



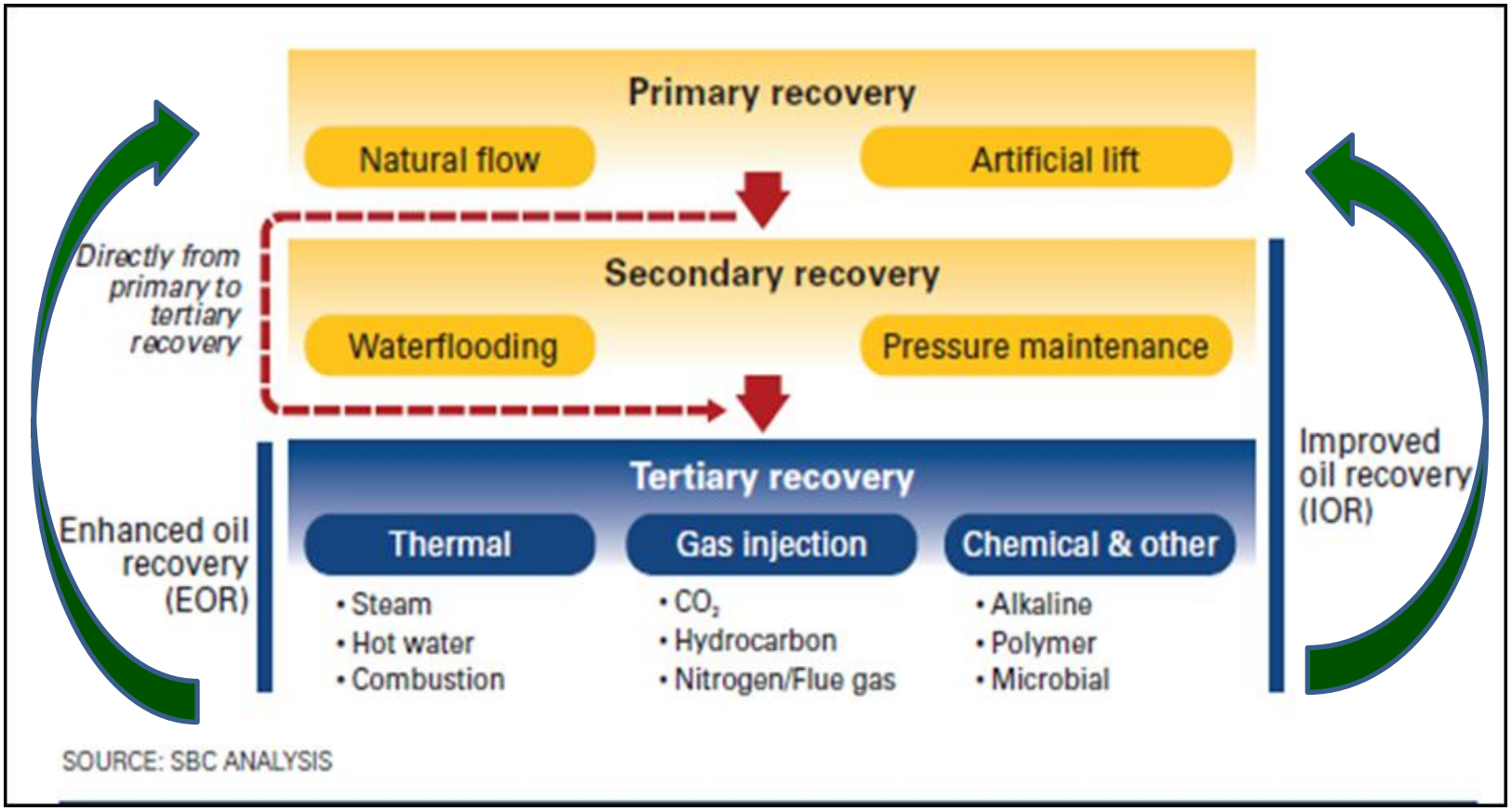
EOR in Indian Context

Workshop on EOR/IOR
20th June 2017

Outline

1. Background
2. ONGC's Journey so far
   - Onshore
   - Offshore
3. Challenges in EOR implementation
4. Critical enablers
5. Summary

What is EOR?



Conventional recovery targets mobile oil in the reservoir and EOR targets immobile i.e. the oil which cannot be produced due to capillary and viscous forces

What is EOR?

- Risk & Challenges
  - Complex, technology-heavy, capital and resource intensive
  - Long lead time

- Benefits
  - Re-energizes the reservoir
  - Enhanced production and increase Recovery
  - Cascading effect in increasing the economic life of the field

