



Life Cycle Water in Oil and Gas Operations

Strategic Approaches
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Overview



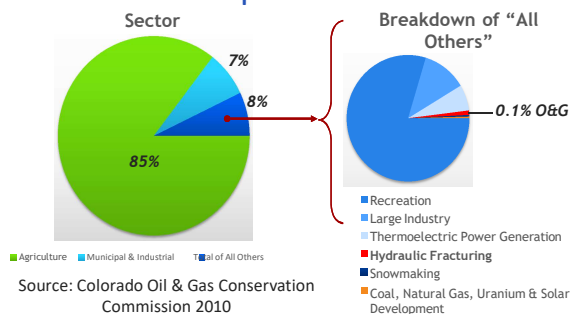
- Water in Upstream
- Water as a Product
- Regulatory Issues
- Collaboration and Research



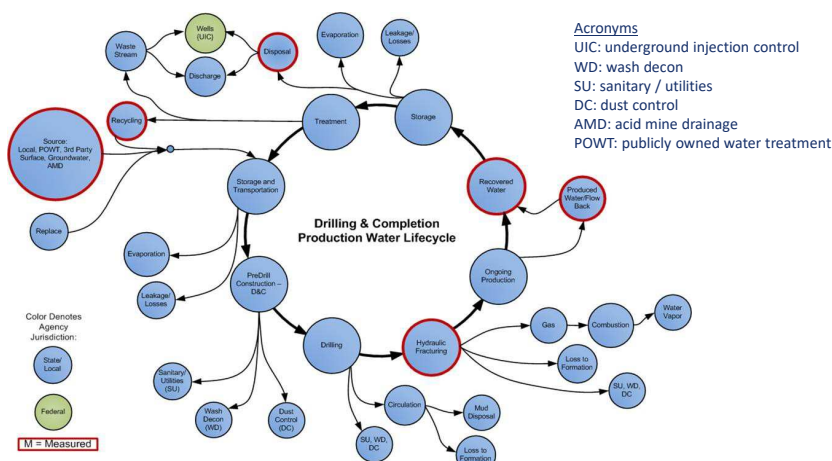
Water in Upstream



- Wells will typically produce energy for 30 years
- Colorado OGCC projected that water usage for oil and natural gas is about 0.08% of total water use in Colorado
- US EPA projected nationwide upstream water use is >1% of total water use



Water Life Cycle in Upstream Operations



Stages of Water Management

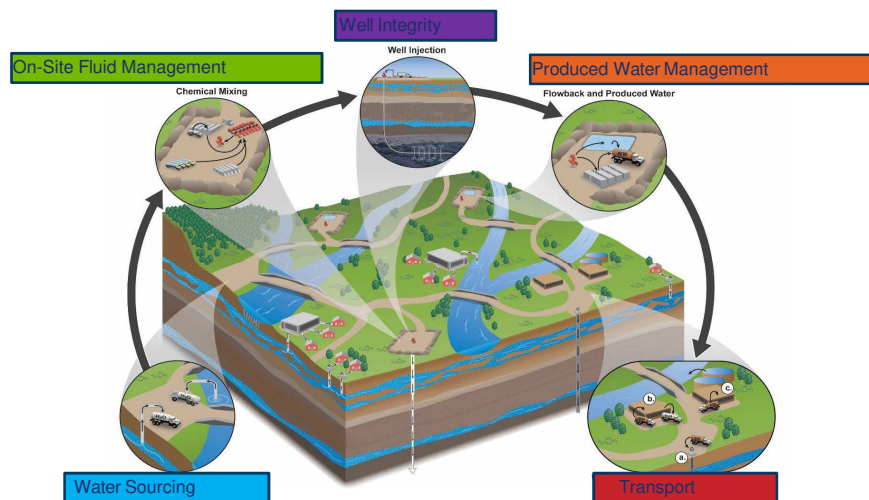
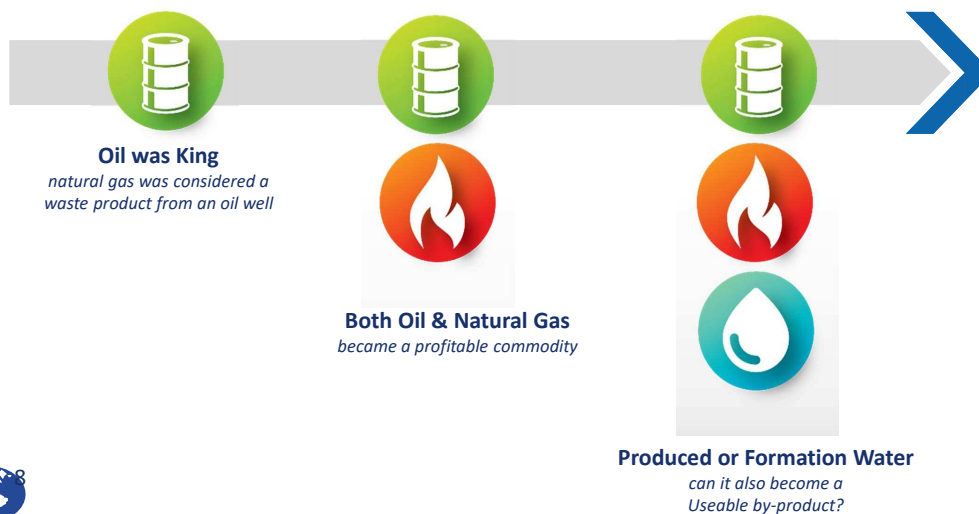


