



# The Path to Green Enhanced Oil Recovery

[www.zencortools.com](http://www.zencortools.com)

February 2024



# Key Concepts of Elastic Wave EOR

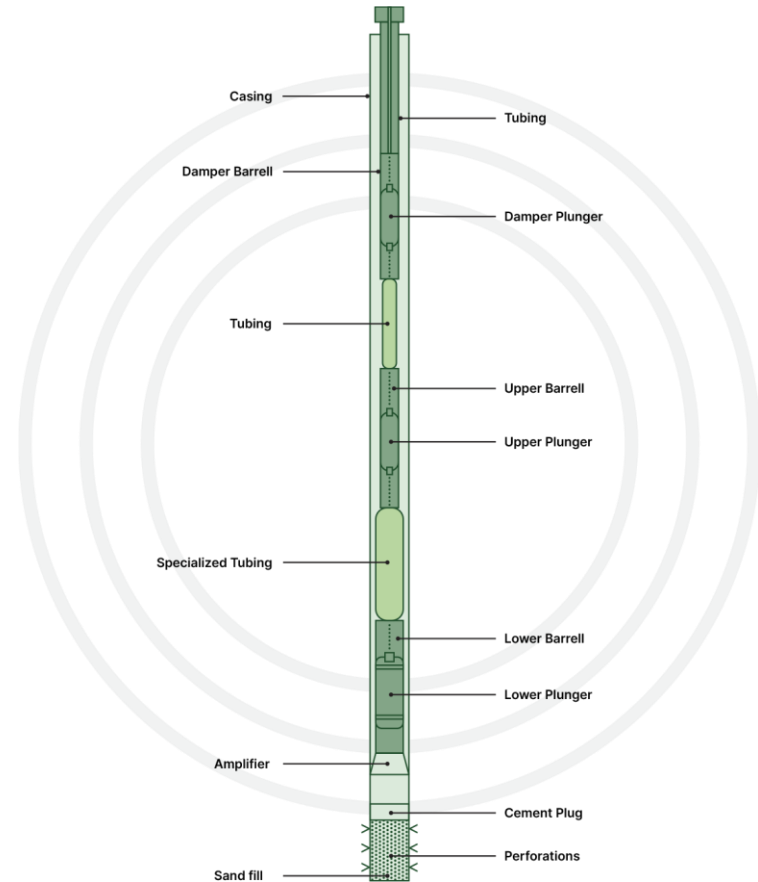
- Tool Creates and Releases High Energy Elastic Waves
- Waves Pass through Fault Blocks and Vertical Zones Mobilizing Virgin Oil
- A Single Tool Enhances Oil Recovery up to a 1.4 Mile Radius
- Simple Tool Installation
- Fully Warrantied Maintenance for Life of Tool\*
- Installation Well has Cement Plug that Provides Isolation to the Reservoir
- Installation Well is Sealed at Surface Providing Isolation to the Environment
- Zero Environmental Impact

*\* certain conditions apply*



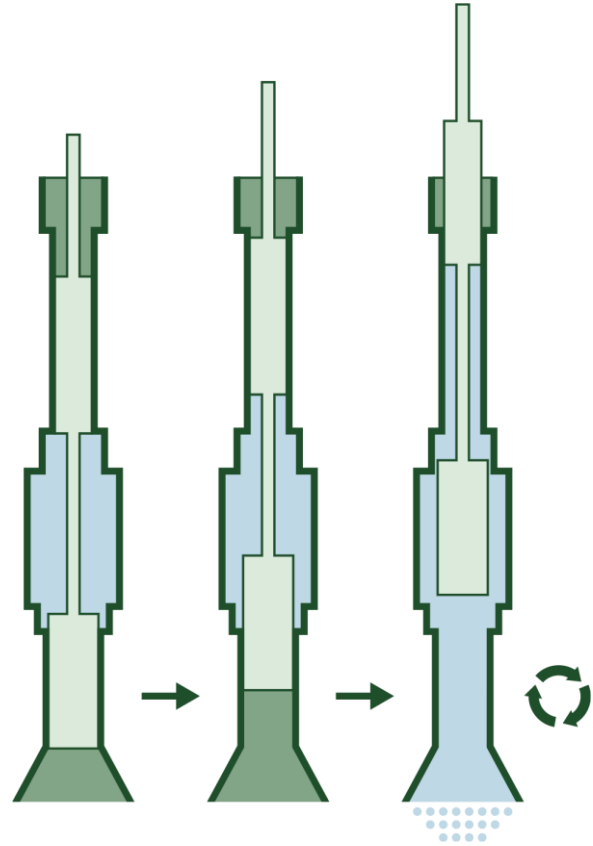
# Installation & Operation

- Tool Assembled in Less than 3 Hours
- Run on Tubing to Target Depth
- Sucker Rods Connect Tool to Pumping Unit
- Tool is then Commissioned to Start