EOR Contribution

EOR ~ 3% of total worldwide production

EOR contribution

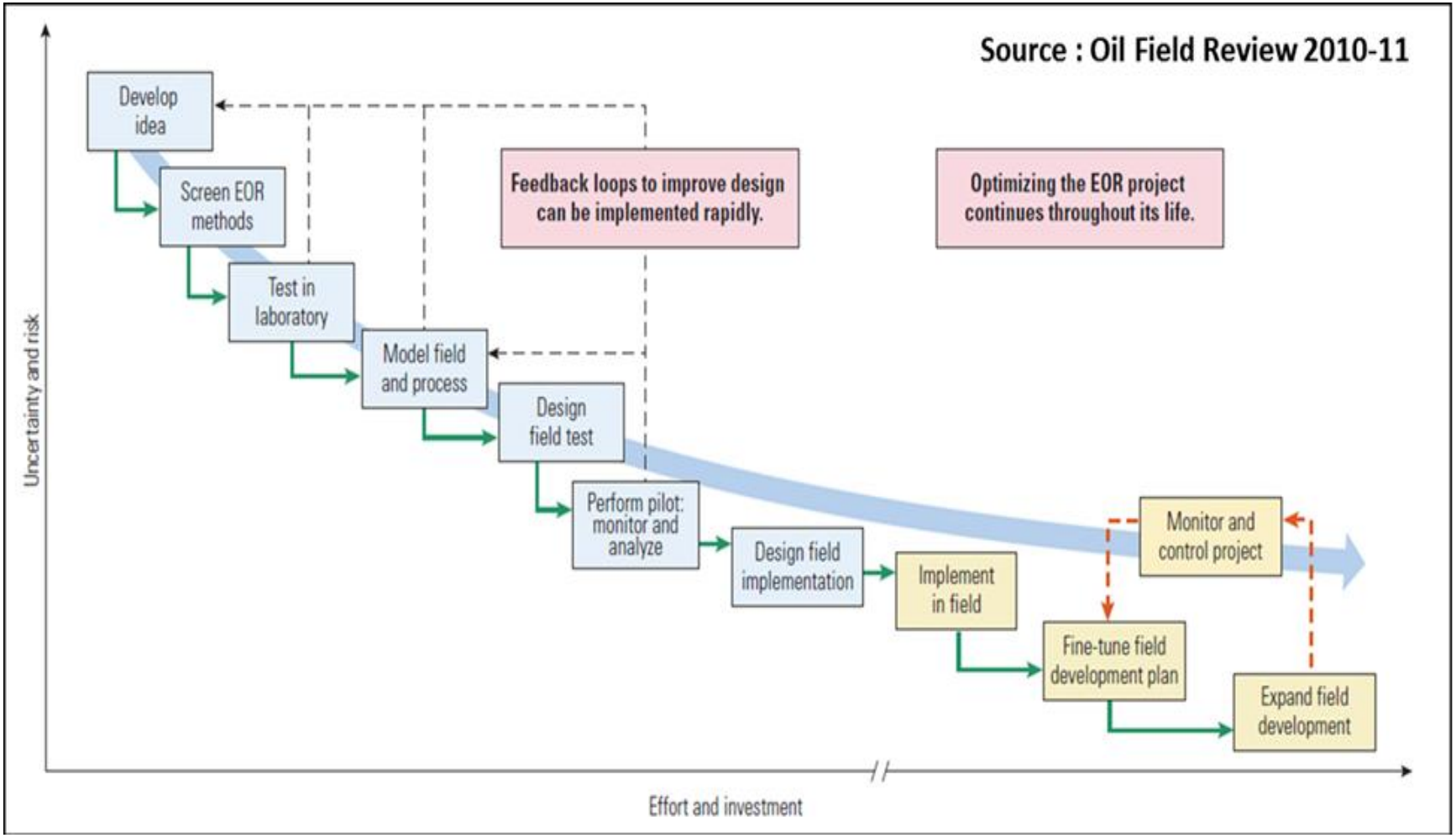
- 12% of Western Onshore Production
- 9% of Onshore production
- 2.6% of ONGC production

In cumulative terms, EOR has contributed

- 4.5% of total Western Onshore production
- 3.3% of total Onshore production
- 1.2% of total ONGC production

Onshore Scenario

Lifecycle of EOR



Staged Process for EOR Project Evaluation and Development

Commercial Ongoing Projects

- **Thermal Processes**
  - In-situ Combustion : Santhal
  - In-situ Combustion : Balol
  - In-situ Combustion : Lanwa

- **Gas Injection Processes**
  - Miscible Gas Injection : GS 12 Sand,Gandhar
  - Water Alternate Gas Scheme : GS 11 Sand,Gandhar
  - Water Alternate Gas Scheme : GS 9 Sand,Gandhar
  - Immiscible Gas Injection in Borholla

