# Interstate Oil & Gas Compact Commission

# *Welcome*

Annual Conference

October 2-4, 2016

Energy Resources, Research and Technology Committee

Chair: Tom Williams

INTERSTATE
Oil & Gas
COMPACT COMMISSION

# Items covered in the discussion

- IOGCC Marginal Well Report
- Review of the IOGCC Mid Year Meeting
- EOR technologies and opportunities for C02 sequestration
- Access issues
- Recommendations

INTERSTATE
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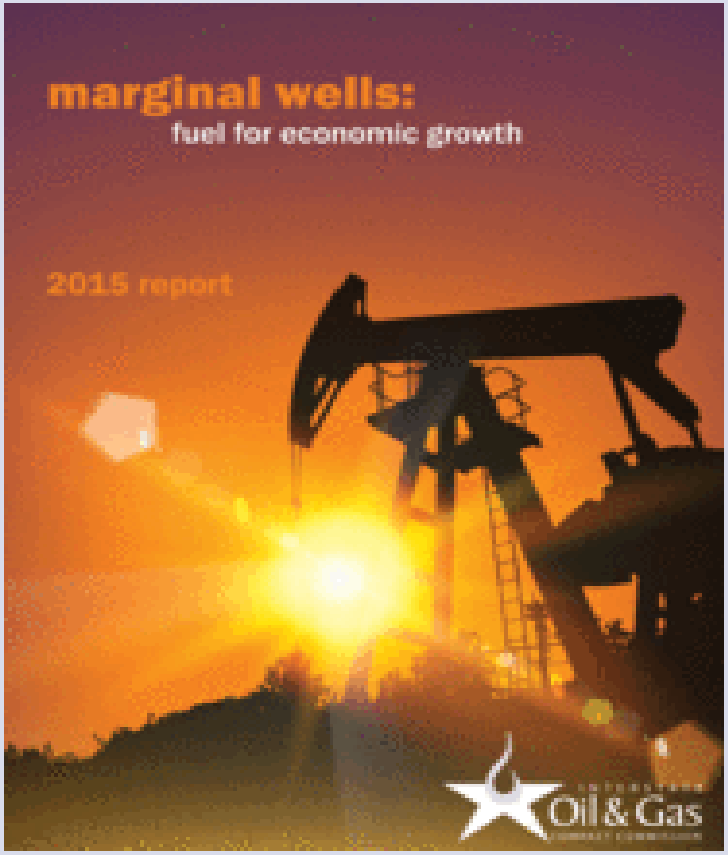
# IOGCC 2015 Marginal Well Report

IOGCC marginal Survey 1992-2015

- Base production >12% of oil and > 7% gas production, 57,000 direct jobs (+ x 3). $4.4 billion in direct earnings.
- 72.2% of all US wells, modest change in numbers y/y, 408,000 oil and 377,000 gas wells.
- Production and reserves threatened by price and costs.



# Definitions
# Marginal Well/Stripper Well

- IOGCC Report: 10Bbl Oil, 60 MCF Gas
- NSWA, IPAA, NPC 1994 Report definition: 15 Bbl oil, 90 mcf Gas. (higher for heavy oil)
- Incentives vary by State and Federal regulations + (26 US Code 613 percentage depletion allowance)
- Tom's definition: can't afford to produce. Threat of field prematurely abandoned thus losing access to recoverable reserves. (also see TX Adm. Code Title 16 part 1)
- For incentives – need to use the NPC definition

# Mid Year Business Meeting

**Ed Cross**, President, Kansas Independent Oil & Gas Association
"State of the Oil & Gas Industry ~ Dynamic Challenges Facing Marginal Well Producers"

**Vello Kuuskraa**, President, Advanced Resource International, Inc.
"Mature, Marginal Oil Wells: A Key Resource for C02 Enhanced Oil Recovery"

