



Oil & Gas Day

11 July, 2017





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Agenda



Cairn : Sand to Oil Journey

Sudhir Mathur
Acting CEO

Resource to Reserve Conversion

Suniti Bhat
Director - Oil & Gas

Enhanced Recoveries & Tight Oil

Matthew Stanley
Senior Technical Fellow

Tight Gas

Sivakumar Pothepalli
Director - Rajasthan

Reserves to Cash Flow

Pankaj Kalra
Deputy CFO

Way Forward

Sudhir Mathur
Acting CEO



Cairn : Sand to Oil Journey

Sudhir Mathur
Acting CEO



Our Vision



- A global, world class E&P player
 - To enhance production levels to 500 kboepd thereby contributing to 50% of India's domestic production & Reserves of > 3 billion barrels of oil equivalent
 - To establish a diversified and sustainable portfolio
 - To deliver long-term value to host Governments, Local Communities and all Stakeholders



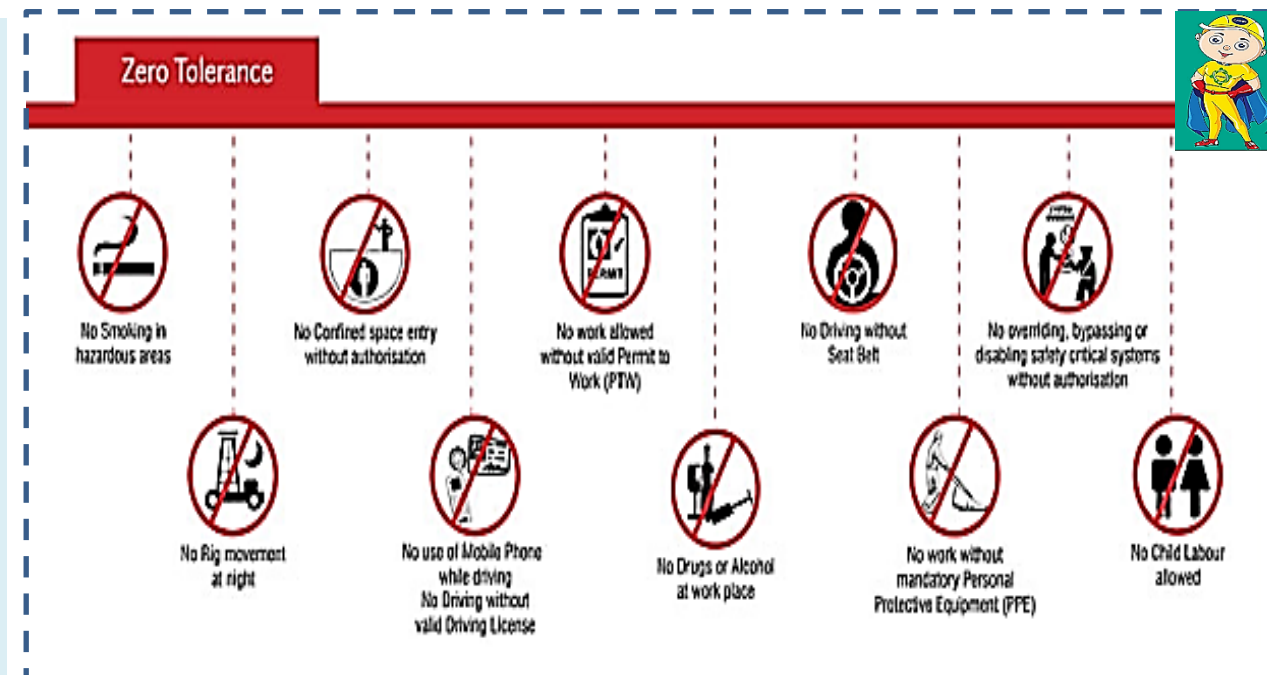
HSE & Sustainability – An Integral Part of Business



Building a zero harm culture

System & Processes *Driving top quartile performance (OGP Indicators)*

- Integrated best-in-class practices for HSE management , risk reduction and sound HSE assurance throughout the field life cycle
- Innovating and Leveraging technology
 - State-of-art plants with extensive application of safety in design
 - Integrated management of cyber security risks
 - Cross-functional performance dashboards & data analytics
 - Robust asset integrity and process safety management



Culture Outreach *Operating Philosophy: Safety first*

- Mandatory HSE training for employees and contractors
- Use of technology to assure road safety (GPS, vehicle tracking etc.)
- Focus on Health programs & Road safety
 - Contractor workforce trained on defensive driving practices
 - Community focused training programs on road safety awareness (21,000+ personnel trained)
- Waste minimization and reuse of produced water



HSE & Sustainability – An Integral Part of Business



Building a zero harm culture

Business Impact *Enables business delivery in safe environment*

- Value drivers for profitability: High safety, reliability & uptime at workplace
- Reducing operating risks and prudent risk management with efficient & safe project execution & Lower cost of insurance
- Optimum usage of energy and water resources
- Positive impact on stakeholders (customers, suppliers, community)



Recognition & Awards *Maintaining global standards*

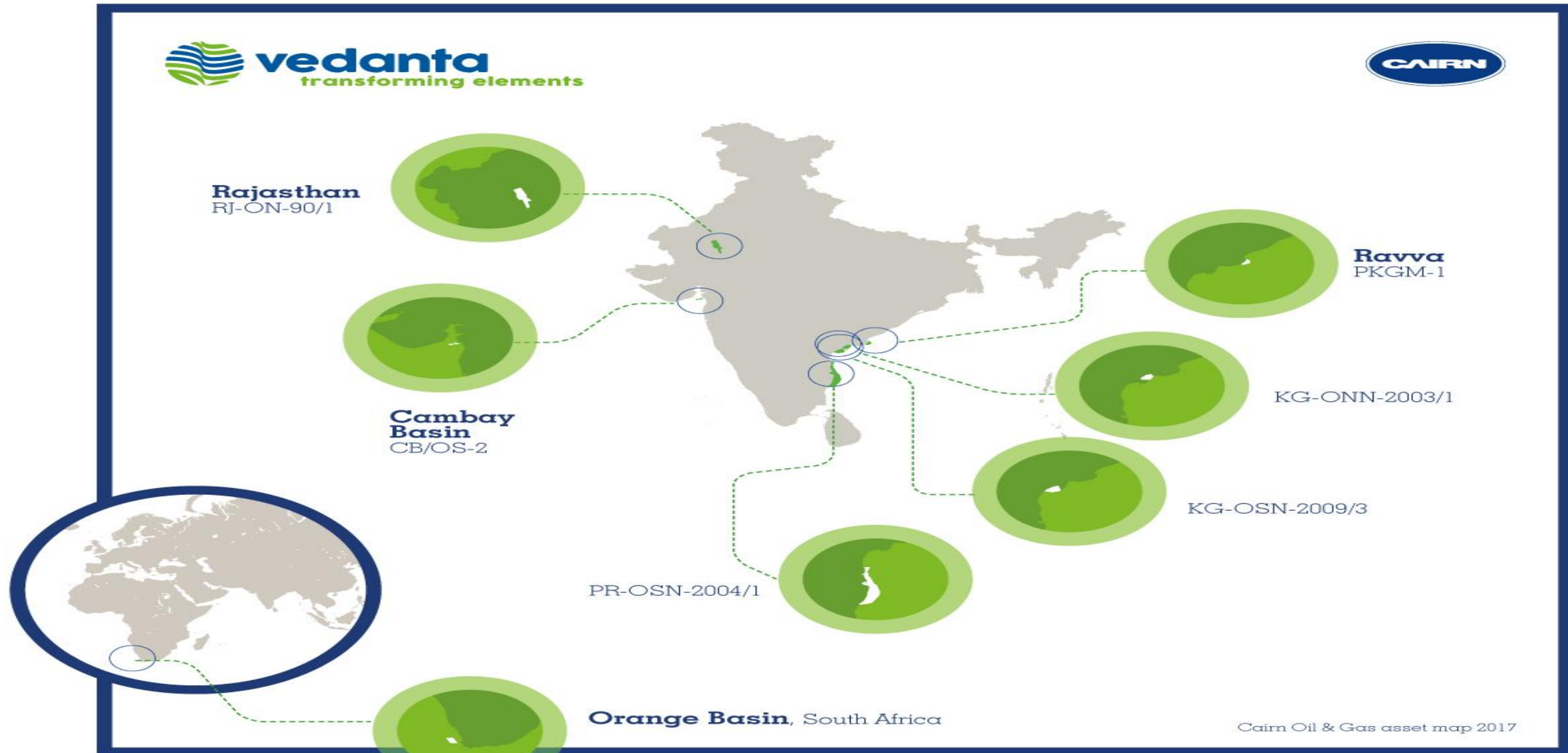
- Operating sites certified to ISO 9001, ISO 14001, OHSAS 18001 & ISO 22301
- Several accolades for HSE excellence:
 - National Safety Awards (Mines), DGMS, Ministry & Labour & Employment, Govt. Of India
 - OISD Safety Award
 - Golden Peacock Award for Risk Management
 - CII SHE Excellence Awards
 - FICCI Safety Systems Excellence Award
 - International Fire & Security Exhibition & Conference Award
 - D.L. Shah Gold Quality Award
 - British Safety Council Merit Awards



Cairn Footprint

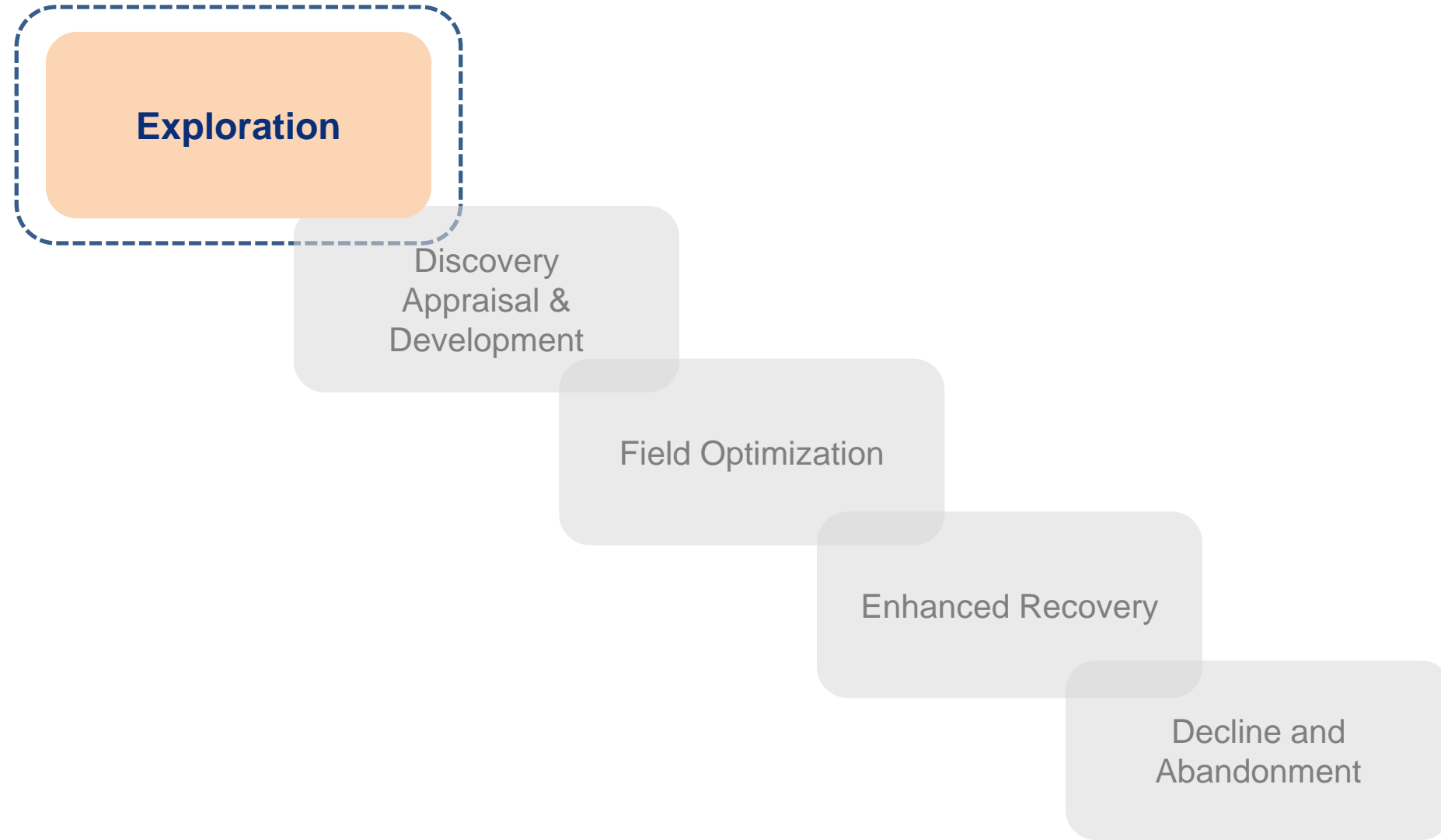


*~7.5 Billion boe of Hydrocarbons Initially In Place
51 discoveries till date*





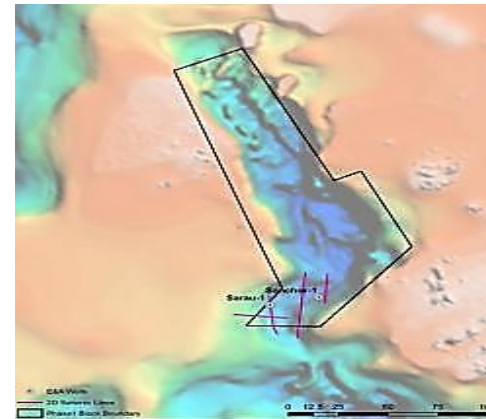
E & P Lifecycle





RJ-ON-90/1 Block: Sand To Oil Journey

“ Oil is found in the minds of men ” – Wallace Pratt



Shell acquires the block

Acquires 2D and 3D seismic

Executed Minimum Work Program as per PSC

May 1995

Pre 1995

2002

Frontier block with meagre 2D

Seismic and two dry wells by ONGC

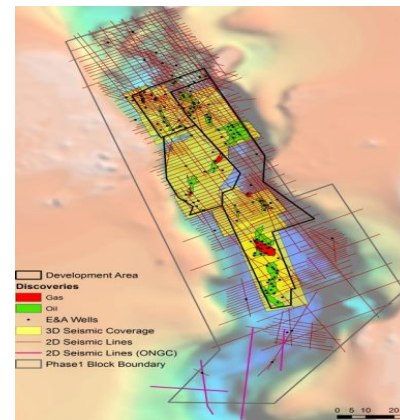
7 Years of Exploration in the Barmer Basin by 2 major O & G Upstream players yields no major discovery



