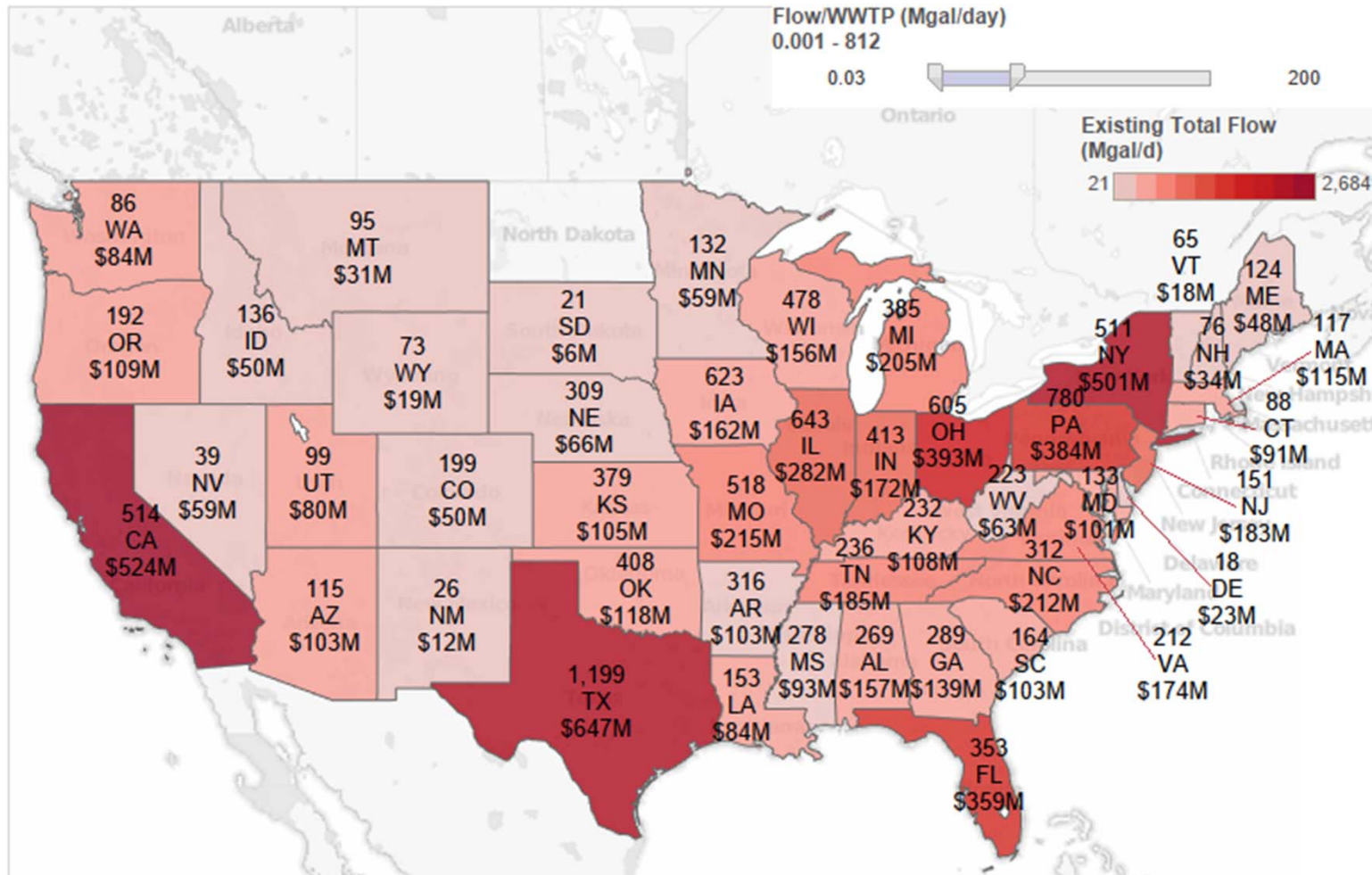


From the bench to a business: challenges for transitioning developmental technology to a commercial enterprise