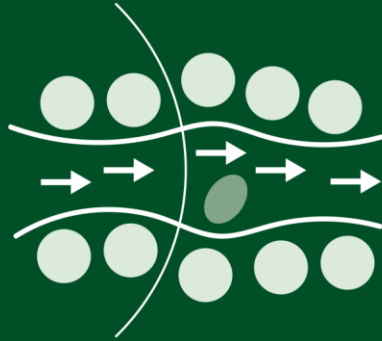


# How it works

- Two Plungers of Dissimilar Size
- Larger, Lower Plunger with Traveling Valve
- Smaller, Upper Plunger Blocked off, Remaining in the Barrel throughout the Cycle, acting as a Seal
- Lower Plunger Lifts more Fluid than Upper Plunger can Evacuate
- Pressure Builds up between the two Plungers
- Lower Plunger Exits Lower Barrel
- High Energy Elastic Waves are Released in Milliseconds
- Cycle Repeats at 6 Strokes/Min Creating a High Energy Elastic Wave each 10 Seconds
- Each Elastic Wave generates 2 Megawatts of Power



# Pore Level Mechanisms



Elastic Wave Creates  
Movement of Oil Droplet



Elastic Wave Creates  
Coalescence of Oil Films  
Adhered to Formation Grains

# Application - Formation Types

- Carbonates – Permian Basin and Middle East
- Sandstones – United States, North Africa, Mexico, and Canada
- Field Types – Waterfloods and Non-waterfloods
- Criteria –
  - Presence of Bypassed Oil
  - $API > 13$
  - $GOR < 2,000 \text{ Scf/STB}$  at Reservoir Conditions
  - Reservoir Heterogeneity

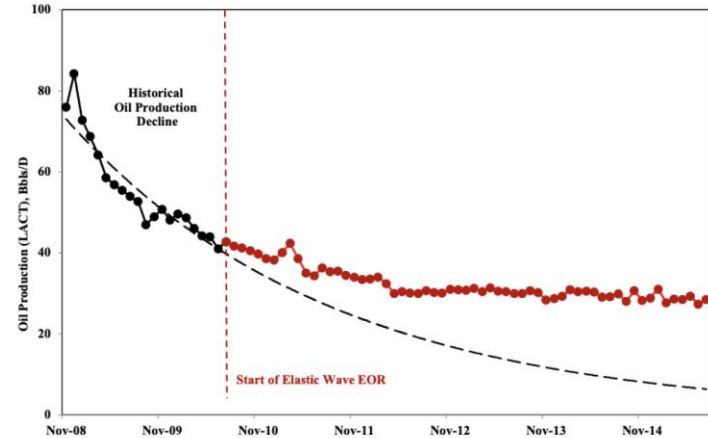




# Carbonate Focus

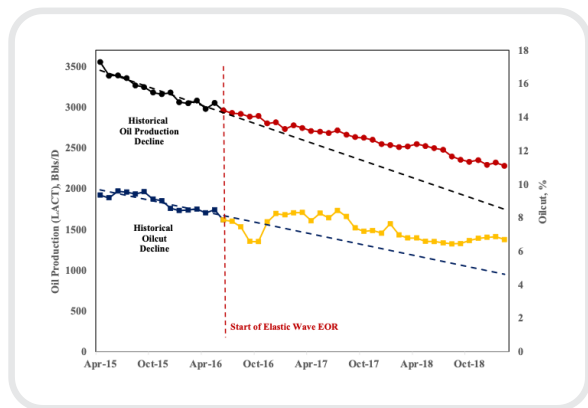
# Clearfork Carbonate (non-waterflood)

Historical Oil Decline Rate	40 %
Oil Decline Rate under Elastic Wave EOR	10 %
Increase in Oil Production	280 %