RJ-ON-90/1 Block: Sand To Oil Journey



Only ~7% of the Total HIIP (6.2 Bnboe) have been recovered till date; Target Potential Recovery of 50% through Enhanced Oil Recovery Techniques



Shell exits and Cairn assumed 100% PI

Accelerated exploration spread over entire block

Focus on basin evaluation with technology induction and best practices

May 2002

2000



Cairn became Operator with 50%PI

Jan 2004

Mangala Discovery - World class reservoir

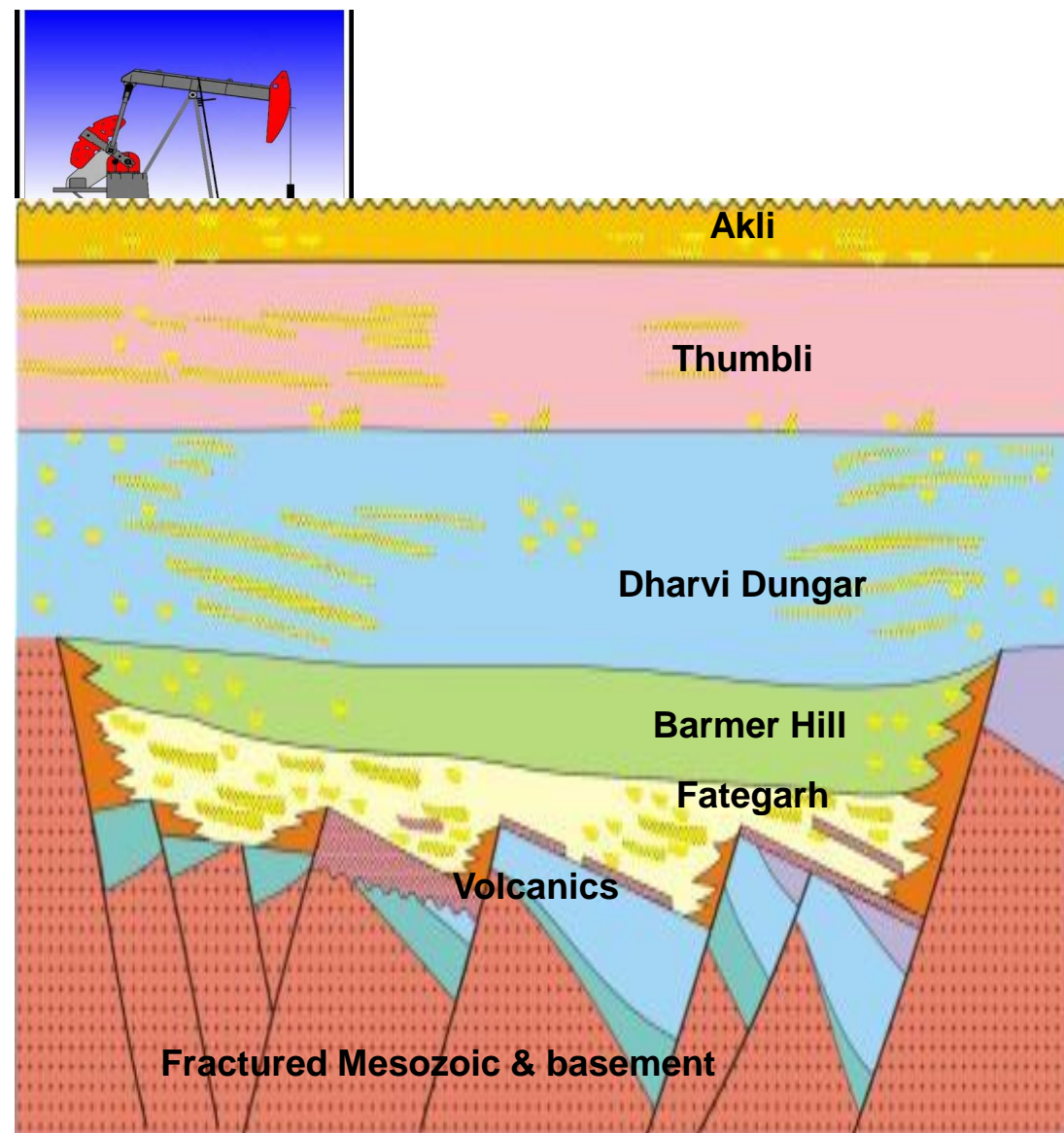
Discovery of **Bhagyam & Aishwariya** in quick succession

Established Barmer Basin on the O & G Map of India with 7 hydrocarbon bearing reservoir systems

RJ-ON-90/1 Block: Multiple Play types in the Basin



Unique proposition of single player in the Basin which has 7 Hydrocarbon bearing Reservoir Systems



Already Established Discoveries at Multiple Levels of the Reservoir System

Thumbli : Tukaram, Raageshwari Oil, Guda

Dharvi Dungar: Saraswati Crest, Kaam West, Guda S7

Barmer Hill : ABH, Vijaya, Vandana, MBH, NI – North, Shakti NE, DP

Fategarh : Mangala, Bhagyam, Aishwariya, Saraswati

Volcanics : Raageshwari Deep Gas

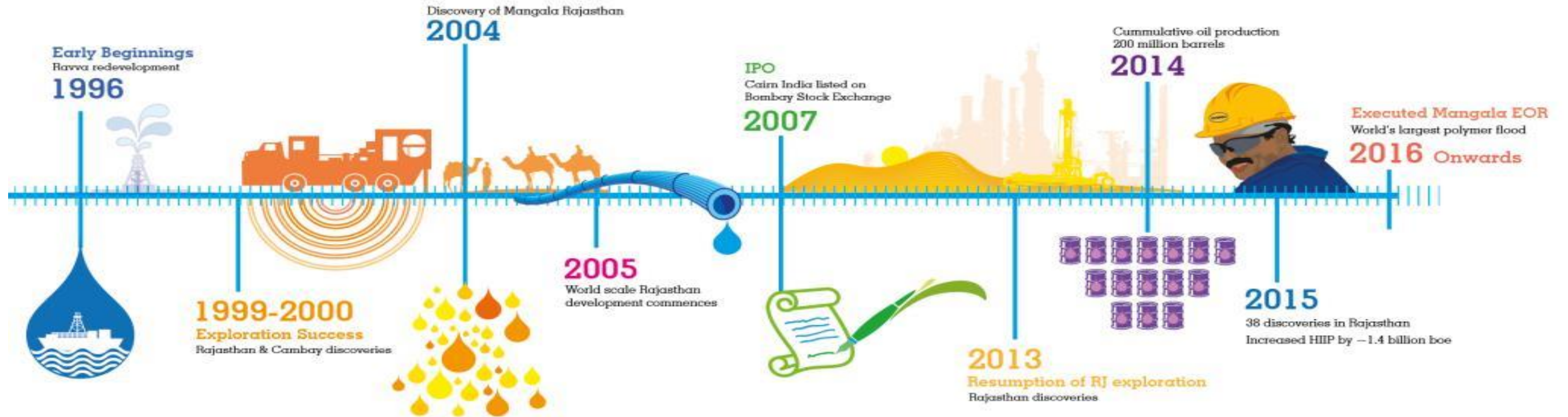
Basement : Saraswati Basement, Saraswati SW



Discovery to Commercial Development



Our Journey



HIIIP – ~7.5 bn boe

Production till date > 800 mmboe across RJ, Ravva and Cambay

Capex Investment > \$ 8 bn

Contribution to Exchequer ~ USD 24 Bn



Technology & Innovation



Key to generate higher value on a sustainable basis

Pipeline

World's longest continuously heated pipeline from Barmer to Bhogat in Gujarat (~700 kms)

Introduced Drag Reducing Agents to enhance pipeline throughput to 240 kboepd; can go further to 300 kboepd

EOR

Implemented the world's largest Enhanced Oil Recovery (EOR) project in less than 12 months

Successfully tested Alkaline-Surfactant-Polymer (ASP) flood process in the Mangala field

Digital Oil Field

Implemented Digital Oil Field across Rajasthan & Ravva

Provides real time data access from anywhere

Technology

As a first in India, Cairn conducted Time Lapse (4D) Seismic technology using an OBC (Ocean Bottom Cable) seismic survey

Hydrofrac technology to monetize Tight Oil & Gas formations



Gross Contribution to Exchequer



Contributing to Nation Building

Particulars	Amount (\$ bn)
Royalty	5.0
Cess & NCCD	4.5
Profit Petroleum	12.0
Sales Tax / VAT	1.5
Corporate & Dividend Distribution Tax	1.3
Total	24.3

Contribution to Exchequer

- Cumulative Contribution till date * to Exchequer is USD 24.3 Billion
- Cumulative Contribution in the last 3 years is ~USD 6.5 Billion

**From Production commencement of each block till March 31st 2017*



Growth Plan



Key Oil Projects	EUR (mmboe)	Capex (US\$m)	Status
RDG	86	440	Commencement of Phase-1 in progress Phase-2 by H1 CY2019
Mangala Infill	4	40	First oil by Q2 FY2018
Liquid Handling	12	120	Project execution to begin in FY2018
Bhagyam EOR	25	100	FDP submitted to JV
Aishwariya EOR	15	60	FDP submitted to JV
Aishwariya Barmer Hill	32	195	Phase-1 expected by Q2 FY 18, Phase-2 Project execution to begin in FY2018

RDG Gas project (Implemented in Phases)

- Phase 1: Ramp up production to 40 – 45 mmcfd
- Phase 2: Gas production to 100mmcfd & Condensate to 5kbopcd

Mangala Infill:

- 15 well Infill drilling program

Liquid handling:

- Upgrading infrastructure to support incremental oil volumes

Bhagyam & Aishwariya EOR:

- Successfully completed injectivity test

Aishwariya Barmer Hill:

- FDP for full field target to be submitted in FY 17 - 18

RJ Exploration

- Focus on identifying high impact plays for appraisal campaign in FY18

KG Offshore

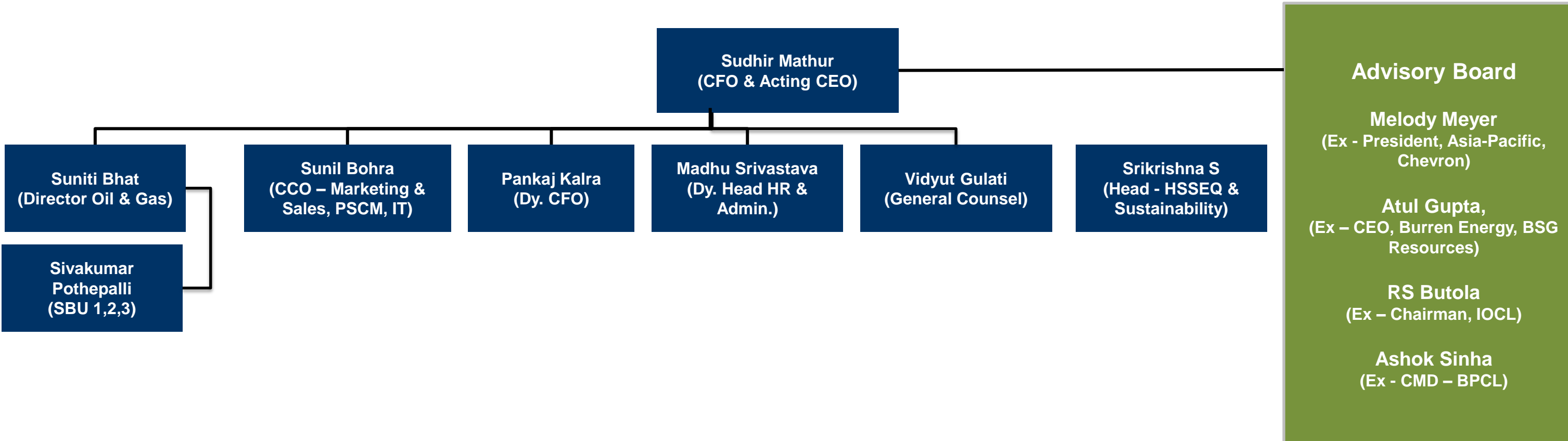
- Preparation for drilling of high prospect exploration wells in FY18

