It’s the little things…

M. Kevin Price
Senior S&T Advisor, MEDRC
U.S. Bureau of Reclamation, ret.

Texas Desal 2018
September 13, 2018
Austin, Texas

Background

A little neglect may breed great mischief ...
for want of a nail, the shoe was lost;
for want of a shoe the horse was lost;
and for want of a horse the rider was lost,
being overtaken and slain by the enemy.

—Benjamin Franklin
Poor Richard's Almanac, preface (1758)

Background

Frustrations:

- Flavor of the month club
- Large dollars focused on one desal issue
  - DOE Hub – energy (pipe parity)
- Experts – practical vs book learning
  - Interdisciplinary requirements
- One country invented desal

Basic Lessons - *The Innovation Deficit in Urban Water*. Michael Kiparsky, 2013

There is an innovation deficit:

- Without **water stress**, institutions and technologies evolve slowly
- In the absence of **regulatory pressure** and **public funding**, change is slow
- Disruption by new technologies is slow due to **large sunk costs** in existing systems

Basic Lessons - *Desalination at a Glance*, IDA, James Birkett, 2010

Innovative new treatment technologies require processes with lower costs and energy that:

- Will be **simple** and capable of high throughputs
- Will be **fast**
- Will operate at **high recovery**
- Will be **reliable**

Basic Lessons - From colleagues at Reclamation

- **Institutional/political needs** create significant technical opportunities,
- Never underestimate a **good story**,
- Strong initial and periodic **technical reviews**,
- **Unsolicited** proposals,
- **Consistent** funding,
- **Outside** advisors and reviewers,
- Strong **technology transfer**,
- **Demonstration** with all affected parties.

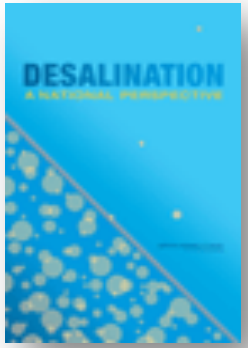
Questions

It is in how you ask the question:

- What **research goals** make sense?
- How much **energy** does it use?
- Does it work?
  - How to reduce **risk**?
- How much does it cost?
  - What are the **values of water**?

If we can manufacture ‘new’ water, what does that make possible?

Observations – Research Goals



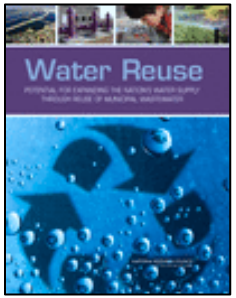
Understand the environmental **impacts** for desal and develop approaches to minimize these impacts **relative to other water supply alternatives**.

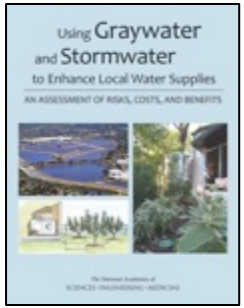
Develop approaches to lower the financial costs of desal so that it is an **attractive option** relative to other alternatives in location **where traditional sources of water are inadequate**.

Desalination: A National Perspective. NAS, 2008

Observations – Research Goals

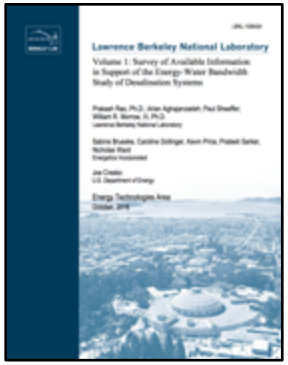
- *Desalination and Water Purification Technology Roadmap*. Reclamation, 2003
- *Water Reuse: Potential for Expanding the Nation's Water Supply*. NAS, 2012
- *Using Graywater and Stormwater to Enhance Local Water Supplies: An Assessment of Risks, Costs, and Benefits*. NAS, 2016





Observations – Energy

Volume 1: Survey of Available Information in Support of the Energy-Water Bandwidth Study of Desalination Systems, LBNL, 2016.



Volume 2: Bandwidth Study on Energy Use and Potential Energy Savings Opportunities in U.S. Seawater Desalination Systems, DOE, 2017.