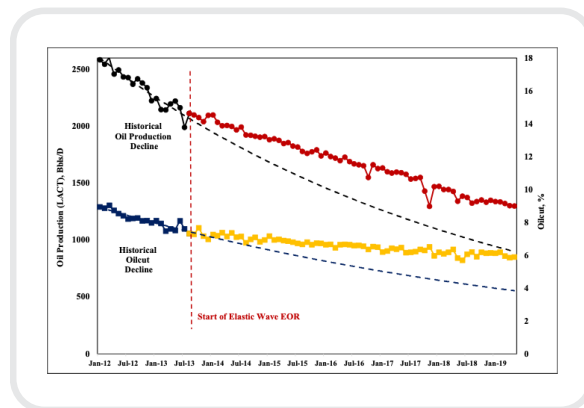




# Clearfork Carbonates (waterflood)

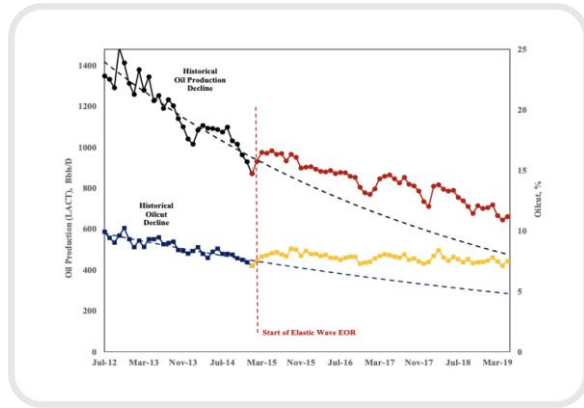


Historical Oil Decline Rate	18 %
Oil Decline Rate under Elastic Wave EOR	7 %
Historical Oilcut Decline Rate	20 %
Oilcut Decline Rate under Elastic Wave EOR	9 %
Oil Production Increase under Elastic Wave EOR	480 B/D (28 %)
Elastic Wave Enhanced Oil Recovered	243,000 Bbls
Severance Tax Credits	\$3.2 Million

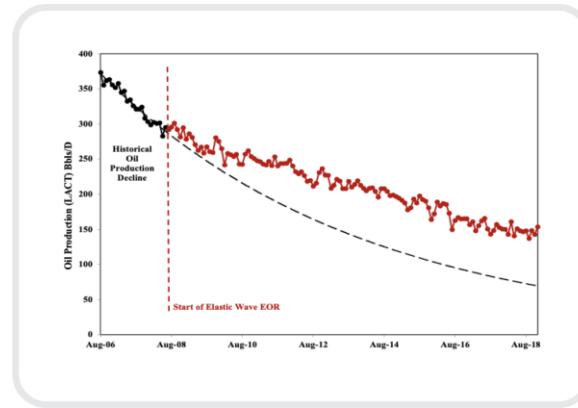


Historical Oil Decline Rate	15 %
Oil Decline Rate under Elastic Wave EOR	8 %
Historical Oilcut Decline Rate	9 %
Oilcut Decline Rate under Elastic Wave EOR	3 %
Oil Production Increase under Elastic Wave EOR	400 B/D (44 %)
Elastic Wave Enhanced Oil Recovered	495,000 Bbls
Severance Tax Credits	\$6.4 Million

# San Andres Carbonates (waterflood)



Historical Oil Decline Rate	14 %
Oil Decline Rate under Elastic Wave EOR	7 %
Historical Oilcut Decline Rate	13 %
Oilcut Decline Rate under Elastic Wave EOR	2 %
Oil Production Increase under Elastic Wave EOR	215 B/D (45 %)
Elastic Wave Enhanced Oil Recovered	245,000 Bbls
Severance Tax Credits	\$3.3 Million

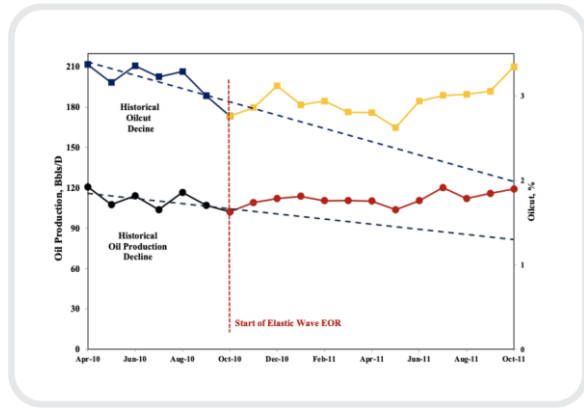


Historical Oil Decline Rate	13 %
Oil Decline Rate under Elastic Wave EOR	9 %
Oil Production Increase under Elastic Wave EOR	73 B/D (100%)
Elastic Wave Enhanced Oil Recovered	250,000 Bbls
Severance Tax Credits	\$1.9 Million