OALP

- Focused team formed for Regional analysis for Basin/sector prioritization & Evaluate prospective basins, high grade areas of interest



Cairn Oil & Gas Business EXCO



Invitees

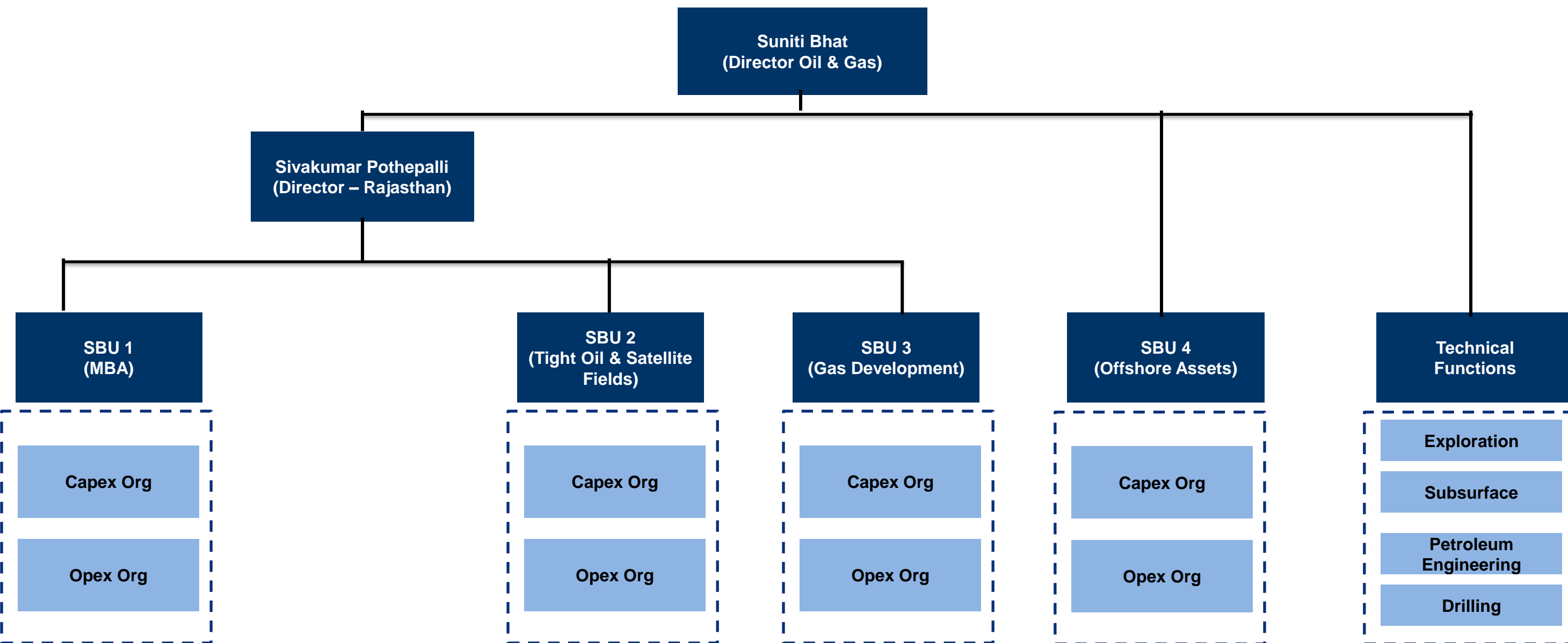
- Manoj Aggarwal
CSR & Public Affairs
- Arun Arora
Corporate Communication
- Arup Chakraborty
Internal Audit/Risk Assurance
- Pinak Mohapatra
Head Exploration
- TBH
(Chief Digital Officer)



Cairn Oil & Gas, SBU Structure



Organization structure geared to deliver vision





Human Resources

Focus on nurturing talent to foster growth



Attract & Retain Quality Talent

Campus Hiring, Hiring for Key Skill-Sets

- Global talent from premier Engineering & MBA colleges with Global/ MNC background
- Industry Stalwarts as Technical Advisors
- Key Skills like EOR Flooding, Artificial Lift, Hydraulic Fracturing, Horizontal Drilling available in-house
- 375+ Total Petrotech talent

Performance and Rewards

Meritocracy, Transparency & Differentiation

- Intensive sessions for Goal Alignment and cascade across the organization
- Differentiated rewards based on performance
- Market Leader in compensation of key talent

Leadership Development

Grooming Leaders internally

- Chairman Workshops - Identification of Future Leaders – 40 Internal Leaders have taken up enhanced roles this year
- 360 Degree Survey, Manager Engagement Scorecard used for Development Feedback
- 8 Years time to autonomy against 12 years average of Industry



Human Resources

Focus on nurturing talent to foster growth



Capability Building

On-the-job, Mentoring, Formal Training

- Professional Career Ladders
- On-the-Job Learning through special projects & rotation, e-Learning
- Behavioral & Technical Learning Programs
- Participation in Industry/ Technical Paper Presentation Forums
- Development Journey for GETs – BOLD

Employee Connect

Periodic connect with Sr. Leadership

- Organization & Department Level Town-halls
- Leader Connect – Interactive sessions with Senior Leadership
- CEO Corner – Forum where employees can directly reach out to the CEO
- V-Connect –Mentors for every employee

Engagement & Wellness

Round the Year Engagement Activities

- Progressive Policies for Wellness, Inclusiveness etc.
- Periodic Survey - Engagement score higher than O&G Industry in 2016 survey
- Annual Department team building retreats
- Yoga, Running & Cross-Fit



Corporate Social Responsibility



Commitment to empower local communities and bring sustainable & inclusive growth

Health and Sanitation

- **Water Project (INR ~ 100Cr.):**
 - 100+ Jeevan Amrit plants benefiting ~10 lac people
- **Health Care & Sanitation**
 - Mobile Health Van's catering basic medical care;> 80k people served;
 - 10k OPD's conducted through support to District Hospital Project
 - Support to institutions to improve healthcare indicators (IMR, MMR)
 - > 10k women impacted through Integrated Health care initiative
 - 25000 + HH toilets (85% utilization achieved)

Renewables

- ~30k people benefited through Solar based micro & off-grid household electrification project in partnership with community
- >10k Saplings planted along with multiple community water conservation structure developed.
- >20k students across 100 schools impacted through school electrification and Roof water harvesting project

Economic Development

- >12k students trained from CEC; Invested ~INR 60 Cr towards setting up excellence centre for advance trainings
- ~ 2k/year students benefit from these initiatives, with avg. income – INR 12k per month
- ~15k farmers benefited through agriculture initiatives; 25% increase in productivity seen for ~5,000 farmers
- 32 dairy cooperatives formed, 5 BMC set up using hi-tech technology - increase in price yield by 300% (INR 8 to INR ~35 per Litre)

Education

- ~4,000 Nandghar to be developed to focus strengthening pre-school learning of 3-6y ears children.
- So far, 90+ Nandghar constructed out of which 1st 50 are in Cairn Operational area
- ~1500 students are benefiting so far
- Infrastructure improvements in schools such as sanitation, computer rooms, libraries



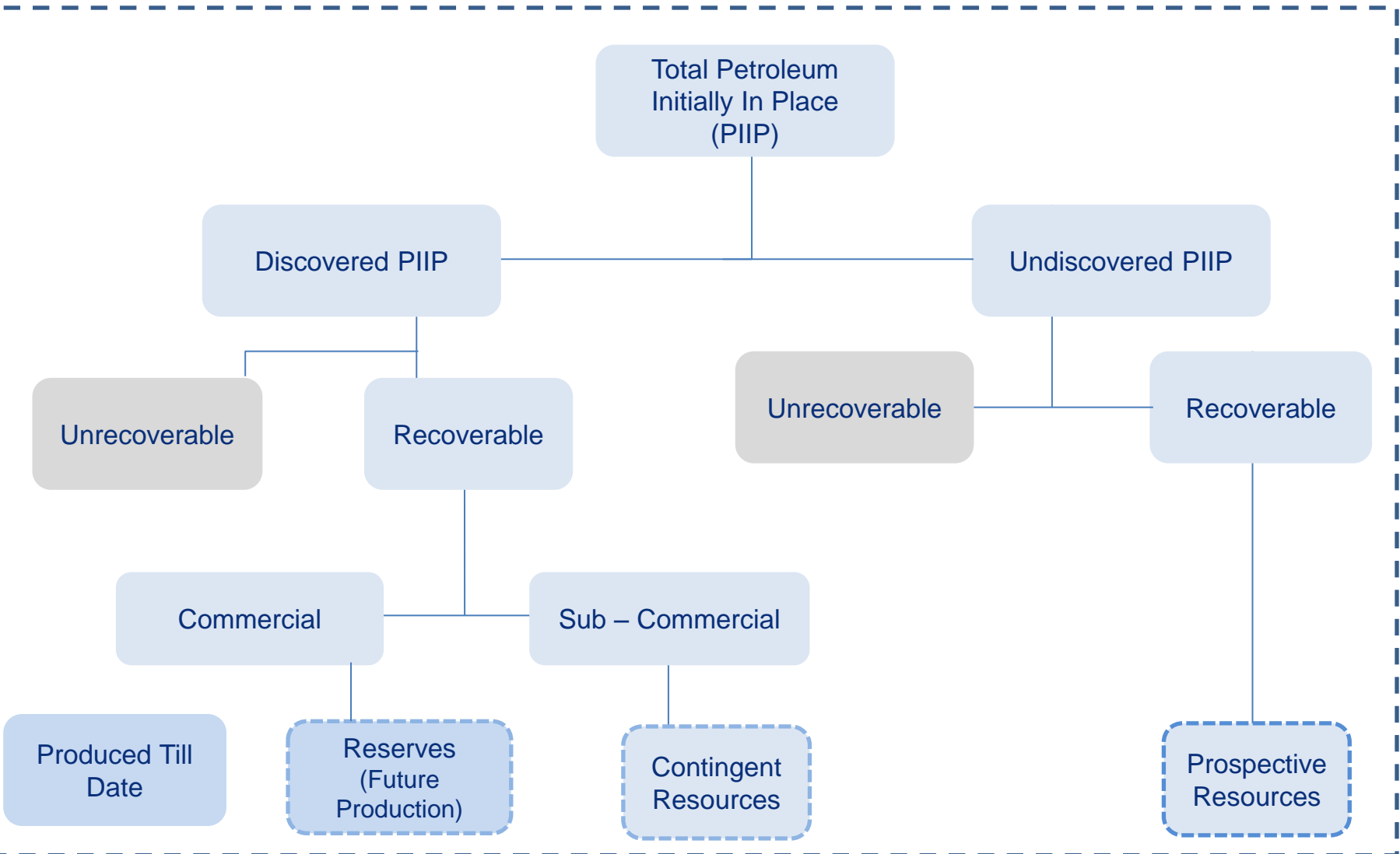
Resource to Reserve Conversion

Suniti Bhat
Director - Oil & Gas



Reserves and Resources: An Overview

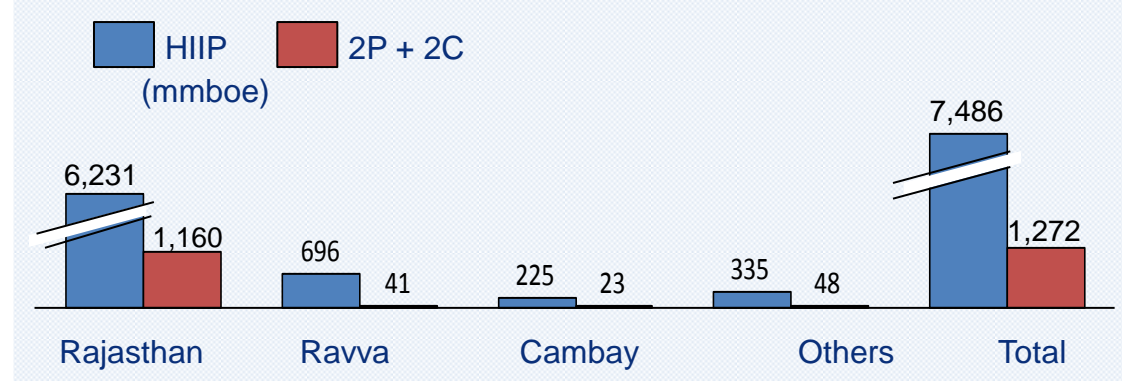
As per PRMS Guidelines



- ❑ Resources are all quantities of petroleum naturally occurring on or within the Earth’s crust
- ❑ Resources further classified
 - ✓ Reserves (1P, 2P & 3P)
 - ✓ Contingent Resources (1C, 2C, 3C)
 - ✓ Prospective Resources (Low, Base, High)

Total Hydrocarbons in Place (HIIP) (In Millions)

- Hydrocarbon Initially in Place of 7.5 bn boe
- 2P* Reserves and 2C Resources of 1.3 bn boe



1. **STOIP** (Stock tank oil initially in-place (mmboe))
 2. **GIIP**: Gas initially in-place (bcf),
 3. **HIIP (OHIP, PIIP)**: Hydrocarbon initially in-place (mmboe),
 4. **EUR**: Estimated Ultimate Recovery = Recovery Factor x In-Place .
 5. **Reserves or Resources** = EUR – production



