



Produced water reuse in US unconventional basins

IOGCC Webinar

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Advisian
Worley Group

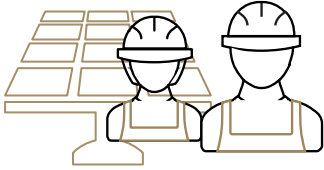
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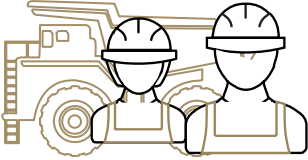
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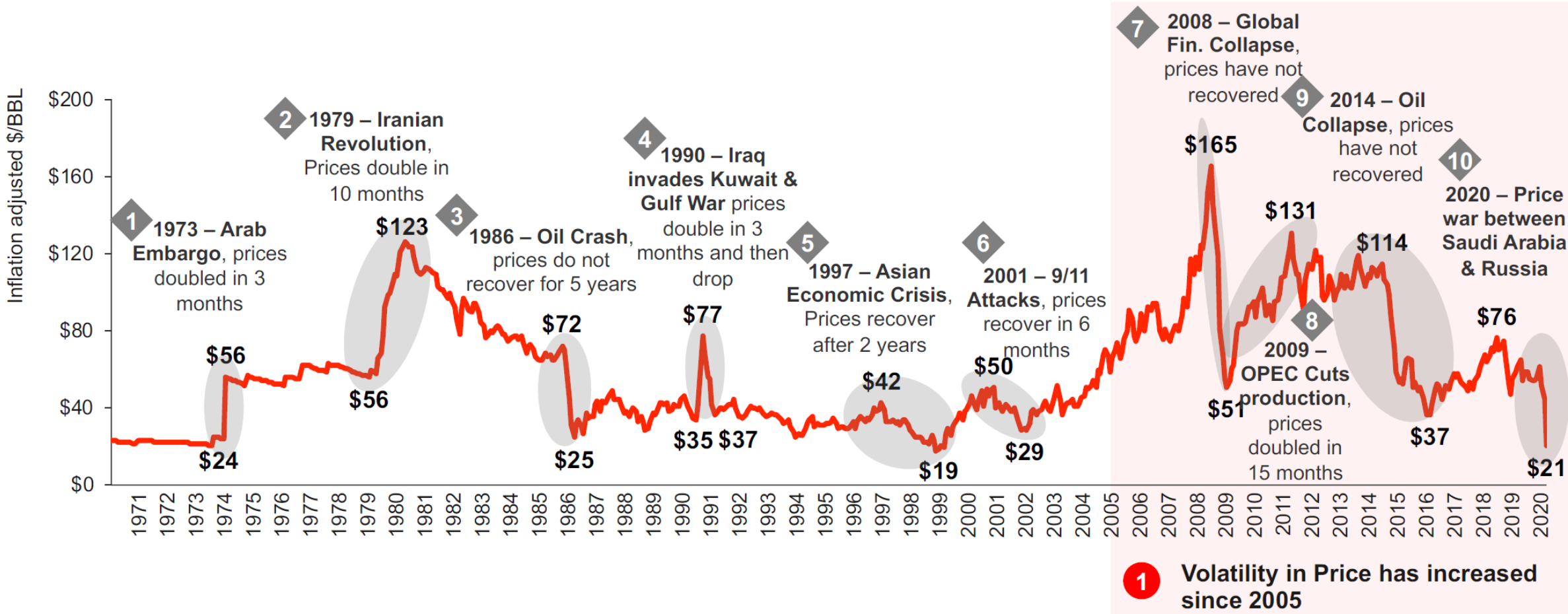
Agenda: Produced Water Reuse

- Industry status
- State of produced water reuse
- Challenges and opportunities to reuse
- Regional differences
- Regulatory
- New trends
- Questions