- **Chemical Processes**
  - Polymer Flood-Sanand

EOR Road Map: Balol

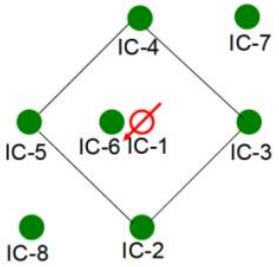
1978-90
Laboratory Evaluation

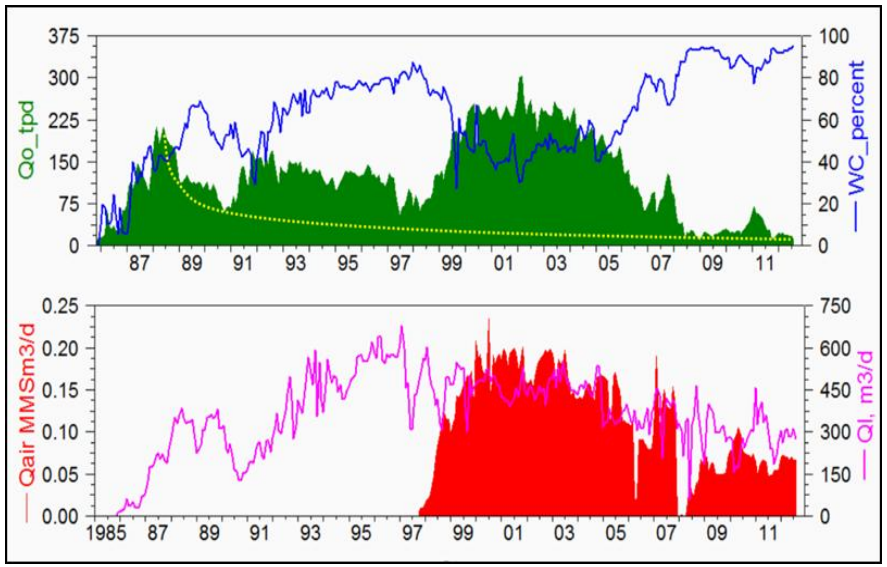
1990
Pilot

1992
Semi-Commercial

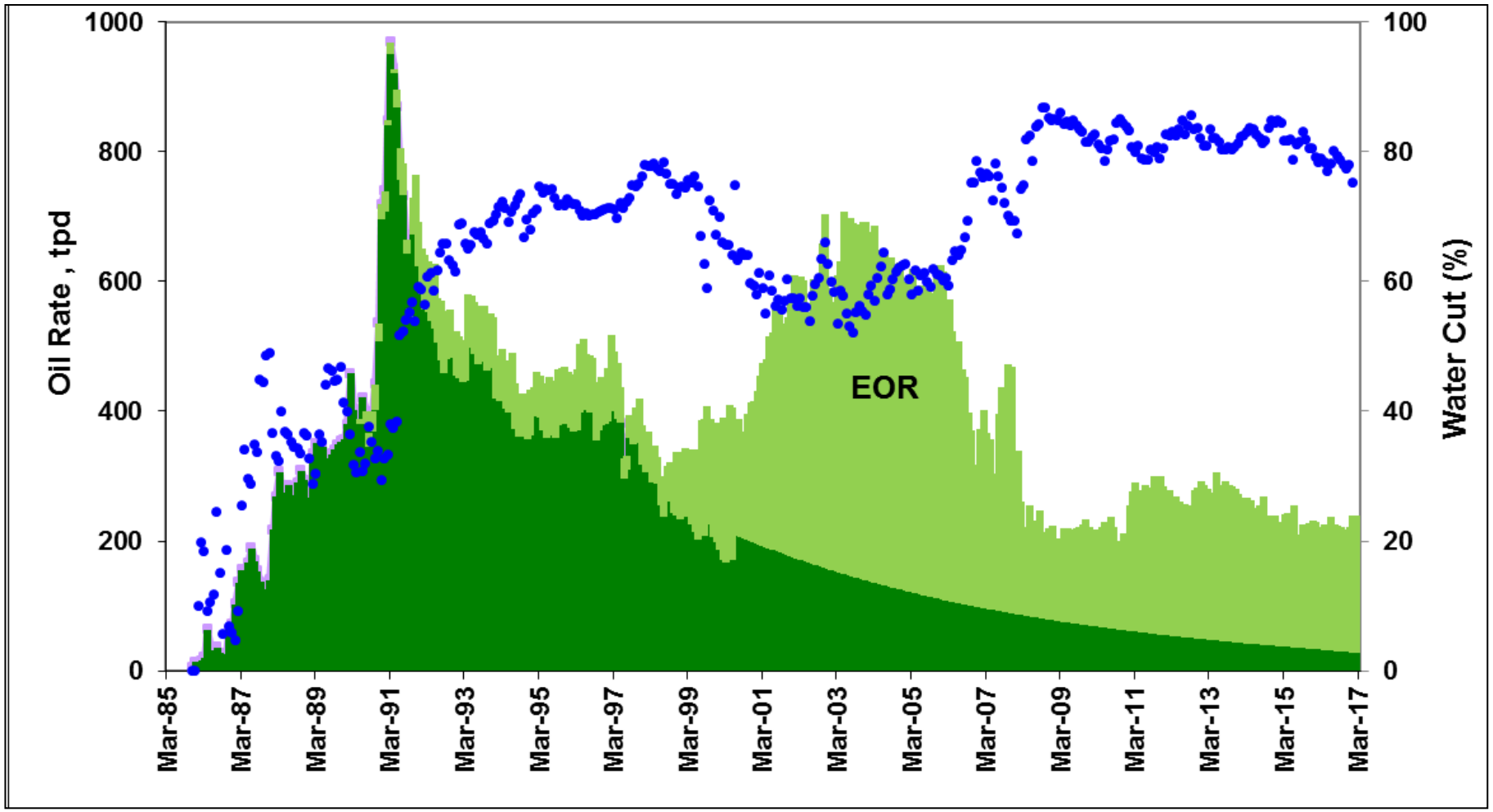
1997
Commercial Phase-I

2000
Commercial Phase-II





Heavy Oil : ISC , Balol