RJ-ON-90/1 Block: Rich Portfolio



Total HIIP of ~6.2 Bnboe with a mix of conventional Oil, Tight Oil & Tight Gas

Mangala, Bhagyam & Aishwariya Fields

- Total HIIP of 2.2 Billion Barrels of Oil Equivalent; ~ 18% recovered so far, plans to take recovery rates to 50%
- Proven track record of recovery rates of ~ 45% of In-place Volumes in Offshore assets
- Application of technological intensive recovery mechanisms of Polymer and ASP to increase recovery
- Demonstrated success through implementation of world's largest onshore polymer flood in Mangala & ASP Pilot in Mangala

Tight Oil and Satellite Fields

- Total HIIP of ~3.7 Billion Barrels of Oil Equivalent
- Successful Appraisal of Barmer Hill through adoption of cutting edge Fracching technologies helping maximize recovery
- Target Recovery Rates of ~15 % of Total Inplace volumes vs. Global Peer Recovery Rates of ~ 10%

Raageshwari Deep Gas

- Total GIIP of 1104 Billion Standard Cubic Feet of Gas
- Targets Rates of Recovery expected at 60%
- Increased recovery through multi stage fracching technology



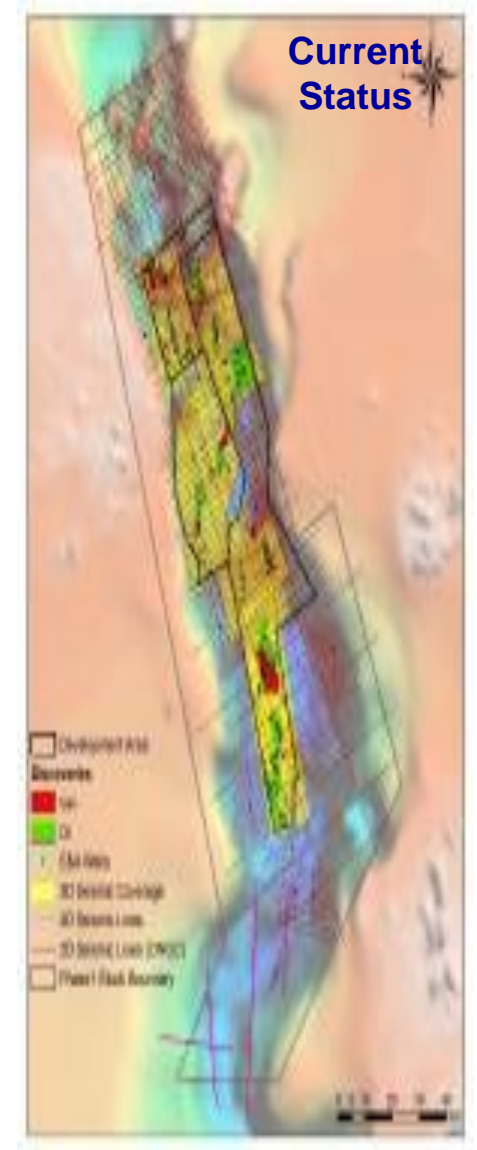
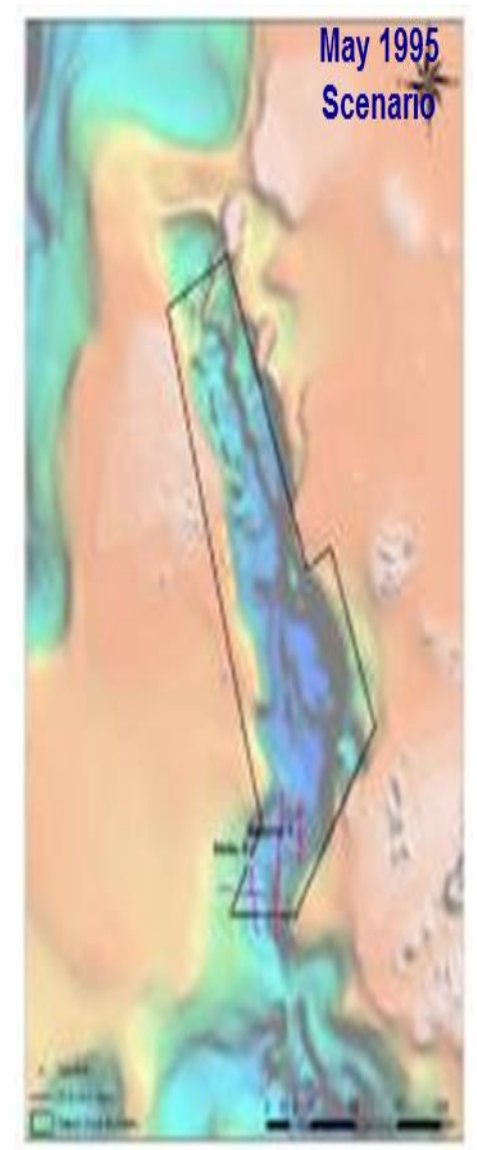
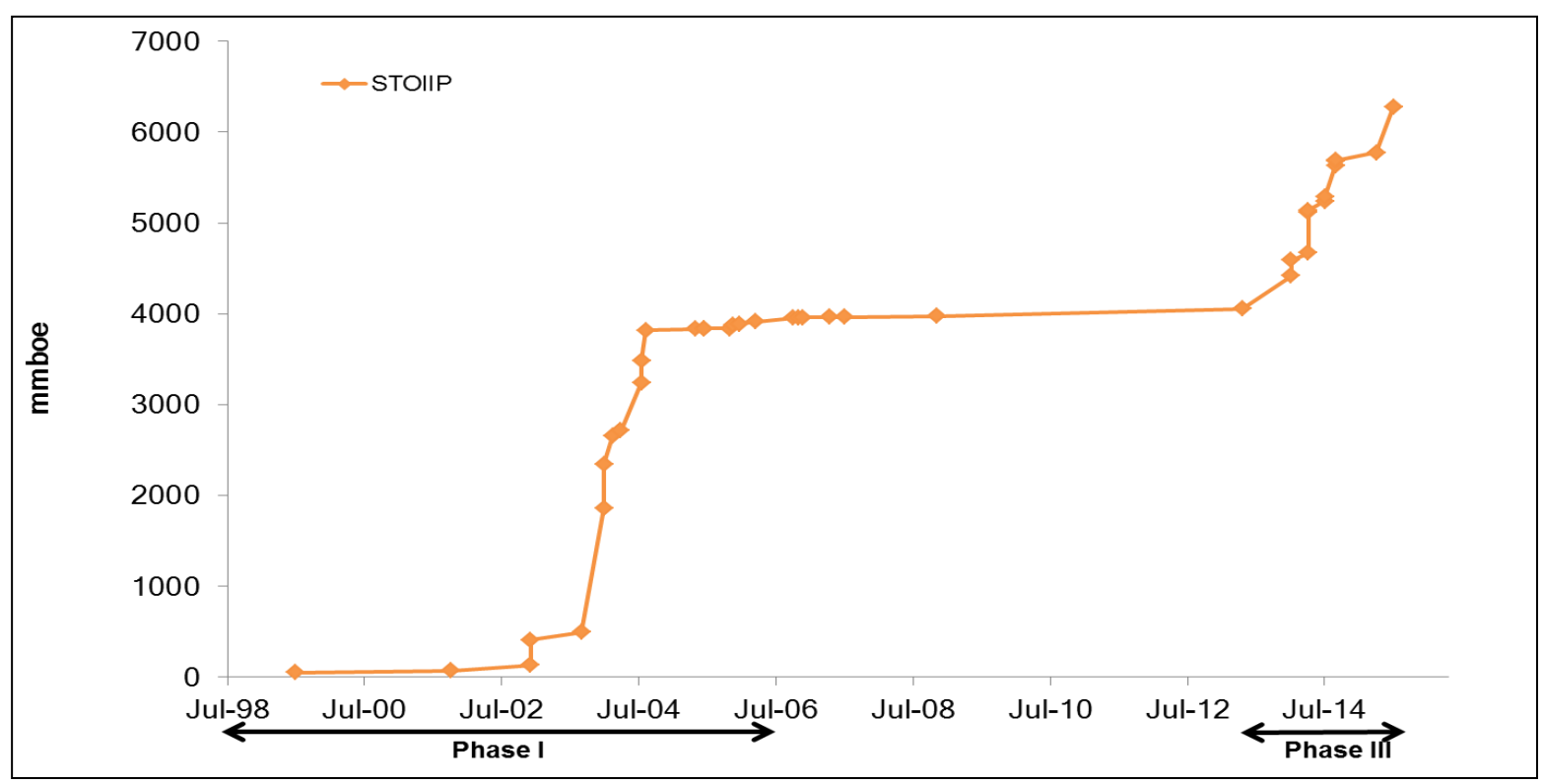
RJ-ON-90/1 Block: Rich Portfolio



Proven Exploration Track Record with 3 Largest Onshore Discoveries

Exploration

- New Plays being identified for drilling
- Prospects will add to the existing in-place Volumes



Ravva and CB / OS-2: Remarkable turnaround



Recovery Rates > 45% of total Hydrocarbons In place



Ravva

- Ravva oil & gas field in the KG Basin was developed in partnership with Cairn, ONGC, Videocon & ROS
- 22.5% Participating Interest with Operatorship
- **As a first in India, Cairn conducted Time Lapse (4D) seismic technology using an OBC (Ocean Bottom Cable) seismic survey**
- Infill drilling campaign arrested production decline and extended the life of the field by identifying areas of un-drained and by-passed oil
- A 225 acre onshore processing facility with 8 unmanned offshore platforms
- Has the capacity to handle 70,000 barrels of oil per day (bopd), 95 million standard cubic feet per day (mmscfd) of natural gas

CB / OS-2

- CB/OS 2 block is in the Cambay basin, developed in partnership with ONGC and Tata Petrodyne
- 40% Participating Interest with Operatorship
- Cairn's operations in CB/OS-2 block are centered on the Lakshmi and Gauri fields
- **Application of advanced geophysical tools transformed the block from a predominantly gas field to an oil field**
- An 82-acre onshore processing facility. It can process 150 mmscfd of natural gas and 10,000 bopd of crude oil



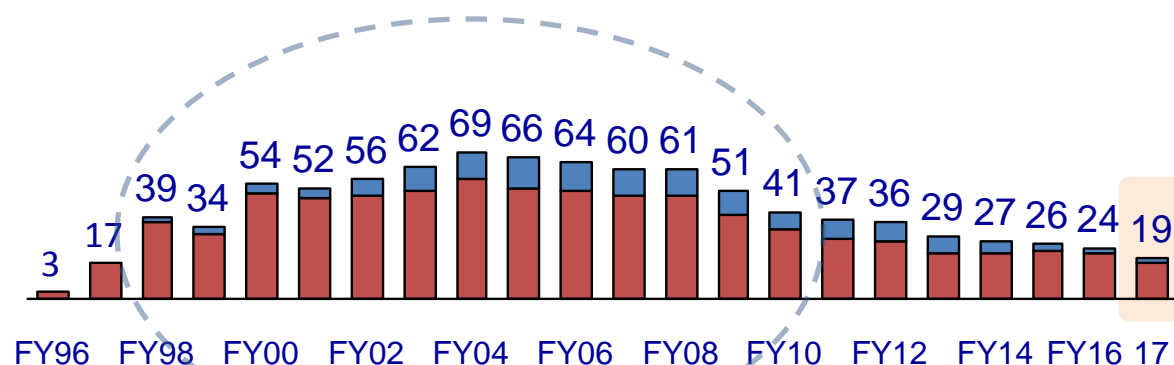
Ravva and CB / OS 2: Remarkable turnaround



Multifold increase in Ravva Production, Cambay Gas field converted Oil Field

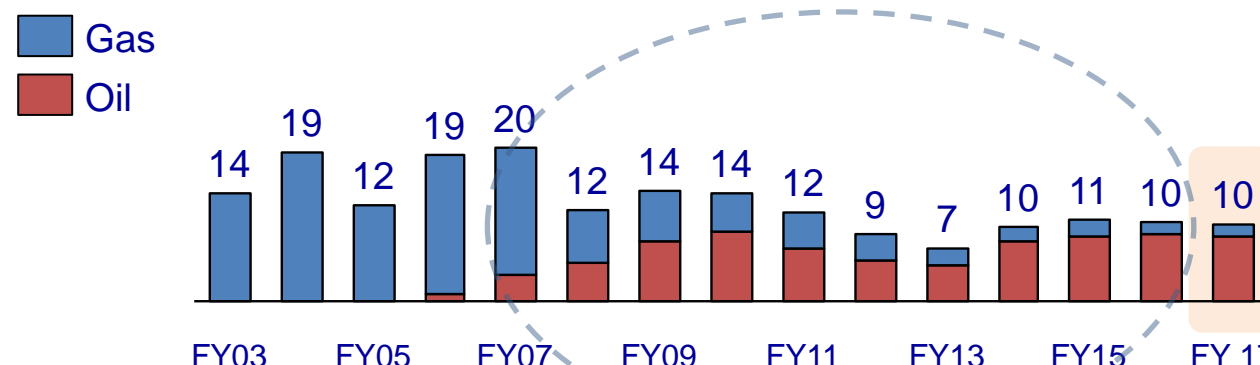
Production Journey: Ravva

(kboepd)



Production Journey: Cambay

(kboepd)



- Targeting incremental opportunities such as
 - Gas lift optimization , Addition of new zones
 - Network optimization
- Mature exploration prospects for exploratory drilling campaign in FY 2018-19