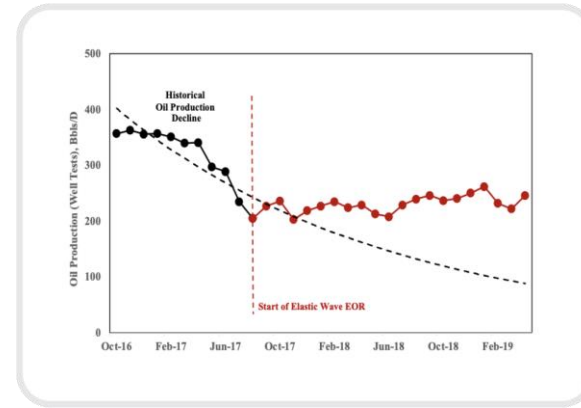
# **Sandstone Focus**

# Conventional Sandstones (waterflood)



## Strawn Sandstone

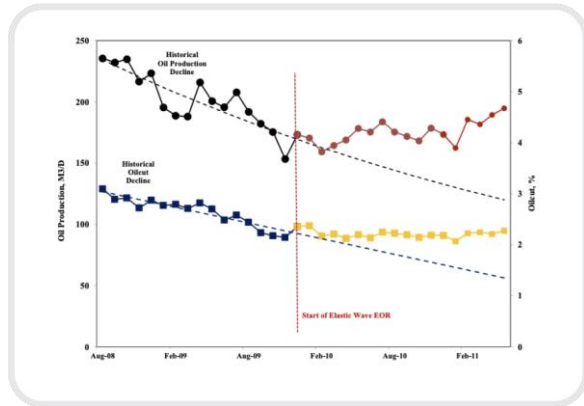
Historical Oil Decline Rate	35 %
Oil <b>INCLINE</b> Rate under Elastic Wave EOR	13 %
Historical Oilcut Decline Rate	20 %
Oilcut <b>INCLINE</b> Rate under Elastic Wave EOR	9 %
Oil Production Increase under Elastic Wave EOR	35 B/D (41 %)
Elastic Wave Enhanced Oil Recovered	7,000 Bbls



## Canyon Sandstone

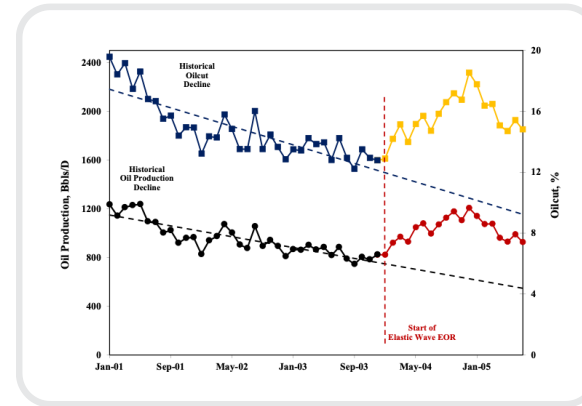
Historical Oil Decline Rate	46 %
Oil <b>INCLINE</b> Rate under Elastic Wave EOR	8 %
Oil Production Increase under Elastic Wave EOR	155 B/D (175 %)
Elastic Wave Enhanced Oil Recovered	44,000 Bbls

# Unconsolidated Sandstones (waterflood)



## Mahwis/AI Khalata Formations

Historical Oil Decline Rate	24 %
Oil <b>INCLINE</b> Rate under Elastic Wave EOR	5 %
Historical Oilcut Decline Rate	26 %
Oilcut <b>INCLINE</b> Rate under Elastic Wave EOR	4 %
Oil Production Increase under Elastic Wave EOR	380 B/D (48 %)
Elastic Wave Enhanced Oil Recovered	100,000 Bbls



