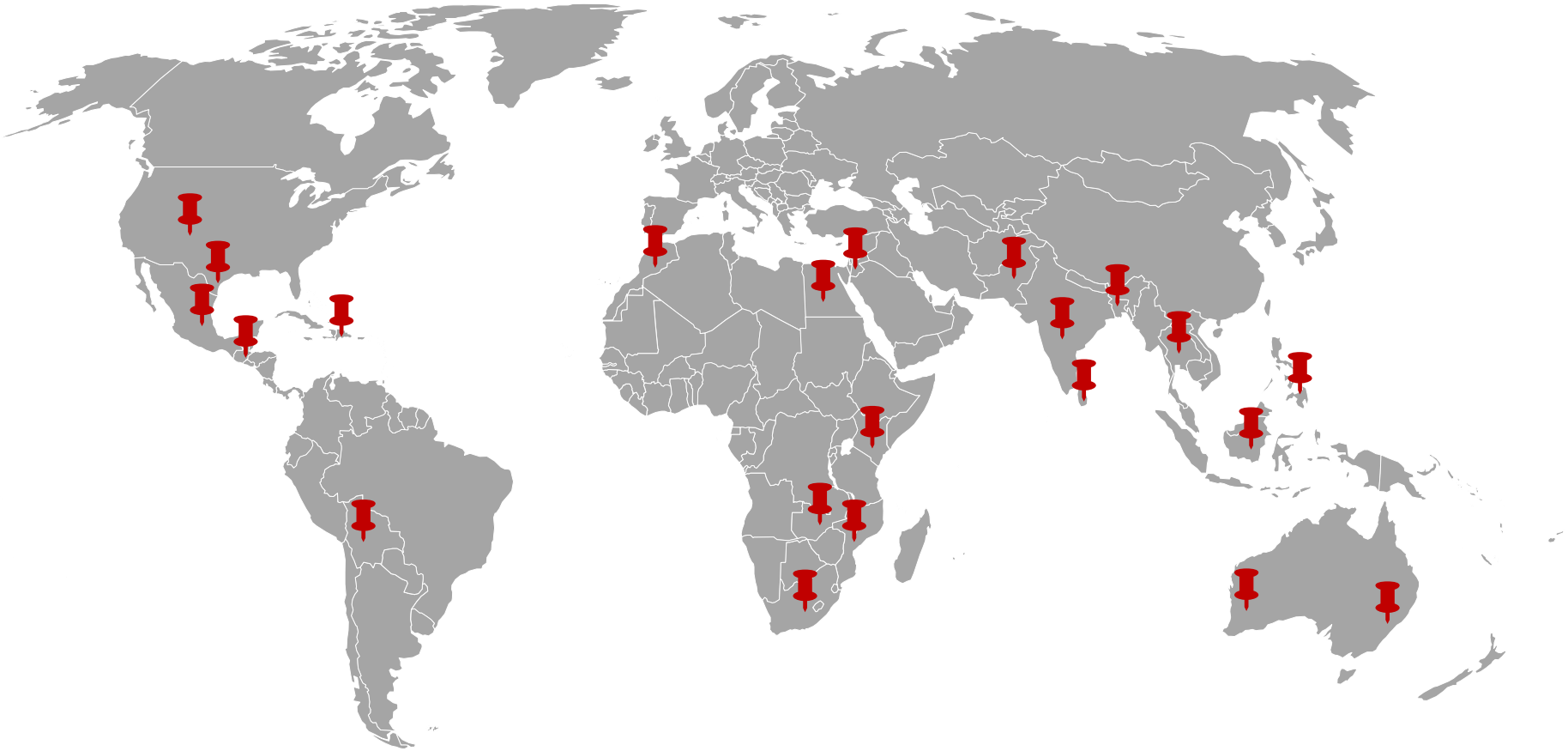
Search categories and terms

Spatial	*Water technology*	*Application*	*Region*
decentralized	water	implemen*	urban
non-centralized	solar-powe*	incorporat*	rural
noncentralized	"solar powe*"	includ*	coastal
"non centralized"	modular	execut*	communit*
onsite	containerized	apply	
on-site	ultraviolet	applied	
"on site"	UV	application	
nongrid	filter		
non-grid	filtration		
"non grid"	membrane		
	"reverse osmosis"		
	desalination		
	treatment		
	technology		