- Effective reservoir management, production optimization help offsetting natural decline
- Infill drilling campaign planned in the current FY

Plant Uptimes of >99% demonstrates Cairn's emphasis on operational efficiencies

Ravva and Cambay put together have produced 400+ mmboe as on Mar 31st 2017

Rich Exploration Portfolio



KG Block

KG – ONN (Nagayalanka)

- Exploration resulted in a light oil discovery and is the **largest oil discovery in the onshore part of the KG basin**
- The Gross Hydrocarbons Initially in Place is approximately 480 mmboe

KG – OSN – (KG Offshore)

- Cairn was awarded **sought after KG-OSN-2009/3 block in the NELP VIII**
- Drilling preparation in the high prospective block for FY 18 drilling

OALP / HELP Bidding Rounds

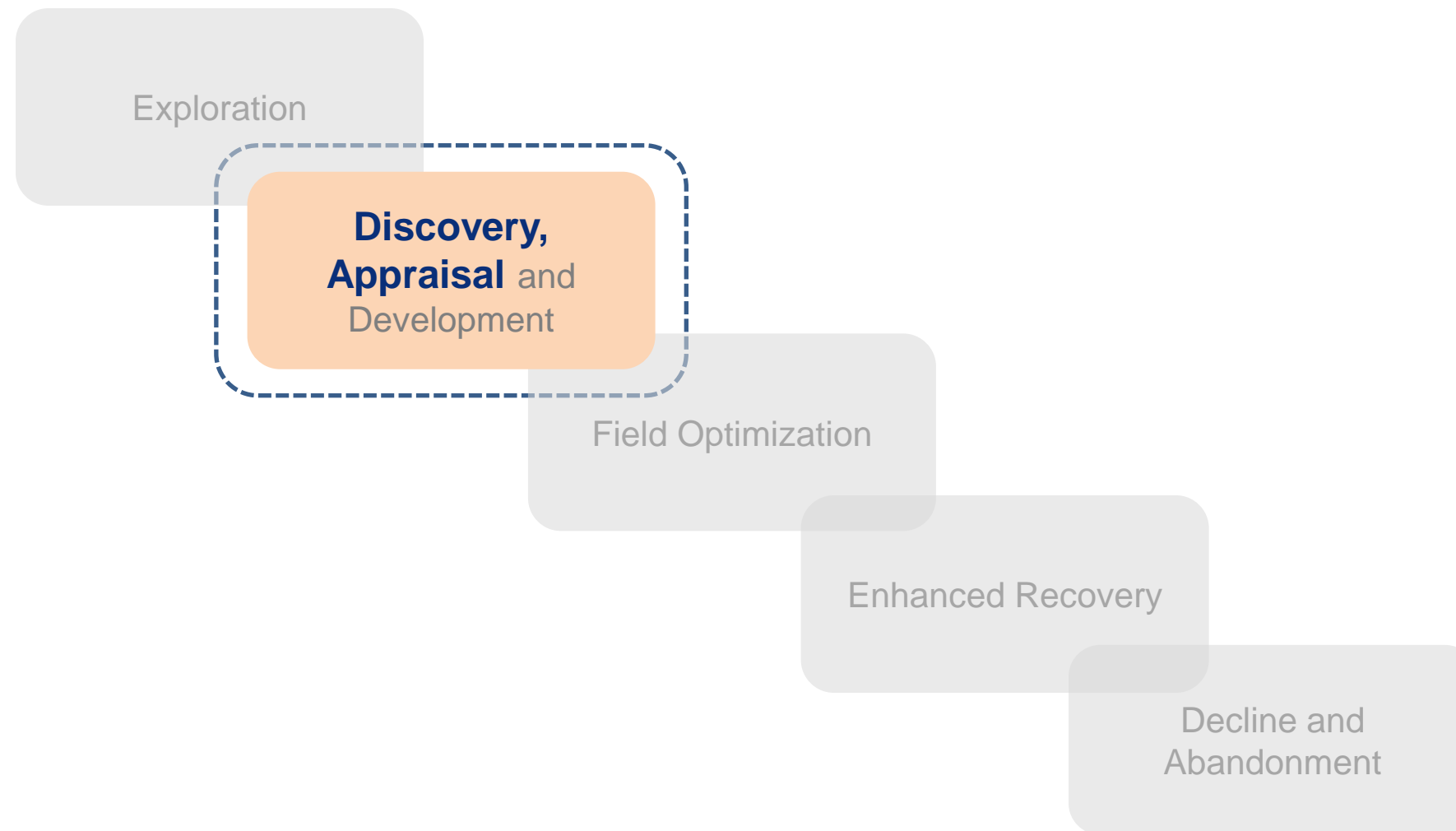
- Regional analysis for Basin/sector prioritization & Evaluate prospective basins, high grade areas of interest
- Prepare for bid rounds (OALP/HELP)



E & P Lifecycle



If Exploration leads to Discovery...

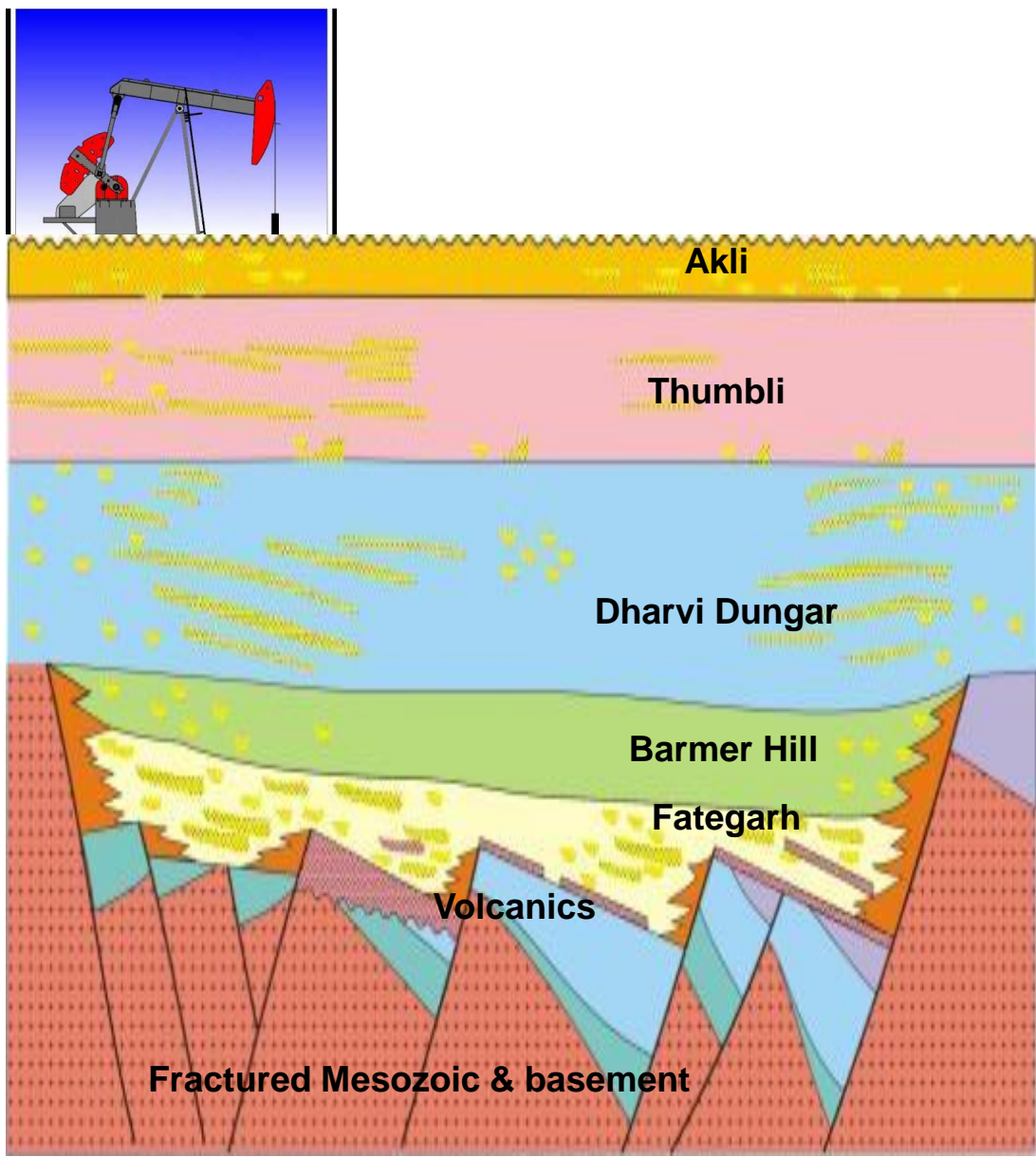




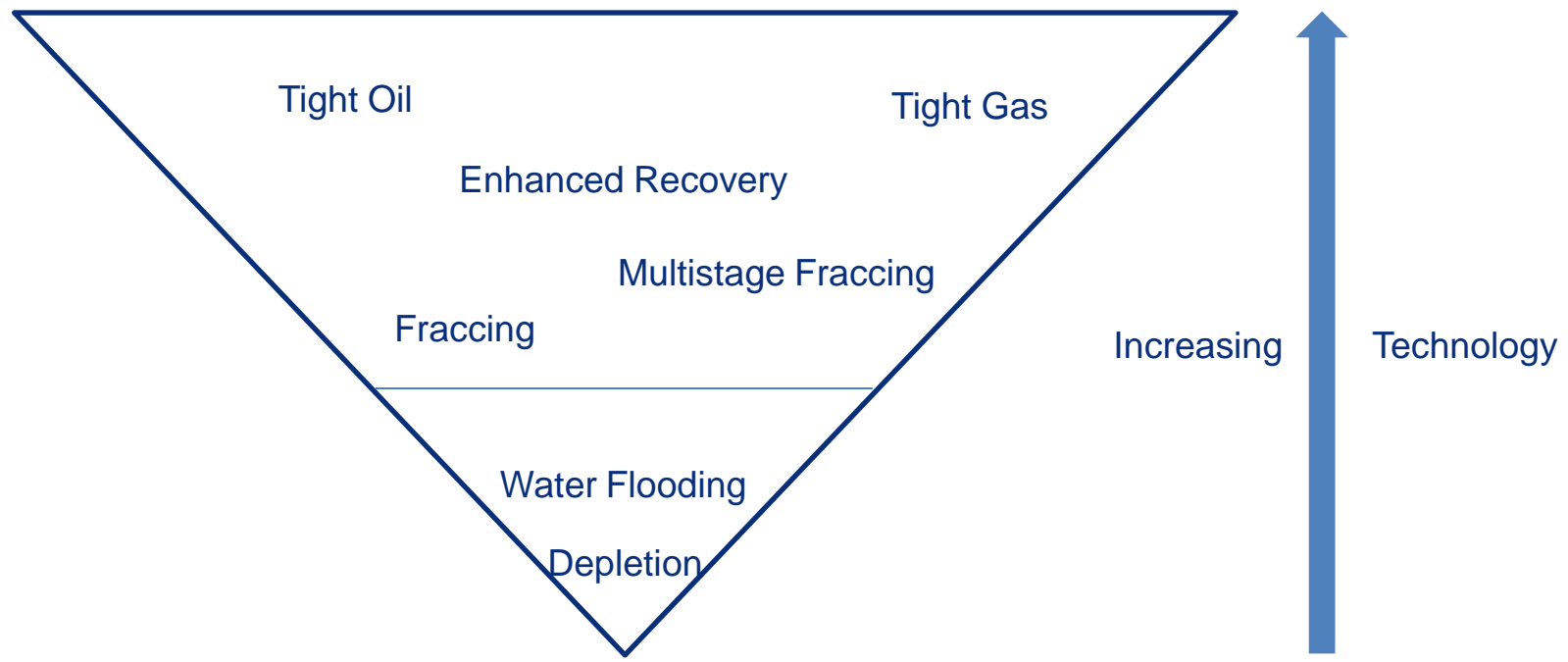
RJ-ON-90/1 Block: Multiple Play types in the Basin



Unique proposition of single player in the Basin



Pioneering efforts in Technology & Innovation driving monetization of multiple plays





RJ-ON-90/1 Block: Discoveries



RJ Block - 3111 Sq Km with rich set of Options

- 1999 - Guda**
- 2001 - Sarawati**
- 2002 – Raageshwari Oil, Raag Deep Gas**
- 2003 – Kaameshwari**
- 2004 – Mangala, Aishwariya, Vijaya, Vandana, Managala Barmer Hill, Bhagyam , Shakti**
- 2005 – GSV, N-C West, NI, Bhagyam South, NI - North**
- 2006 – NE, NP, Shakti NE 1, KW 2, KW 3**
- 2007 – Saraswati Crest, KW 6**
- 2008 – Tukaram**
- 2013 – Raageshwari S1**
- 2014 – ABH, V2Y Channel, Guda S7, NR 3, KW – 8, SL 1, NL 2, DP 1, Saraswati SW, Aishwariya 46**
- 2015 – Saraswati Basement, Raageshwari North 1**

- ✓ Feb 2013: Government approval for exploration in development areas
- ✓ Aggressive drilling and seismic campaign to test new plays
 - ✓ Acquired 1500 sq km of high quality 3D seismic data
 - ✓ 50 Exploration and appraisal wells drilled
 - ✓ **13 new discoveries**
- Established 1.8 bn boe in- place resource during 2013-15 ; total in-place resource of ~ 6.2 bn boe
- Unlocked tight oil potential in the basin utilizing new techniques in seismic inversion, petrophysics and hydraulic fracturing