Figure adapted from EPA 2015

Source: JISEA: Jordan.Macknick@NREL.GOV

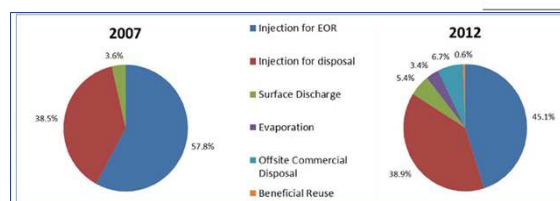
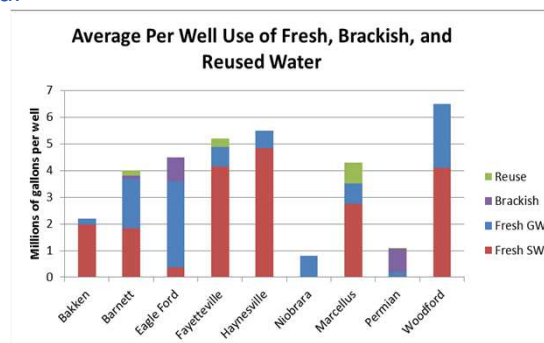
Water as a Product



Produced Water Management



- Generated from most producing oil and natural gas wells in the U.S.
- Cost of managing the water is a key consideration to producers
- Every play has a different “water profile”
- They “get what nature gives them”



Source: Groundwater Protection Council

Source JISEA: Jordan.Macknick@NREL.GOV

Data collected from: (Freyman 2014; Taylor 2012; Nicot et al. 2014; Nicot et al. 2012; Scanlon, Reedy, and Nicot 2014; Louisiana Ground Water Resources Commission 2012; EPA 2015a; BHP Billiton 2014; Hansen, Mulvaney, and Betcher 2013; Goodwin et al. 2014)