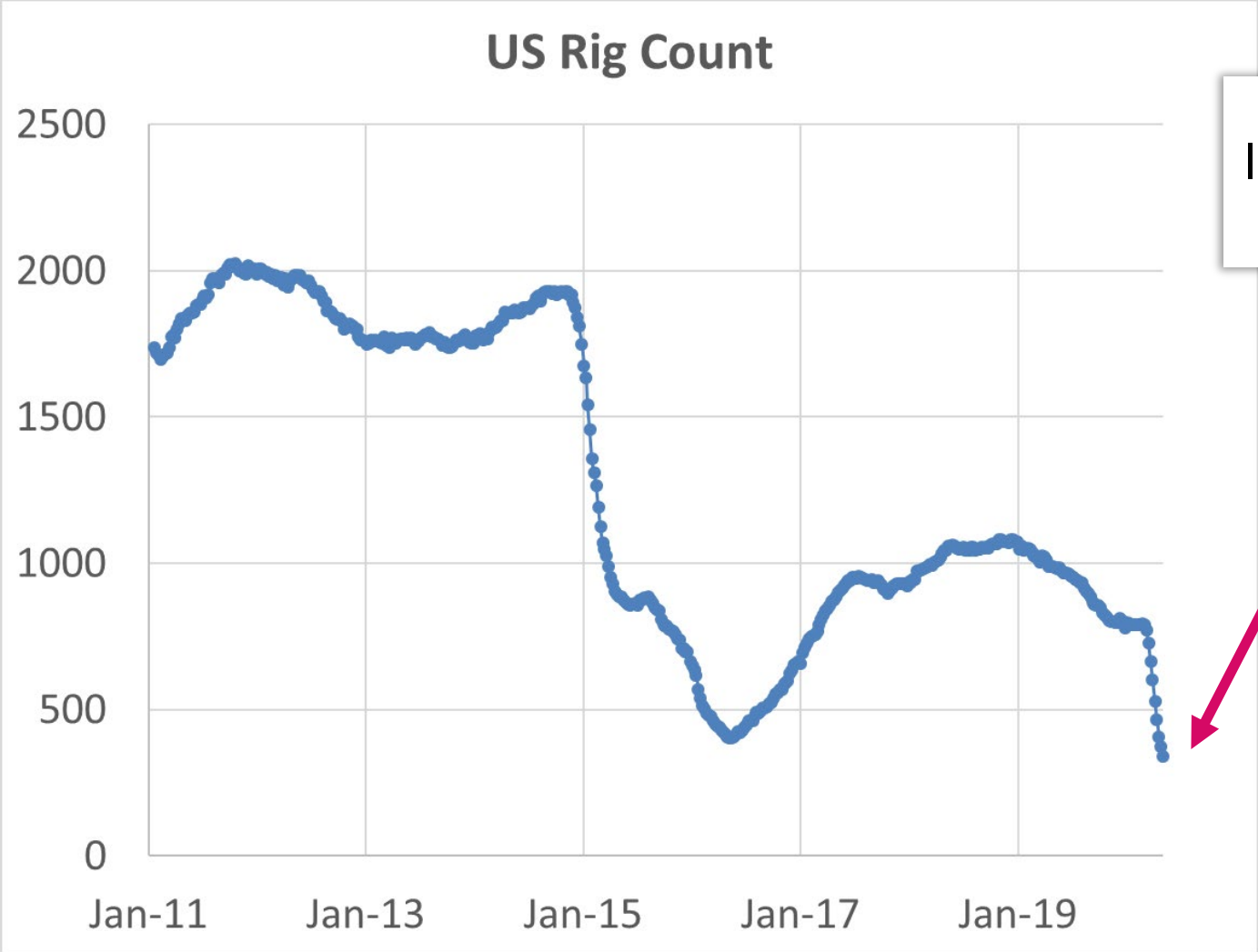
Non-produced water

10 Major Oil Price Events - In the Last 50 Years

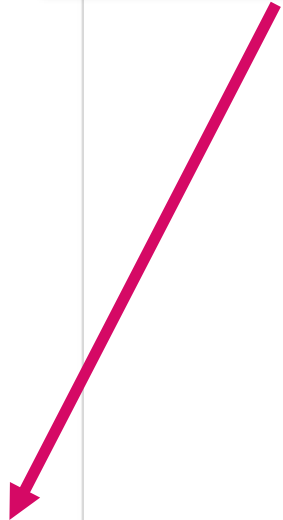


Sources: IBM Analysis, EIA, IEA, FRED, BP Statistical Review, CapitalIQ

US Industry Activity



US rig count is lowest since 1944 and still falling.



Source: Baker Hughes

Natural Gas Pricing: Less Horrible

Five-year chart not great

Three-month chart is ~flat
(before COVID-19)

Natural Gas Futures Overview



Natural Gas Futures Overview



Source: Investing.com

Oil & Gas Industry Status

Exclusive: Chesapeake Energy preparing bankruptcy filing

Shale Producers Diamondback, Parsley Energy to Cut May Oil Output

HighPeak Energy Plans New Merger Following Scuttled Grenadier Deal

The crash in oil prices forced a renegotiation of a previous combination that was expected to form the largest pure-play northern Midland Basin E&P.

By Emily Patsy, HartEnergy.com Tue, 05/05/2020 - 05:38 PM

RESTRUCTURINGS | PUBLIC CAPITAL

Oklahoma Oil Producer Chaparral Energy Raises Going Concern Doubts

Reuters Tue, 05/12/2020 - 04:10 AM

U.S. LEGAL NEWS APRIL 9, 2020 / 4:38 PM / 3 DAYS AGO

Exclusive: U.S. banks prepare to seize energy assets as shale boom goes bust

Shell to Divest Appalachia Shale Position in \$541 Million Deal

The divestiture is part of Shell's strategy to focus on the development of light tight oil assets, Shell Upstream Director Wael Sawan says.

By Emily Patsy, HartEnergy.com Mon, 05/04/2020 - 04:00 PM



REUTERS

Business Markets World Politics

BUSINESS NEWS

MAY 8, 2020 / 12:15 AM / 3 DAYS AGO

U.S. drillers cut oil & gas rigs to historic low -Baker Hughes

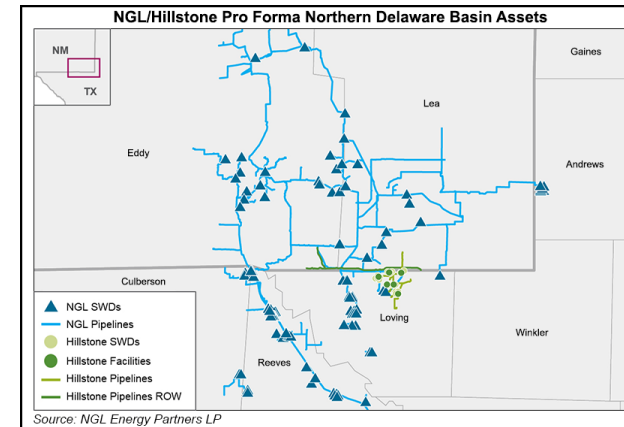
Key: Investors stopped funding O&G before the oil price collapse.

Evolution of Water for Unconventional (Change is Constant!)