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Fermilab E-beam Workshop
Fermi National Accelerator Laboratory
Batavia, IL
May 10, 2018

US Wastewater Treatment Market Size = \$7.1B/year



Sludge Thermal Hydrolysis

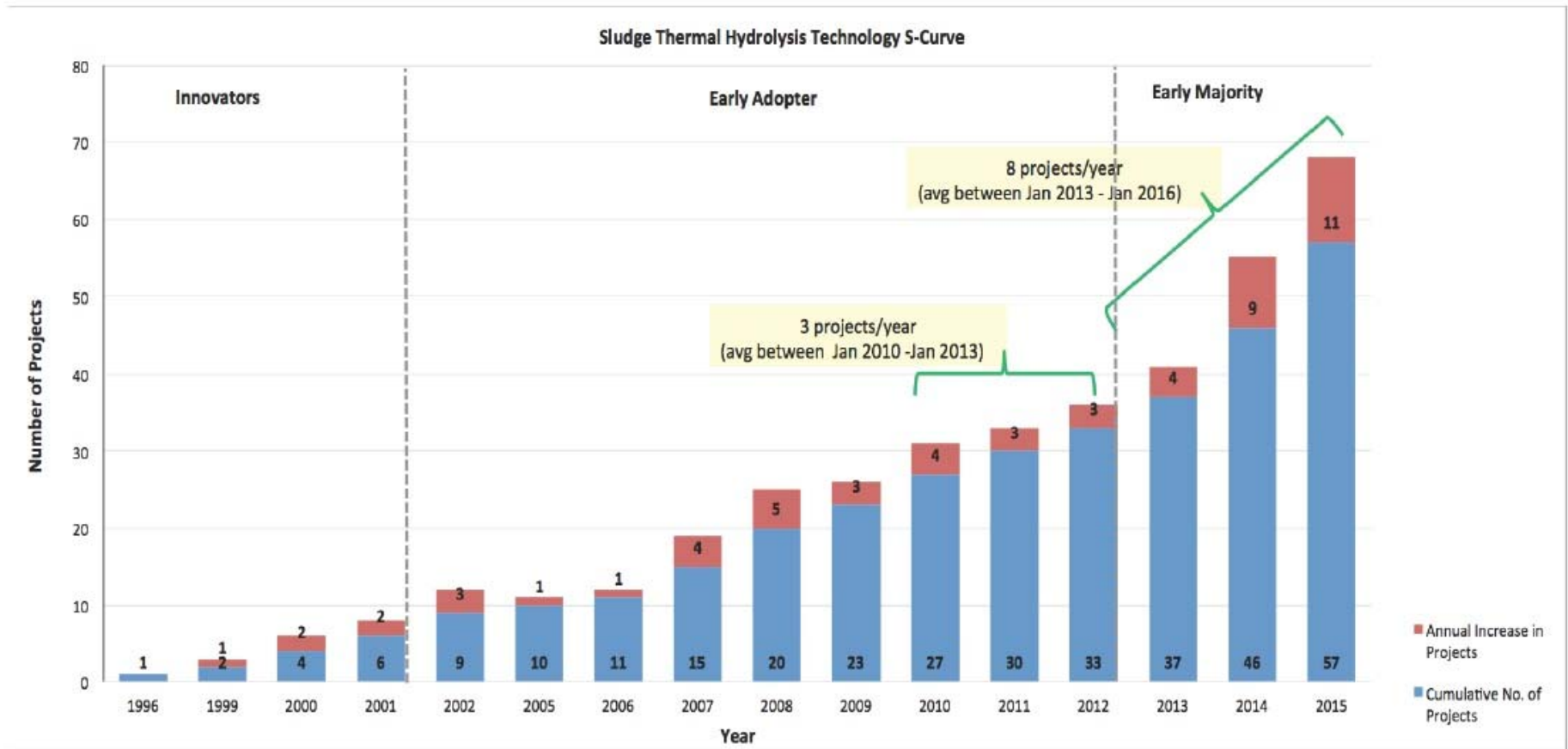


Figure 5: Cumulative and annual increase in number installed projects (between 1996 up to 2015)