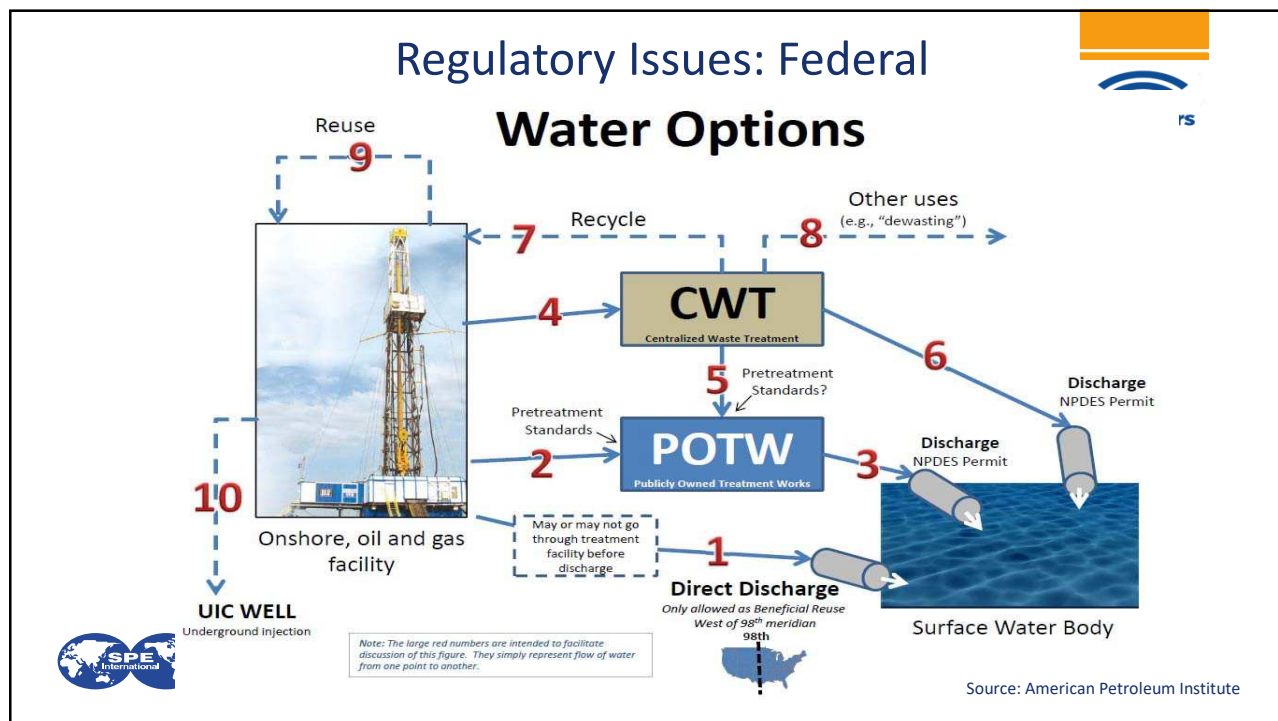
Produced Water: Part of the Solution



- Opportunities
 - Water sourcing, management and disposal
 - Not a significant user of water compared to other sectors
 - Bring “trapped water” to the surface –net gain to the system
 - Collaboration to achieve progress
- Actions necessary to maximize opportunities
 - Laws and regulations that support beneficial reuse of water
 - Improvements in water treatment technologies
 - Reduced cost of water treatment
 - Entities interested in accepting the treated water



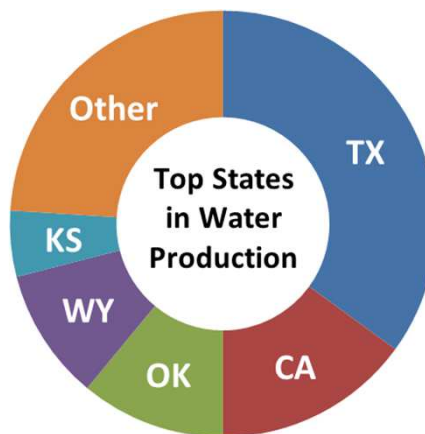
Regulatory Issues: Federal Water Options



Regulatory Issues: States

States set requirements

- Permit usually not needed for:
 - Use of produced water or
 - Reuse of flowback water
- Permit is needed for discharge to surface
- Permit may be needed if provided to another user
- State regulations are evaluated and assessed: TX, NM, CO



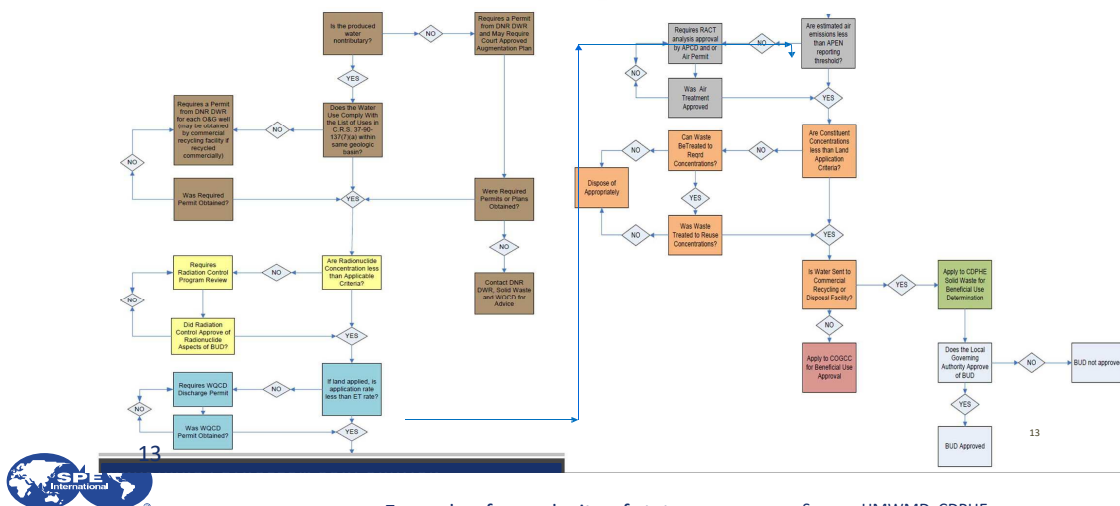
Source: Veil, J. "U.S. Produced Water Volumes and Management Practices in 2012."

Regulatory Issues: Colorado Recycling



PRODUCED WATER RECYCLING FLOW CHART

CDPHE/HMWMD Informal Guidance-February 2016



Example of complexity of state process

Source: HMWMD, CDPHE

Collaboration and Research



Industry is working together on:

- Water on demand design
- Water lifecycle evaluation
- Water risk assessment
- Water data management
- Water recycle technology



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Collaboration and Research: National Academy of Sciences



WORKSHOP ON **Use of Flowback and Produced Waters:** OPPORTUNITIES AND CHALLENGES FOR INNOVATION

<http://nas-sites.org/uhrroundtable/past-events/water-workshop/>



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