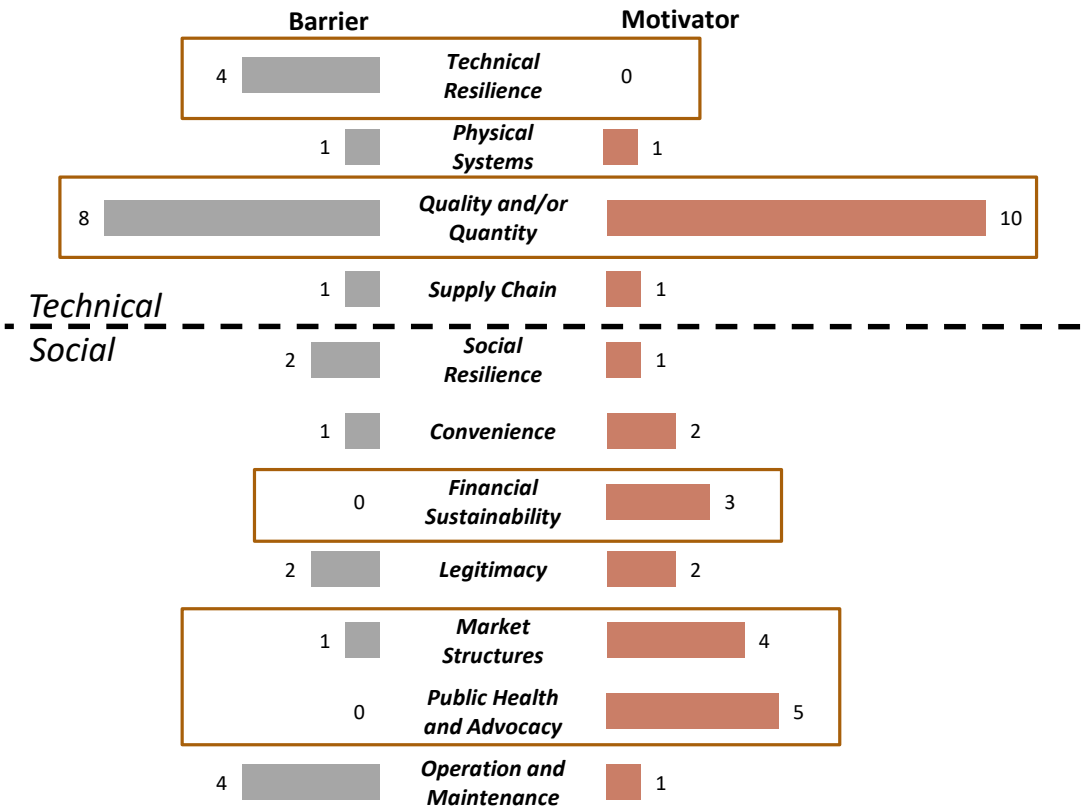
Literature review flowchart



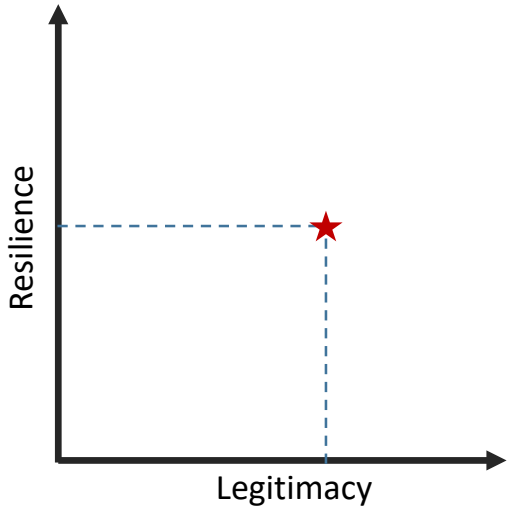
Wide Distribution of Studies



Solar Disinfection



- Most Barriers on Technical Side
- Most Motivators on Social Side
- Quality/Quantity will be dependent on particular site/applicatio



Heat Map: Motivators

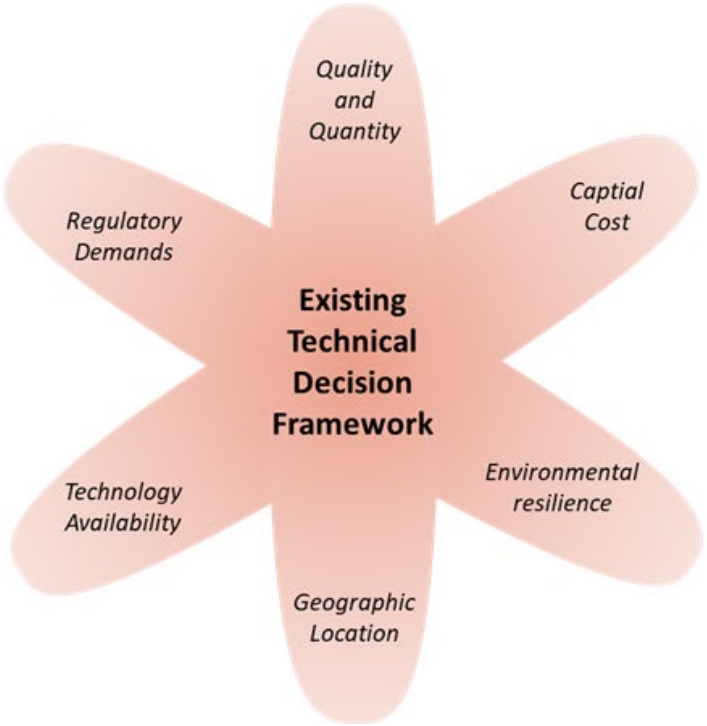
	Chlorination	Flocculant-Disinfectant	Membrane Filtration	Ceramic Filtration	Biosand Filtration	Stone filters	Activated carbon	Boiling	Solar Disinfection
Technology Efficiency	16%	20%	40%	22%	7%	40%	22%	18%	8%
Water Treatment	14%	30%	2%	12%	20%	30%	0%	0%	7%
Supply Chaiin	5%	2%	2%	4%	2%	10%	0%	5%	4%
Environmental Conditions	1%	2%	4%	1%	0%	0%	0%	0%	0%
Financial Sustainability	11%	14%	11%	7%	5%	10%	11%	5%	9%
Governance Structures	4%	5%	0%	2%	0%	0%	11%	0%	5%
Socio-demographics	1%	0%	9%	4%	2%	0%	0%	9%	9%
Operation and Maintenance	1%	0%	9%	3%	7%	10%	0%	0%	3%
Public Health and Advocacy	16%	5%	7%	11%	15%	0%	11%	9%	19%
User Preference and Behavior	31%	23%	16%	36%	41%	0%	44%	55%	35%
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%

