



**MEOR**

Chemiphase Ltd




# Microbial Enhanced Oil Recovery

- Our Proven Technology for Increasing Oil Well Yields





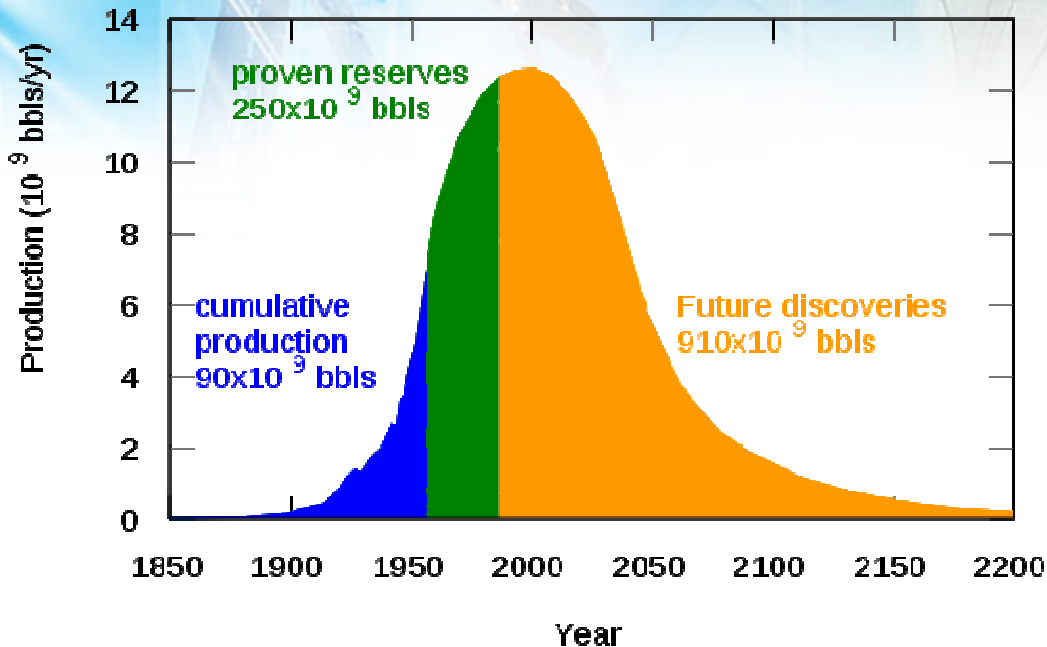
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## **Why do we need to employ MEOR when we are already producing oil?**

- Peak Oil Predictions are Falling
- Previously un-extractable oil reserves are More-Costly to Produce
- Remaining well reserves require more Costly-Stimulation

# “Peak Oil” Expectations



**Peak oil** is the point in time when the maximum rate of global petroleum extraction is reached, after which the rate of production enters terminal decline.

- The UK Industry Taskforce on Peak Oil and Energy Security (ITPOES) reported in late October 2008 that peak oil is likely to occur by 2013
- In 2008, the IEA predicted a plateau by 2020 and a peak by 2030
- Conservatively peak oil will occur in about 20 years time.





## After “Peak Oil”

- “All the easy oil and gas in the world has pretty much been found. Now comes the harder work in finding and producing oil from more challenging environments and work areas.”  
— **William J. Cummings, Exxon-Mobil company spokesman, December 2005**
- As “Peak Oil” is reached all the easily accessible oil has been extracted and further extraction using conventional extraction techniques will become increasingly expensive.
- Finding New Reserves will prove more expensive and less attractive, transportation and refining costs are denting profits.



## **New Oil Reserves - a viable option?**

*“It is pretty clear that there is not much chance of finding any significant quantity of new cheap oil. Any new or unconventional oil is going to be expensive.”*

— **Lord Ron Oxburgh, a former chairman of Shell, October 2008**

- **Known - 4 barrels consumed for every 1 barrel discovered.**
- **Conclusion- We need to extract as much oil from known sources as possible**





**How much oil is Recovered from  
a formation at the present?**

Today's Conventional Oil Recovery processes are only able to retrieve **15-50%** of the available oil in most reservoir's

**What are the steps and how do We  
Achieve a Greater production %**





## Primary Oil Recovery (5-25% Oil Yield)

- During the ***primary recovery stage***, reservoir drive comes from a number of natural mechanisms.
- These include:
  - 1) **natural water displacing oil downward into the well,**
  - 2) **expansion of the natural gas at the top of the reservoir,**
  - 3) **expansion of gas initially dissolved in the crude oil,**
  - 4) **gravity drainage resulting from the movement of oil.**
- While the underground pressure in the oil reservoir is sufficient to force the oil to the surface, all that is necessary is to place a valve on the well head to connect the well to a pipeline network for storage and processing.
- During this stage typical oil recovery is between 5-25% of the total oil residing in the well.



## Secondary Oil Recovery (10-25% Oil Yield)

- Over the lifetime of the well the pressure will fall, and at some point there will be insufficient underground pressure to force the oil to the surface. Secondary recovery relies on the supply of external energy into the reservoir from;
  - 1) *Injecting fluids to increase reservoir pressure (replacing or increasing the natural reservoir drive)*
  - 2) *Pumping to bring the oil to the surface.*
  - 3) *Increasing pressure by natural gas injection, gas lift (which injects a mixture of gases into the bottom of a production well, to reduce the overall density of fluid in the well-bore)*
  - 4) *Typical secondary oil recovery is 10-25% of the total oil residing in the well*





## **Current Production Performance**

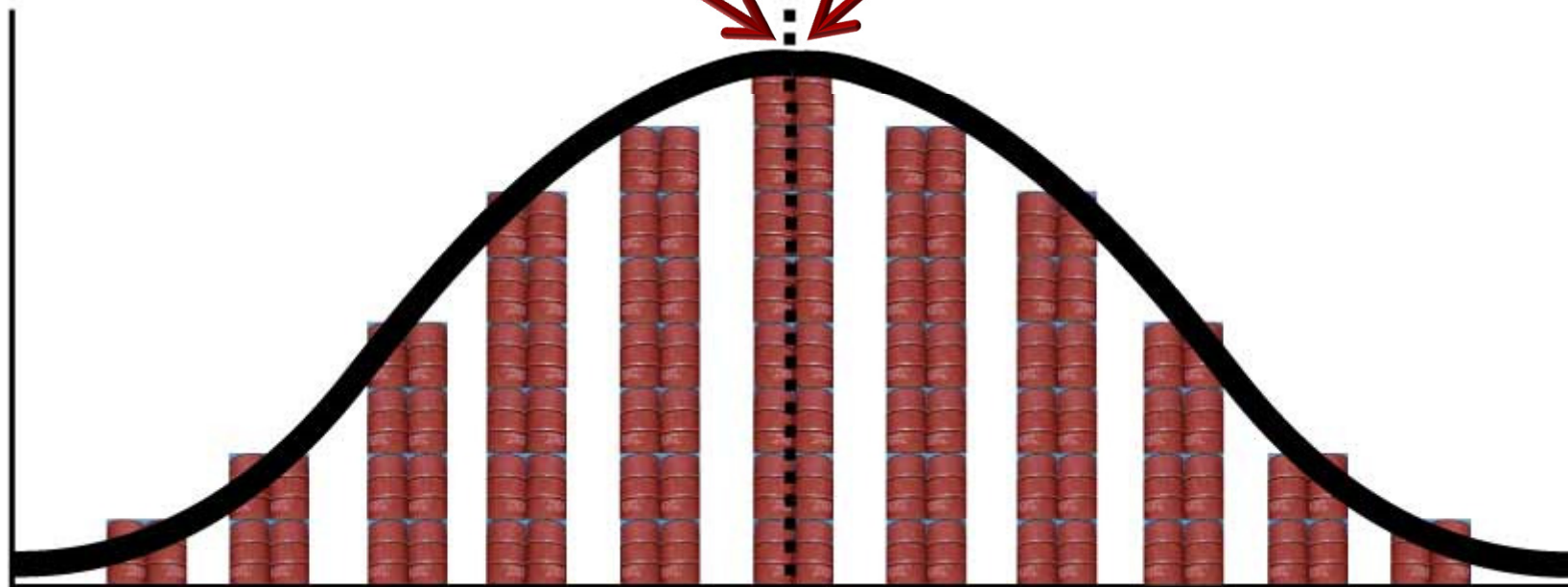
- Using the uppermost estimates of percentage yield, we can see that there is at least:

**50% of the total oil remaining  
in the well after Primary and  
Secondary recovery**



Mid point

Top of the curve



*1<sup>st</sup> half*

*2<sup>nd</sup> half*

**When you plot the production of an aggregate of oil fields, it approximates a bell curve**





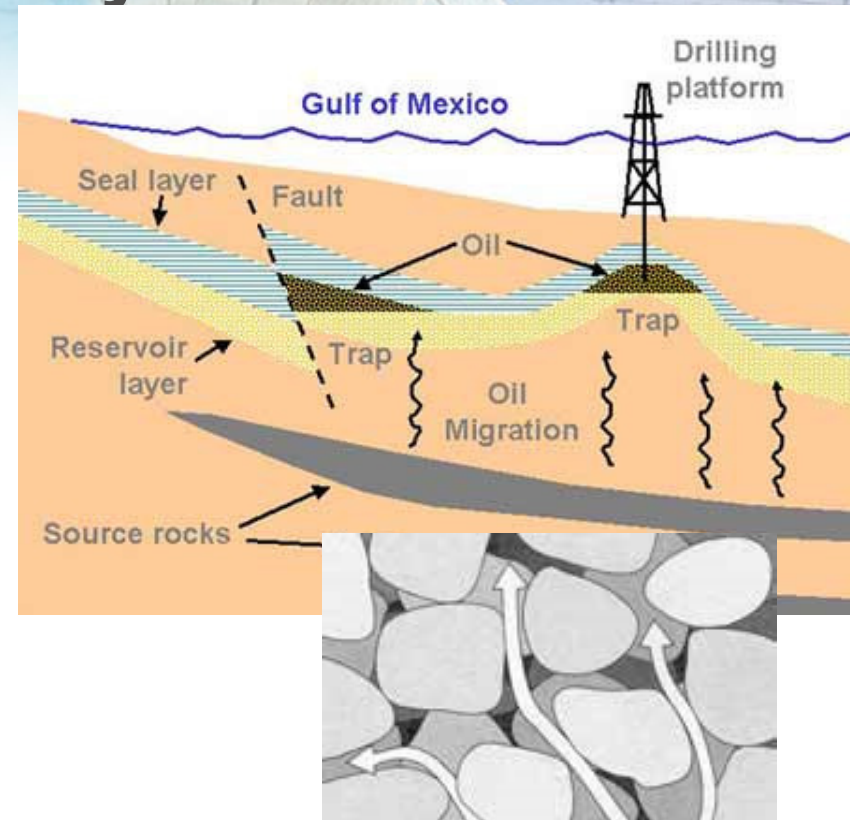
**US Oil Production**  
1859-2004



- Many oil fields, countries, and oil companies have already peaked.
- The US peaked in 1970.
- 53 of 68 oil producing countries are in decline.

# But an oil well isn't a hollow cavity.

- It's a large deposit of stones or sandstone sandwiched between two layers of impervious rock. The hollow spaces between the stones or sand are filled with thick and viscous oil.
- A pipe is lowered into the mixture of oil and stones or sand and the oil is pumped up.



It takes time for oil to ooze from zones of high pressure to the zone of low pressure near the pipe.





## How do we extract the remaining oil?



**5-25% yield**

**10-50% yield**

**40-88% yield**

How can we extract the remaining oil?

