The Produced Water Society
Seminar 2017
January 18-20, 2017

PRODUCED WATER CHALLENGES IN A LIMITED REUSE, LIMITED DISPOSAL ENVIRONMENT

RICK McCURDY

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OPTIONS FOR PRODUCED WATER WITH` NO PLACE TO GO

- Keep It In The Reservoir
  - >Don’t Produce It
- Industry Cooperation
  - >Share It With Your Friends
- Beneficial Reuse
  - >Keep It Above Ground

Keep It In The Reservoir

DON’T PRODUCE IT

KEEP IT IN THE RESERVOIR

- Restrict Water Production Chemically
  - > Blocking Gels
  - > Silicate Gels
  - > Cement
  - > Relative Permeability Modifiers
- Separate and Re-inject
  - > Generally, not in the same reservoir
  - > Most common to set a packer and inject into a non-productive, upper zone via the annulus

- Issues
  - > Most commonly used on vertical conventional wells with high permeability.
  - > Permanent blockage – possibility to block oil and gas as well.
  - > Can result in a near wellbore “doughnut” of water hindering hydrocarbon movement.
  - > Still requires a disposal zone
  - > Issue with necessary downhole tubing and jewelry

Industry Cooperation

SHARE IT WITH YOUR FRIENDS

INDUSTRY COOPERATION

- Industry peers share produced water with one another so as to minimize produced water disposal
  - > Simple concept, yet not so simple to enact
    - Requires willingness to share infrastructure locations and capabilities
    - Requires willingness to share drilling and completion schedules with your peers
    - May require new infrastructure (pipelines, impoundments, etc)
    - In many areas, may require new state regulations regarding the movement of produced water from one operator to another or from an operator to a third part and then to another operator
    - Potential water compatibility issues need to be reviewed up front