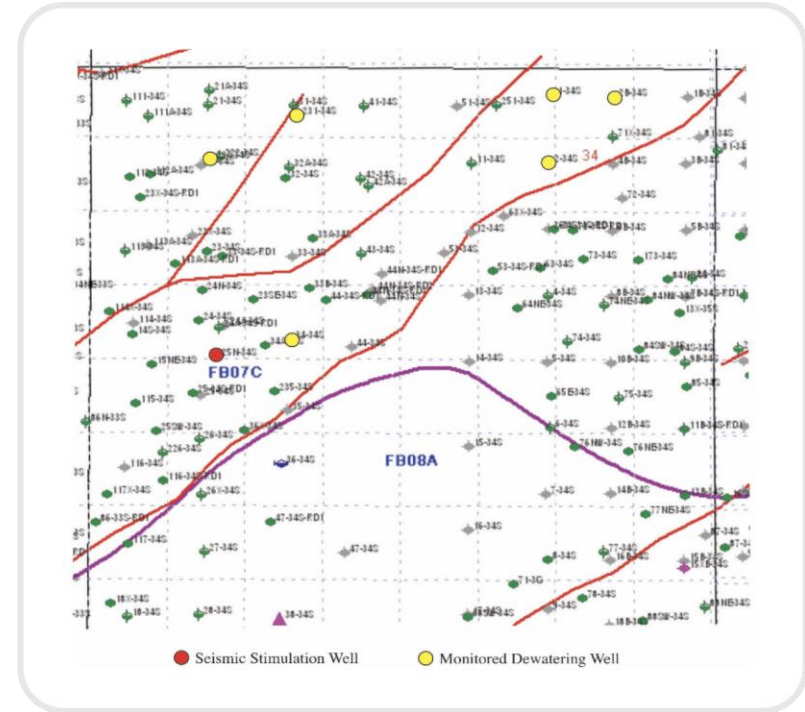
## Stevens Sandstone

Historical Oil Decline Rate	17 %
Oil <b>INCLINE</b> Rate under Elastic Wave EOR	12 %
Historical Oilcut Decline Rate	14 %
Oilcut <b>INCLINE</b> Rate under Elastic Wave EOR	25 %
Oil Production Increase under Elastic Wave EOR	560 B/D (85 %)
Elastic Wave Enhanced Oil Recovered	240,000 Bbls

# **Stimulation Across Flow Barriers**

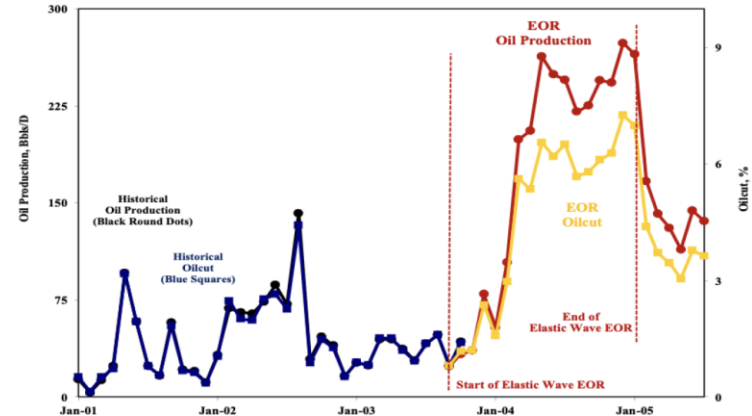
# Elastic Wave EOR through Fault Blocks (Horizontal Flow Barriers)

- Purpose of Study is in Two Parts:
  - 1) Determine if Elastic Wave EOR will Mobilize Oil in a Completely Watered Out Field
  - 2) Will Elastic Waves Cross Fault Blocks to Affect EOR
- Red lines Represent Fault Lines
- Strong Water Influx from Northeast to Southwest
- Pilot Monitored Dewatering Wells Located Across Fault Lines