~2010

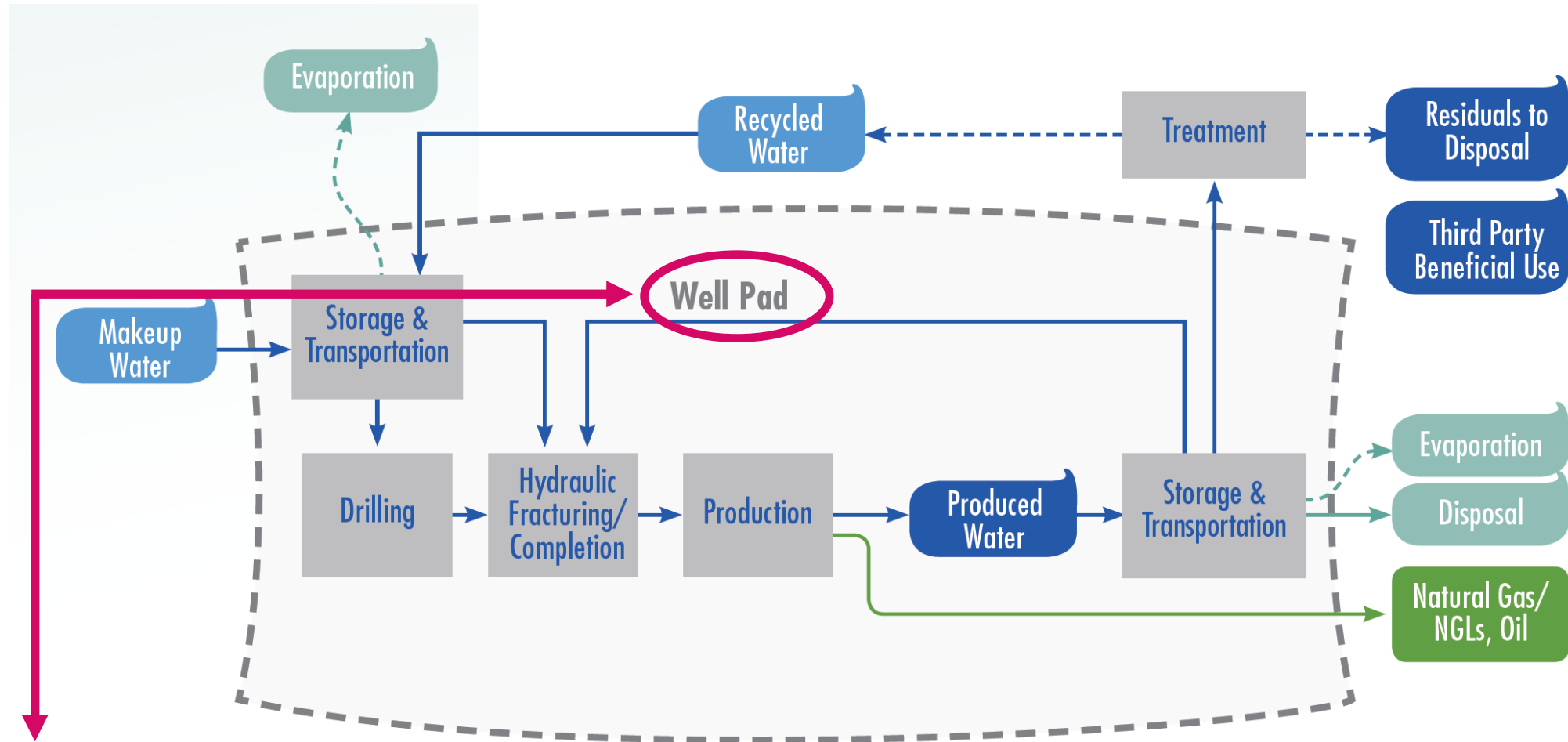
- Barnett Shale, Bakken, Marcellus
- Local source, local SWDs