**Stephen Melzer**, President Melzer Consulting,
"EOR / IOR Technologies and Technology Transfer"

**Greg Schnacke**, Governmental Relations, Denbury Resources Inc.
"Opportunities & Barriers to Protecting, Preserving & Enhancing Legacy Oilfields"

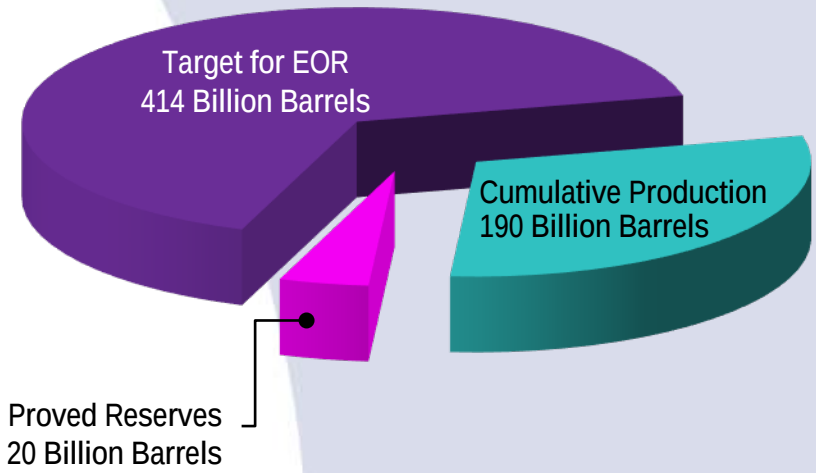
# Ed Cross: Kansas Oil & Natural Gas Dynamics

- Average Daily Oil Well Production = 3.2 BOPD
  - 72% of Kansas crude oil production from marginal wells
  - 94% of total Kansas oil wells are classified as marginal wells
- Average Daily Natural Gas Production = 41 McF
  - 74% of Kansas natural gas production from marginal wells
  - 81% of Kansas natural gas wells are classified as marginal wells
- Supports 118,000 Kansas jobs and $3 billion in family income

# Large Volumes of Oil Remain "Stranded" in Discovered Conventional U.S. Oil Fields

Original Oil In-Place: 624 B Barrels

Remaining Oil In-Place: 414 B Barrels




*Does not include "tight" oil production or reserves.
Source: Advanced Resources International analyses, 2015.

**Traditional primary recovery and waterflooding have recovered only about a 1/3 oil in-place in discovered conventional U.S. oil fields, leaving behind a target of over 400 billion barrels.**

EOR technology can be used to recover this "stranded" oil is miscible/immiscible $CO_2$ injection.

**However, these mature oil fields and their marginal wells need to remain available for effective application of $CO_2$-EOR.**