MBR

- Wastewater
- Stormwater
- Drinking Water
- Desalination
- Water Reuse**

1. FACILITY TYPES

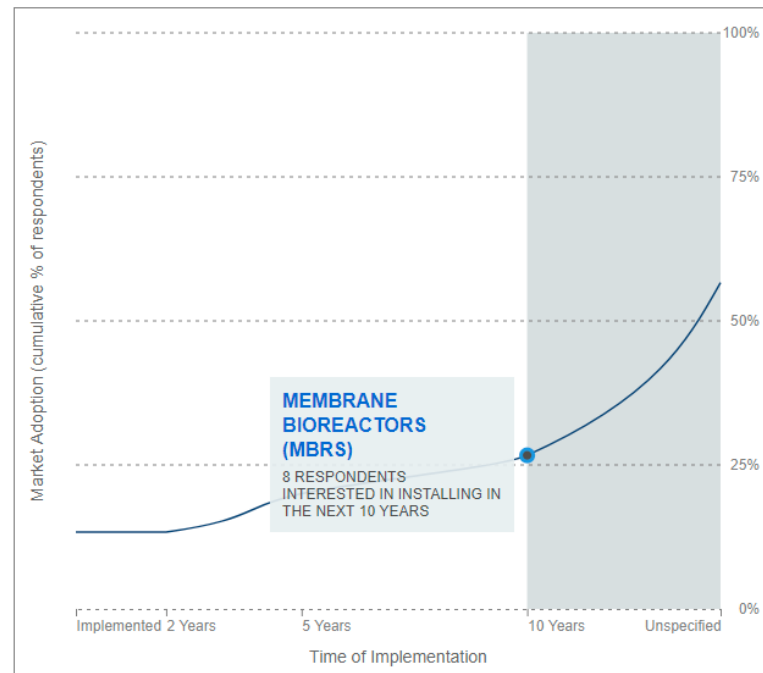
2. TECHNOLOGY CATEGORIES

3. SPECIFIC TECHNOLOGIES

- Direct potable reuse
- Indirect potable reuse
- Fit-for-purpose reuse
- Biological activated carbon
- Granular activated carbon
- Ozone-biologically active filtration
- Concentrate treatment
- Forward osmosis
- Membrane bioreactors (MBRs)**
- Microfiltration/ultrafiltration
- Nanofiltration
- Nitrate control
- Ozonation
- Soil aquifer treatment
- Reverse osmosis