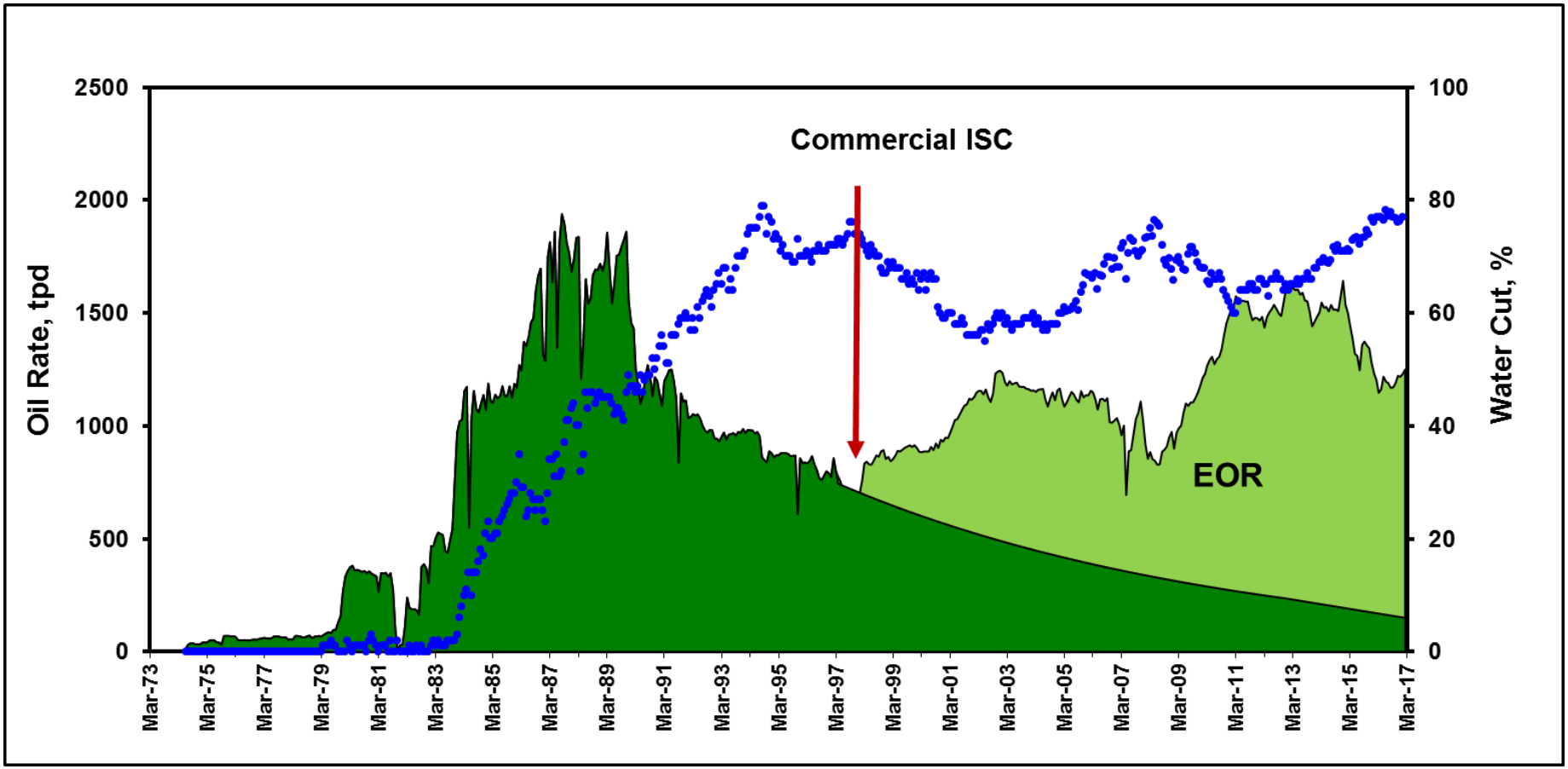


Envisaged Primary Recovery : 15 %

Recovered : 20 %

Recovery envisaged : 43 %

Heavy Oil : ISC , Santhal

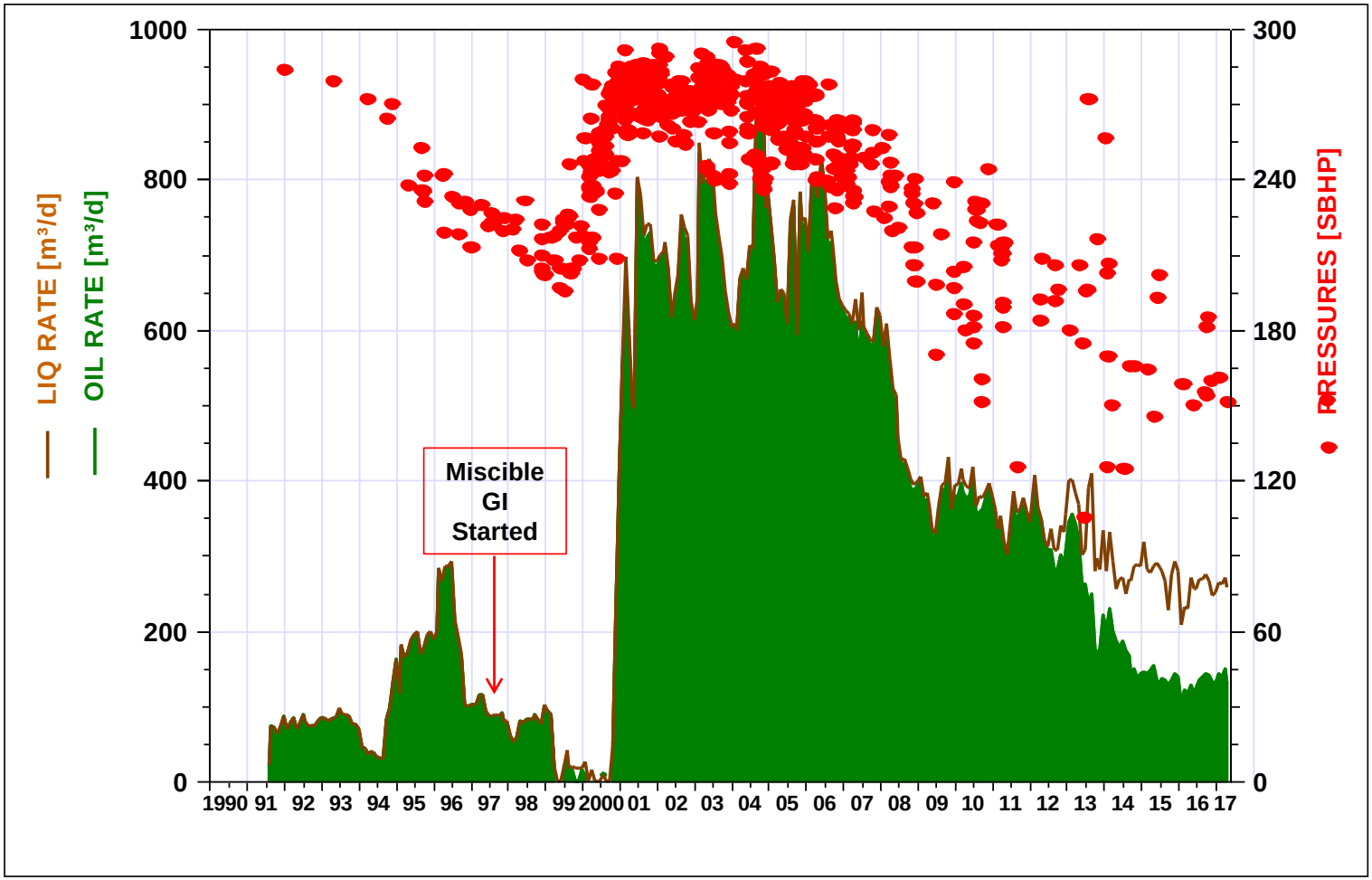


Envisaged Primary Recovery : 17 %

Recovered : 28 %

Recovery envisaged : 43 %

Light Oil : Miscible HC Gas , Gandhar

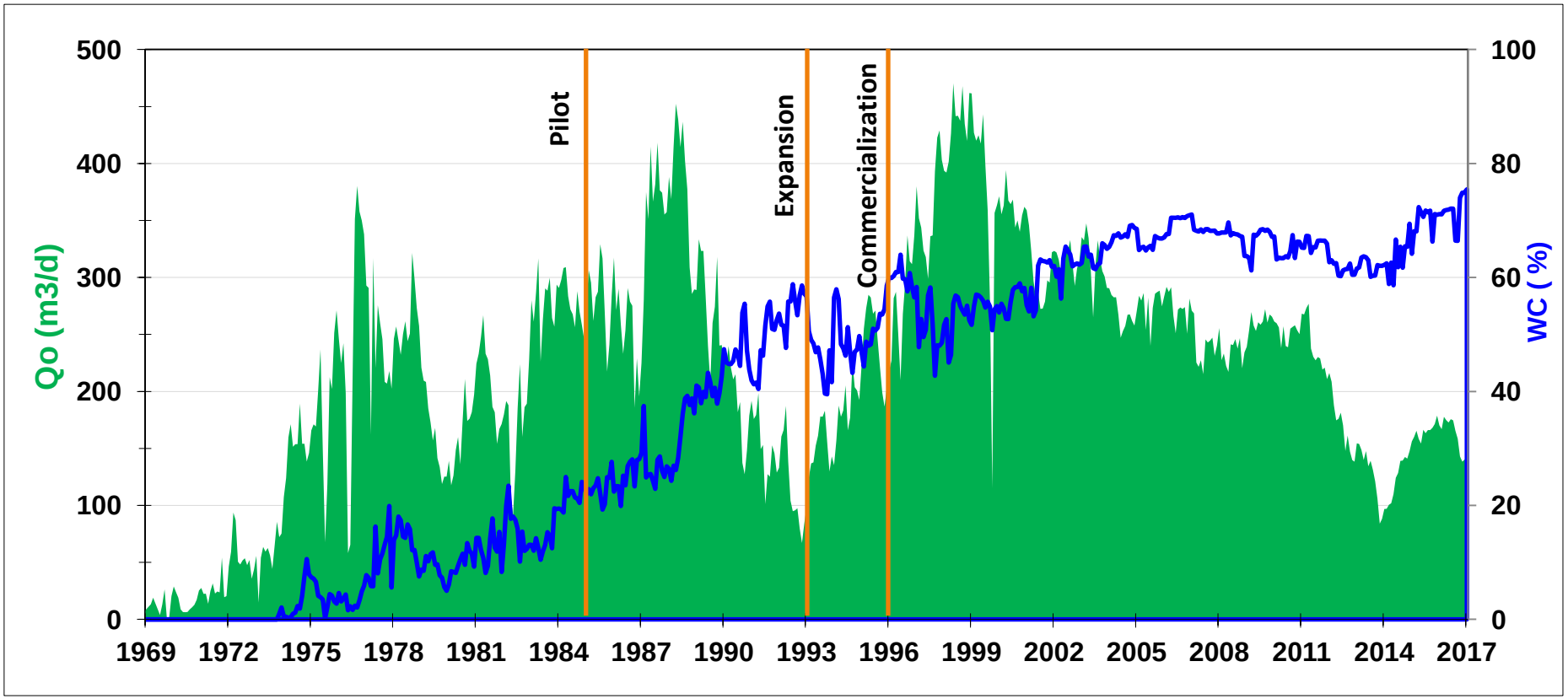


Recovery through WF : 36%

Recovered Miscible GI : 50%

Recovery envisaged : 54%

Medium Oil : Polymer Flood, Sanand



Recovery through WF : 15%

Recovered through Polymer : 26%

Recovery envisaged : 39%

Ongoing EOR Pilots

- ASP pilot-Jhalora (K-IV) : Too Early to Tell
- ASP pilot- Kalol-XII : Under Evaluation