Today

- Permian dominates
- Water pipeline networks
- Growing reuse
- Water midstream

State of Produced Water Reuse



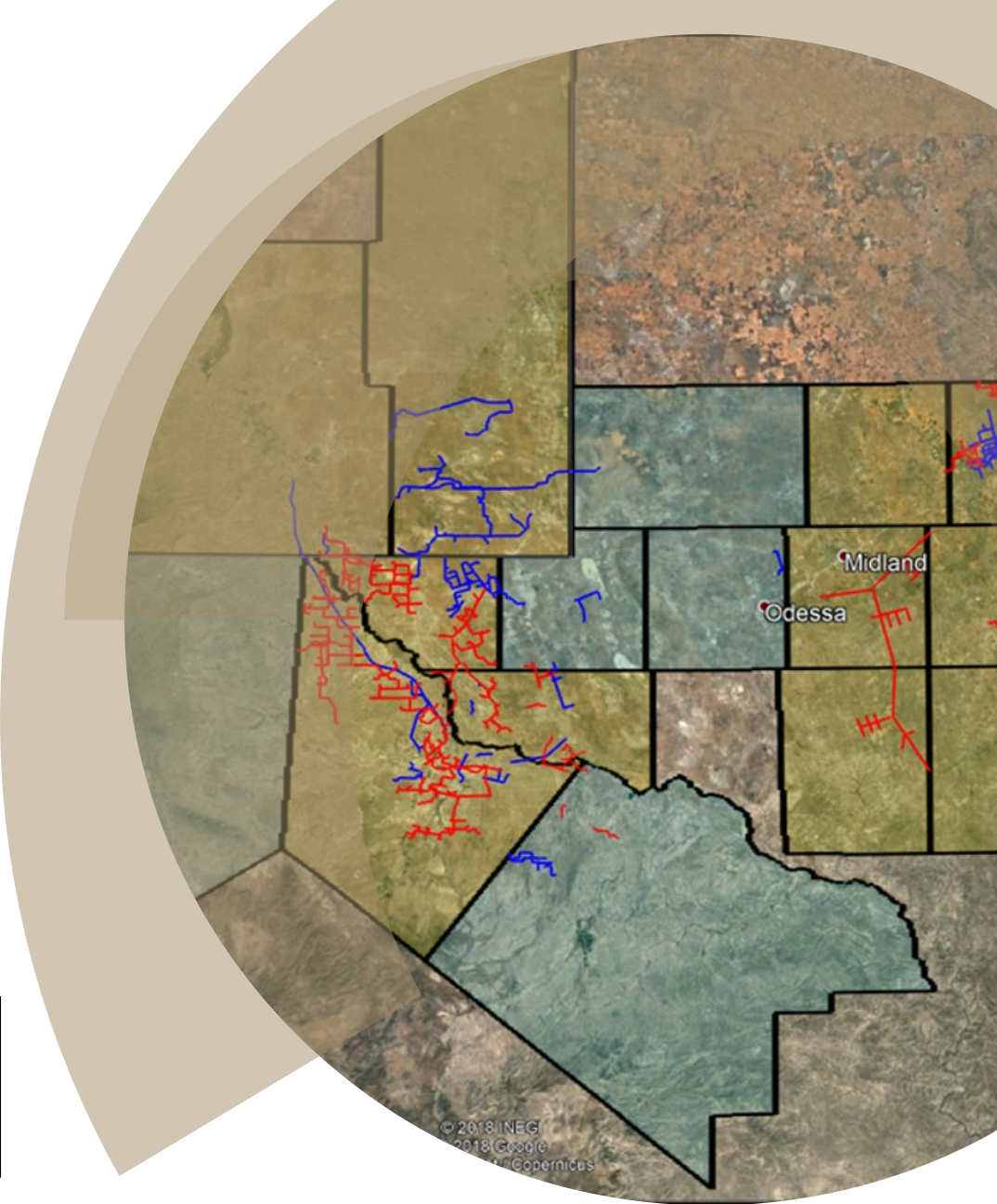
Source: EWI Report 2015

Water Systems Growing

- Permanent buried produced water pipeline systems growing (graphic shows partial list in Permian)
- Permanent source water pipelines less common (often use temporary lay-flat hose)
- Pipeline systems aggregate water and facilitate reuse

Legend

----- Producer midstream
----- Third-party midstream



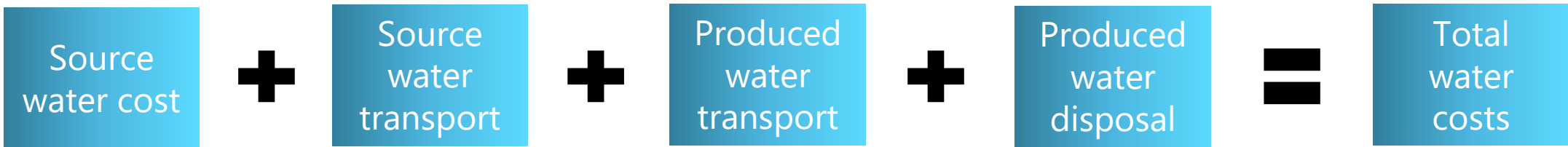
Regulation and Water Cycle

Example of regulatory involvement in oil & gas water cycle

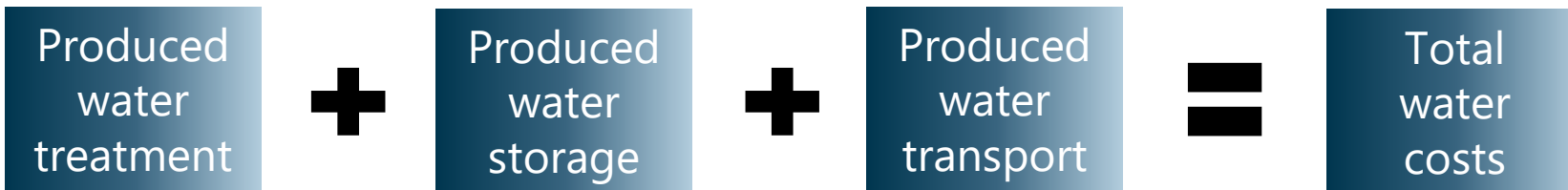
Sourcing	Transportation	Storage	Hydraulic fracturing	Disposition	Beneficial use
<ul style="list-style-type: none">• State water rights laws and regulations determine legal rights to water• Many states require permits• Contracts utilized for water from municipal / alternate sources	<ul style="list-style-type: none">• Trucks obtain permits/licenses• Pipelines in many cases require multiple easements to be leased/purchased.• Permits needed when pipelines intersect roads, streams, railways, etc.	<ul style="list-style-type: none">• Permits required to build and operate storage pits (some states)• Tanks authorized by Application for Permit to Drill or by rule• Secondary containment requirements• Spill prevention and control (SPCC) plans may be required• Stormwater permits may be required	<ul style="list-style-type: none">• Typically regulated under state oil/gas programs• Reporting is made for each job• Many companies report to Frac Focus (national chemical disclosure database)• Transportation and storage of chemicals used may be regulated by federal, state, and local agencies	<ul style="list-style-type: none">• Produced water disposed by discharge to surface water must be authorized by NPDES• PW sent to municipal treatment must follow NPDES regs. for pre-treatment and meet additional standards• Wells used to inject for EPR must be permitted under UIC Class II	<ul style="list-style-type: none">• Typically not subjected to additional regs. other than tracking flow/disposition of the produced water• Existing beneficial uses of water outside oil/gas industry may require permits• Local authorities can adopt standards more stringent than state• As additional uses are considered, it is likely more regs. will be adopted