Heat Map: Barriers

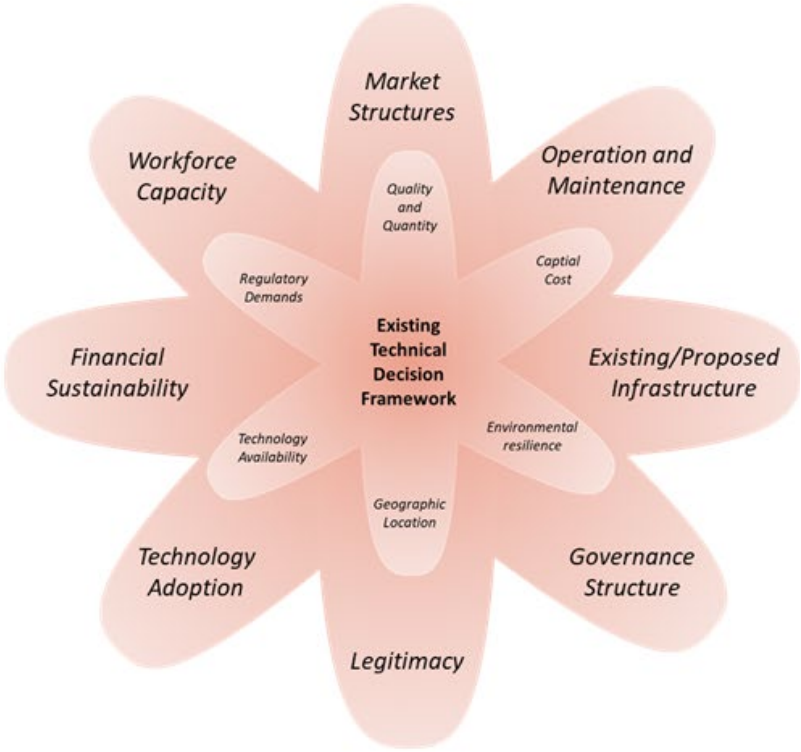
	Chlorination	Flocculant-Disinfectant	Membrane Filtration	Ceramic Filtration	Biosand Filtration	Stone filters	Activated carbon	Boiling	Solar Disinfection
Technology Efficiency	3%	3%	32%	21%	21%	67%	22%	11%	3%
Water Treatment	32%	24%	11%	11%	16%	17%	0%	6%	16%
Supply Chain	3%	0%	14%	4%	2%	0%	0%	0%	4%
Environmenta Considerations	2%	3%	5%	1%	0%	0%	0%	6%	5%
Financial Sustainability	6%	12%	0%	7%	4%	0%	0%	6%	8%
Governance Structures	2%	3%	0%	4%	2%	0%	0%	0%	6%
Socio-demographics	5%	3%	5%	6%	5%	0%	0%	11%	5%
Operation and Maintenance	2%	0%	8%	12%	7%	17%	0%	6%	1%
Public Health and Advocacy	15%	12%	8%	12%	7%	0%	22%	39%	14%
User Preference and Behavior	32%	41%	16%	24%	35%	0%	56%	17%	38%
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%

System of Systems Approach: Linking the social and operating environment with technologies

Technology Drive Framework



Social and Operating Framework



Leveraging Knowledge to Other Scenarios

This work has led to adoption in two projects starting this fall:

Collaborative Research: NNA Research: Capturing Indigenous Knowledge to Co-Design more Effective Operations, Maintenance and Management of Water Infrastructure

- National Science Foundation Award# 2127353
- PI Faust, Co-PI Katz

Assessing the Impact of APRIME on Industrial Sector Supply Portfolios: Chemical Industry Case Studies

- DOE NAWI: Funding pending
- PI Katz, Co-PI Faust