# Results: Elastic Wave EOR through Horizontal Flow Barriers

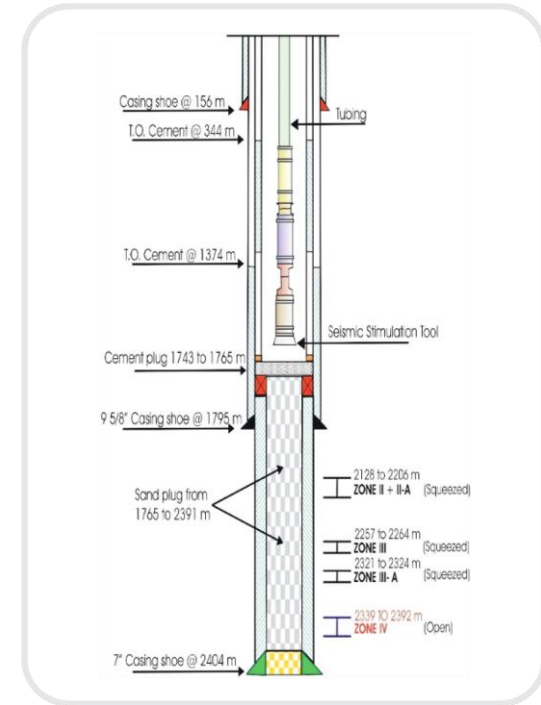
Historical Avg Oil Production	46 B/D
Oil Production Peak Avg under Elastic Wave EOR	243 B/D (580 %)
Historical Avg Oilcut	1.4 %
Oilcut Peak Avg under Elastic Wave EOR	6.8 % (450 %)





# Elastic Wave EOR through Separate Zones (Vertical Flow Barriers)

- Purpose of Study is to Determine if Elastic Wave EOR will Mobilize Oil in Vertically Separated Zones with no Crossflow
- EOR Source Well is Open to the Reservoir through a Single Zone, Zone IV
- Elastic Waves can only Enter the Reservoir through Zone IV
- Monitoring Wells are Offset Production Wells Completed into Single Zones
- Results will Clearly show if Elastic Waves can Affect EOR Across Vertical Flow Barriers



# Results: Elastic Wave EOR through Vertical Flow Barriers

Monitoring Well Name	Zone(s)	Historical		Elastic Wave EOR		
		Oilcut %	Oil Rate m3/D	Oilcut %	Oil Rate m3/D	Increase m3/D
8	II, II-A	15	30	20	50	20
80H	II-A	20	30	63	80	50
81H	II	23	35	29	49	14
95	V	10	55	44	110	55
125	V	20	23	71	84	61
72	IV, V	30	35	33	40	5

Summary - Elastic Waves Mobilized By-Passed Oil in a all 6 Zones that are Vertically Separated

Increase in Oil Production: 203 m3/D (1,200 Bbls/D)

Increase in Oilcut: Average of 19 % to 43 %



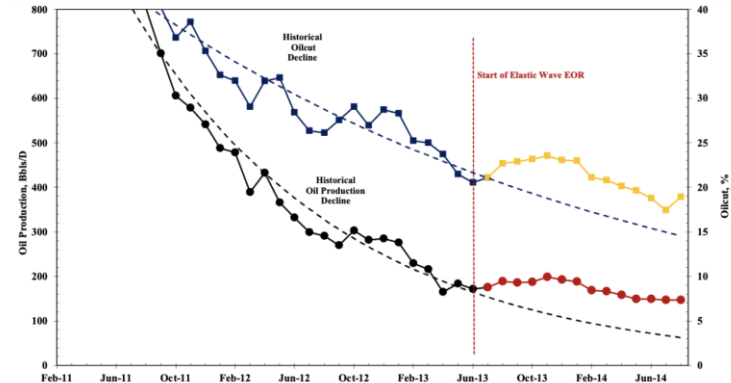
# Shale Focus

# Shale

## Shale Field Characteristics

- Field permeability too low to waterflood, averaging < 0.01 mD
- Northeastern Williston Basin Oilfield
- Tool power 1/5th of Current Version

Historical Oil Decline Rate	53 %
Oil Decline Rate under Elastic Wave EOR	22 %
Historical Oilcut Decline Rate	30 %
Oilcut Decline Rate under Elastic Wave EOR	18 %
Oil Production Increase under Elastic Wave EOR	100 B/D (125 %)
Elastic Wave Enhanced Oil Recovered	28,000 Bbls



# Compelling Economics

# Compelling Economics - Texas - TRRC Certified Tertiary EOR Technology\*

## Field Requirements (A Single Tool Covers up to a 1.4-Mile Radius)

- GOR < 2,000 Scf/STB at reservoir conditions
- API Gravity > 13
- Reservoir heterogeneity

## Zencor Provides

- Tool and Ancillary Parts at No Upfront Cost to the Operator
- Free Use of the Tool from Installation and through the time period from filing of the H-12 to Approval of the H-13\*\*
- On-site Supervision During Installation of the Tool at no Cost to the Operator