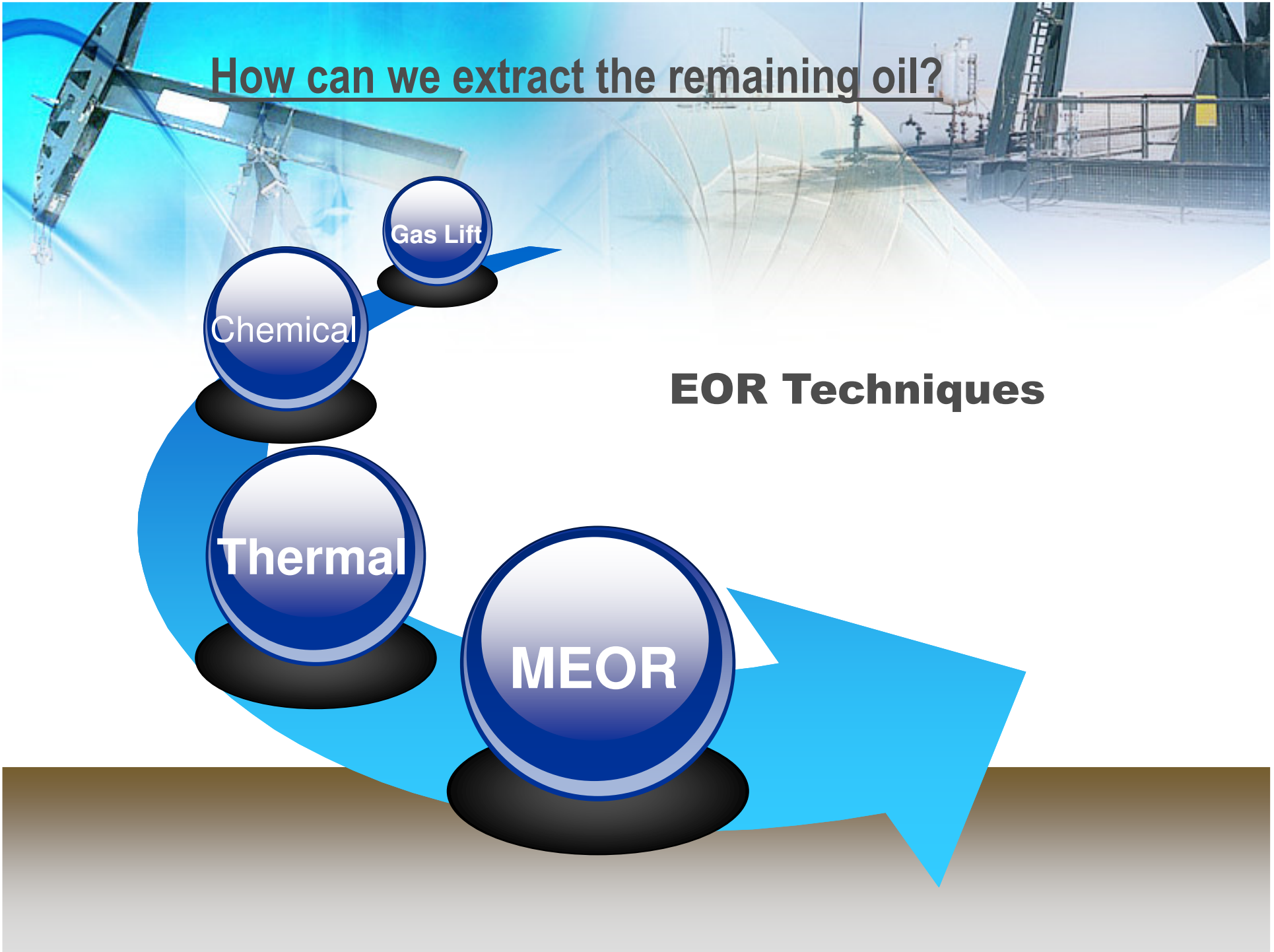
Gas Lift

Chemical

Thermal

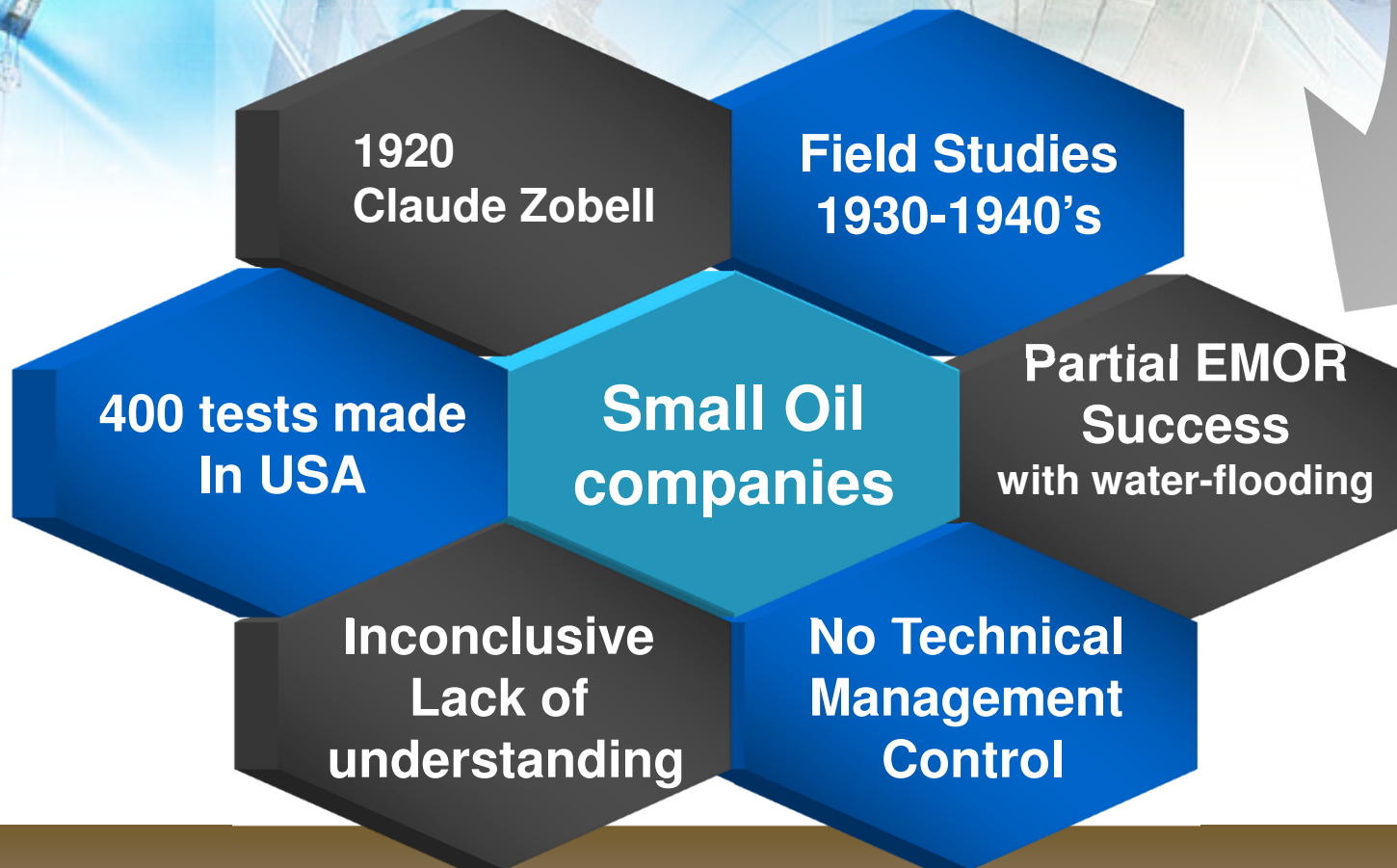
MEOR

**EOR Techniques**





# EMOR History



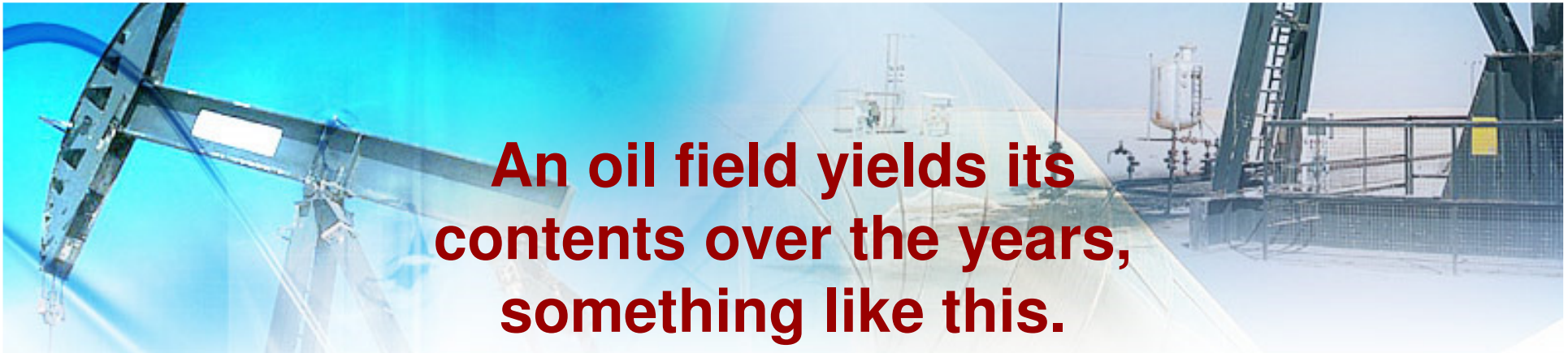
MEOR processes were thought of as unpredictable with various limiting factors - such as microbe types, reservoir properties, fluid properties, infrequent testing



## What benefits can Chemiphase offer ?

- The whole reason for employing any EOR technique is to increase the life and productivity of a well.
- Fundamentally, the mechanisms that govern oil release due to beneficial microbial growth are very much the same as those proven and demonstrable chemical and physical effects derived from well known EOR techniques.
- Bacteria can be manipulated to act in a number of beneficial ways, this includes;
  - Producing bio-surfactants
  - Producing bio-polymers
  - Increasing the gas drive
  - Bio-cracking
  - Bio-film plugging
  - Bio-competitive exclusion





**An oil field yields its contents over the years, something like this.**



*An oil field empties rapidly at the start and yields lots of oil.*

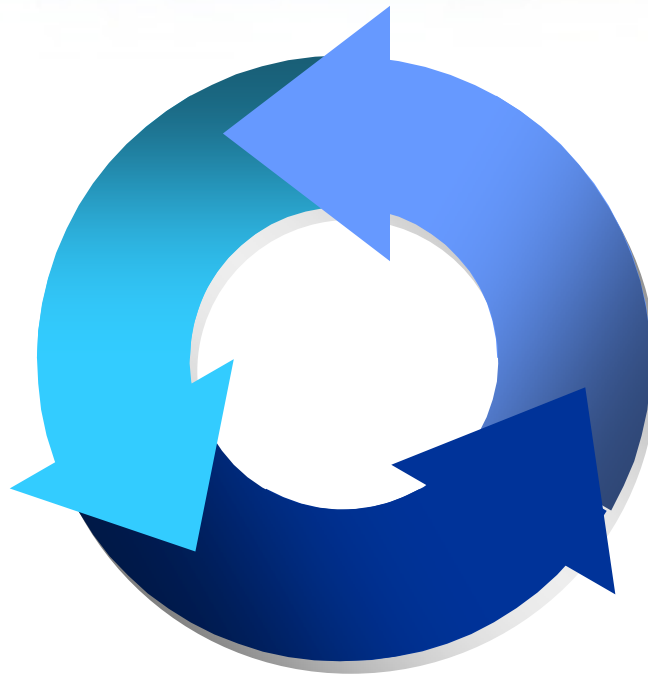
*Then the flow slows down gradually.*

*Towards the end the flow eases to a trickle.*



Chemiphase  
MEOR  
Has 2 Unique Processes

ProSurF 342  
Part A



Pro-Biologica  
1000  
Part B

Further 30% Increase in Yield





Part A

**ProSurf 342**

**Powerful  
Cleaner,  
Dewaxer &  
DeGreaser**

**Anti Scale  
&  
Corrosion  
Agents**

**Transporting  
Agents for  
Heavier Oils  
&  
Asphaltenes**



# ProSurf 342

**Increased Oil Yield**

**Improved Oil Flow & Mobility Properties**

**Scale & Corrosion Control**

**H<sub>2</sub>S and SRB Control**

**Well Cleanup**





Part B

# For Increased Oil Production

Environmentally Acceptable

High Salinity and Temp  
Resistance

**Pro-Biologica 1000**

Oxidises H<sub>2</sub>S and  
minimises corrosion

Self Transporting  
through  
the  
Oilfield pay-zones

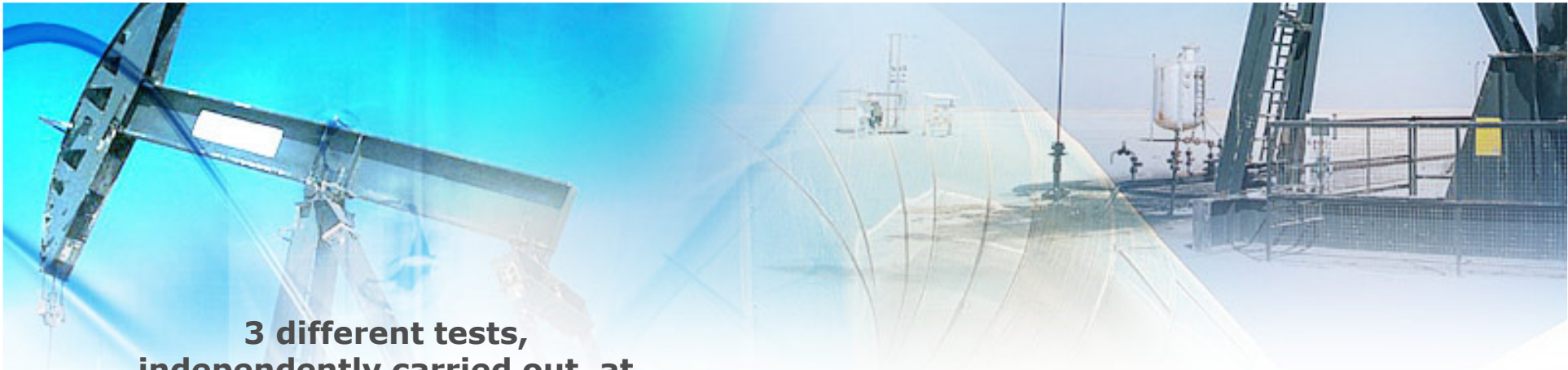


Produces Powerful Bio-Surfactants  
For Descaling, Dewaxing and Oil Flow

Ability to degrade the  
heavier oils and  
asphaltene,s to lighter,  
recoverable product