SURVEY RESULTS

30 RESPONDENTS



4. LOCATION OF UTILITIES

UNITED STATES

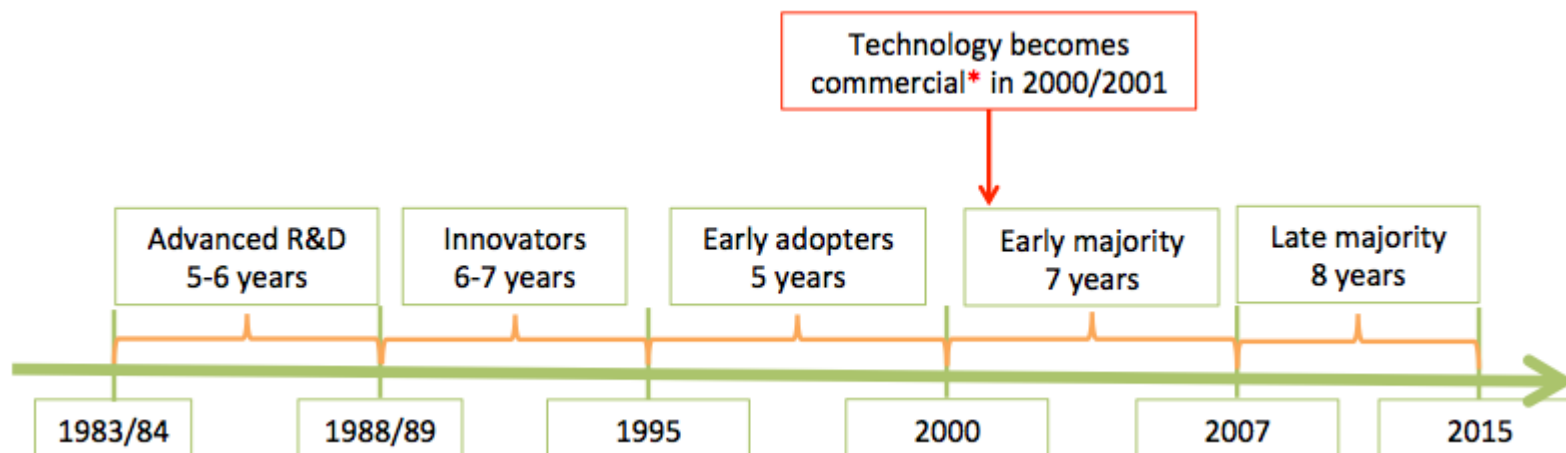


International

5. WATER REUSE APPLICATIONS:

- Potable
- Non-potable

Membrane Bioreactor



Technology/S-Curve stage	Innovators	Early Adopters	Early Majority	Total
UV disinfection	5 years	5 years	8-10 years	18-20 years
Membrane Bioreactor	6-7 years	5 years	7 years	18-19 years
Sludge pretreatment	7 years	4 years	6-7 years	17-18 years
Struvite precipitation	3 years	3-4 years	~6-7 years	12-14 years

"Developmental" technologies

62 RESPONDENTS

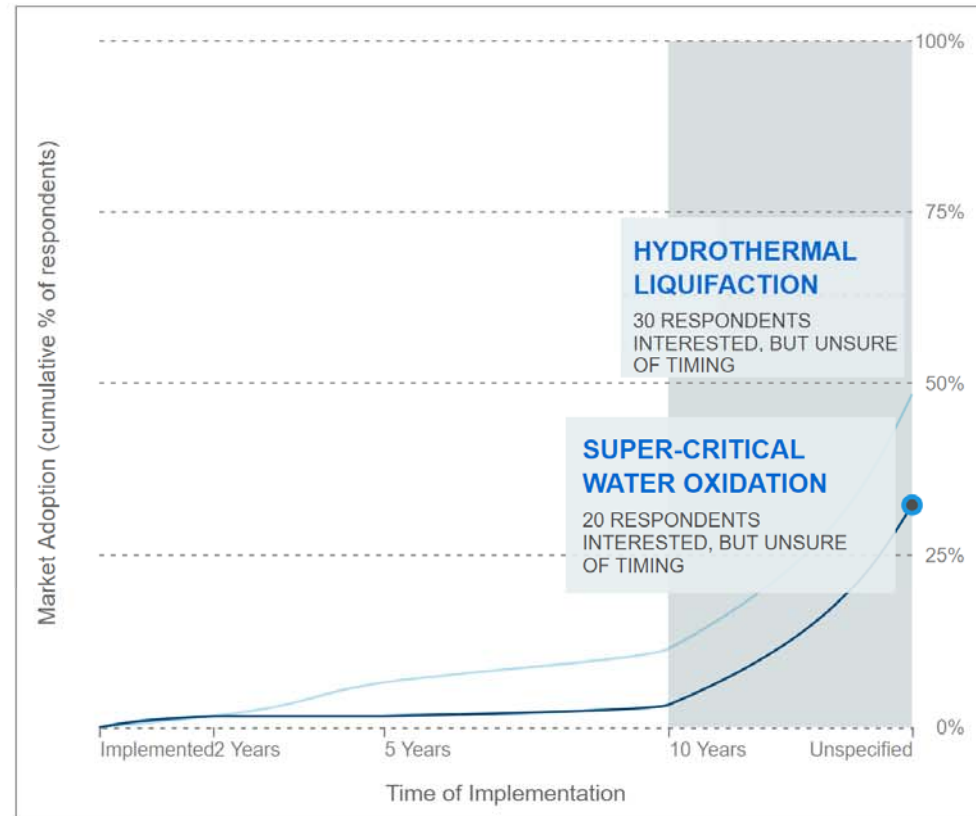
2. TECHNOLOGY CATEGORIES

- Nutrient
- Solids Management
- Energy
- Biosolids to Energy
- Digestion Enhancements
- Intelligent Water Systems
- Disinfection
- Collection Systems
- Other

3. SPECIFIC TECHNOLOGIES

- Hydrokinetic energy recovery
- Onsite renewables (e.g. solar or wind)
- Thermal energy recovery
- Gasification
- Hydrothermal liquifaction
- Pyrolysis
- Super-critical water oxidation
- Biological augmentation (e.g.