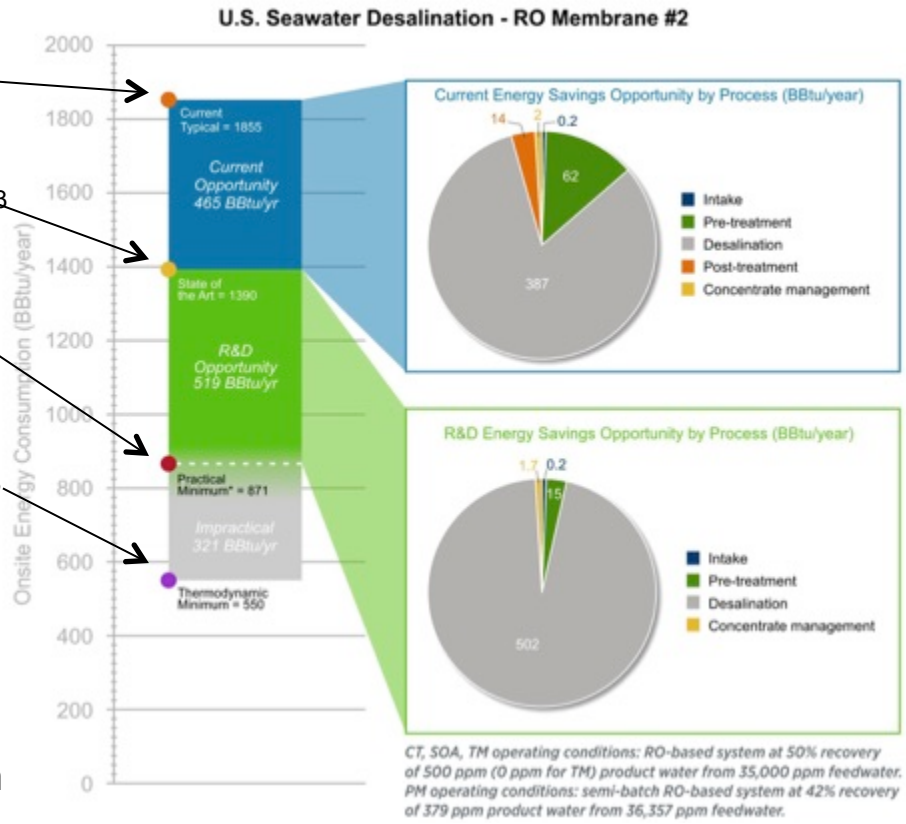
Observations – Energy

CT - 3.3 kWh/m^3

SOA – 2.7 kWh/m^3

PM – 1.5 kWh/m^3

TM – 1.05 kWh/m^3



Current **T**ypical
State **O**f the **A**rt
Practical **M**inimum
Thermodynamic **M**inimum

Observations – Risk, Pay for Performance

OMAN HUMANITARIAN DESALINATION CHALLENGE

Oman Humanitarian Desalination Challenge

Hand-held, stand-alone, low-cost, desalination device for short-term use and rapid deployment following a humanitarian crisis.

www.desalinationchallenge.com Challenge Video

Two parallel tracks

1. The humanitarian desalination **Prize** – The Research Council
   - USD 700,000 prize
   - 2018 - 2022

2. Yearly **Pathway Research** grants – USAID
   - est. USD 80,000 each
   - est. two per year, 2019 - 2021

MEDRC مجلس البحث العلمي The Research Council

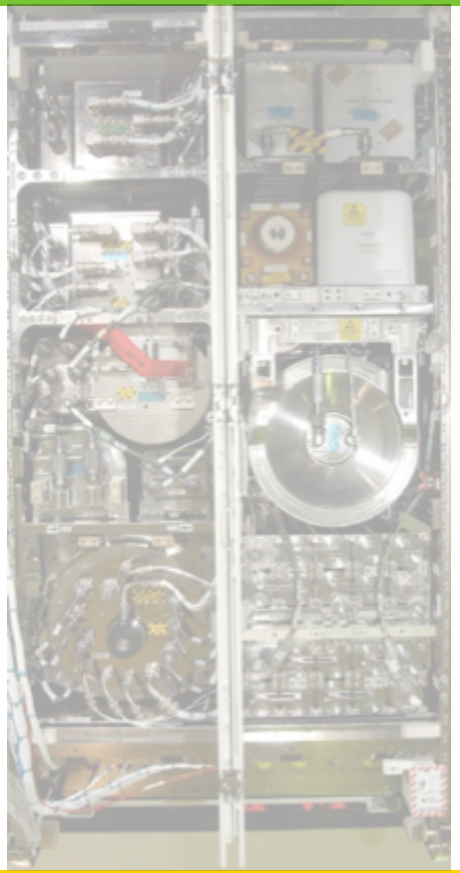
Observations – The Values of Water

From *The Economic Conception of Water,* Michael Hanemann, 2006

- Plato observed: "only what is rare is valuable, and water, which is the best of all things...is also the cheapest”
- Adam Smith observed: “Nothing is more useful than water; but it will purchase scarce anything; scarce anything can be had in exchange for it. A diamond, on the contrary, has scarce any value in use; but a very great quantity of other goods may frequently be had in exchange for it”

