Water & Energy In Industry

National Academies Board on Energy & Environmental Systems (BEES)

Energy Water Nexus Forum

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Director, Research ASME

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National Academy of Sciences

Washington, DC

ASME

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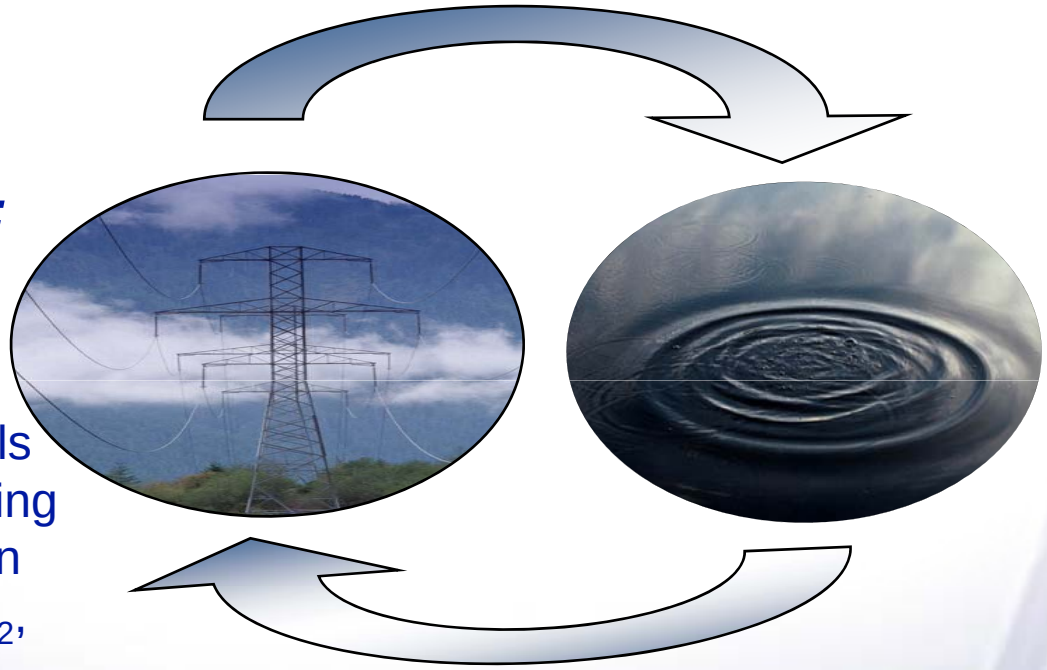
Energy and Water are… Interdependent

Water for Energy and Energy for Water

(Courtesy Mike Hightower, Sandia)

Energy and power production require water:

- Thermoelectric cooling
- Hydropower
- Energy minerals extraction/mining
- Fuel Production (fossil fuels, H_2, biofuels)
- Emission control



Water production, processing, distribution, and end-use require energy:

- Pumping
- Conveyance and Transport
- Treatment
- Use conditioning
- Surface and Ground water

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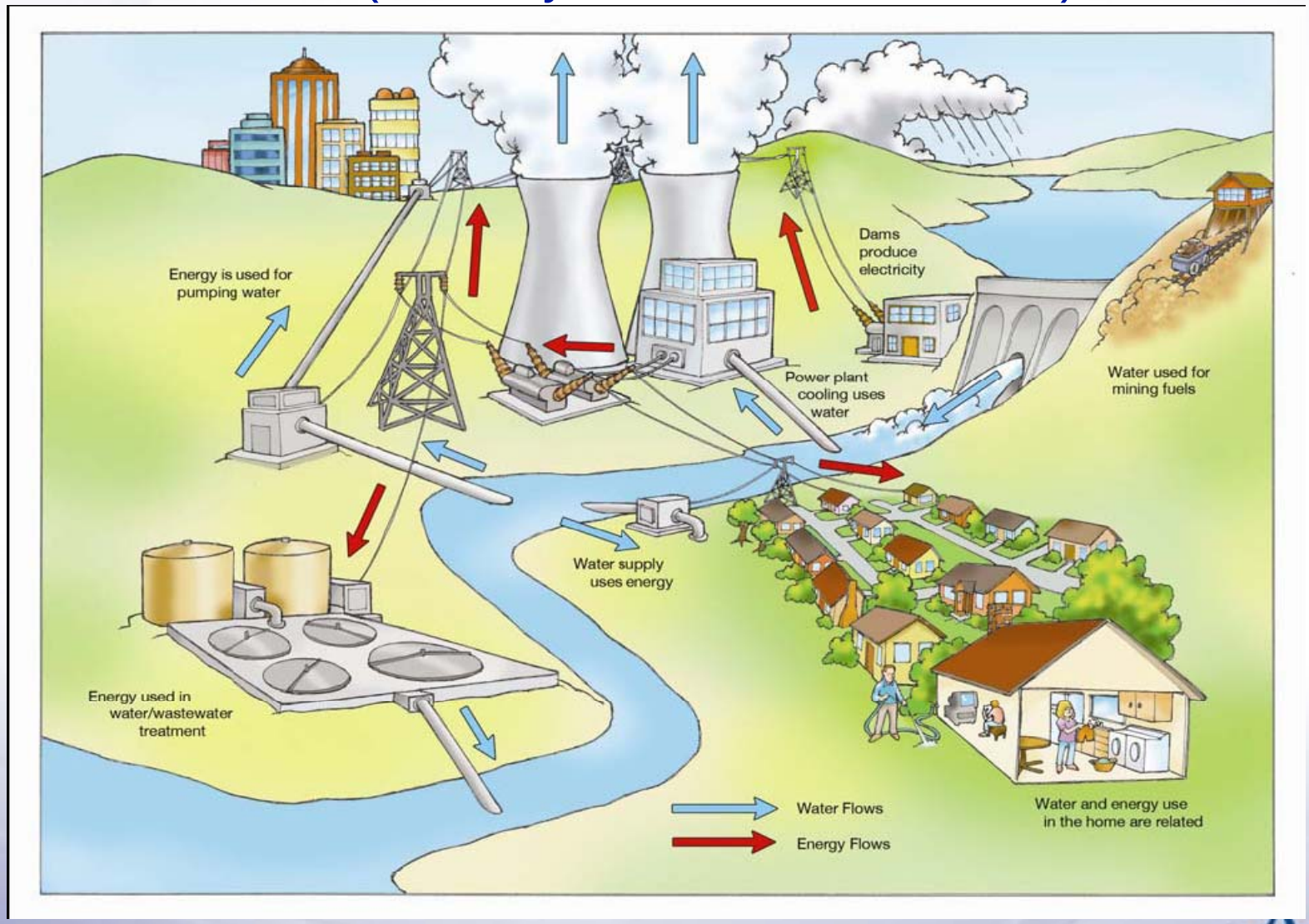
Examples of Interrelationships Between Water and Energy (Courtesy Robert Goldstein, EPRI)