38 oil and gas discoveries in RJ till date

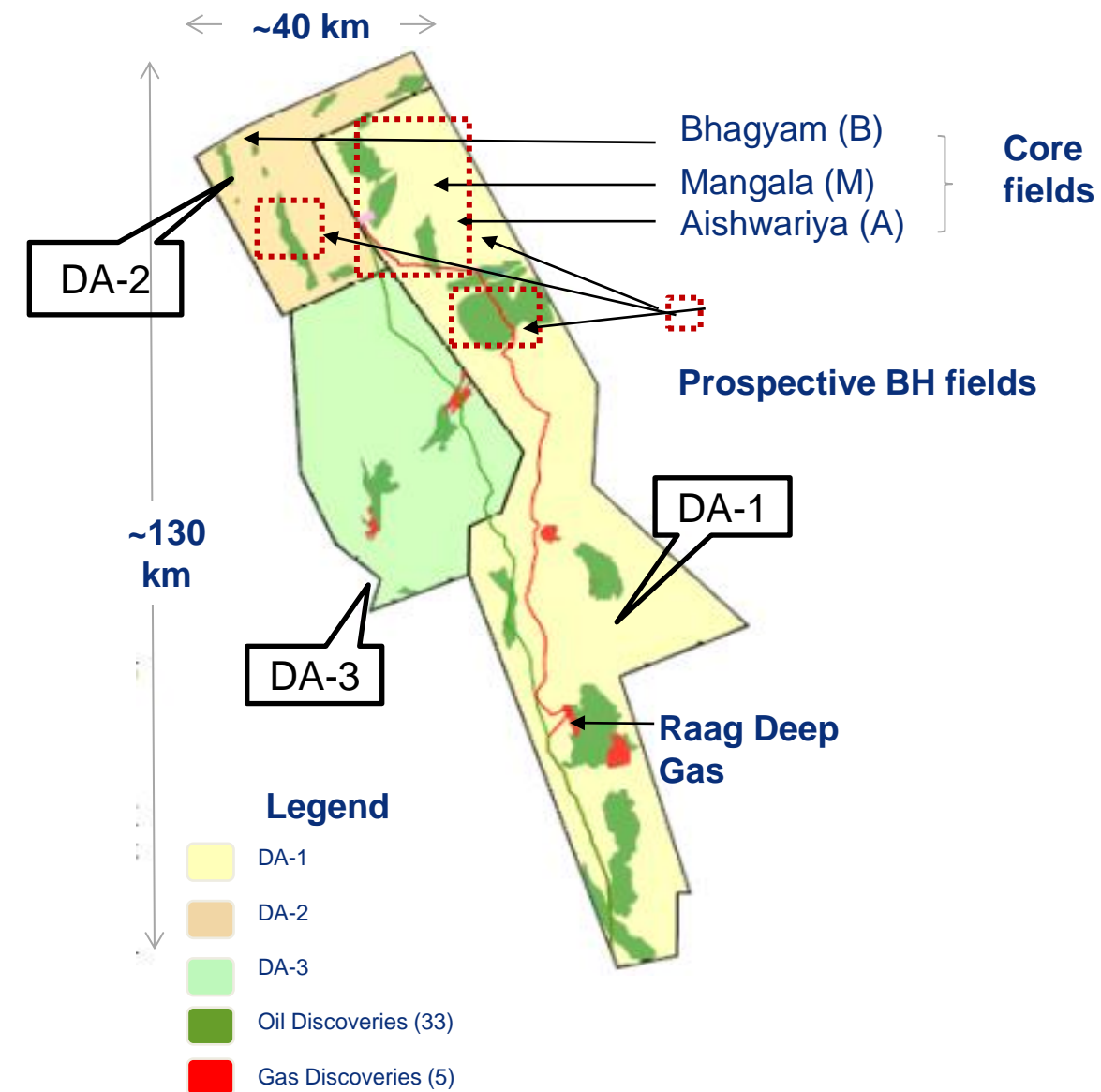


RJ-ON-90/1 Block: Discoveries



RJ Block - 3111 Sq Km with rich set of Options

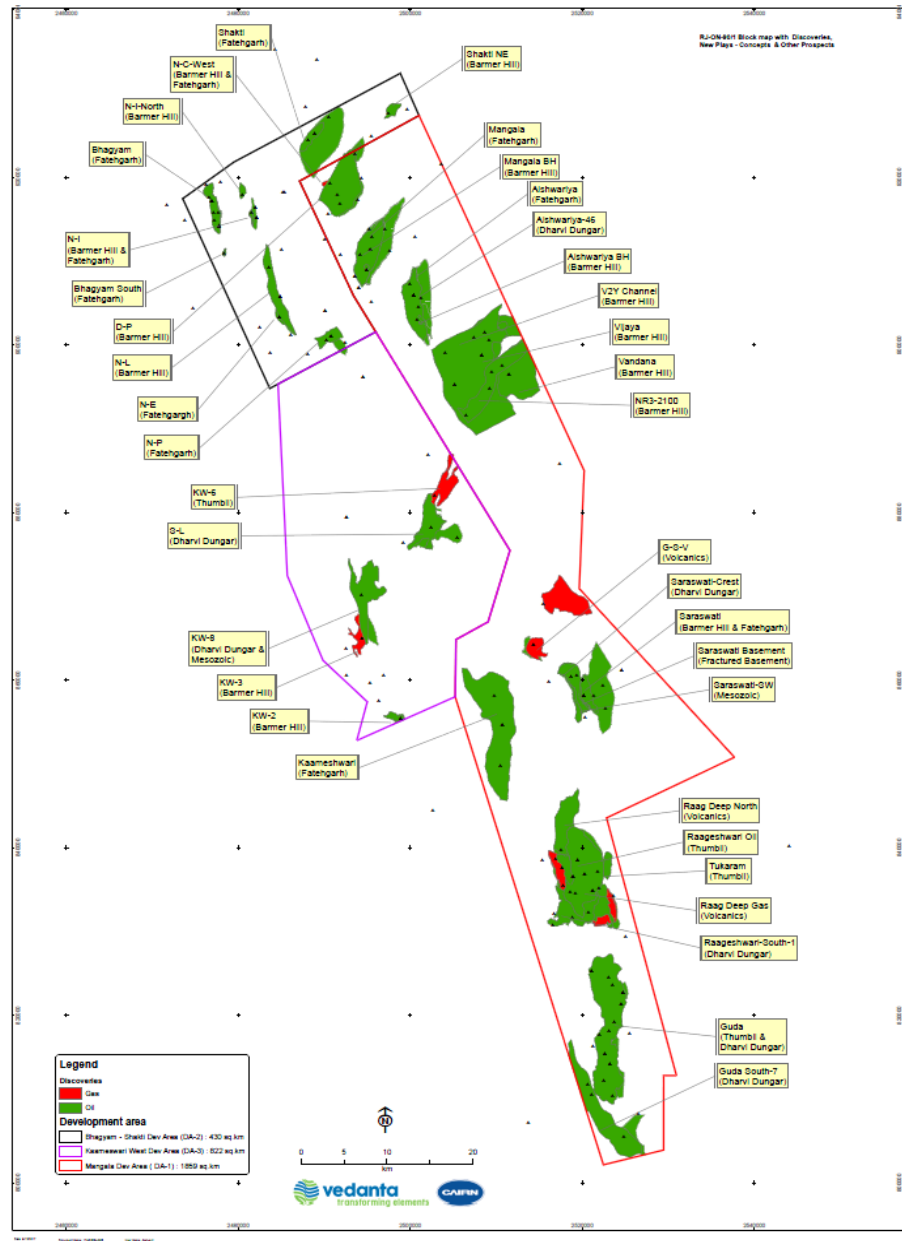
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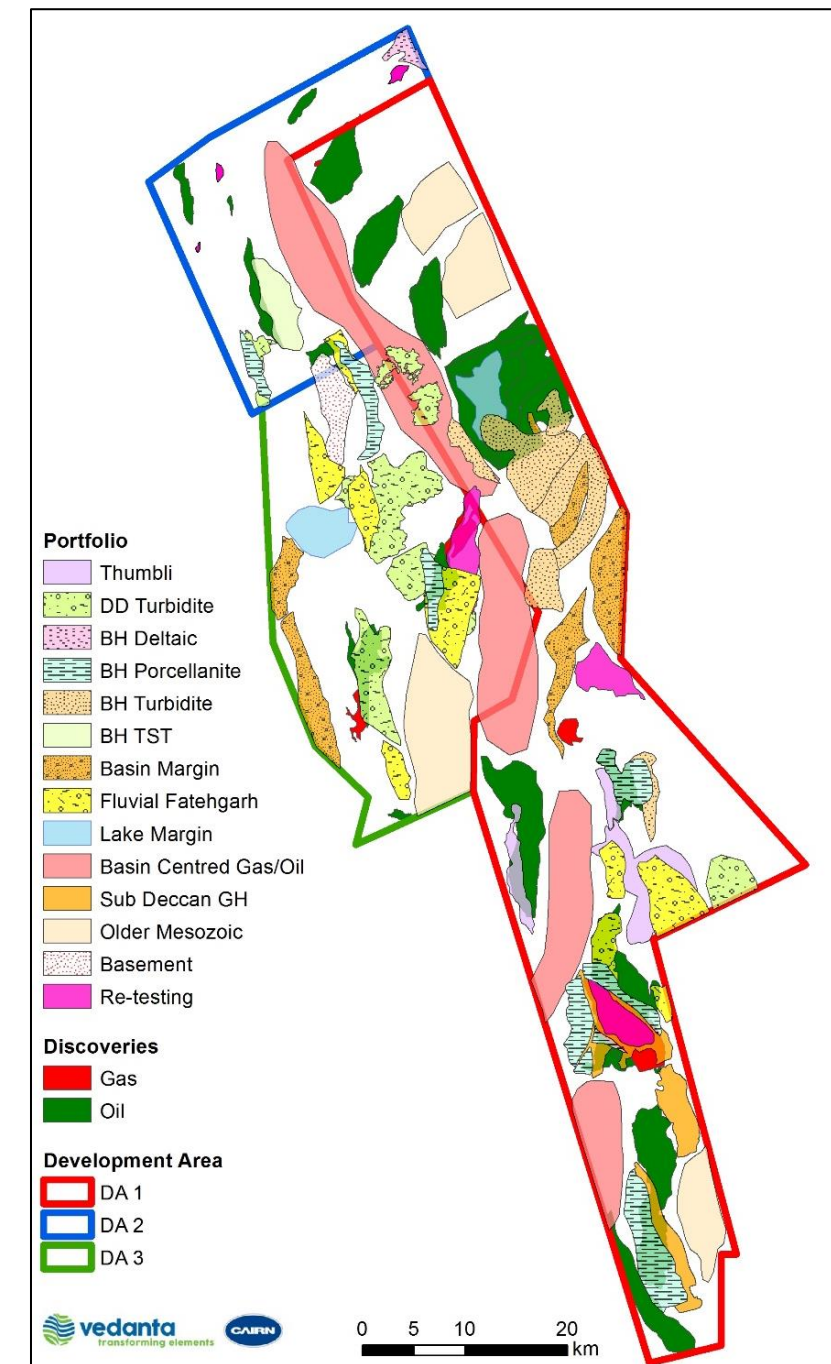
38 oil and gas discoveries in RJ till date



Discoveries and Future Potential



Discoveries in each stratigraphic interval	Formation	Lithology	Number of Prospects in Portfolio
	Uttarlai	[Lithology: Yellow sandstone]	
	Jagadia	[Lithology: Yellow sandstone]	
	Nagarka	[Lithology: Yellow sandstone]	
	Akli	[Lithology: Grey sandstone]	
4	Thumbli	[Lithology: Grey sandstone]	6
6	Dharvi Dungar	[Lithology: Grey sandstone]	4
13	Barmer Hill	[Lithology: Grey sandstone]	14
10	Fatehgarh	[Lithology: Yellow sandstone]	12
3	Deccan Volcanics	[Lithology: Black volcanic rocks]	3
1	Ghagar-Hakra	[Lithology: Yellow sandstone]	4
	Karentia Volcanics	[Lithology: Black volcanic rocks]	
	Lathi	[Lithology: Yellow sandstone]	3
1	Malani Volcanics	[Lithology: Red volcanic rocks]	1