Planned EOR Projects

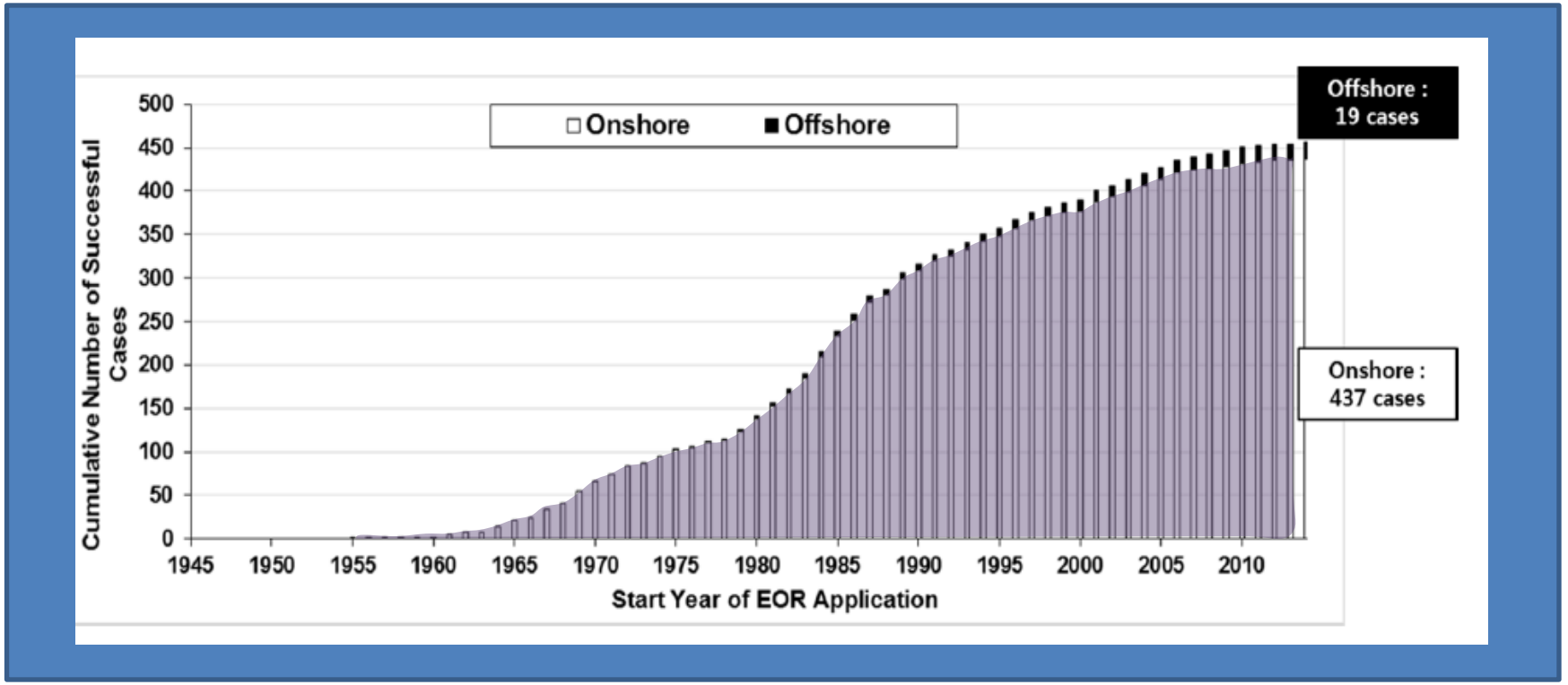
- Commercial
  - ASP : Viraj-K IX+X
- Pilot
  - Polymer : Bechraji
  - Cycle Steam Stimulation : Lanwa
  - ASP : Sobhasan : SS-II

Conceptualized EOR Projects

- Gravity Assisted Immiscible Gas Injection : Kasomarigaon
- Air Injection : Gamij
- Polymer flood : North Kadi
- Miscible CO_2 injection : GS-11 , Gandhar
- Miscible Hydrocarbon Gas injection : LBS-2 sand of Laiplingaon
- ASP flood : KS-III, Sanand