ASME At a Glance

- More than 125,000 members globally
- Nearly 150 countries
- Headquarters in New York
  - Offices in Brussels, Beijing, New Delhi
  - Institute offices in Atlanta, Houston, Washington D.C.
- Digital library with journals, conference proceedings, and ASME Press e-books
- 530 standards, used in more than 100 countries

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ASME Vision

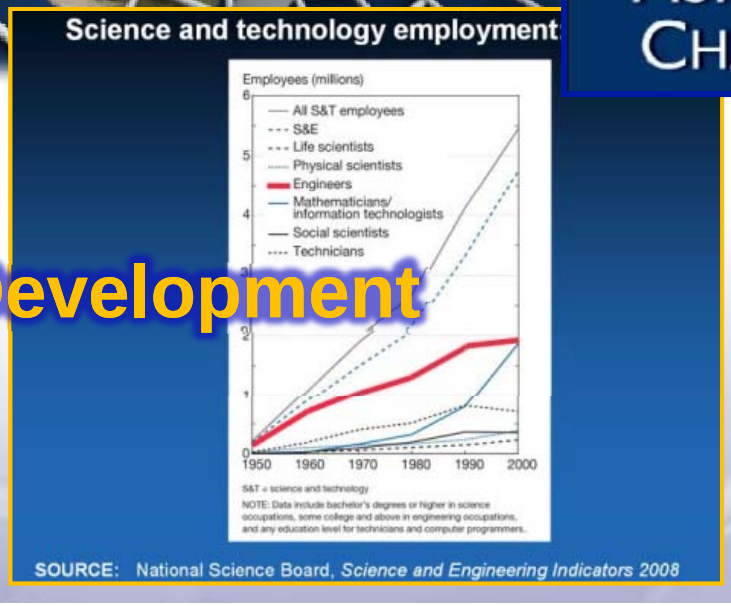
- ASME will be the essential resource
- For mechanical engineers and other technical professionals throughout the world
- For solutions that benefit humankind

ASME's Strategic Focus

Global Impact

Energy

ASME ENERGY GRAND CHALLENGE ROADMAP



Workforce Development

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ASME ENERGY GRAND CHALLENGE ROADMAP

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August 2009

Prepared by:

ENERGETICS
A Subsidiary of VSE Corporation

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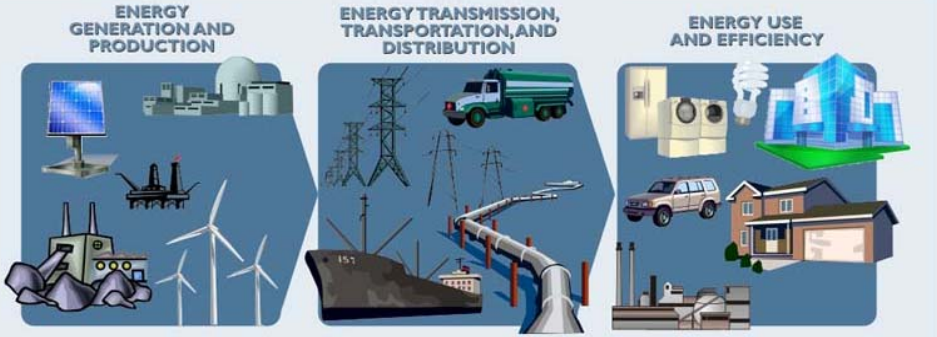
STRATEGY

ASME will serve as an essential energy technology resource for business, government, academia, practicing engineers and the general public and as a leading energy policy advocate. As a credible, unbiased voice, ASME will be a key source of energy technology information and standards. We will achieve this by leveraging our knowledge-based communities, expanding our energy portfolio, building a more effective energy workforce, and supporting balanced energy policies in the United States and other areas of the world.

ENERGY VALUE CHAIN



ASME PRIORITIES

BUILD AND LEVERAGE ASME CAPABILITIES IN ENERGY TO MAKE INCREASED CONTRIBUTIONS TO MAJOR ENERGY CHALLENGES

Create a cohesive, unified presence for ASME in the energy sector

- Serve as an impartial, authoritative, rational voice in energy matters by offering technical expertise to regulators and policy-makers
- Develop and promote codes and standards and related products and services to support energy technology innovation and commercialization
- Support the expansion and development of a more effective energy workforce
- Increase public awareness and knowledge of the energy sector

Build partnerships to increase the effectiveness and impact of ASME initiatives

TOP OPPORTUNITIES

- Form a self-sustaining energy focal point within ASME to maintain a holistic approach to internal and external communications.
- Strengthen alliances with other societies and international organizations to address energy issues and challenges.
- Provide a rational, informed voice for political engagement.
- Identify gaps in current and emerging technologies and related standards for energy generation, production, electricity transmission (including smart grid and energy storage), distribution, transportation, and efficiency.
- Develop a comprehensive web-based clearinghouse of energy information and a search engine to facilitate efficient retrieval of relevant information.
- Increase ASME's profile in renewable and emerging technologies.
- Increase ASME's understanding, profile, and contributions regarding the energy-water nexus.
- Develop a new generation of engineering workforce
- Build on existing ASME capabilities and expertise in the nuclear area