Observations – The Values of Water

- 1962 creation of the federal Water Resources Council
- **EPA** – quality - drinking and wastewater quality
- **Bureau of Reclamation** – quantity – conveyance, storage, hydropower, recreation
- **Army Corps of Engineers** – control - flood control, navigation, storage, hydropower, recreation
- **Department of Army** – rapidly deployable, as close to user as possible, weight important
- **Department of Navy** – water for shipboard use, small footprint and volume, weight and cost not as important
- **Department of Agriculture** – manage agricultural water resources, cost and quality important
- **Department of State** – national security
- **NASA** – light weight, recyclable, cost not as important
- **NOAA** – predicting storm events
- Others – DOE, HHS, SWAQ, etc.



Observations – The Values of Water

- **Net new water** for national security, jobs, economic stability: Israel/Palestine/Jordan, Singapore, GCC
  - R**educe imports, increase local control and drought proofing**: San Diego County Water Authority, Eastern and Western Municipal Water Districts, Groundwater Replenishment System, many others
- **Peaking vs. base load** net new water manufacturing plants
- **Insurance**: Yuma Desalting Plant, Eastern Australia
- **One Water**, each drop used more than once
  - Water **trading** between regions: Israel/Palestine/Jordan, Las Vegas/Mexico
- **Diversify** water supply sources, **water portfolios**: Singapore, Southern CA
- **Embedded energy** in regional transfers: N. to S. CA
- **Energy storage** for renewables (similar to pump storage)

Observations – The Values of Water - Israel

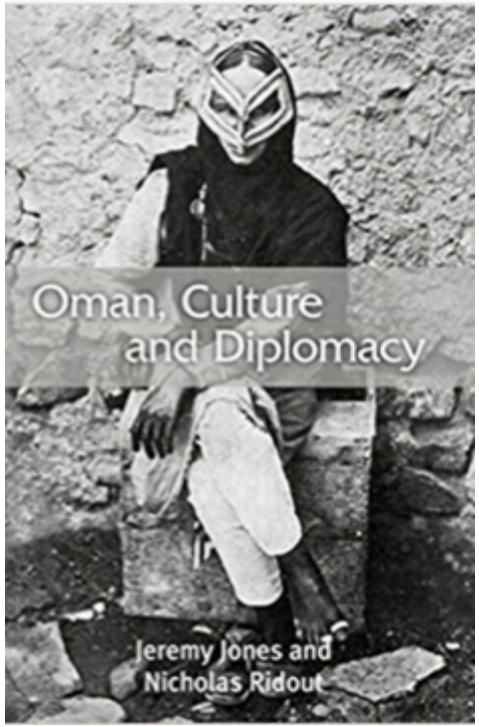
Israeli experience (*Quantifying the actual benefits of large scale seawater desalination in Israel, Israel Water Authority*, Tenne, 2011)

- Estimated cost of desalination in Israel - $0.55 to 0.75/ m^3
- Cost vs value - value includes socio-political benefits and environmental impacts, not studied or valued
- Measurable benefits from improved quality and increased quantities

Observations – The Values of Water - Israel

- Quantity benefits - ($0.24/$m^3$)
  - increased reliability
  - jobs/economic activity/GDP
  - reducing withdrawals from existing supplies (otherwise leads to further and irreversible degradation)
  - each m^3 of desal creates 0.6 to 0.7 m^3 of wastewater
- Quality benefits - ($0.12/$m^3$) (traditionally minimize water costs and ignore quality benefits)
  - reduce hardness (lowers scaling of equipment, lowers amount of detergents, improves laundering/dishwashing)
  - lowers NaCl in wastewater (reduces irrigation rates, improves crop productivity, and reduces soil damage)
- Estimated cost benefits, $0.36/$m^3$ vs. $0.55 to 0.75/$m^3$

Other Observations



Oman, Culture and Diplomacy. J. Jones, 2012.

- MEDRC – two grand challenges, water and peace through capacity building
- Oman – Culture, Diplomacy, and Water Scarcity
  - Managing scarce water resources leading to agreement through conversation, reciprocity and mutual respect.
  - Omani falaj, Iranian qanats, Spanish and New Mexico acequia
- What does this make possible?