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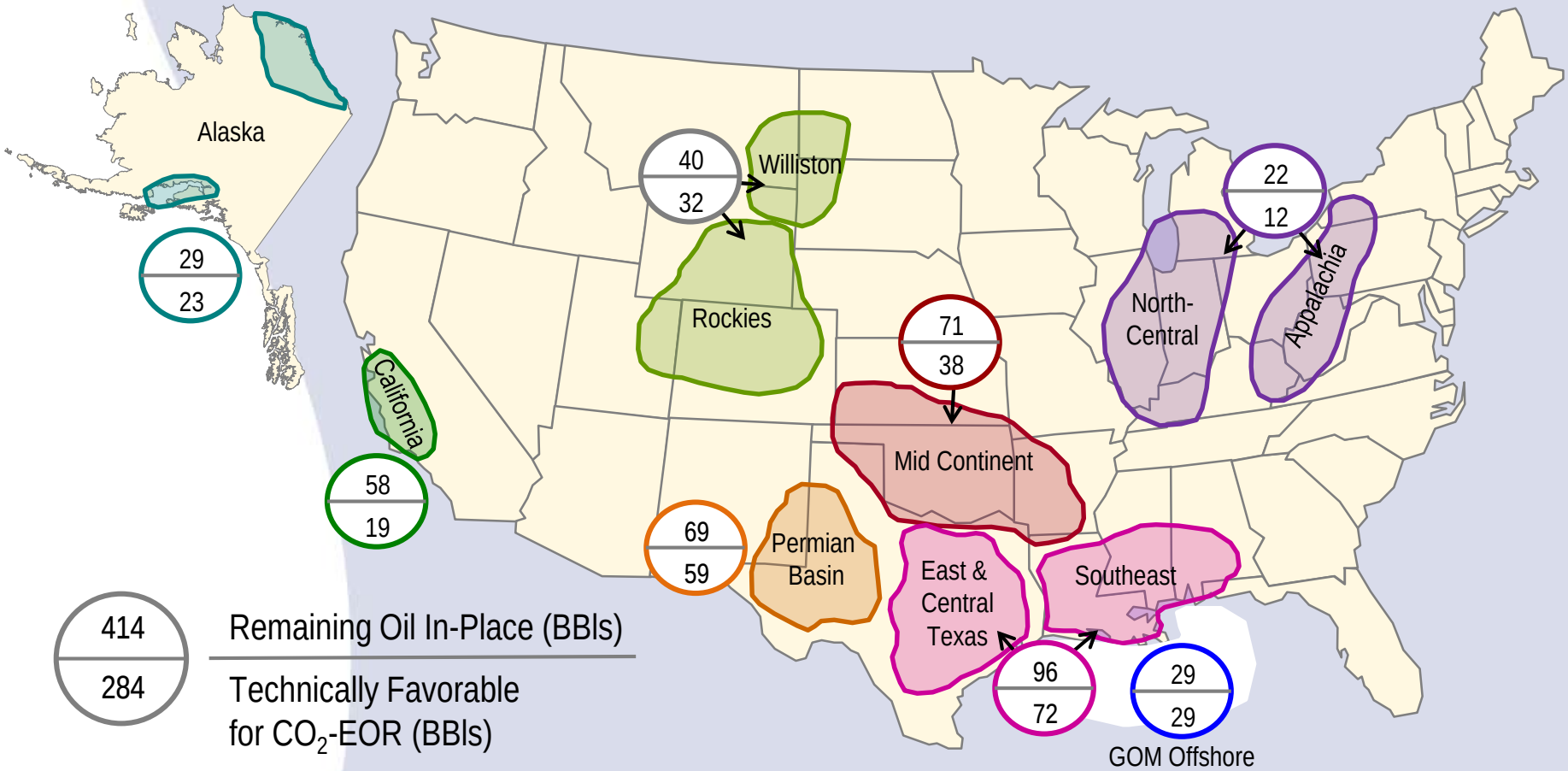
# The Regional $CO_2$-EOR Targets

**Of the 414 B barrels of remaining oil in-place, 284 B barrels is technically favorable for $CO_2$-EOR.** Much of oil resource is in the Permian Basin, Gulf Coast, the Mid-Continent and East/Central Texas.



# Advances in $CO_2$-EOR Recovery Technologies

**Recovering more of the oil "left behind" after industry's and nature's waterfloods rests on successful development and integrated application of four "next generation" $CO_2$–EOR technologies:**

1. Improved reservoir conformance to reduce unproductive channeling of $CO_2$ through high permeability flow paths.
2. Advanced $CO_2$ flood designs to target the high remaining oil saturation reservoir segments bypassed, or poorly swept, by the waterflood.
3. Enhanced mobility control to reduce viscous fingering and to improve the mobility ratio.
4. Development and use of fluids and chemicals that reduce the $CO_2$/oil minimum miscibility pressure (MMP).

Application of these technologies would benefit greatly from the design of "smart wells" and real-time feedback of information from the reservoir.