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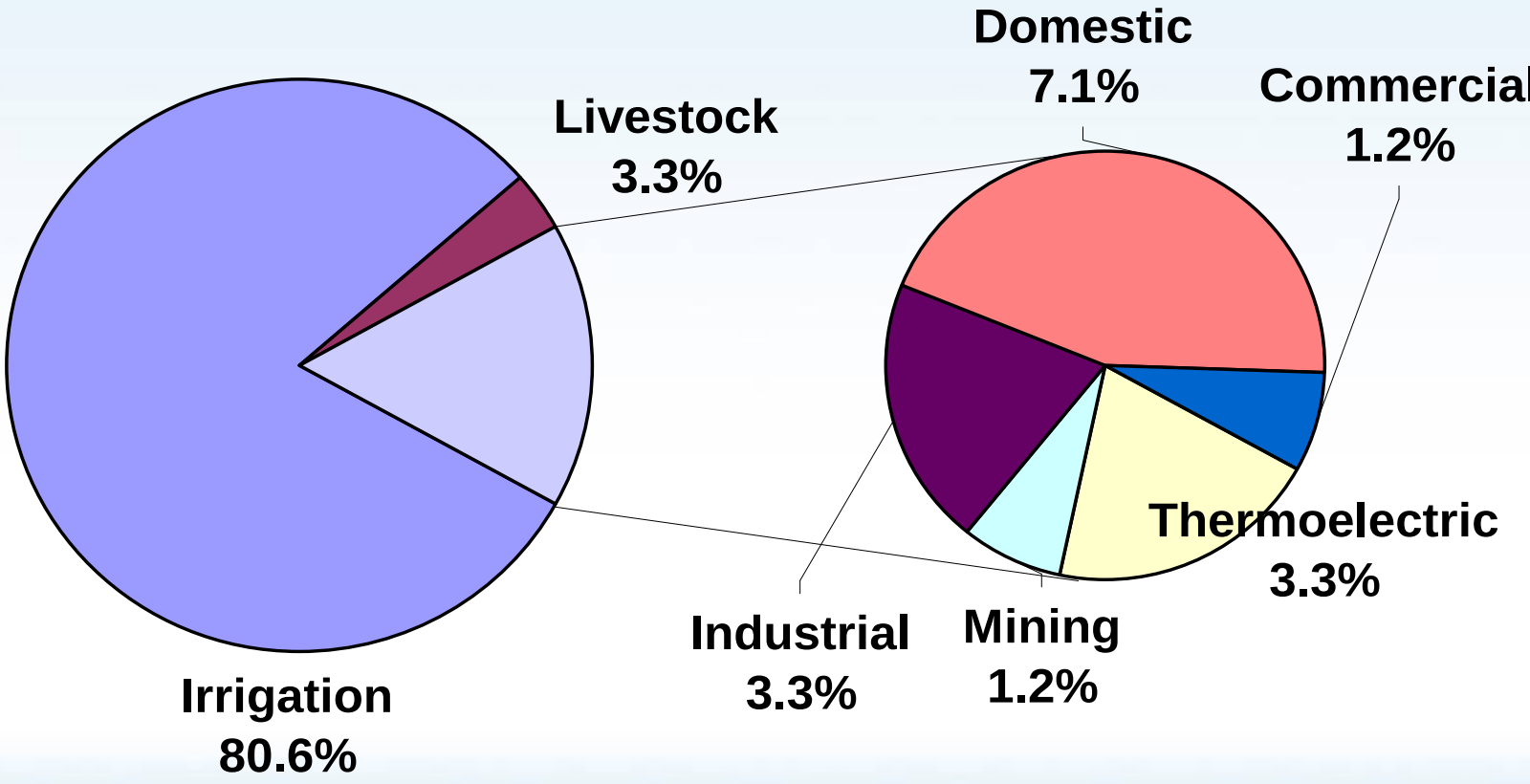
ASME Energy-Water-Nexus Activities

- ASME Energy Grand Challenge Roadmap
  - Top Priority – "Increase ASME's understanding, profile, and contributions regarding the Energy-Water-Nexus"
- 2011 ASME International Mechanical Engineering Conference & Exposition (IMECE)
  - Theme "Energy & Water Scarcity"
- 2012 IMECE – Keynote address "Energy Diversity" Thomas L. Friedman, Foreign Affairs Columnist, New York Times

Water Consumption by Sector

(Courtesy Mike Hightower, Sandia)

U.S. Freshwater Consumption, 100 Bgal/day

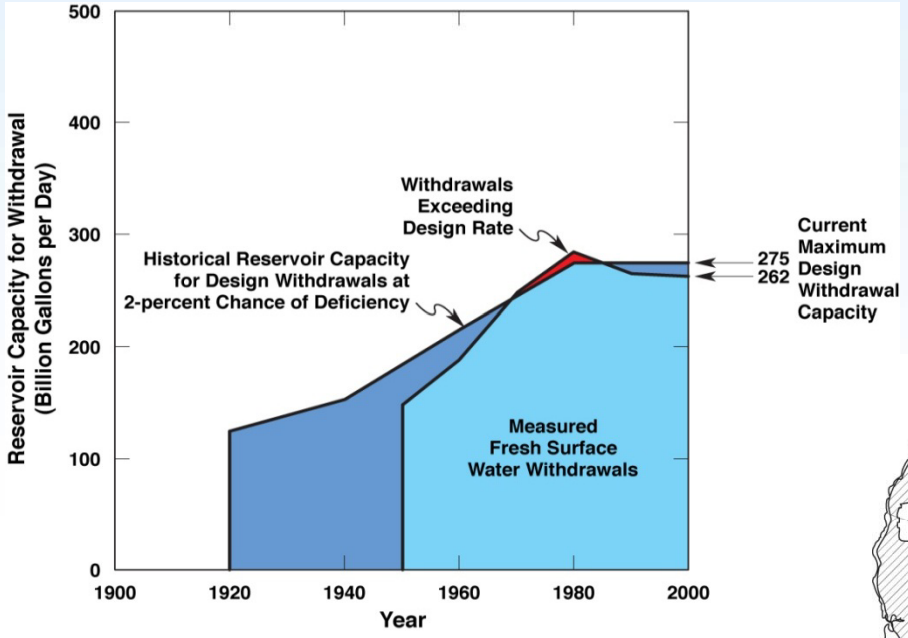


[USGS, 1998]