## Cash Flow (for a field of 300 Bbls/D pre EOR within a 1.4-mile radius)

(at a 10 Percent Increase in Oil Production via EOR, using an Oil Price of \$70/Bbl)

Minimum increase in oil sales revenue via EOR	\$63,000/Month
Minimum Severance Tax Credit (at 2.25% of Total Revenue)	\$15,600/Month
Lease of Tool	(\$7,500/Month)
<b>Net Gain via EOR</b>	<b><u>\$71,100/Month</u></b>

\*At the open meeting of the Texas Railroad Commission on November 23rd, 2007, Commissioners Williams, Carrillo and Matthews unanimously approved the application of Occidental Permian Ltd. to have Zencor Tools (formerly ASR) elastic wave stimulation technology officially recognized by the state as an Enhanced Oil Recovery technique, pursuant to Statewide Rule 50, on its Wasson South Clearfork Unit in Gaines County. The TRRC has subsequently approved all other successful applications submitted by our company.

\*\*Pilot terms continue until H-13 submission is ruled on. Once ruling is published, the Operator pays the monthly Lease of \$7,500 in arrears from first Installation, in addition to a one-time fee of \$27,500 (part paying the cost of the stimulation tool, ancillary parts and installation). An ongoing Lease of \$7,500/Month is paid thereafter. Zencor monitors Tool and field performance and repairs the Tool as needed, at its expense. The \$7,500/Month Lease is the Only Continuing Cost to the Operator. The Lease is a year-to-year obligation, with a 90-day cancellation notice.

# Patents

## United States

Suite of 9 patents granted

## Foreign Granted and Pending

Australia Austria Azerbaijan Belgium Brazil Canada Colombia Denmark Egypt France Germany India Indonesia  
Italy Kazakhstan Kuwait Mexico Netherlands Nigeria Norway Oman Poland Qatar Romania Russia Saudi  
Arabia Spain United Arab Emirates United Kingdom

## Worldwide

Extensive patent family granted

# ZENCOR TOOLS

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# Endorsements



"The use of high-energy elastic waves offers an original type of Enhanced Oil Recovery that assists in mobilizing trapped oil near the wellbore and at the same time imposes zero environmental impact. My experience with the company dates back to 2011, it's low cost and ease of installation adds to its potential for significant worldwide deployment."

**Quote from Dr. Kamal Ben-Naceur – GM of Nomadia Energy Consulting**



"Elastic Wave Stimulation is an affordable and efficient method of increasing the well injectivity or productivity. Historic application success demonstrated with more than 200 wells confirms the potential of the technology in (sic) reservoirs with a wide range of reservoir and fluids characteristics."

**Quote from Dr. K. Furman, et al. – Schlumberger-Terratek, Utah, USA**



"On the basis of critical interpretation of reported work, Elastic Wave Stimulation appears capable of increasing efficiency of oil production in depleted reservoirs without damaging seismicity effects, such as micro-earthquakes"

**Quote from Dr. M. Irfan, et al. – University Teknologi Petronas, Perak, Malaysia**



"The main message of this study is strongly supported by numerical simulations: Elastic Wave Stimulation will mobilize trapped oil, thus increasing oil production."

**Quote from Dr. Steve Pride-Lawrence Berkeley National Laboratories, California, USA**



"I read an article about Zencor Tools (formally ASR) in the American Association of Petroleum Geologist publication "EXPLORER." The article pointed out that the ASR technology was the first Enhanced Oil Recovery technology in forty-two years to be effective and that the State of Texas would grant a 50% Severance Tax reduction for ten years to operators who used the technology and it proved to be effective on their leases.

**Our company tried it and after a lengthy testing period during which we kept meticulous records, the technology either increased production or stemmed the decline curve depending on the area of our leases we tested. Two of our several producing horizons from shallow (less than 2,000 feet) to our deeper zones (to 4,300 feet) responded as predicted.**

Zencor Tools' (formally ASR) projection proved accurate and they were instrumental in walking the data through the State in order to obtain the Severance Tax relief, which was approved in a timely manner.

We would not hesitate to recommend to producers in a mature waterflood area such as ours to consider using Zencor Tools' (formally ASR) technology to enhance their own production."

**Quote from A.V. Pieroni - Owner BTO Venture Inc. Texas, USA**