SURVEY RESULTS



4. LOCATION OF UTILITIES

UNITED STATES



International

5. MILLION GALLONS/DAY:

- 0-10
- 10+ - 50
- 50+

Barriers to Modernizing



Underinvestment



Technology Deployment
and Validation Challenges



Conservative Risk-Averse
Industry



Regulatory Barriers

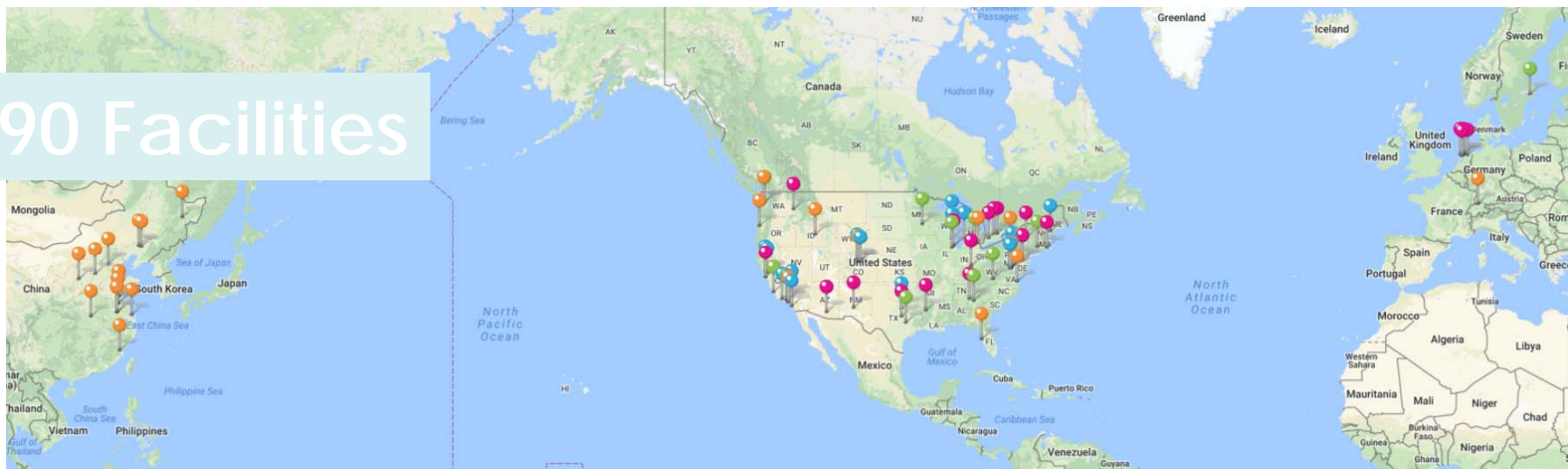


Social and Behavioral
Challenges

FAST WATER

Facilities Accelerating Science & Technology

90 Facilities



- Level 1
- Level 2
- Level 3
- Level 4

- **Level 1:** A university or research lab that can assist with bench-scale work but is not dedicated to piloting new technologies
- **Level 2:** A water resource recovery facility that is interested in innovation and willing to host a project, but does not have a dedicated test facility
- **Level 3:** A water resource recovery facility or research lab with a dedicated physical space available for piloting innovative water technology
- **Level 4:** A staffed facility dedicated solely to R&D/piloting of new technologies (can be housed at a functioning WRRF)



LIFT

Leaders Innovation Forum
for Technology

122 Technologies
114 Companies