Economics of Reuse

Water costs without reuse



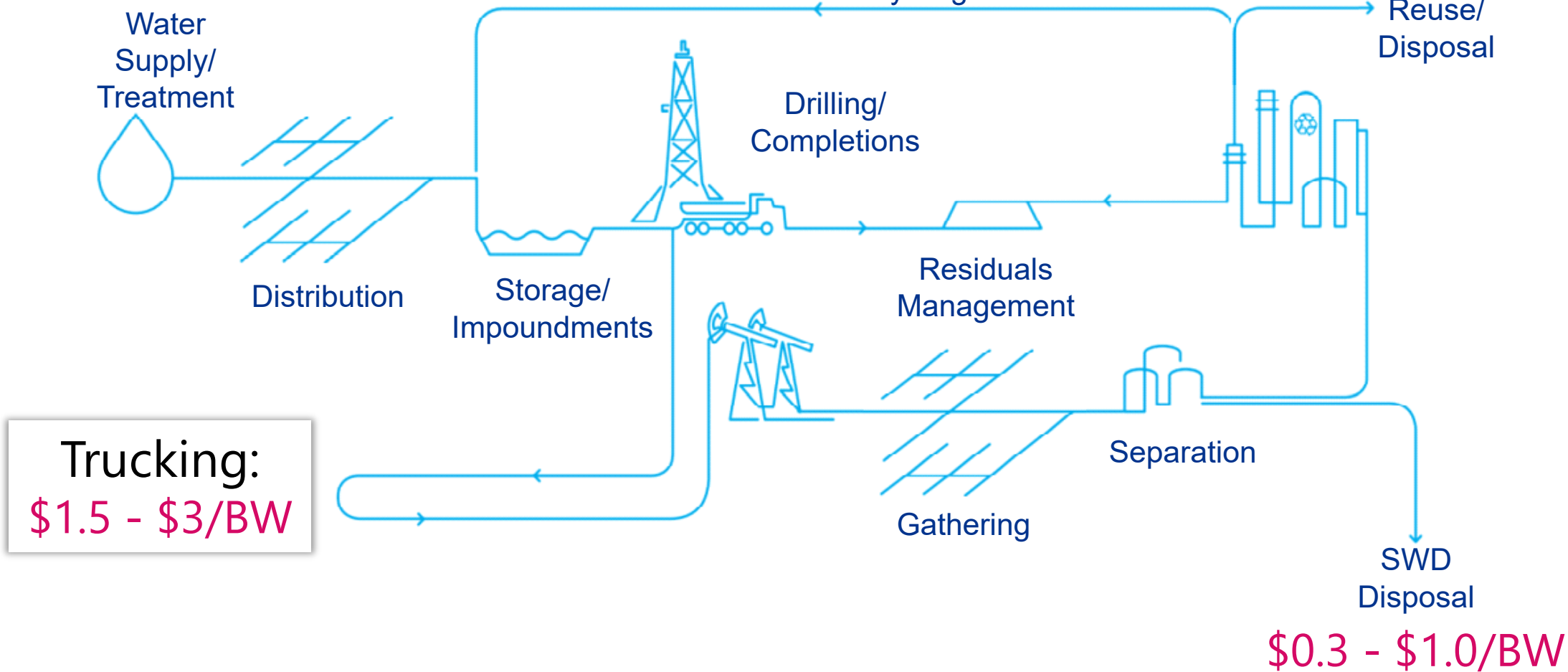
Water costs with reuse



What is the cost?

\$0.4 - \$1.0/BW

\$0.2 - \$0.8/BW



Trucking:
\$1.5 - \$3/BW

Challenges of Produced Water Management (Old List)



Adapting to State Regulatory Frameworks



Transport



Storage



Underground Injection



Treatment



Spill Management & Mitigation



Treatment Residual Management



Air Emissions



Wildlife Protection

Source: [GWPC Produced Water Report](#)

Challenges of produced water management (Since March)

- Corporate and water CapEx funding
- Short term thinking
- Pressure about sustainability from investors

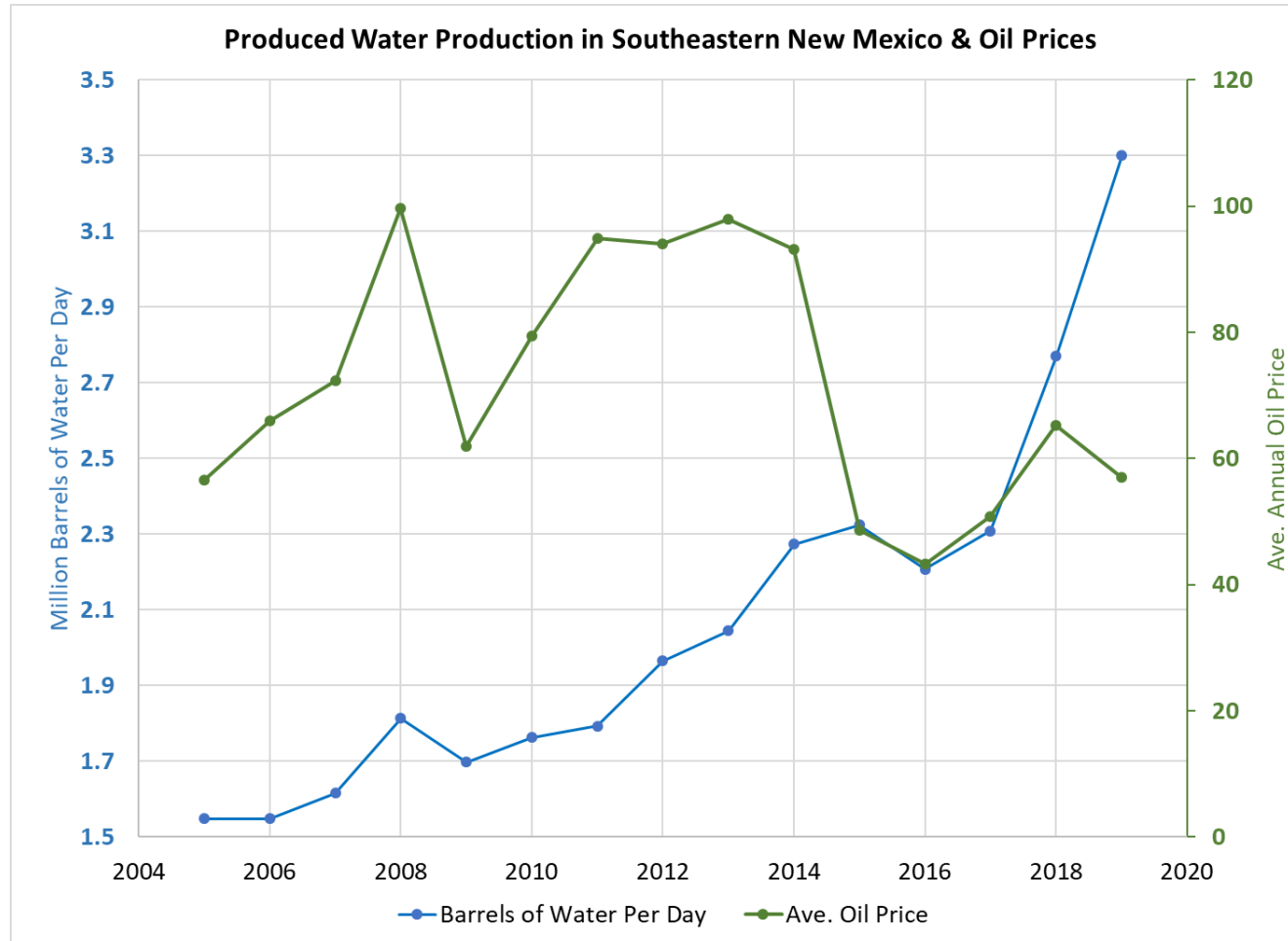
Looking ahead:

- Disposal formation limitations
- Company owned vs. commercial regulations



Produced water disposal in New Mexico

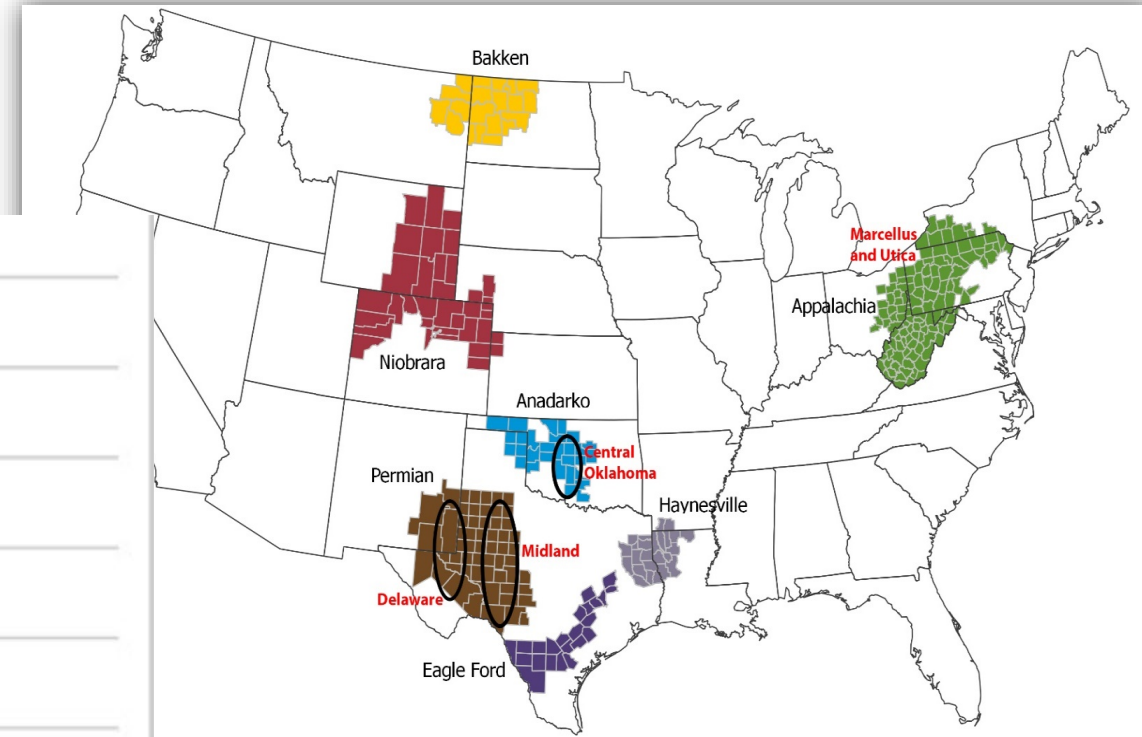
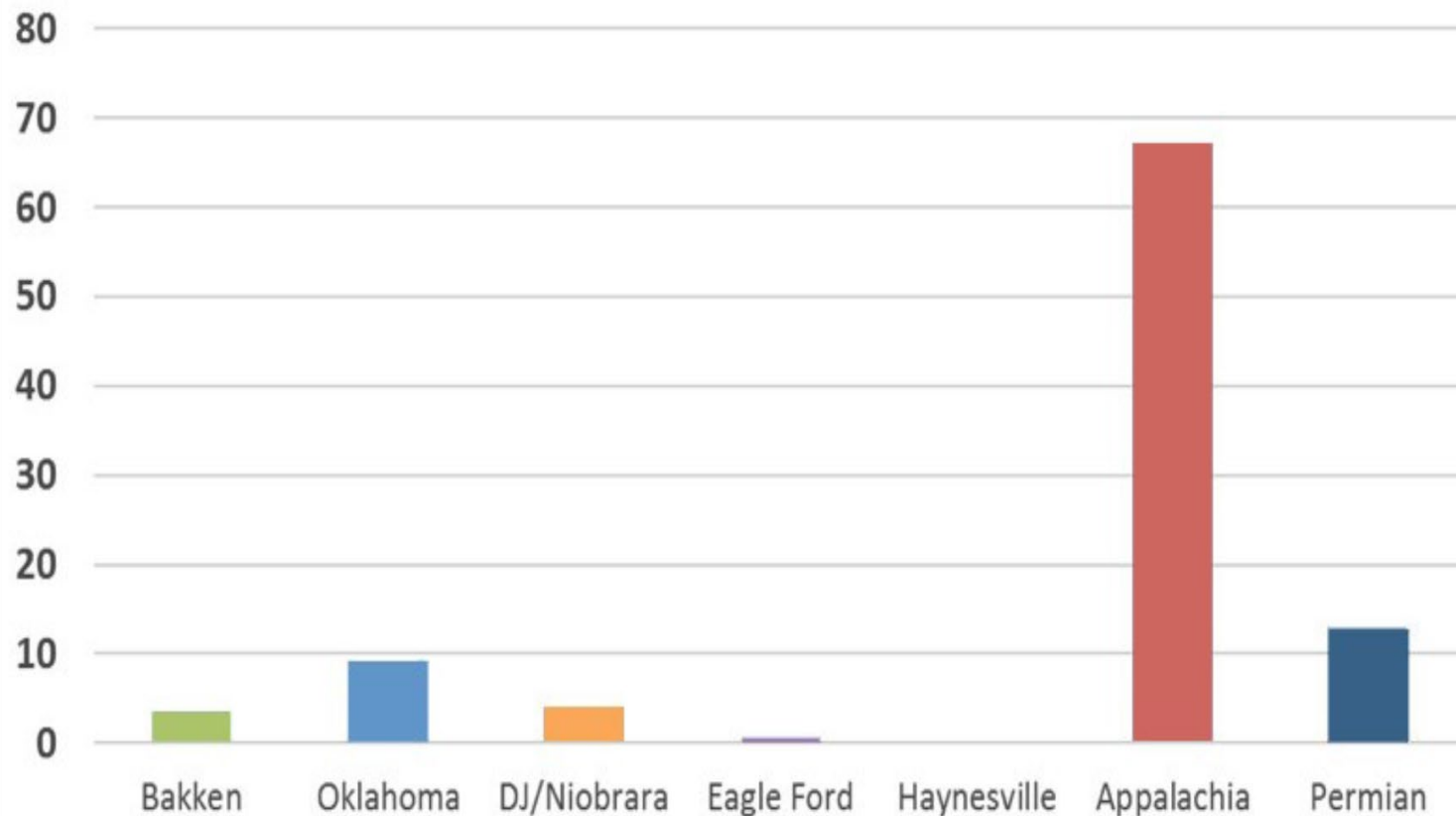
Water production increased in 2018 & 2019 in spite of much lower prices than before 2014