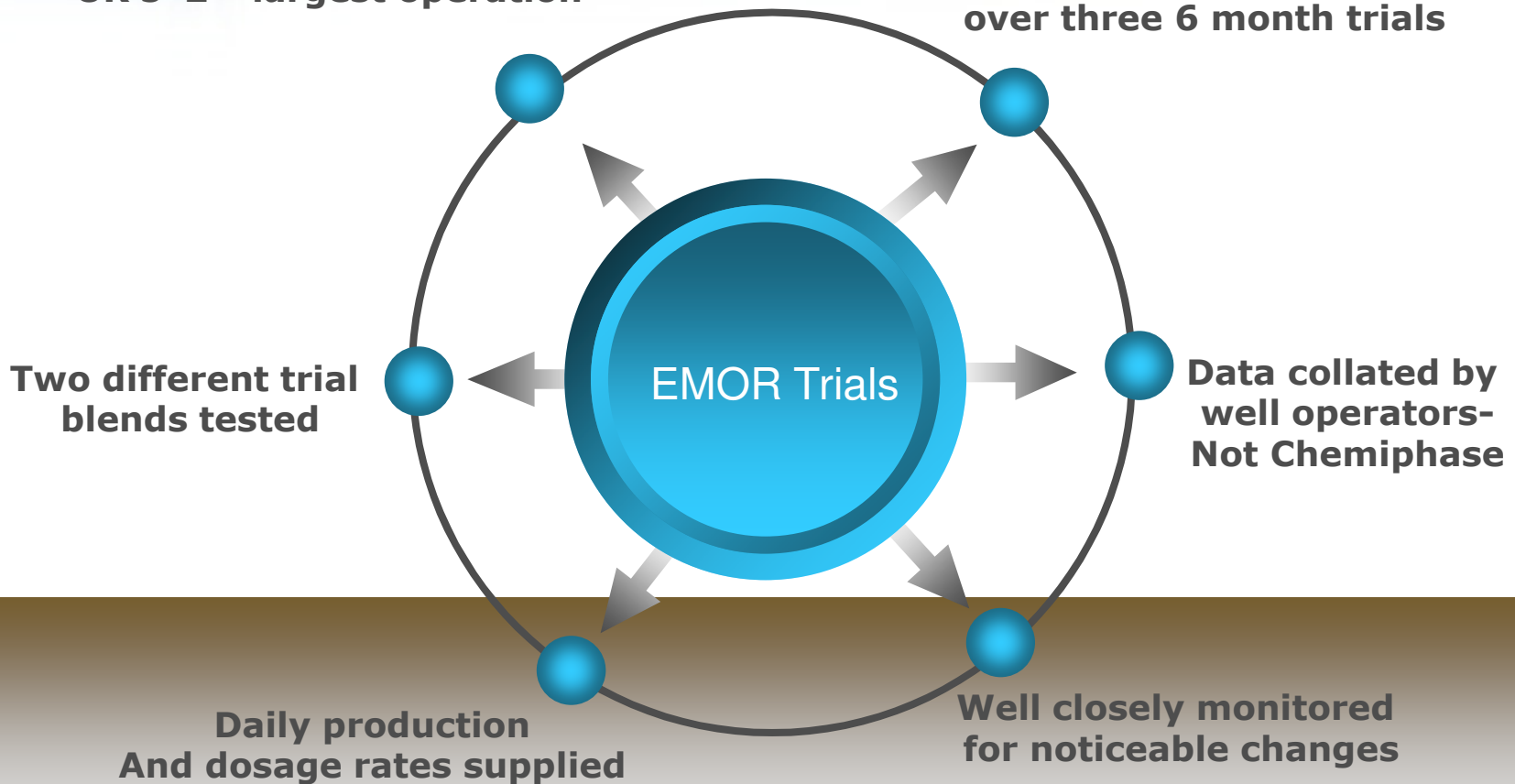
The image features a composite background. On the right, a large oil pumpjack (jack-o'-lantern) is shown against a clear blue sky. In the foreground, several large, silver, insulated industrial pipes are visible, some with red markings. The left side of the image is dominated by a semi-transparent blue overlay that contains a faint, stylized human face and various abstract geometric patterns and lines, suggesting a digital or data-driven theme.

# EMOR Test Data



**3 different tests,  
independently carried out at  
UK's 2<sup>nd</sup> largest operation**

**Carried out in 2010/2012  
over three 6 month trials**








# What we saw

**Increased Oil Yield**



**H<sub>2</sub>S and SRB Control  
& Well Clean up**

**Improved Oil to Water  
ratio**



**Advanced Environmental Programme to increase Yield and Reduce Pumping Costs**

**EMOR Treatment for Cleaner and more Efficient Wells**

**24% Increase In Oil produced**

**1.6% Increase of Oil to Water Ratio**

**Reduction in SRB & H<sub>2</sub>S Levels**

**Minimises Corrosion And Scaling**



# Our EMOR Results

**Before**

**During**

**After**

**OIL 136bpd**

**OIL 169bpd**

**OIL 140bpd**

**Oil:Water 9:3**

**Oil:Water 11:9**

**Oil:Water 9:8**

**H2S 500ppm**

**H2S 3ppm**

**H2S 200ppm**

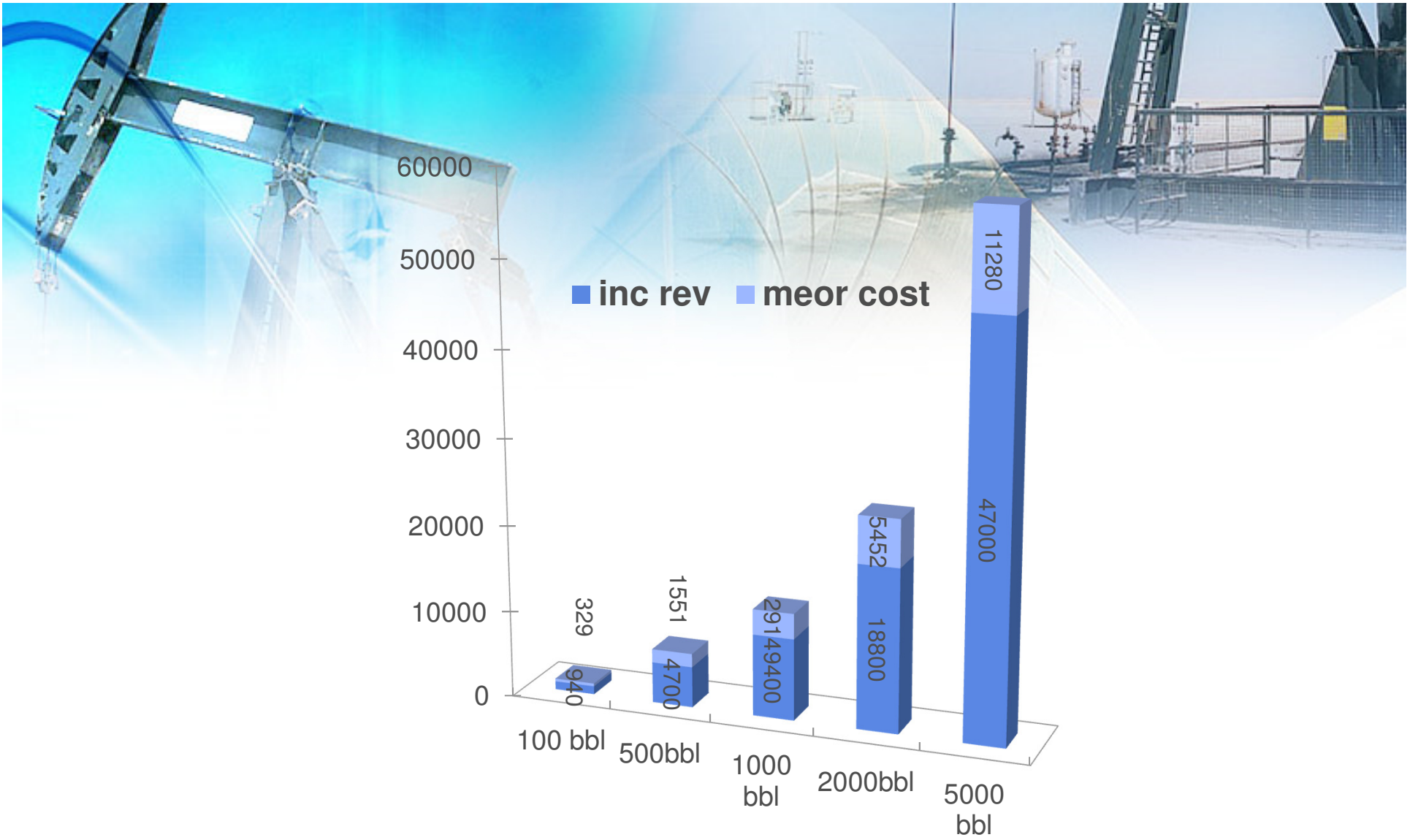
**SRB  $1 \times 10^8$**

**SRB 10-100**

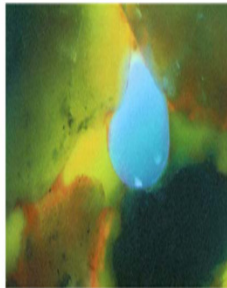
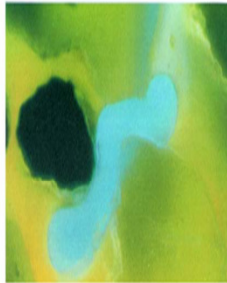
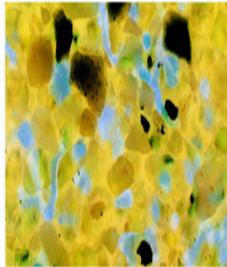
**SRB  $1 \times 10^4$**