# Melzer Presentation:

**Studies co-funded by DOE and RPSEA.**

**1994 the National Petroleum Council (NPC) Marginal Well Study**

**NPC 2011 Report - Prudent Development of North American Oil and Gas Resources**

Residual oil zones, called ROZs,

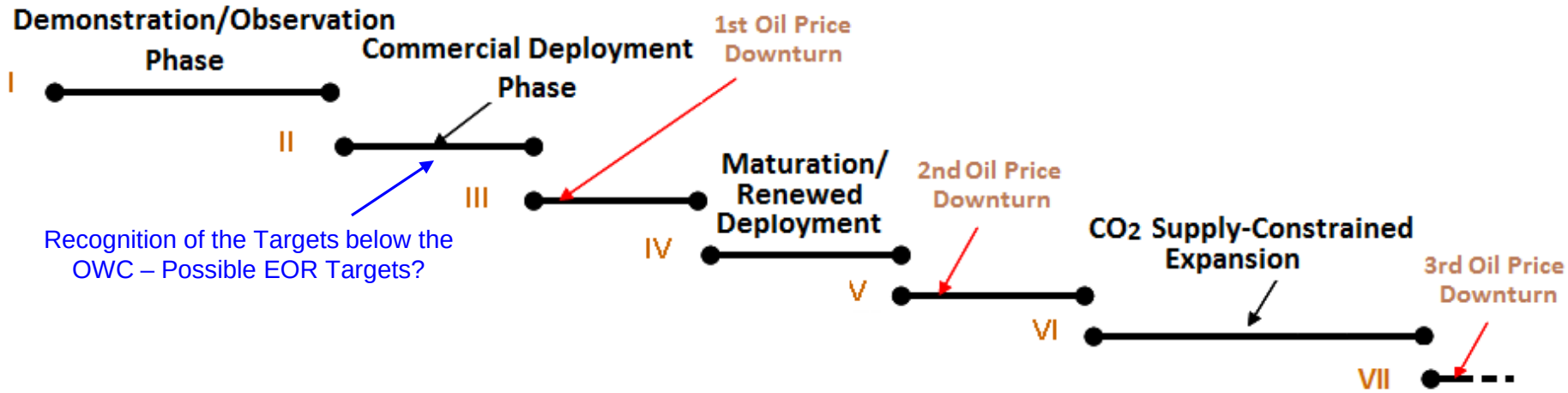
Areas of immobile oil found below the oil-water contact of a reservoir. ROZs are similar to reservoirs in the mature stage of "waterflooding," in which water has been injected into a formation to sweep oil toward a production well.