Energy uses 27 percent of all non-agricultural fresh water

ENERGY and WATER

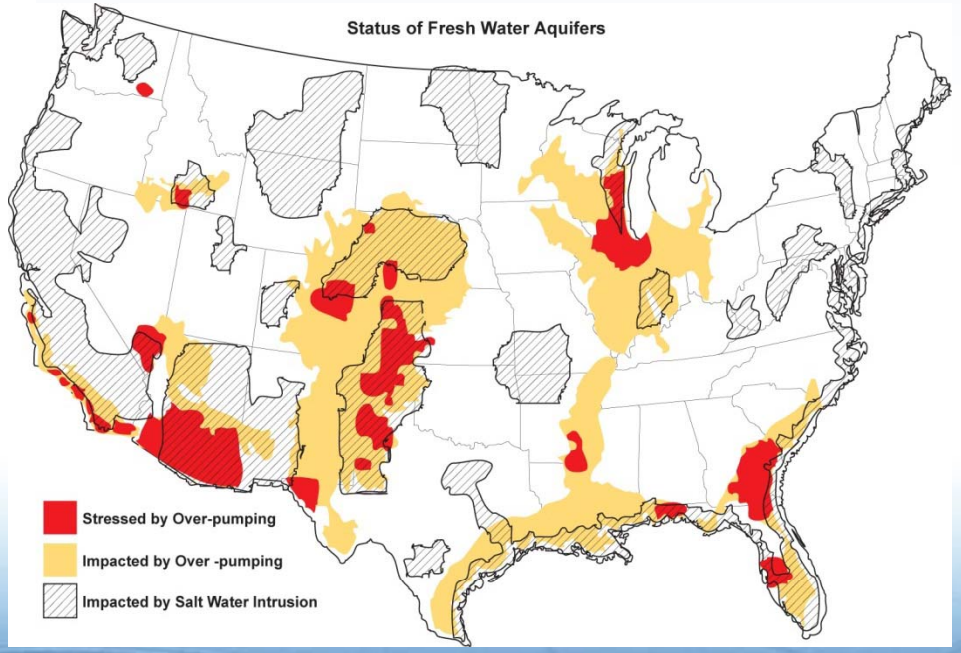
Growing Limitations on Fresh Surface and Ground Water Availability (Courtesy Mike Hightower, Sandia)



(Based on USGS WSP-2250 1984 and Alley 2007)

- Little increase in surface water storage capacity since 1980
- Concerns over climate impacts on surface water supplies

- Many major ground water aquifers seeing reductions in water quality and yield



(Shannon 2007)

ENERGY and WATER

Water Limitations are Already Impacting Energy Development

(Courtesy Mike Hightower, Sandia)

- Recent energy facility permitting issues due to water availability

ENERGY and WATER

2003 Heat Wave Impact on French Electric Power Generation

(Courtesy Mike Hightower, Sandia)

- Loss of 7 to 15% of nuclear generation capacity for 5 weeks
- Loss of 20% of hydro generation capacity
- Large-scale load shedding and shut off transmission to Italy
- Sharp increase of spot-market prices: 1000 to 1500 $ / MWh for most critical days