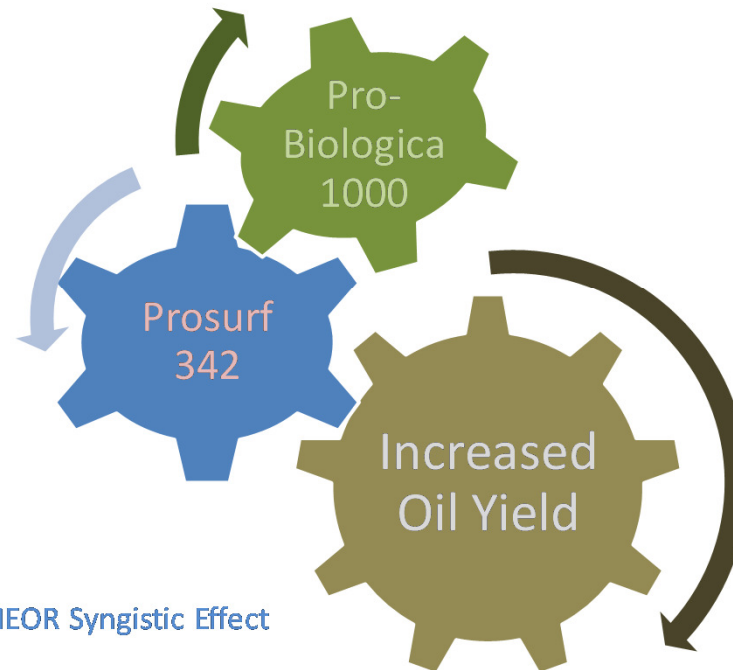


## MEOR Cost versus Increase Production



Oil phase in sediments, from Wilson et al. (1990)

# Ultimate Performance



2 Tier MEOR Syngistic Effect



A photograph of an industrial facility, possibly an oil refinery or chemical plant, with various structures and pipes. The image is overlaid with a semi-transparent blue and white geometric pattern.

## Use Chemiphase EMOR

For We Do Not Want To See The Sun Go Down On  
Your Oil Production !!!



- Our Proven Technology for Increasing Oil Well Yields



## ***OUR MISSION***

- Develop a Sophisticated MEOR Programme for the existing International Marginal Production Oil-well Market
- Our Approach is to increase oil production from Marginal fields by 30% or more
- The added Production will be a direct result of harvesting the “extra heavier” oil components that normally would remain down hole.



## Marginal Well -MEOR SUMMARY

- This Chemiphase technique has the potential to be cost-efficient in the extraction of oil remained trapped in capillary pores of the formation rock, Pipelines or in areas not swept by the classical or modern enhanced oil recovery (EOR) methods, such as Carbon Dioxide, Steam, Miscible Displacement, Caustic Surfactant-Polymers & Water Flooding.





# Current Best Practices

- Carbon Dioxide 15-25 \$/barrel cost
- Steam Injection 13-18 \$/barrel cost
- EOR 14-16 \$/barrel cost
- Solvent Washes 10.5-14 \$/barrel cost
- Acid Fracturing Injections 10-12 \$/barrel cost
- Chemiphase EMOR 6-11 \$/barrel cost
- \*Includes all set up costs, Insurances & Taxation



# The Potential Market

- Enhanced Oil Recovery in Oil Wells /Formations
- Marginal Wells and High Wax/Asphaltene formations
- Cleaning of Oilfield Surface Equipment
- Pipelines, above & Below Sea
- Processes for all types of Oil/Biodiesel re-clamation
- Tar Sands Oil Recovery & Water Purification
- Large Oil's Spills in Oceans/Lakes & land remediation process



# The Story So Far

- Proof-of-concept and Application Equipment completed
- Strong Documented interest from potential customers
- Discussions with several potential Alliance Partners
- Assembled an experienced multi-discipline team



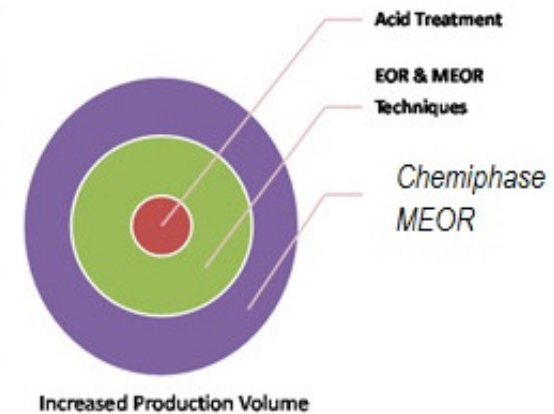
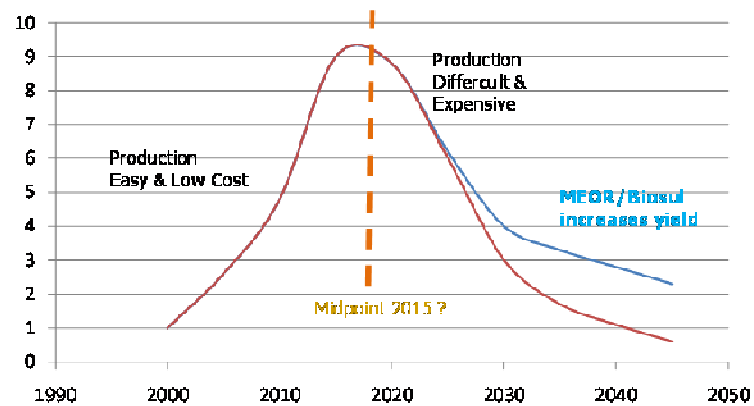


## ***The Next 12 months***

- Obtain Working Capital
- Win awaiting “Contract Bids Applications”
  - Marginal wells, De-Scaling & Corrosion Control, Pipeline & Tank Storage Cleaning,
- Complete manufacture capability of 100 tonnes/Week for
  - Prosurf 342 & Biologica 1000 product ranges
- Undertake further MEOR product trials with:
  - Star Energy-Egdon Oil-USA, Army- China oil Companies - IRAQ, NOC & SOC
  - Company -OMV, Austria oilfields- Qatar Projects
- Assemble experienced multi-discipline team