Offshore Scenario

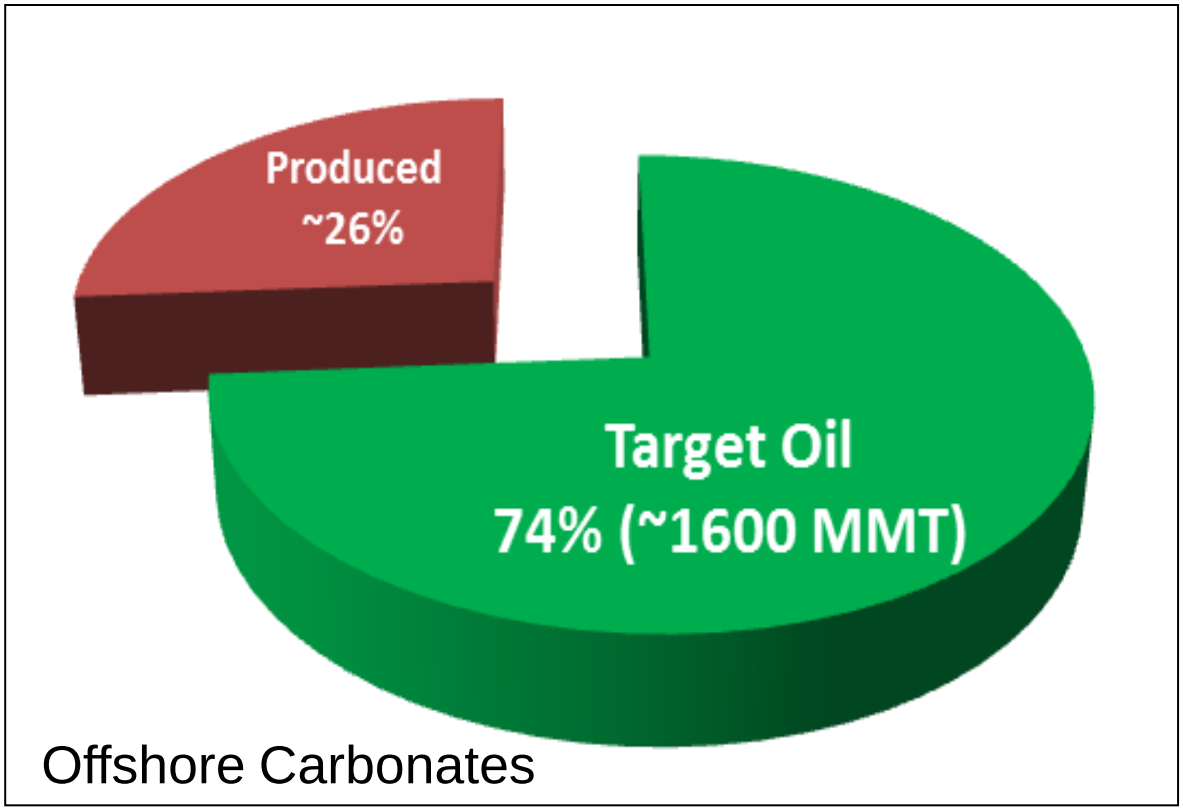
Offshore EOR : Few & Far…..



Cumulative number of successful cases of EOR application by start year **(Energies 2016, 9, 44)**

Opportunities

- Known resources in known Location
- Modest additions on a large base : Gain substantial



Challenges in Offshore

- Carbonate Environment :
  Complex rock mineral composition, dual porosity system, fracture density

- High Salinity (>30,000 ppm) & Temperature (~115 ^{o}C), Hardness (>2000 PPM):
  Limits application of Chemical EOR methods

- Large well spacing

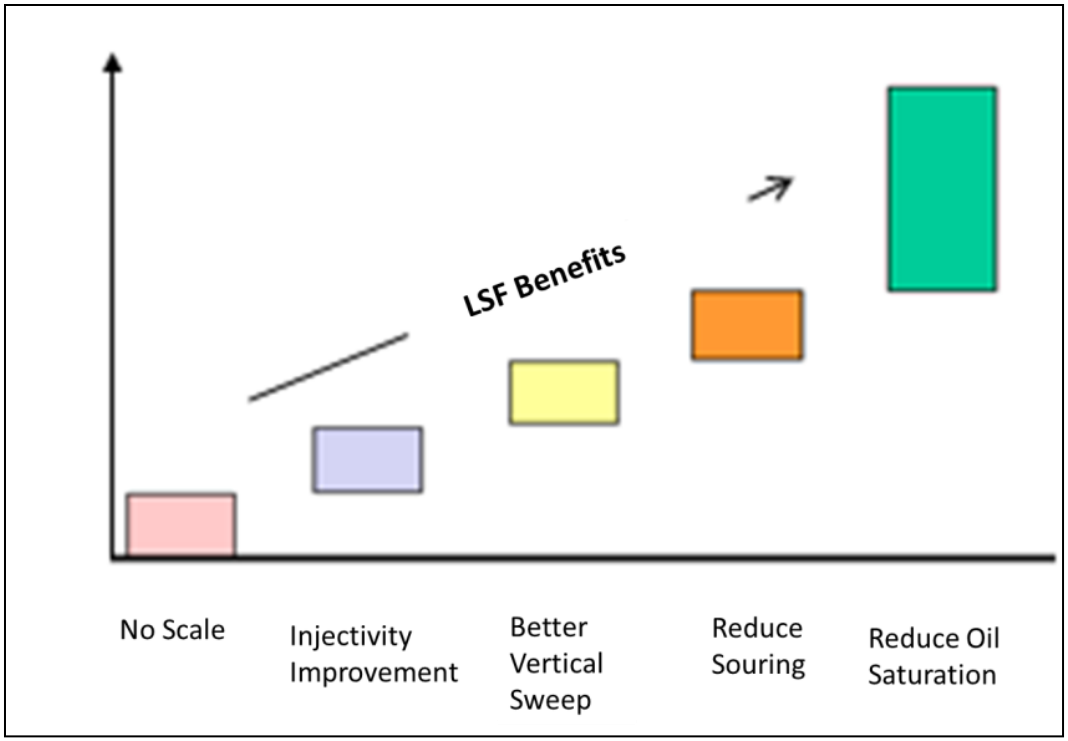
EOR Pilots

- Completed
  - SWAG in Mumbai High: Premature breakthrough of water and gas, objective couldn't be met.
  - Single well Micro pilot on Low Salinity Water Flood in Mumbai High : First time in the world in offshore carbonate
- Ongoing
  - SWAG in Heera Field : No significant gain. Further studies like Pressure gradient, PLT and tracer survey are planned.
- Planned
  - Low Salinity waterflood in Western Periphery, Mumbai High South
- Conceptualised
  - Low Salinity waterflood in South Heera