Normal conditions in August

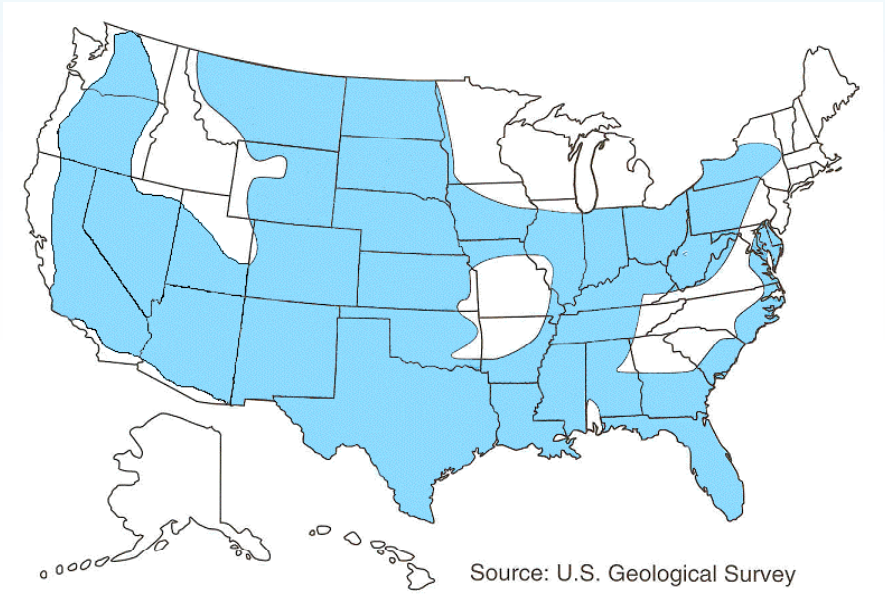
Bort-les-Orgues Réservoir

August 27, 2003

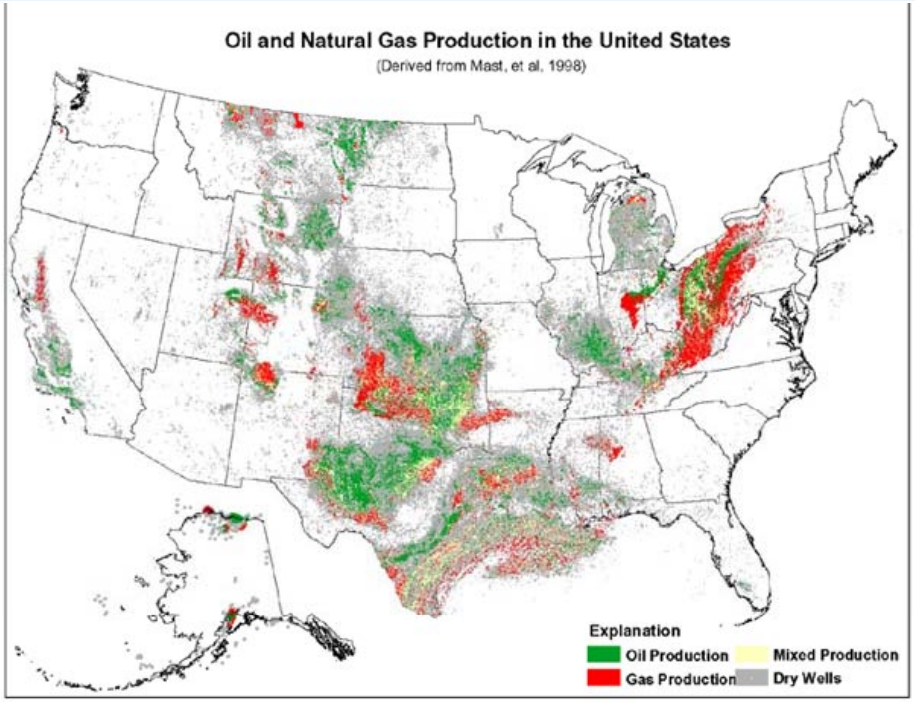
ENERGY and WATER

Non-traditional Water Resource Availability

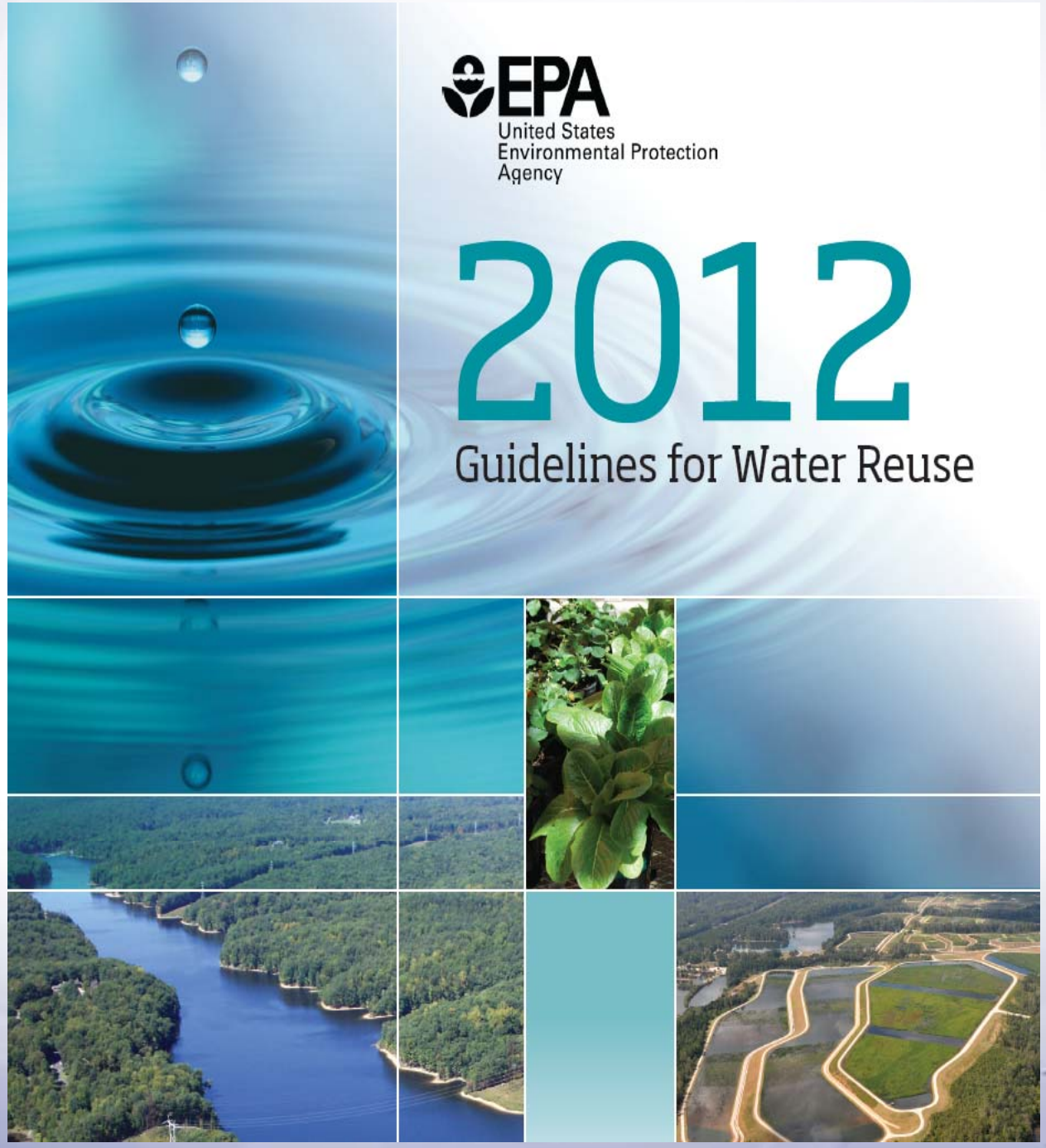
(Courtesy Mike Hightower, Sandia)