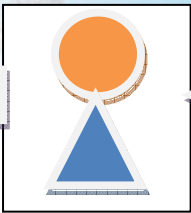
# Chemiphase MEOR

## MEOR/Biosul the Future

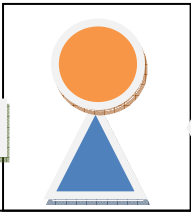


# Example of Installation

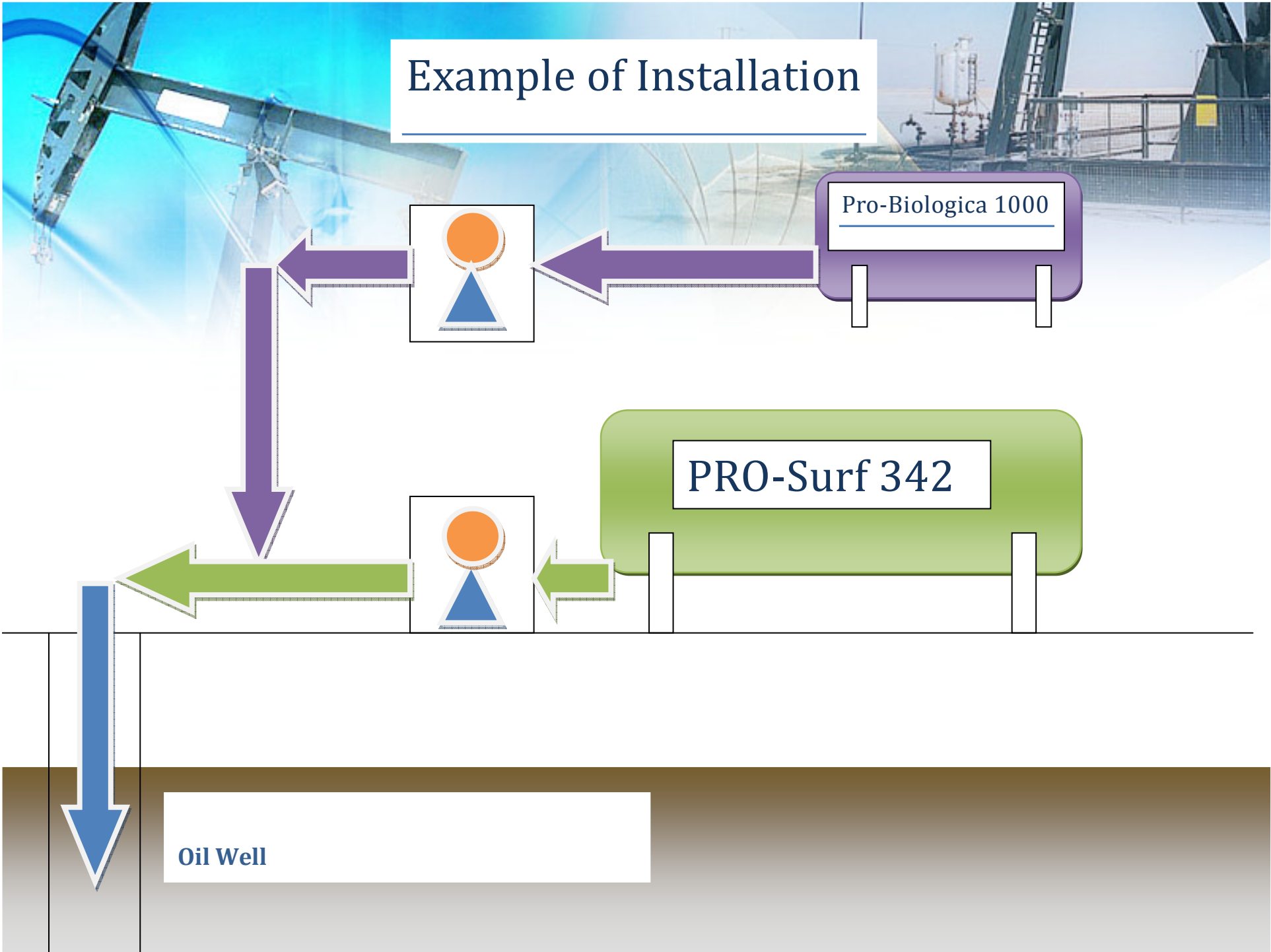
Pro-Biologica 1000



PRO-Surf 342



Oil Well







## Benefits For Customers

- Significantly Increases Oil Production 30%
- Great Marginal Well Performance
- Reduces Well Equipment Downtime through “MEOR cleaning integrity”
- The Service Provides Trace-ability, Accountability and Operations Management
- Reduces costs for replacing equipment due to Corrosion, Scaling and Fouling tendencies
- **Fully Environmental Programme**



# Product Features

- Clean all oilfield well equipment to maximise pumping rates
- Increase reservoir pressure,
- Improve Gas driven oil production
- Reduce oil viscosity:
- Emulsify Oil-Water, Reduce Surface Tension and Interfacial Tension
- Dissolve Carbonates, Increase Permeability (open pores)
- Produce Bio-films, Influence on Flow Properties
- Reduces Corrosion, Scaling and Fouling tendencies



## *Product Development Partners*

- Oil Majors offshore
- Oil companies inshore
- Oil Service Organisations
- Bio-diesel (renewable energy) Producers & Distributors
- Platform & Pipeline Cleaning Contractors
- Tar Sands Operators





# MEOR Practice

## Reservoir parameters

- *Rock Type*
- *Residual Oil Saturation*
- *Permeability*
- *Pressure*
- *Temperature*
- *Wet-tability*
- *Oil Density*
- *pH*
- *Trace Elements*

## Microbe Parameters

- ❖ *Microbe Species*
  - *(Anaerobic or Facultative aerobic)*
- ❖ *Growth Rate*
- ❖ *Microbial Products*
- ❖ *Nutrient Consumption/Habit*
- ❖ *Survival and Competitiveness*




# The Market Drivers

- Legislation Requirements
  - Reach Agreement –World wide
  - Reducing non environmental products
- Increased Productivity
- Maintaining Balance Sheet Assets- marginal wells
- Payback due to reduction in costs associated with poor marginal wells



## ***Payback to Customers***

- Cutting Edge Technology
  - A Fully Environmental Programme
  - Best Fit Programme between Cost & Performance
  - Chemiphase- MEOR has proven to be a Very Effective, Easy Application for our Customers
  - Especially for ones who have a wide range of Marginal Oil Wells
- 





# The Potential Market

- **20 Years Later The System Has Not Improved**

The background image shows an industrial facility with a large, translucent dome structure in the center. To the left, there is a large metal crane or gantry structure. In the background, various industrial tanks and pipes are visible under a clear sky. The overall scene is brightly lit, suggesting a sunny day.

## ***Important Activities***

- Build Succinct Support Team
- Work Closely with Direct Funding & R-D Teams
- Build Larger Modular Treatment System
- Undertake Larger scale projects and Carry out further Trials
- Complete Infrastructure, including Sales & Support



## Milestone

## Project Dates

Complete IP & Marketing Plan

Jun-July 12

Schedule Equipment Needs & Costs

Ongoing

Collate technical Data, carry out surveys

Ongoing

Prepare Sales Documentation & pricing

Completed

Prepare Sales Tenders for Contracts

6 bid completed

Organise Hiring of Sales & Support Team

September 12

Devise 2 Sales & 1 Support Training Prog

August 12

Present MEOR to Oilfield Contractors

Ongoing





# Current Research

- In around 15% of the Worlds oil-wells the environmental conditions make it very difficult for bacteria to survive, and those that do often have a decreased ability to carry out the chemical processes needed to enhance oil recovery.
- *We are working to create strains of bacteria that are better able to survive these harsh conditions but still retain the ability to carry out the chemistry needed for MEOR.*
- Genetic engineering is being used to develop micro-organisms that can not only live in the high temperatures of an oil well, but can also subsist on inexpensive nutrients, remain chemically active, and produce substantial amounts of bio-surfactants.
- *Our research is developing bacteria that can be grown on inexpensive agricultural/Industrial waste materials, which is abundant in supply and is environmentally friendly.*



# Objective

- Sustainable Development and MEOR
- MEOR reduces or eliminates the need to use harsh chemicals during oil drilling, an environmental compatible method of carrying out secondary or tertiary oil recovery.
- We believe MEOR is the most commercially viable option
  - Our work on genetic engineering has & will develop more effective microbial bacteria
  - These microbes can be grown on inexpensive and abundant nutrients.
  - Our new methods for developing and growing MEOR bacteria have lowered production costs and making it a more attractive alternative to traditional chemical methods.