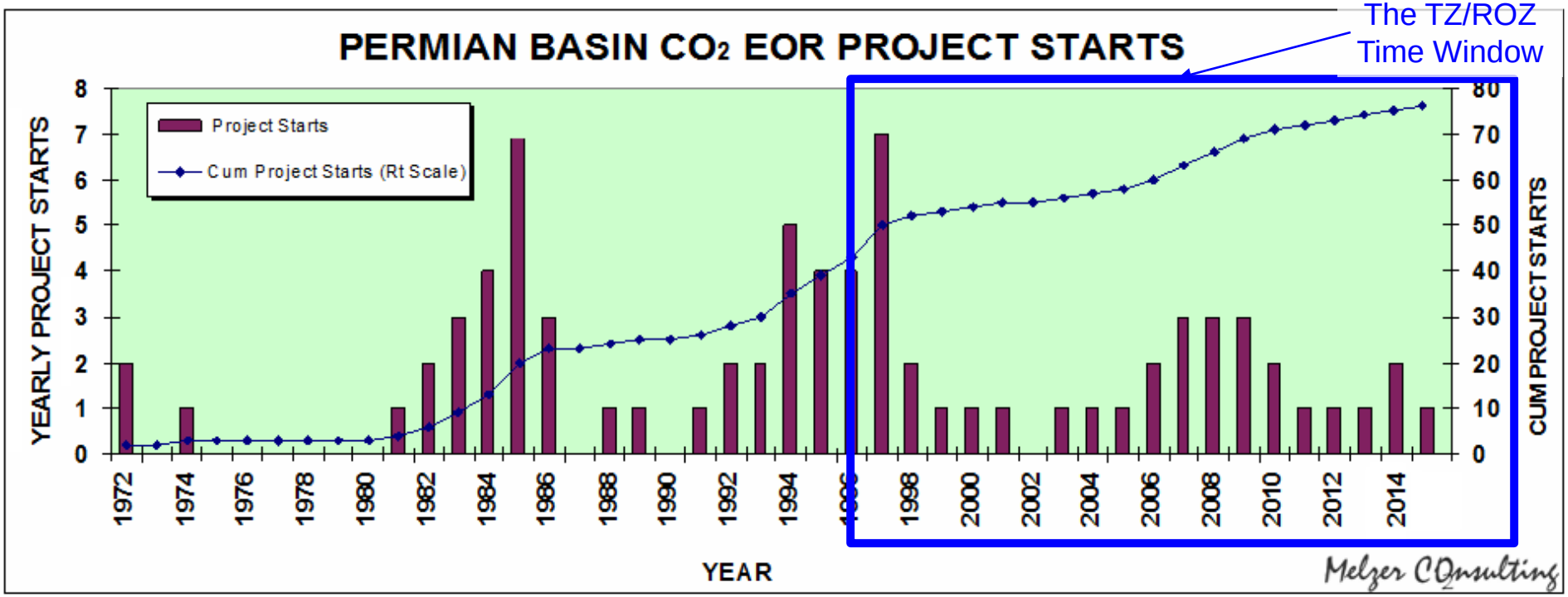
$CO_2$ flooding is the only (currently) demonstrated recovery technology for ROZs

http://residualoilzones.com/featured-interview-rpsea/

# $CO_2$ EOR History

## The Phases of $CO_2$ Enhanced Oil Recovery



# ROZ Milestones

| | |
|---|---|
| **2006** | ARI Estimates the Size of the Oil Resource Beneath 48 Major Oilfields (San Andres Fm in the Permian Basin) – 31 Billion Bbls |
| **2008-2011** | First RPSEA Study (UTPB) Hydrologically Modeling the Lateral Sweep and Introducing "Fairways" Concept of ROZ (Greenfields) without an Overlying MPZ |
| **2009-2014** | Industry Expands ROZ Projects (Now 15 including a Pure Greenfield Project) |
| **2012-2015** | 2nd RPSEA Study (UTPB, ARI, Arcadis) Mapping the Extent of PB ROZs (191 Billion Bbls in 12 Key PB Counties), Publishing a ROZ 'Cookbook' Designed to Help Find and Exploit ROZs and Looking for ROZs Outside of the PB |
| **2014** | ROZ Research Leads to Understanding Horizontal Well Depressuring the Upper ROZ (DUROZ) Play |

# Summary: Access needed, coupled with technology applied to increasing production in conventional and marginal wells

- Marginal wells produce more oil than we import from the middle east
- Conventional/marginal wells provide access to twice as much oil as we have produced
- Challenge: Independents do not have the resources to conduct R&D.
- RD&D can help reduce all OPEX cost (including regulatory compliance)
- Access to technology:  tools to make informed decisions
  - Mesh academia, operators, service providers – ability to leverage funding from government and industry.
  - Technology Transfer - Network to share best practices

# Stakeholders

- Operators (large and small)
- Landowners
- States
- State Regulators
- C02 Providers
- Fed Government (DOE, BLM and BIA)
- Public/Community

# Working Group Recommendation

IOGCC support efforts to increase production from marginal/conventional in an environmentally responsible manner.

- **Support organizations which develop or disseminate technologies**
- **Investments in R&D, tax incentives, reasonable regulations.**
- **Support efforts which lead to regulatory certainty**
- **Avoid rules which incent premature abandonment of mature fields**