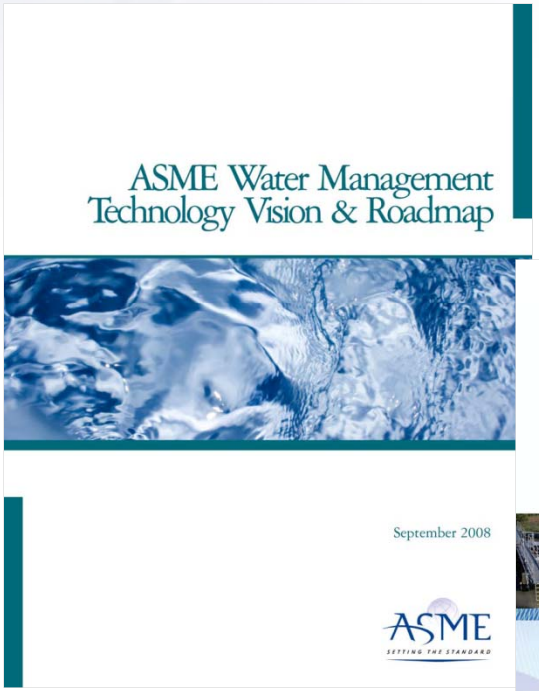


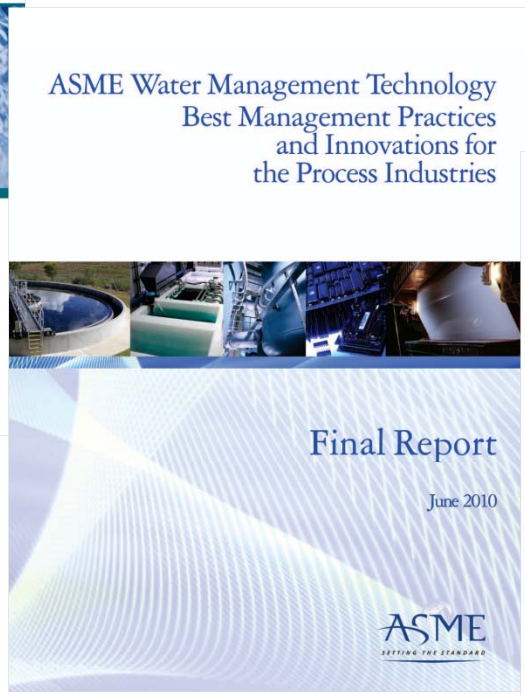
Saline Aquifers

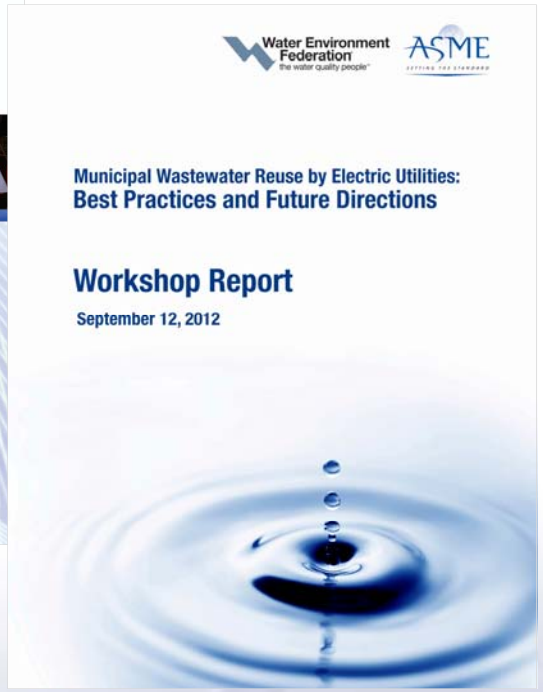


Oil and Gas Produced Water


EPA
United States
Environmental Protection
Agency
2012
Guidelines for Water Reuse







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ASME Water Management Technology Vision / Roadmap Workshop

- ASME Water Management Technology Vision – Roadmap Workshop - Held 5/9-10/2007
  - Goal – "**Define ASME Role in Water Management Technology**"
  - Vision – ***"ASME will be recognized as a key resource in the development & integration of water management technology solutions that enable the sustainable use & reuse of water***
  - ***ASME will bring diverse partners together to find multidisciplinary solutions to water management technology issues***
  - ***ASME will play a particularly critical role in addressing water use in the industrial sector through technology."***

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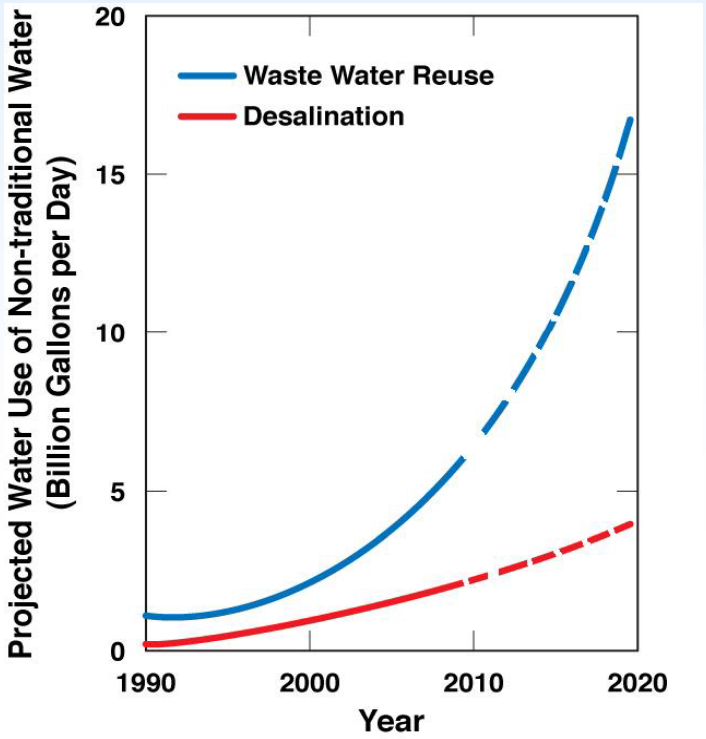
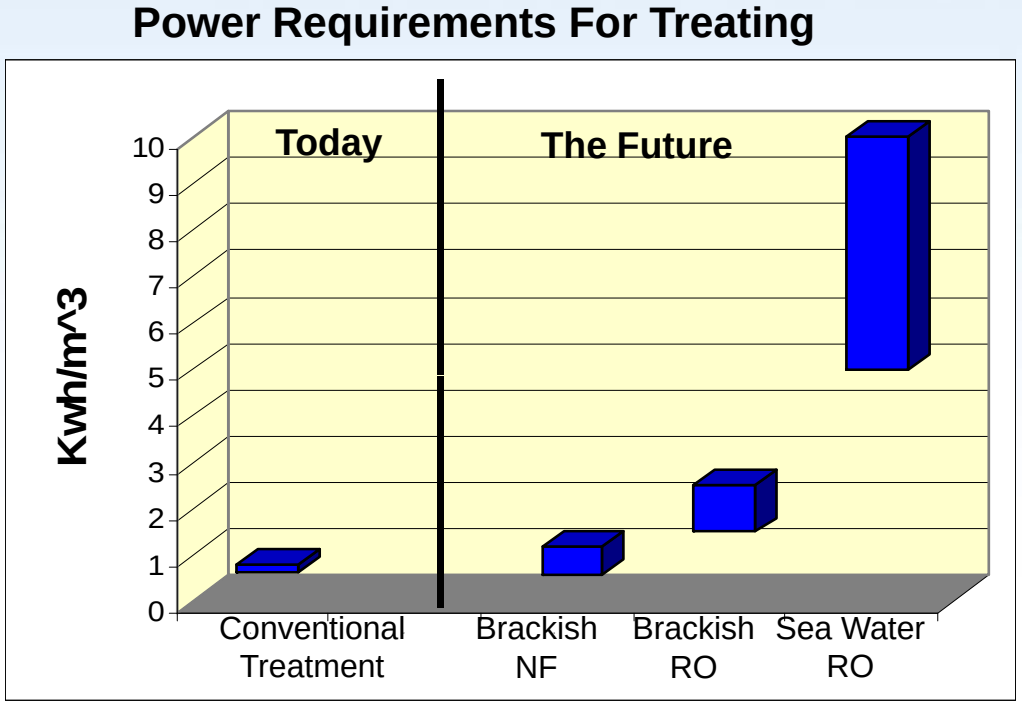
Growing Use of Non-traditional Water Resources (Courtesy Mike Hightower, Sandia)