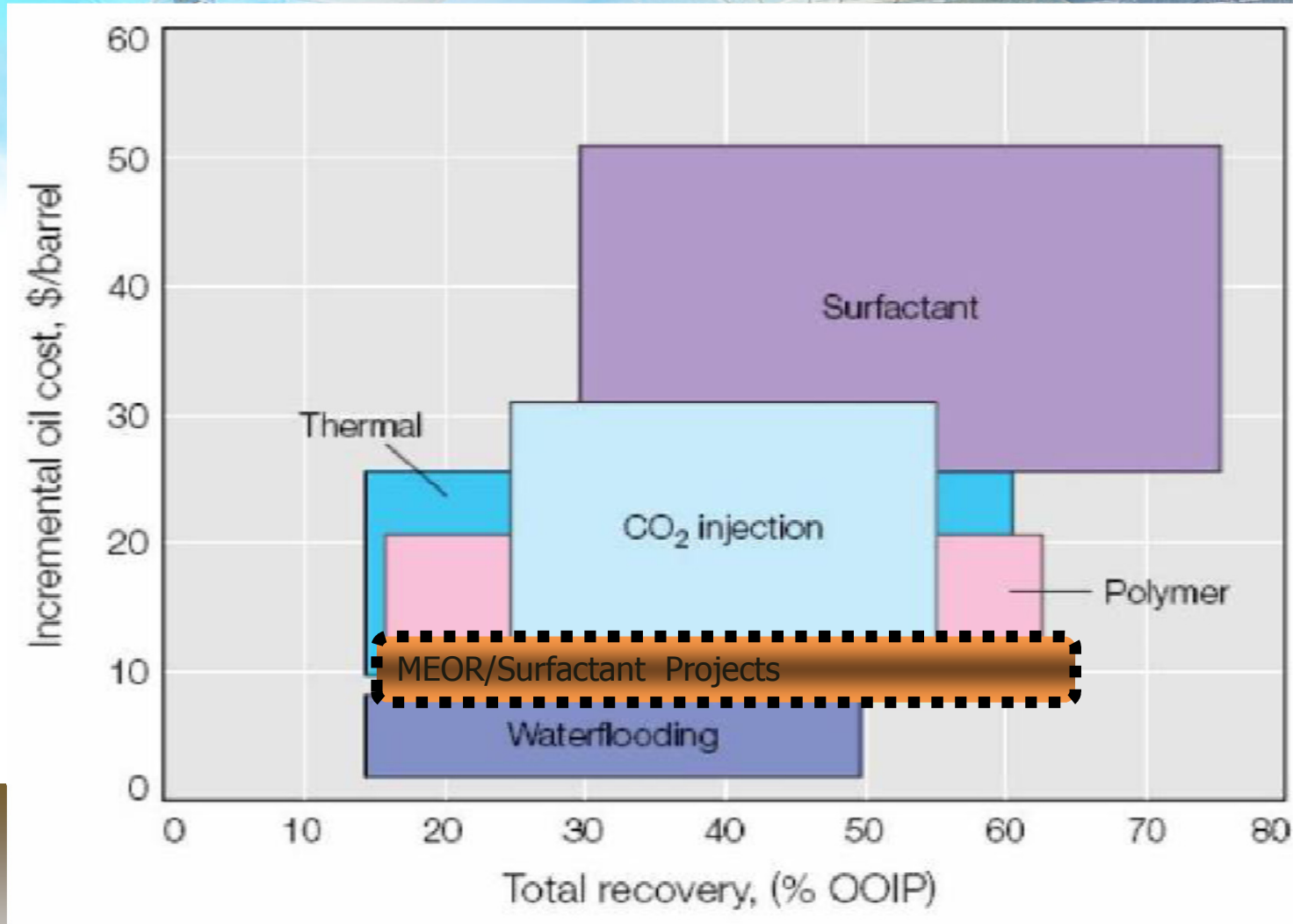


# Future Biological Products

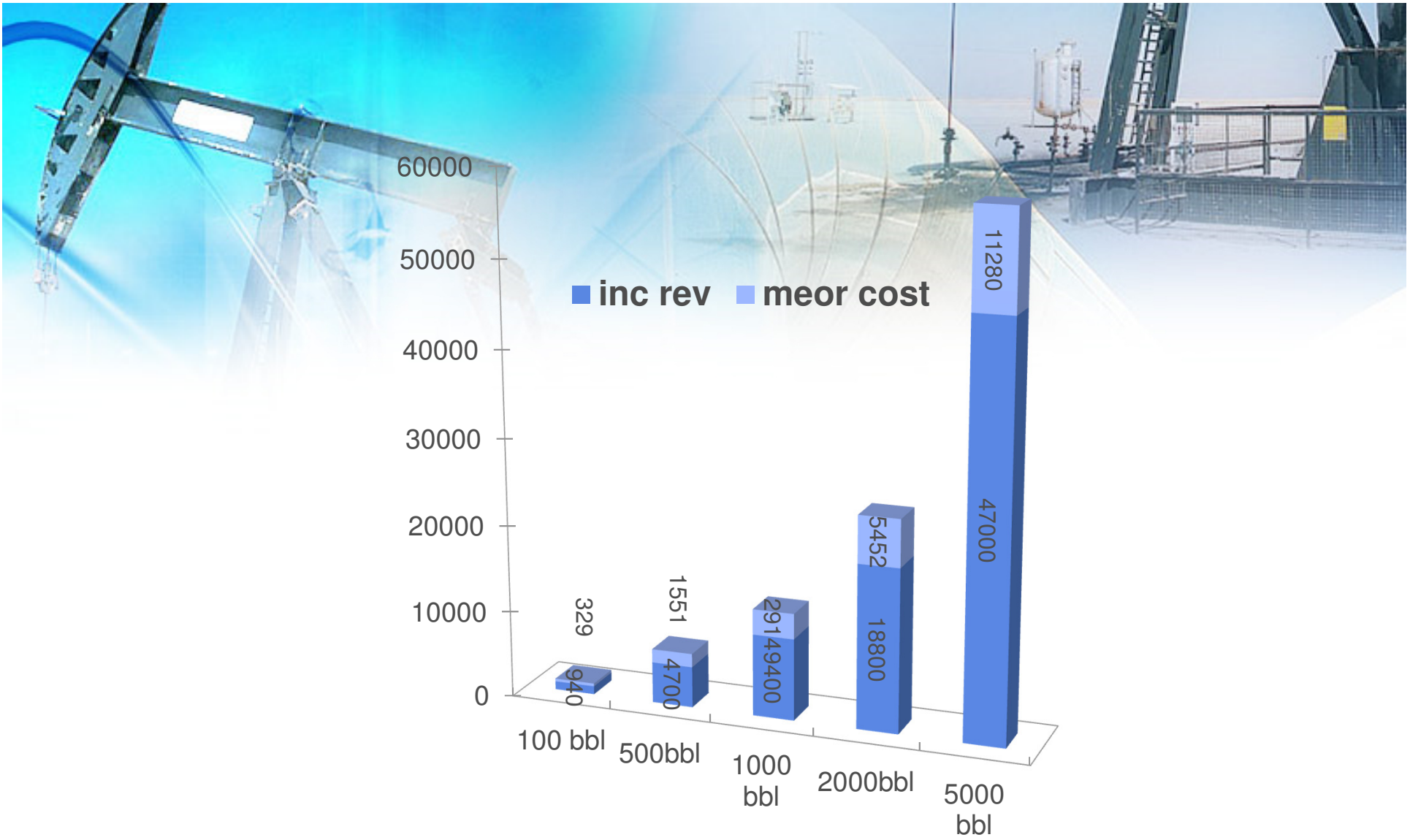
- We are organising a microbial consortium containing a collection of hyperthermophilic, barophilic, acidogenic, anaerobic bacterial strains for enhanced oil recovery from oil reservoirs where temperatures range from 70° C. to 90 Deg C.
- *The said microbial consortium is unique in producing a variety of metabolic products mainly CO<sub>2</sub>, methane, bio-surfactant, volatile fatty acids and alcohols in the presence of specially designed nutrient medium package.*
- Our metabolic products will increase sweep efficiency of crude oil from oil bearing poles of rock formation.



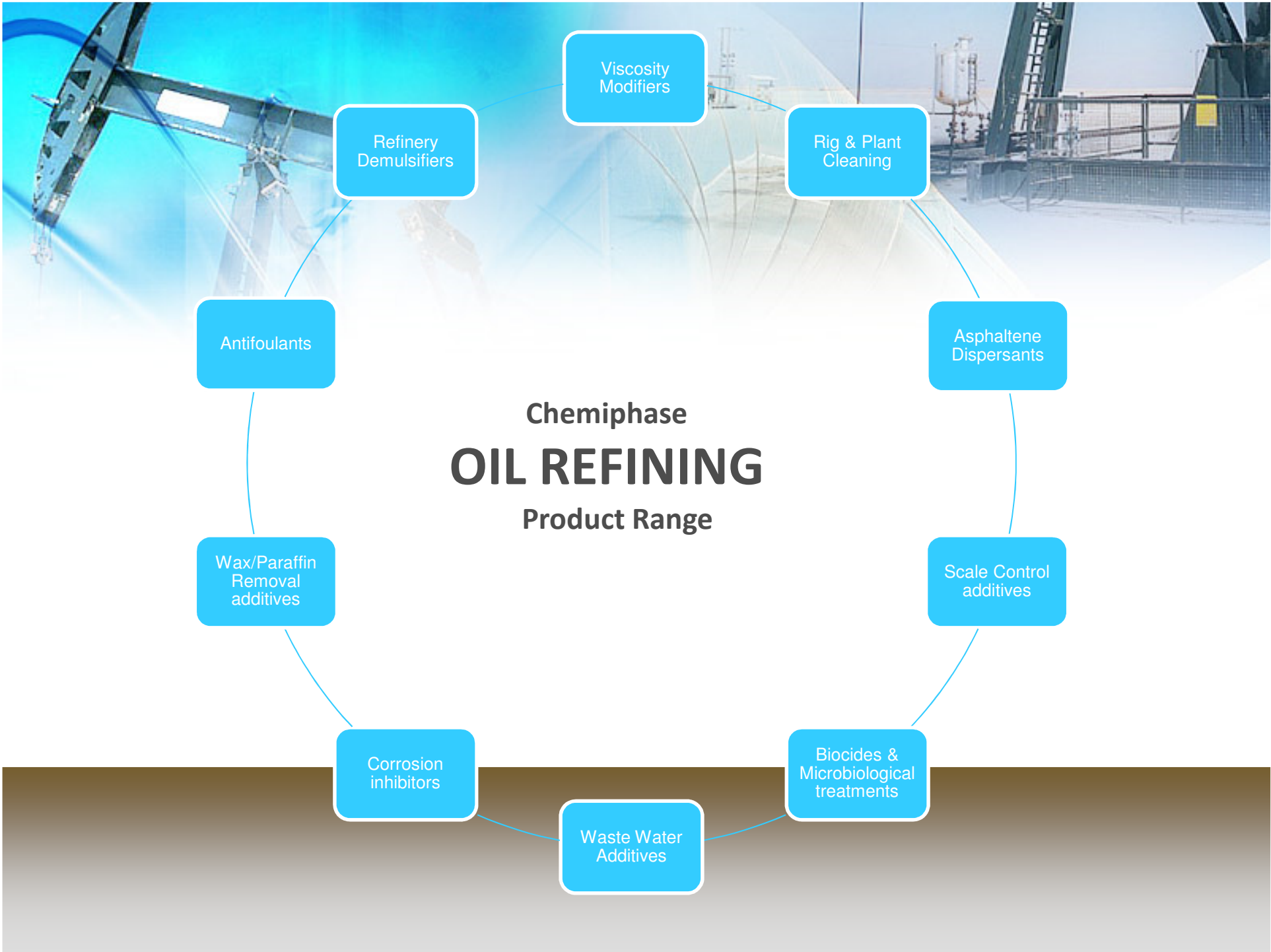
# Cost versus Reward for various EOR techniques