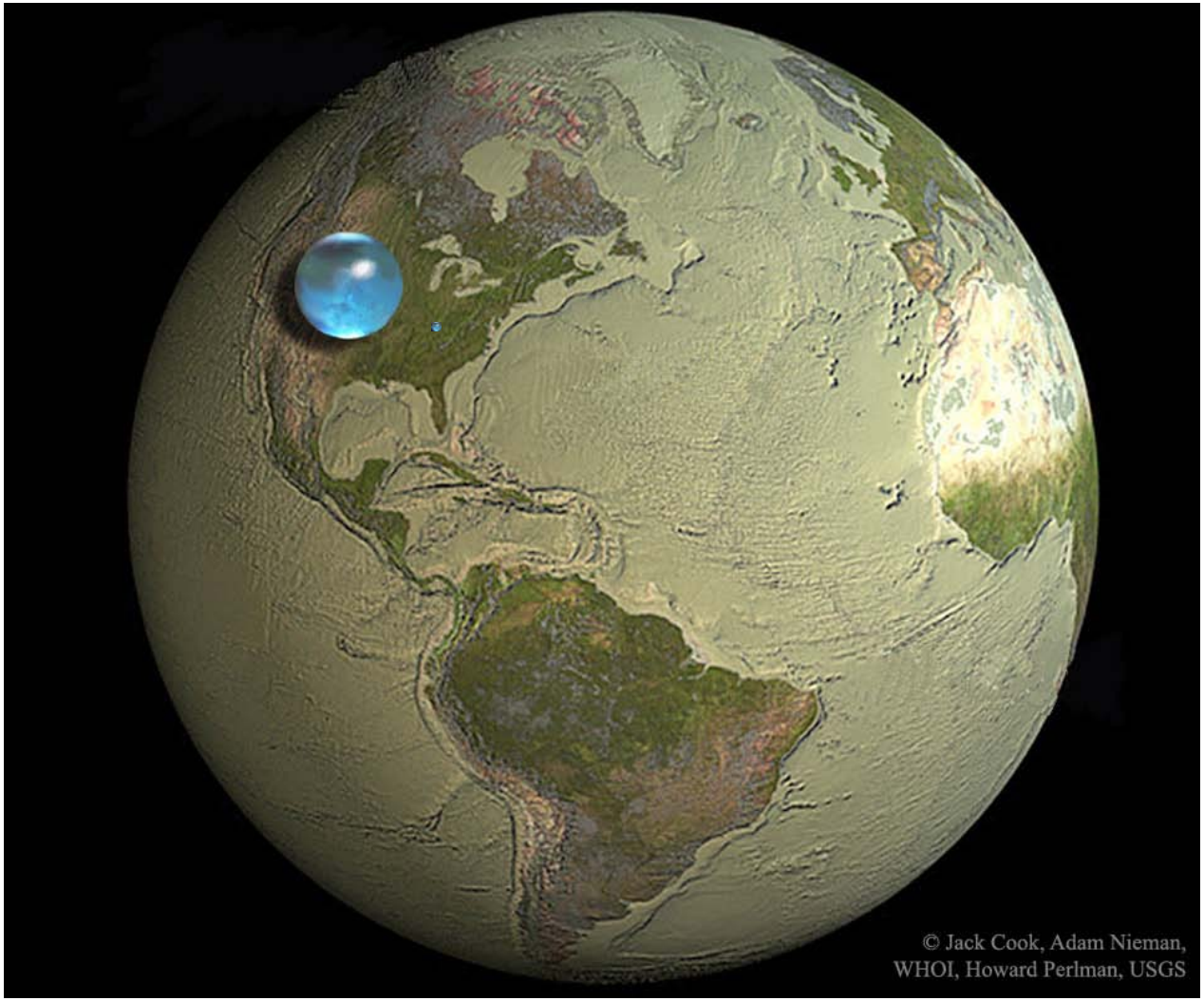
Beneficial Reuse

KEEP IT ABOVE GROUND

BENEFICIAL REUSE

- Treatment of produced water to recover some quantity of fresh water, plus potentially other usable products