Discovery to Reserves

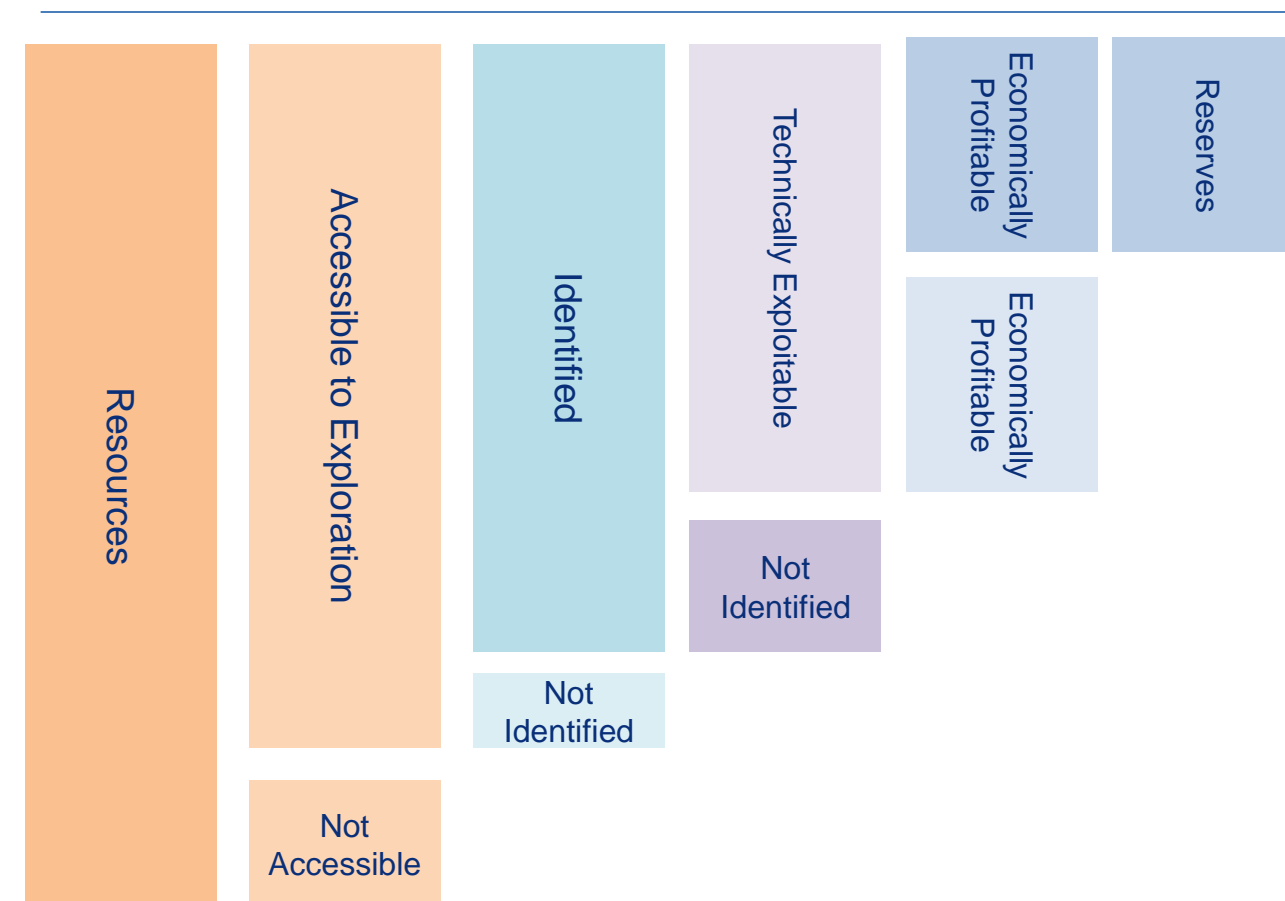


When Discovery leads to Commercial Development

- Resources Comprise of Contingent and Prospective Resources
- The estimates of oil and gas reserves have an intrinsic uncertainty.

Commercial Consideration for Classification under Reserves PRMS Guidelines

- ✓ Economically viable project
- ✓ Developed in a reasonable time frame (typically 5 Years)
- ✓ Market for all or atleast expected sales quantities of production
- ✓ Evidence that legal, contractual, environmental & other social and economic concerns will allow for project implementation

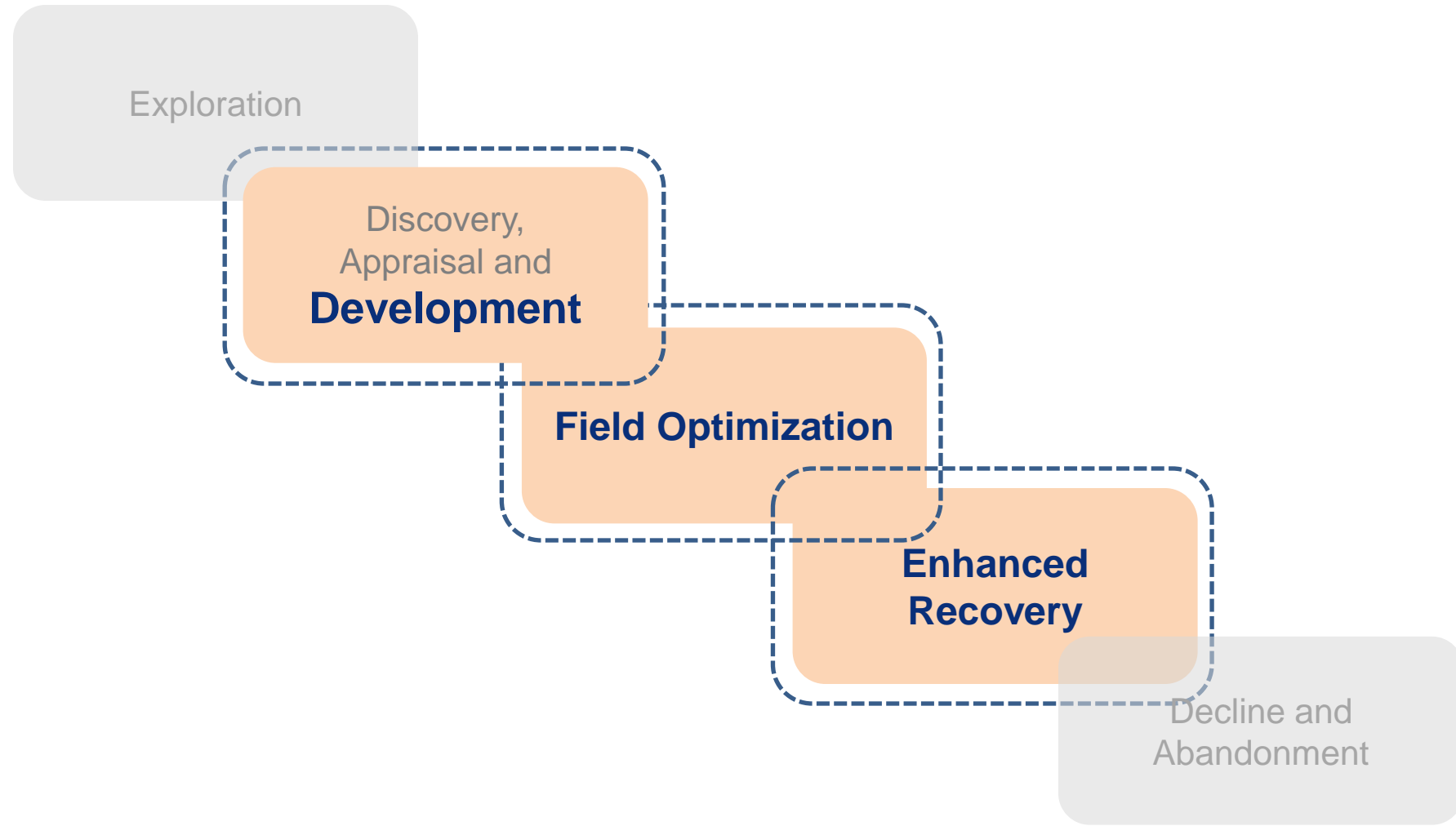




E & P Lifecycle



Discovery and successful appraisal leads to commercial development..

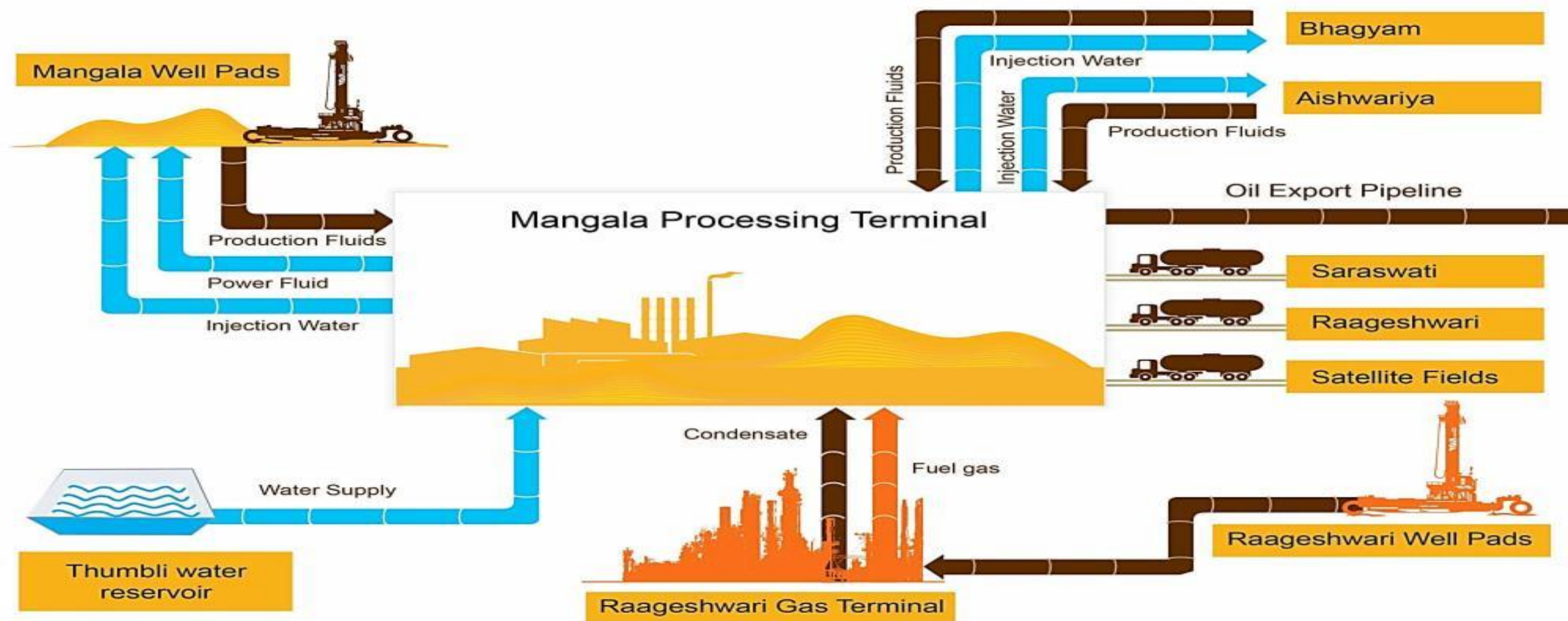




Discovery to Commercial Development



Rajasthan Development

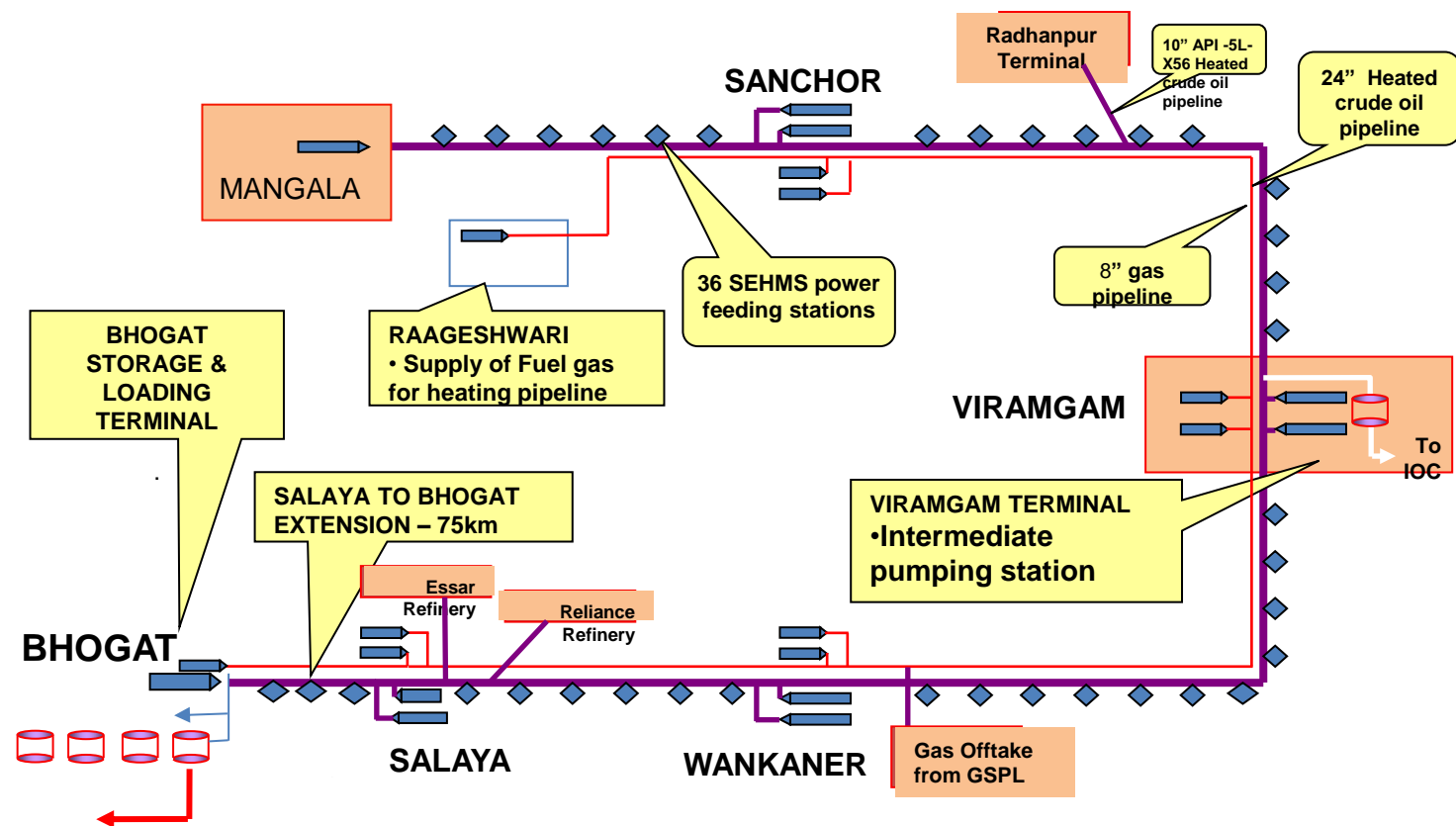


~ USD 6.5 Bn spent so far in Rajasthan Barmer Basin
600+ Wells drilled so far..