Source: PW Data from the New Mexico Oil Conservation Division

Regional Differences in Produced Water Management & Reuse

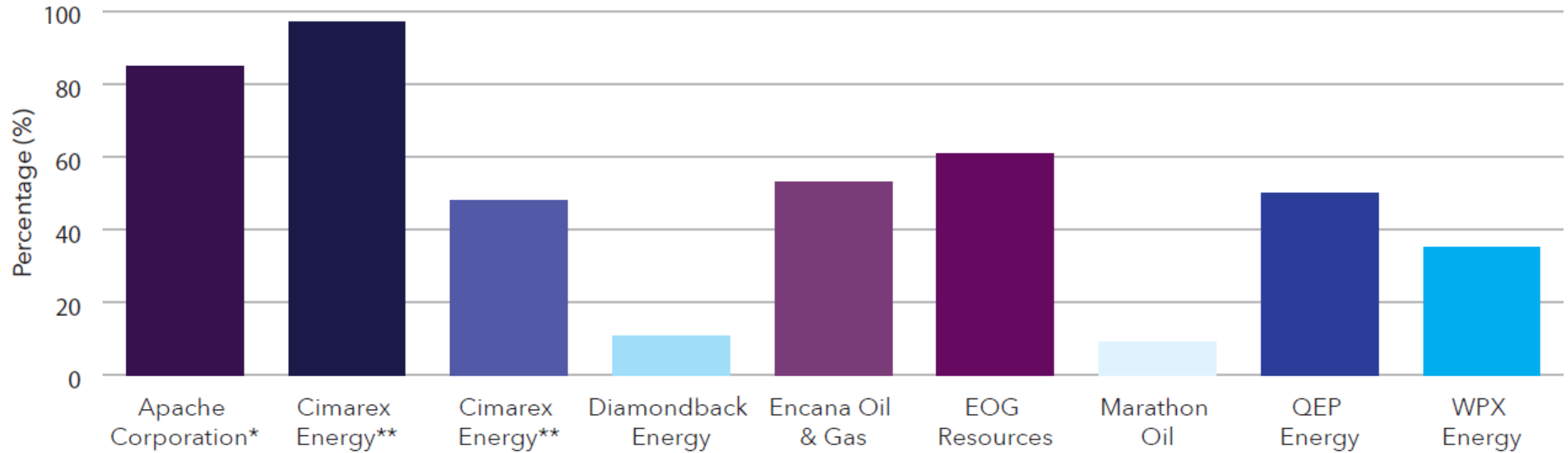
Percent Reuse in 2017



Source: [GWPC Produced Water Report](#)

Permian reuse increasing

Share of frac water demand met through recycled volumes for select Permian Basin producers (2018)