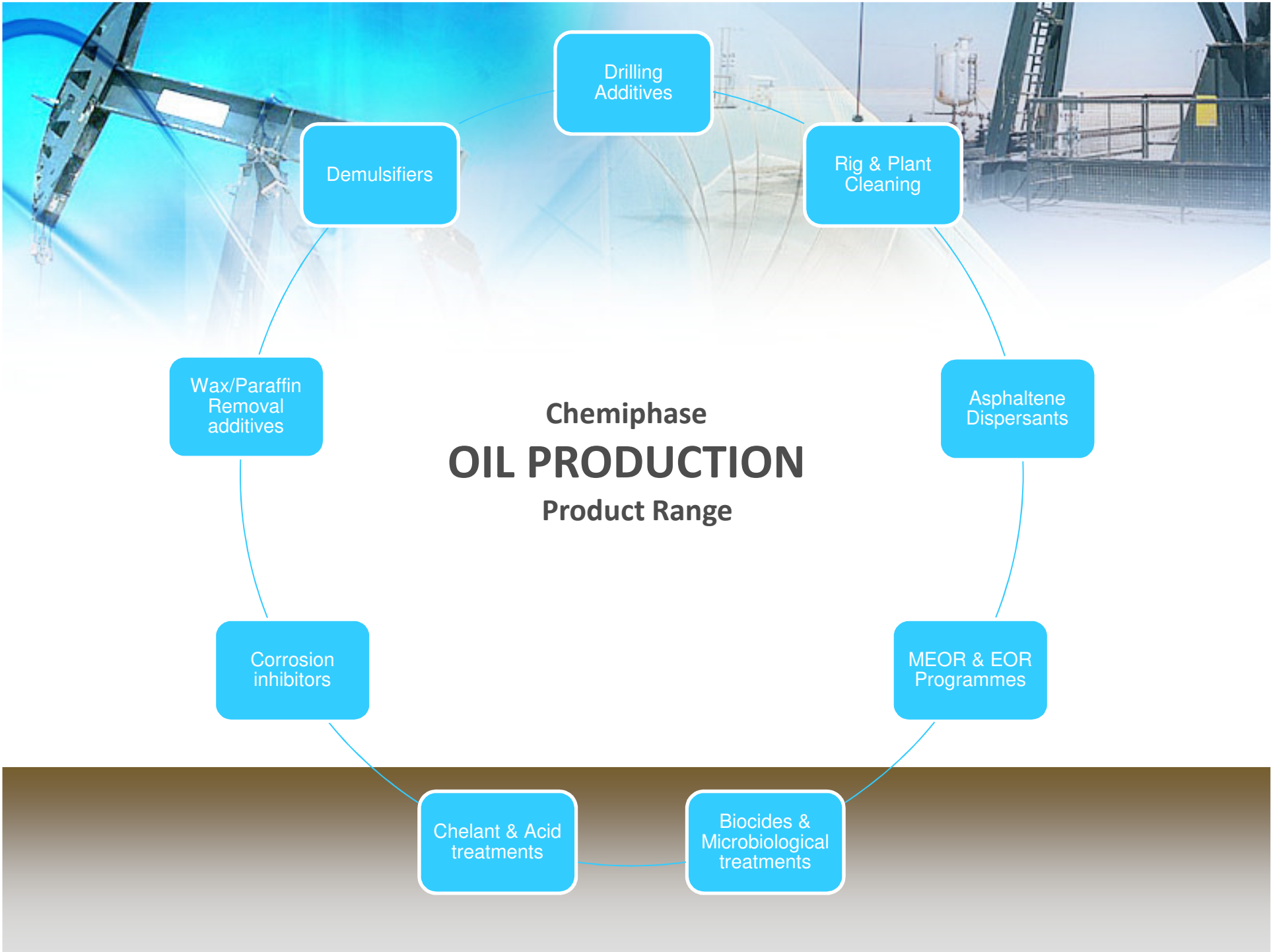
from: Simandoux et al. (1990) Managing the Cost of Enhanced Oil Recovery. IFT Journal, vol 1.

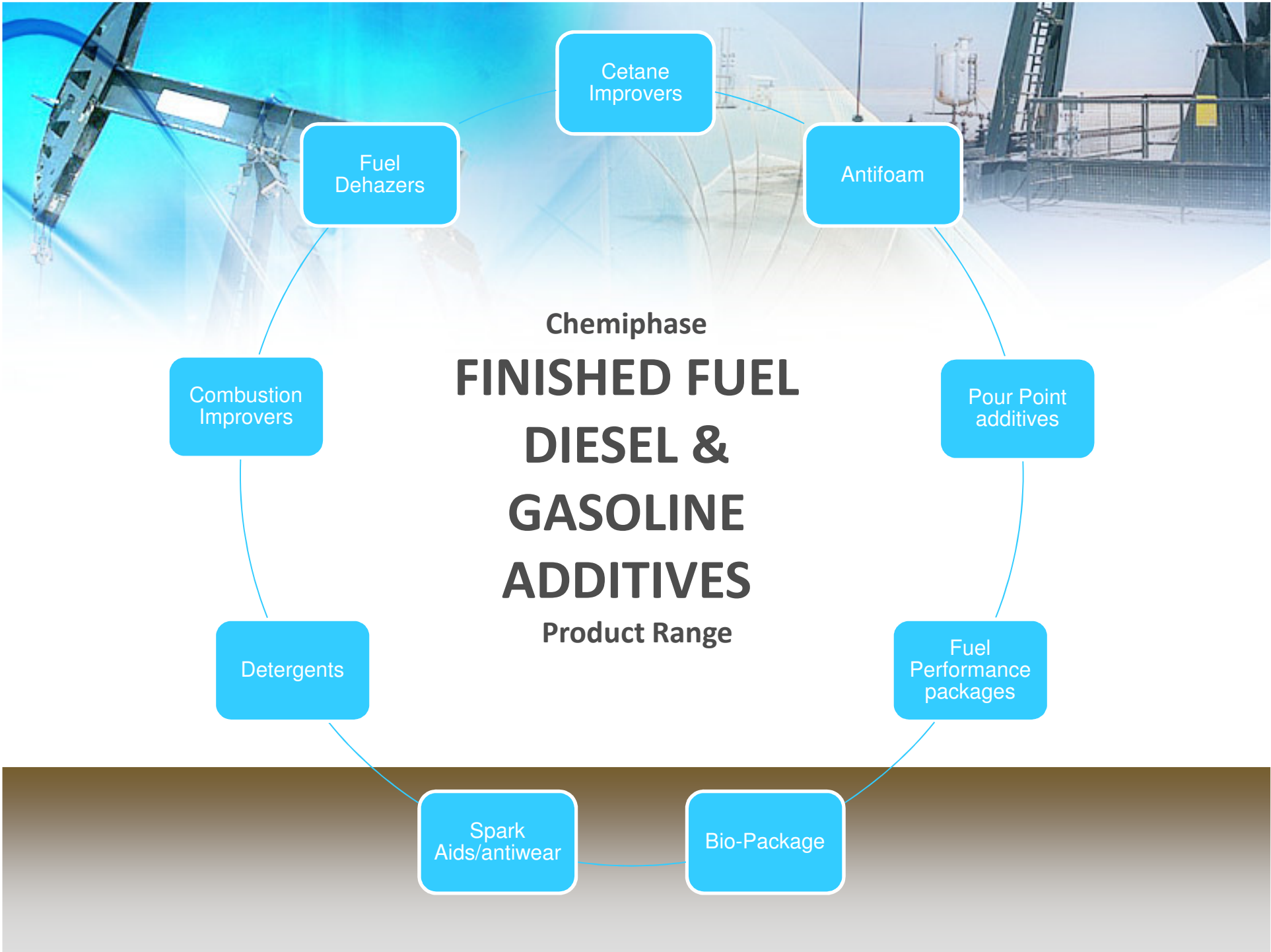


## MEOR Cost versus Increase Production











**Thank You!**

Chemiphase Ltd