(Modified from Water Reuse 2007, EPA 2004, Mickley 2003)



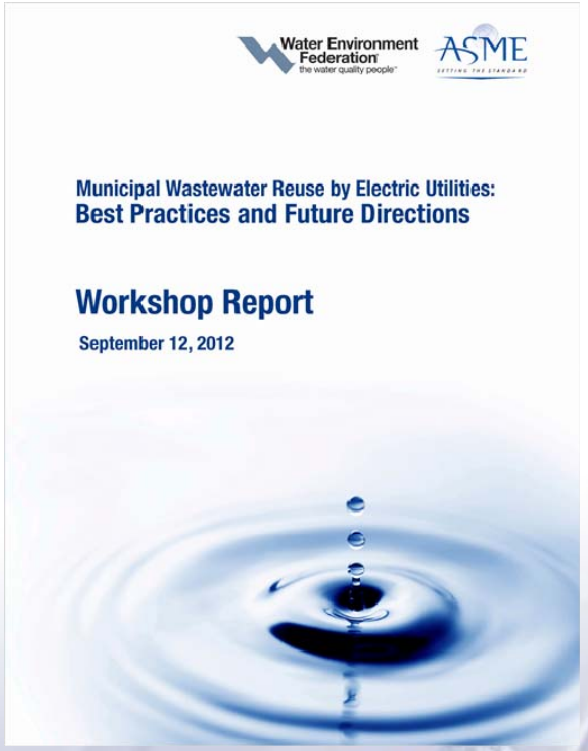
(Einfeld 2007)

- 32 Billion Gallons Municipal Waste Water produced / Day
- Desal growing at 10% per year, waste water reuse at 15% per year
- Reuse not accounted for in USGS assessments
- Non-traditional water use is energy intensive

ENERGY and WATER

ASME/WEF Municipal Wastewater Reuse by Electric Utilities: Best Practices and Future Directions Workshop

- Workshop held May 21–22, 2012 at the ASME Washington, DC offices
- Brought together more than 25 leading experts from municipal wastewater plants and electric utilities
- **GOAL:** To identify best practices and potential paths forward for increasing the use of municipal wastewater in electric utilities across the United States
- Includes brief case studies from successful municipal wastewater reuse projects at electric utilities
- Outlines characteristics to successful projects and potential project barriers
- Identifies potential projects that electric utilities, municipal wastewater treatment plants, ASME, and WEF can take to support the launch of new wastewater reuse projects at electric utilities.



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Wastewater Reuse at Electric Utilities
SUCCESSFUL PROJECTS

HAVE

- Active collaboration and agreement between wastewater treatment plants and electric utilities
- Clearly defined water quality and flow rates
- Optimal and adaptable system design
- Compliance with all regulations
- Ongoing education and outreach efforts

OVERCOME

- Absence of a dedicated regulatory framework
- Lack of information sharing and best practices
- Risk aversion and resistance to change
- Inability of stakeholders to work cooperatively and collaboratively

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Stakeholders, ASME, and WEF work together to
Gather data to enable system optimization
Compile best practices for water reuse
Develop and implement technology guidelines
Establish a collaborative forum
Develop and disseminate public education resources

Palo Verde Nuclear Generating Station Water Reclamation Facility

Because of its desert location, Palo Verde is the only nuclear power facility that uses 100% reclaimed water for cooling. Unlike other nuclear plants, Palo Verde maintains “Zero Discharge,” meaning no water is discharged to rivers, streams, or oceans. (Courtesy Bob Lotts, Arizona Public Service Company)

Water Reclamation Facility

- **The Palo Verde Water Reclamation Facility (WRF), is a 90 MGD tertiary treatment plant that reclaims treated secondary effluent from the cities of Phoenix, Scottsdale, Tempe, Mesa, Glendale and Tolleson.**

  (Courtesy Bob Lotts, Arizona Public Service Company)

Water Use

- **2011 cooling water Intensity**
  - 762 gallons/MWh
- **2011 cooling water use**
  - 73,173 acre feet
    - 24 Billion Gallons
- **Cooling Water cycles**
  - 23.3 - 5 year average
    - 25,000 – 29,000 TDS PPM
    - (air quality standards limit PV to 30,000 ppm TDS)

(Courtesy Bob Lotts, Arizona Public Service Company)

ASME Industrial Demineralization (Desalination):
Best Practices and Future Directions

Workshop Report

ASME Washington Center, January 28–29, 2013

April 2013

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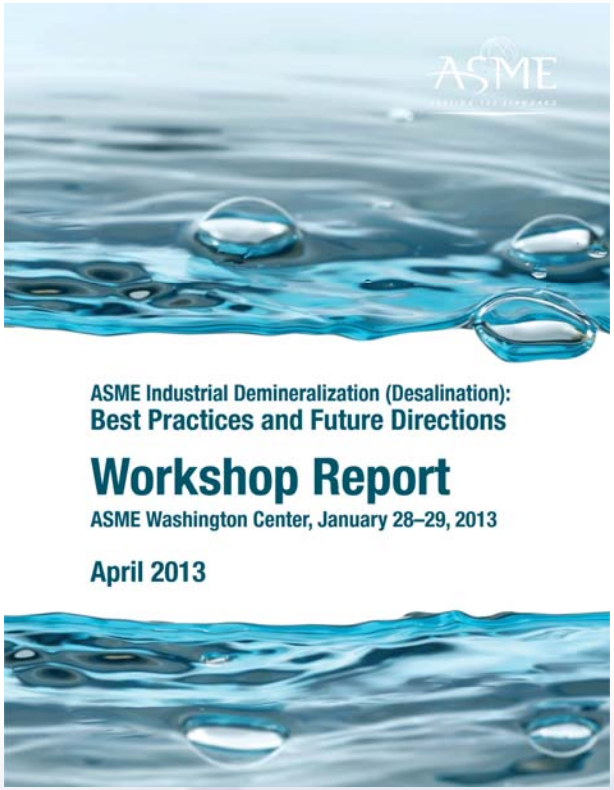
ASME Industrial Demineralization Best Practices and Future Directions Workshop