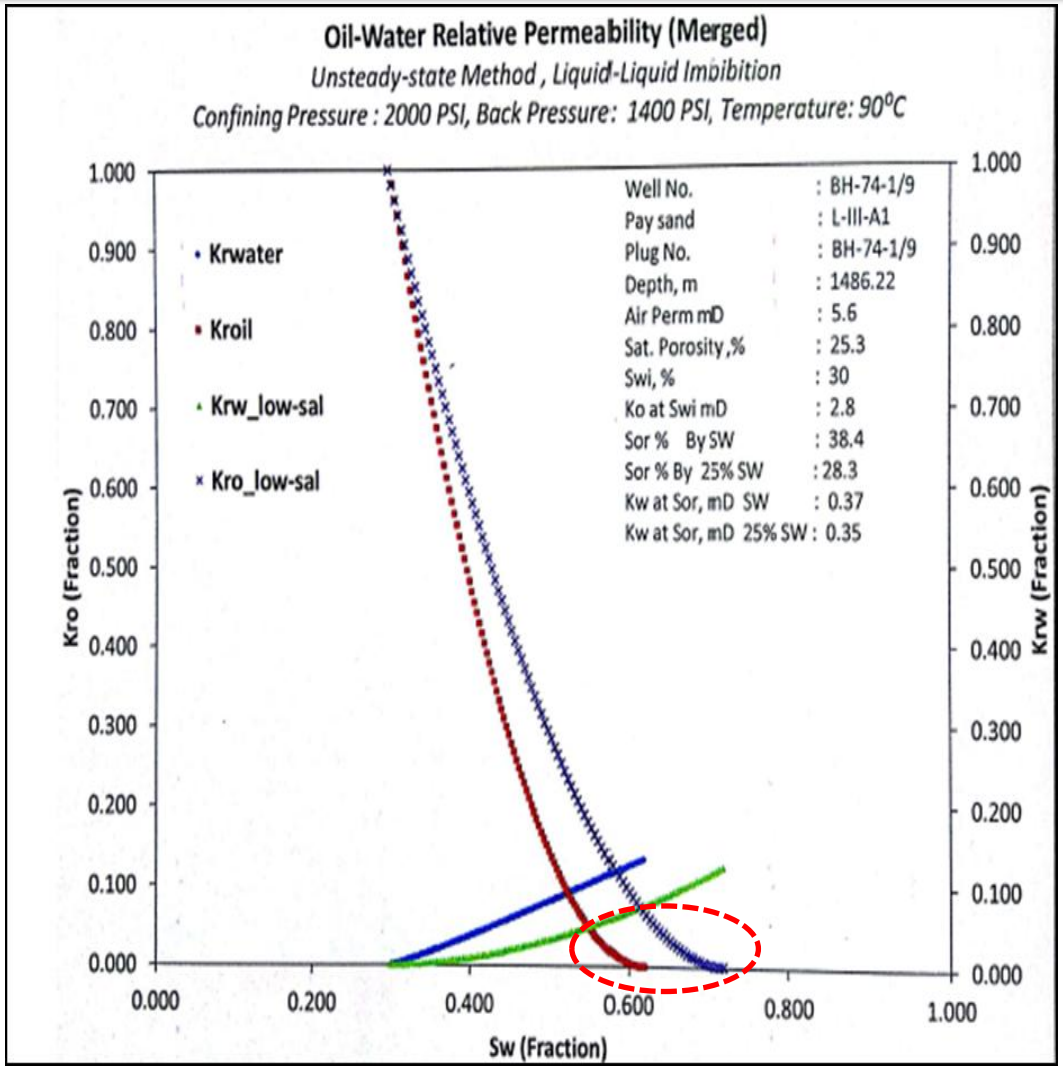
Low Salinity Waterflood

- LSF in Mumbai High & Heera
  - Laboratory Studies : MH & Heera
  - Simulation Studies : MH

- Upscaling from Lab to Field
  - Single Well LoSal Pilot conducted in MH South
  - Application being planned in MHS & S Heera



LSWF in Western Periphery



Relative K studies suggests incremental oil recovery with reduction in Sor by 10%

Challenges in EOR implementation

Challenges in Mature Fields

- Legacy infrastructure and rising operating costs
- Integrate new development within current facilities
- Add new facilities to the existing one (Marginal economics)
    - ✓ Increasing water production
    - ✓ Late life opportunities

Challenges in Offshore

- Large well spacing
- High retrofitting cost
- Logistic of transporting EOR agents
- Waste Management & HSE issues
- Fear of Unknowns & mindset

EOR Enablers

Knowledge Partners

COLLABORATIONS

UNIVERSITY OF CALGARY

THE UNIVERSITY OF TEXAS AT AUSTIN

UNSW THE UNIVERSITY OF NEW SOUTH WALES SYDNEY • AUSTRALIA

ARI

EOR Enablers

- Management focus
  - Long-term commitments & willingness to take risks
  - Vision for ultimate oil recovery instead of immediate oil gain
  - Research & Development
  - Excellence in operational practices

- Management policy
  - Companies should manage EOR projects in a technology portfolio during the Pilot phases
  - Economic viability should not be mandatory for designing and implementing EOR pilot

Incentivizing EOR

- Government policy : Fiscal incentives
  - Reduced rate of royalty / Sliding Scale of royalty
  - Exemption from Cess
  - Weighted tax deduction on expenditure for Pilot EOR projects
  - Incentive for implementing EOR for progressive volume production
  - Tax discount for mature field development through EOR

Summary

- Informed understanding of the process is the pre-requisite of success
- Tailor made EOR technique to suit specific reservoir
- Adoption of innovative & smart ways in mature field redevelopment
- Reduction of long lead time from concept to field implementation
- Collaboration with reputed Universities/ Institutions for immediate transfer/ upgradation of knowledge
- Relook into the current economic model : Fiscal incentives can be the game changer

Thank You