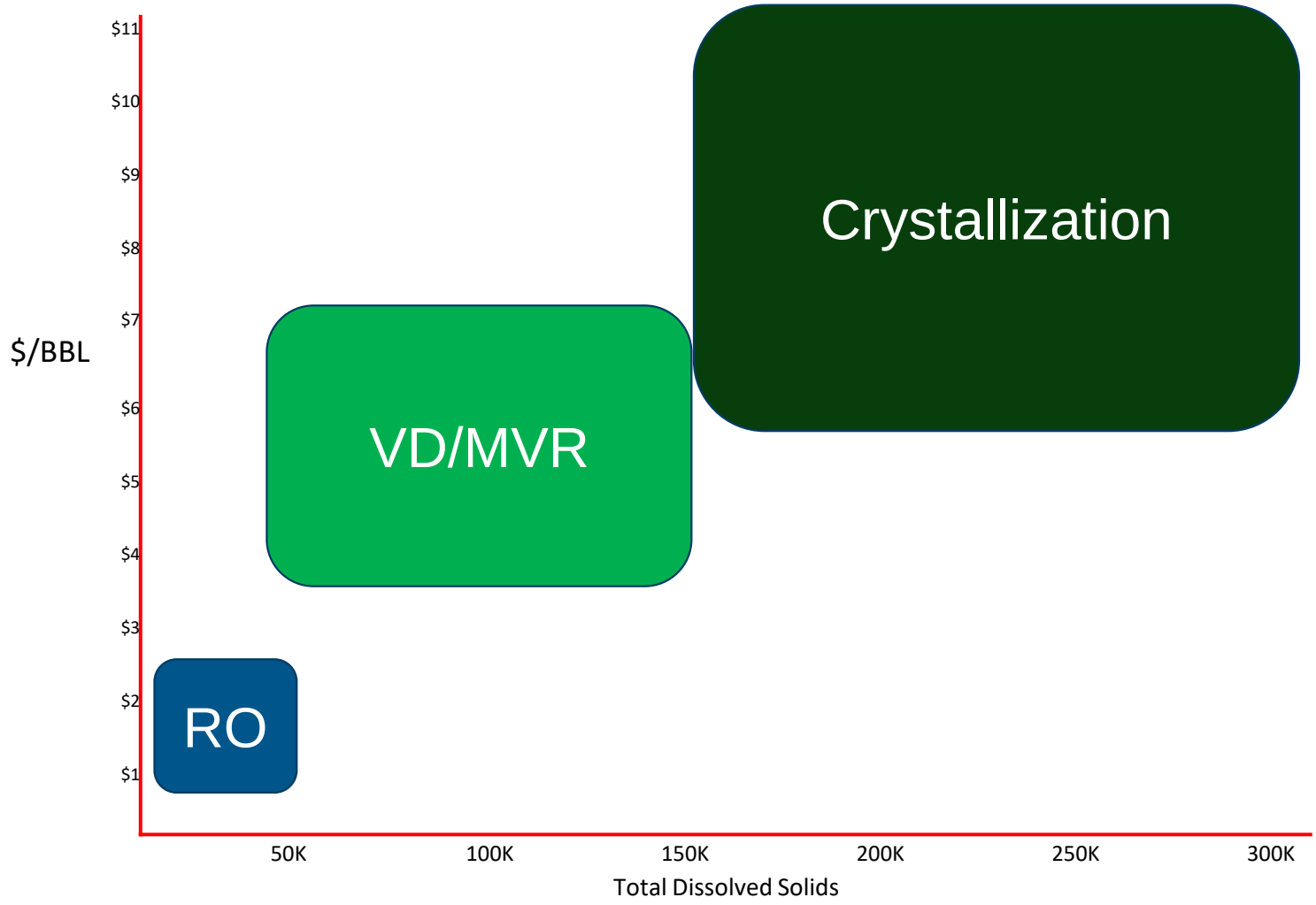
BUT FIRST



BENEFICIAL REUSE

- Treatment of produced water to recover some quantity of fresh water, plus potentially other usable products
- Conventional Technologies
  - Reverse Osmosis
    - Inefficient in brines with total dissolved solids (tds) > 50,000 mg/l
  - Vapor Distillation, Mechanical Vapor Recompression
    - Generally best with brines with tds between 50,000 and 150,000 mg/l
  - Crystallization
    - No tds limit
- Some common issues with these technologies
  - Economics
  - Power demand
  - Waste generation

ECONOMICS


$/BBL
$11
$10
$9
$8
$7
$6
$5
$4
$3
$2
$1
Crystallization
VD/MVR
RO
50K
100K
150K
200K
250K
300K
Total Dissolved Solids

POWER DEMAND

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- VD/MVR & ZLD plants typically need 6-8 kwh / bbl water processed
- 50,000 bpd plant would use 109.5-146.0 gwh/year
- Avg household consumption is 10,932 kwh/year[1]
- Avg household in Oklahoma has 2.55 people[2]
- A single 50,000 bpd plant will have the energy demand of a city with a population of 25,000-34,000 people!

1 – U.S Energy Information Administration (2014)
2 – U.S. Census 2010

WASTE / PRODUCT GENERATION

Capacity		Products and waste			
bbl/day	MGD	Filter Cake, (tons/day)	Distillate, (bbl/day)	Salt (tons/day)	$CaCl_2$ Brine (bbl/day)
5,000	0.2	53	4,000	107	1,000
50,000	2.1	533	40,000	1,066	10,000
100,000	4.2	1,066	80,000	2,132	20,000
200,000	8.4	2,132	160,000	4,264	40,000
300,000	12.5	3,198	240,000	6,396	60,000

1

Numbers based off of typical composition of a produced water that is relatively high in salinity with a moderate level of hardness.

POTENTIAL TECHNOLOGIES

- MEMBRANE DISTILLATION

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MEMBRANE DISTILLATION

- Pros
  - Membrane is resistant to fouling
    - only pretreatment is oil removal
    - Hardness and bacteria have not shown to be troublesome
  - Low energy demand
  - Can handle high TDS brines
  - Can utilize waste heat sources
  - Potential to provide recovery of a distillation unit at the cost of an RO
- Cons
  - Oil can foul membranes
  - While more economical than a VD/MVR process and much less energy intensive – still cannot compete with majority of Class II SWD options; however, waste heat can swing the pendulum
  - Not commercially available

HINDRANCES TO BENEFICIAL REUSE

- HOW WILL THE WATER BE USED?
- WHAT IS IN THE WATER?
- WHERE WILL IT BE USED?

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