- Held January 28–29, 2013 at the ASME Washington, DC offices
- Brought together a broad cross-section of industrial demineralization and water reuse experts from industry, government, and academia
- **GOAL**: To identify best practices and potential paths forward for increasing the use of demineralized water in industrial processes across the United States
- Includes a brief overview of industrial demin (market, technologies)
- Outlines characteristics to successful projects and potential project barriers
- Identifies actions that ASME and its partners can support to increase the use of demineralized water in industrial processes



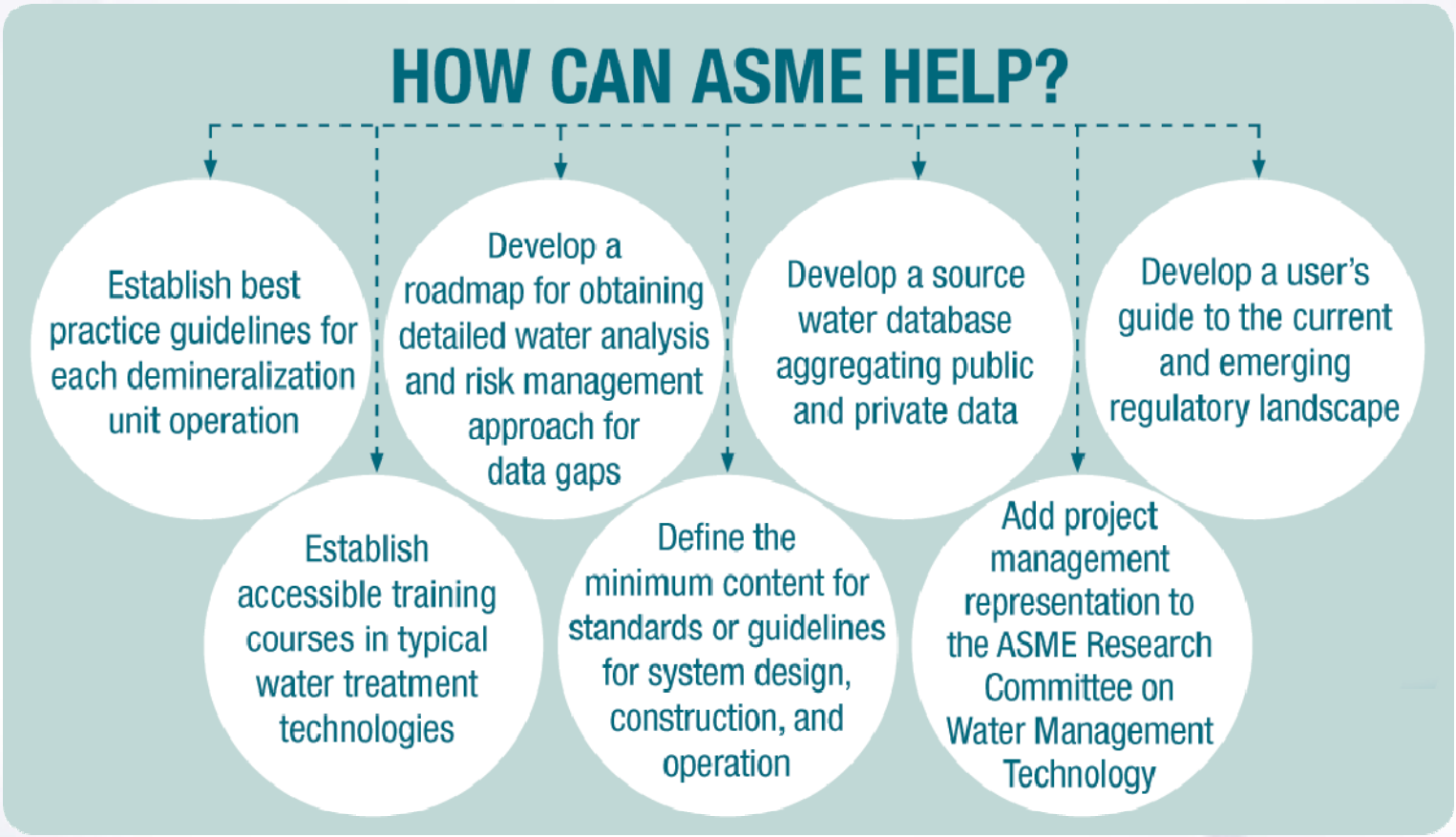
Industrial Demineralization
SUCCESSFUL PROJECTS

HAVE

- A system design that considers water management and quality data
- Prioritized end-user requirements
- A complete and well-informed project cost estimate
- Frequent and meaningful communication among all project participants
- A solution provider with proven, successful experience working with end users

OVERCOME

- Inadequate or changing definition of project requirements
- Incomplete basis for project and system design due to lack of comprehensive water data
- Lack of documented best practices to guide new demineralization projects
- Difficulty making a convincing business case for demineralization projects
- Insufficient project management and internal communication
- Inadequately trained and experienced workforce



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Frito Lay Process Water Recovery Treatment Plant (PWRTP)

- Located in Grande, AZ, the plant is almost entirely run on renewable energy and reclaimed water
- The process water that is used to move and wash potatoes and corn, clean production equipment, and for other in plant cleaning and productions needs, is reclaimed for reuse in the process.
- The PWRTP system recycles up to 75% of the facility's process water—enabling Frito-Lay to reduce its water use by 100 million gallons (380,000m^3) annually.

Aerial View of PWRTP (Photo credit: Frito-Lay)

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Thank You

Any Questions?

- **Additional information:**
- **Michael Tinkleman, Ph.D., Director, Research ASME**
- **TinklemanM@asme.org**
- **202-785-7394**
- **For copies of ASME Water Roadmap, ASME Water BMP Report & ASME/WEF Municipal Waste Water Reuse in Electric Utilities**

http://committees.asme.org/K&C/TCOB/BRTD/WMT/Accomplishments.cfm

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