*In Alpine High

** In Culberson Wolfcamp

*** In Reeves Wolfcamp

Source: GWI interviews, company investor presentations and reports

Source: GWI

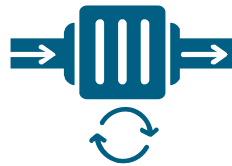
Trends in water management

(Before oil price crash)



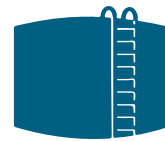
Sourcing

- ↓ Fresh
- ↑ Brackish
- ↑ Reuse



Treatment

- Mobile unit
- Fixed plant
- Wellsite bacteria



Storage

- ↓ Frac tanks
- ↑ Ponds
- ↑ Above ground storage tanks



Transport

- ↓ Trucking
- ↑ Permanent pipelines
- ↑ Temporary lines



Disposal

- ↑ Saltwater disposal wells
- ↑ Reuse in new frac wells
- Reuse outside O&G

Source: [GWPC Produced Water Report](#)

Trends in water management

(Since March)



- Lower rig count > less source water needed > lower reuse volumes
- Extreme cost focus
- Fewer new water pipelines and SWDs
- Consolidation of companies and water systems

Key Issues for Oil & Gas Regulators & Water Management

- Disposal formation pressure
- Permit by producer vs. Permit for Water Midstream (commercial permit)
- Timeliness of permits for impoundments and SWDs
- Liability for spills when water transferred to commercial & liability for ownership of produced water
- Seismicity



Regulatory & Policy Initiatives to Facilitate Reuse



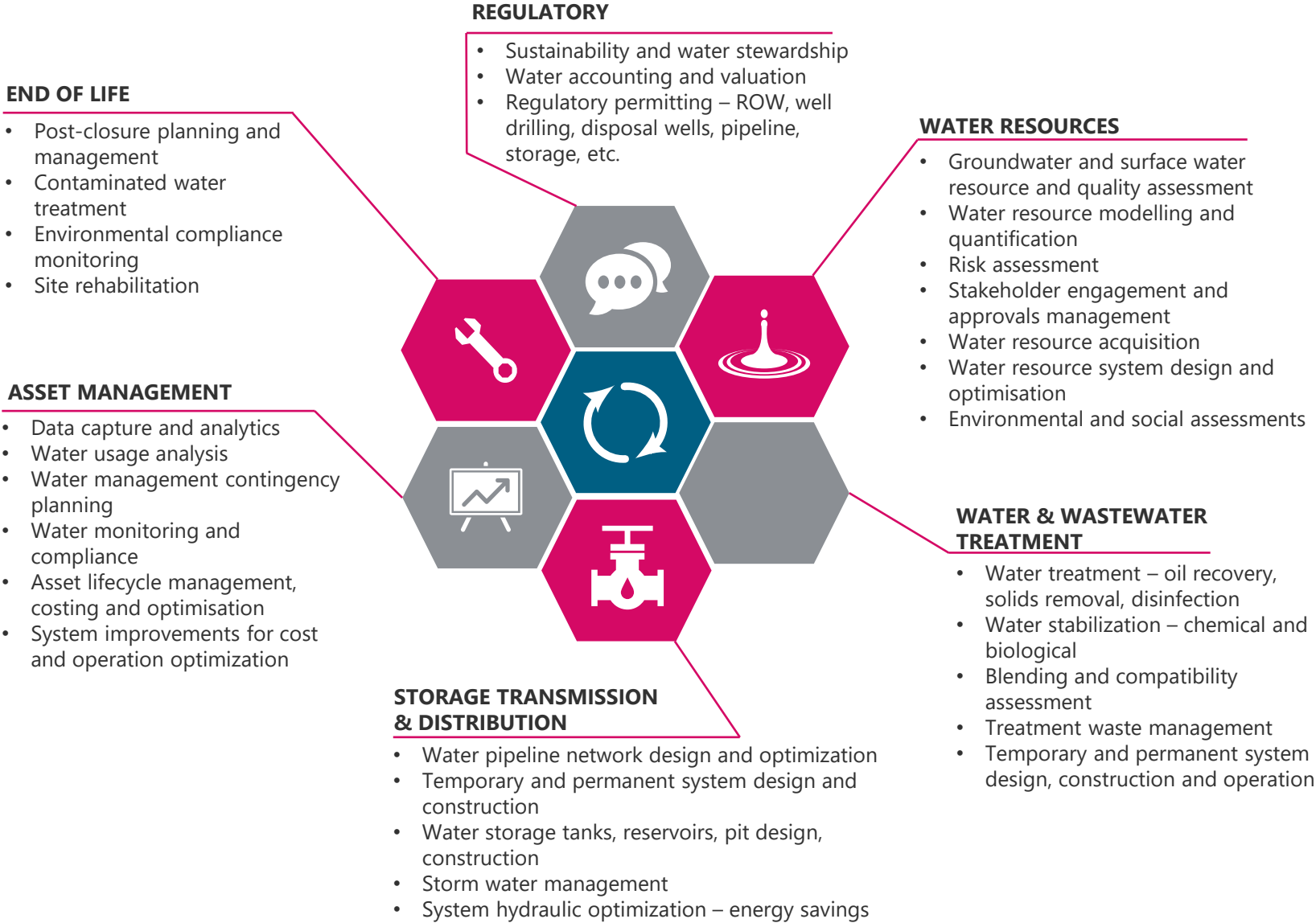
- Tracking water transfers
- Commercial designation
- Storage
- Temporary lay-flat lines
- Right-of-way on county roads
- Clarity of regulations
- Incentives
- Produced water ownership

Oil & gas water reuse: The big picture

- Prices, rig count and reuse will recover
- Disposal formation limits and more commercial systems
- More connectivity of water systems will promote reuse
- Reuse: Increasingly economically viable



Advisian's water and environmental capabilities





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Michael.Dunkel@Advisian.com or 469-585-6468.

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