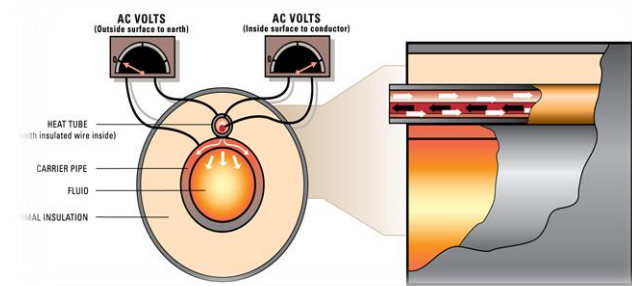
Discovery to Commercial Development



World's longest heated Pipeline of ~ 700 Kms



Skin effect heating system



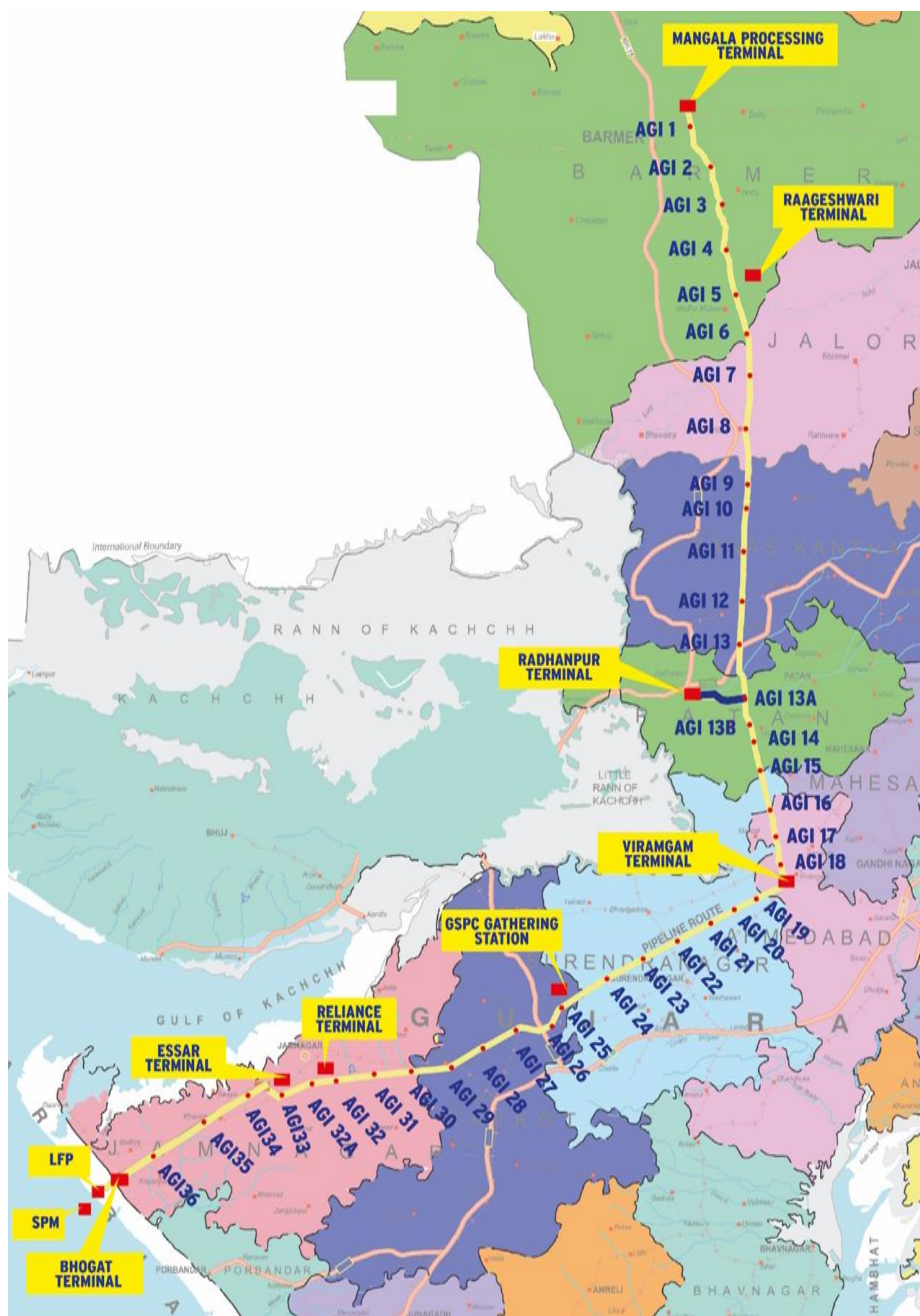
SPM & Tanker Loading



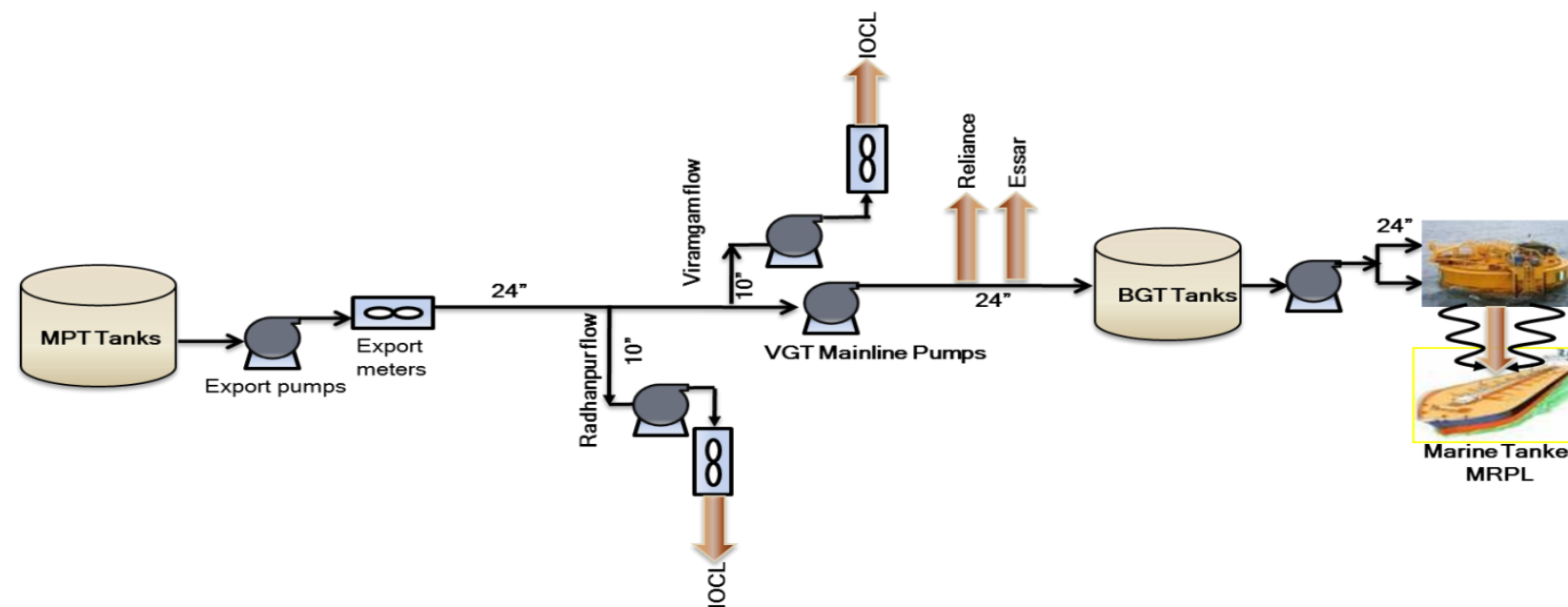
- ❑ Passing through 2 states (Rajasthan and Gujarat), 270 villages, 45000 Land owners and 700 crossings
- ❑ Marine export facility at Bhogat coastal terminal with SPM
- ❑ Accredited with ISO14001 and OSHAS18001



Export Pipeline System – Brief description



- ✓ 38 Above Ground Installation (AGI) for heating of Pipeline to maintain crude temperature above 65 Deg C
- ✓ Intermediate pumping station at Viramgam
- ✓ Terminal/Offtakes- Radhanpur, Viramgam (IOCL), Reliance, ESSAR, Bhogat (MRPL)





Enhanced Recoveries & Tight Oil

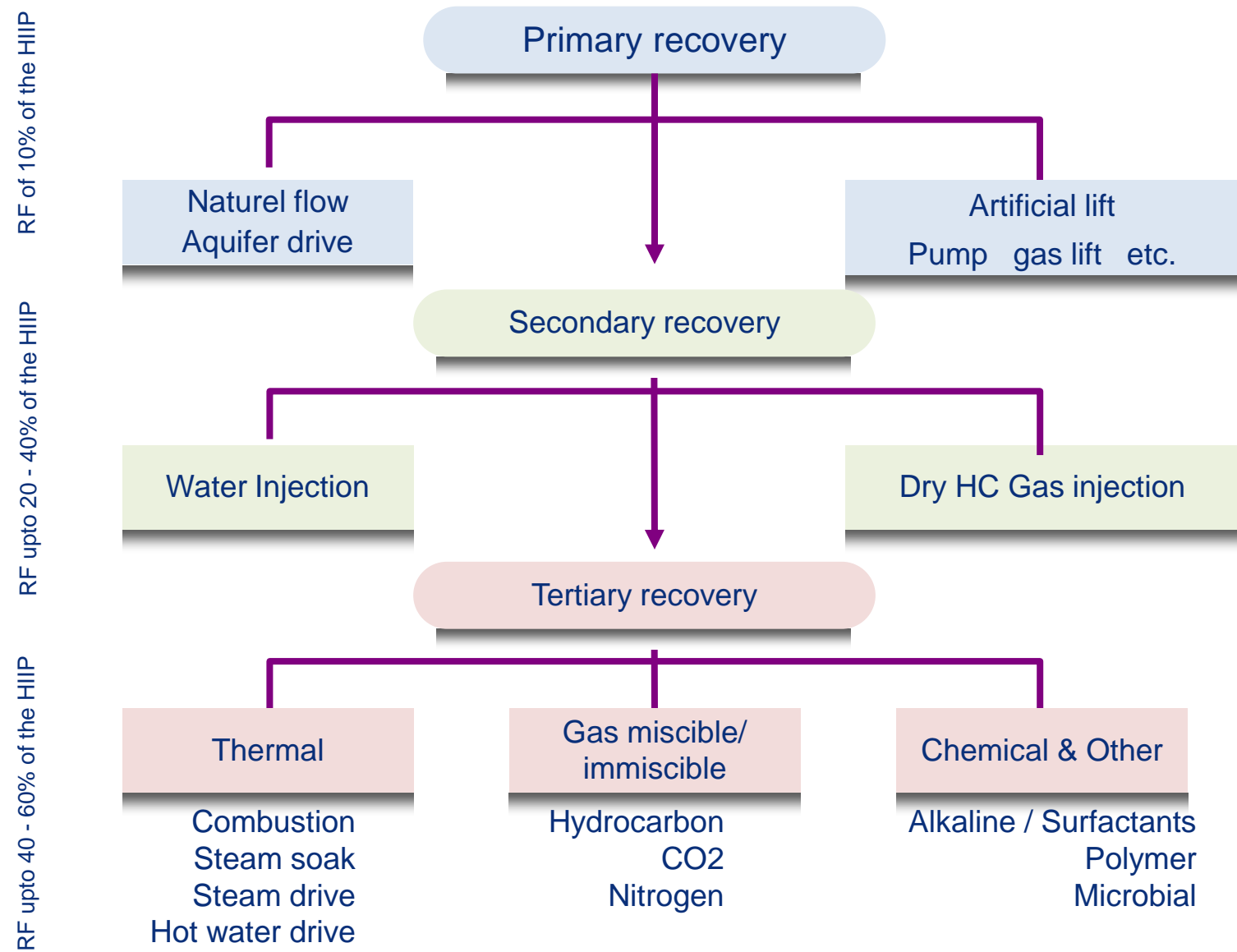
Matthew Stanley
Senior Technical Fellow



Hydrocarbon Recovery Mechanisms



Mechanisms to target Recovery Rates of 50%



- **Core Fields** have been on production through Water Flood
- **Worlds Largest Onshore polymer flooding** program implemented in Mangala
- Submitted of **Development plans to implement polymer flooding in Aishwariya & Bhagyam**
- **ASP Pilot successfully completed**
- **Plans underway to implement World's largest ASP (Alkali Surfactant Polymer) flooding**

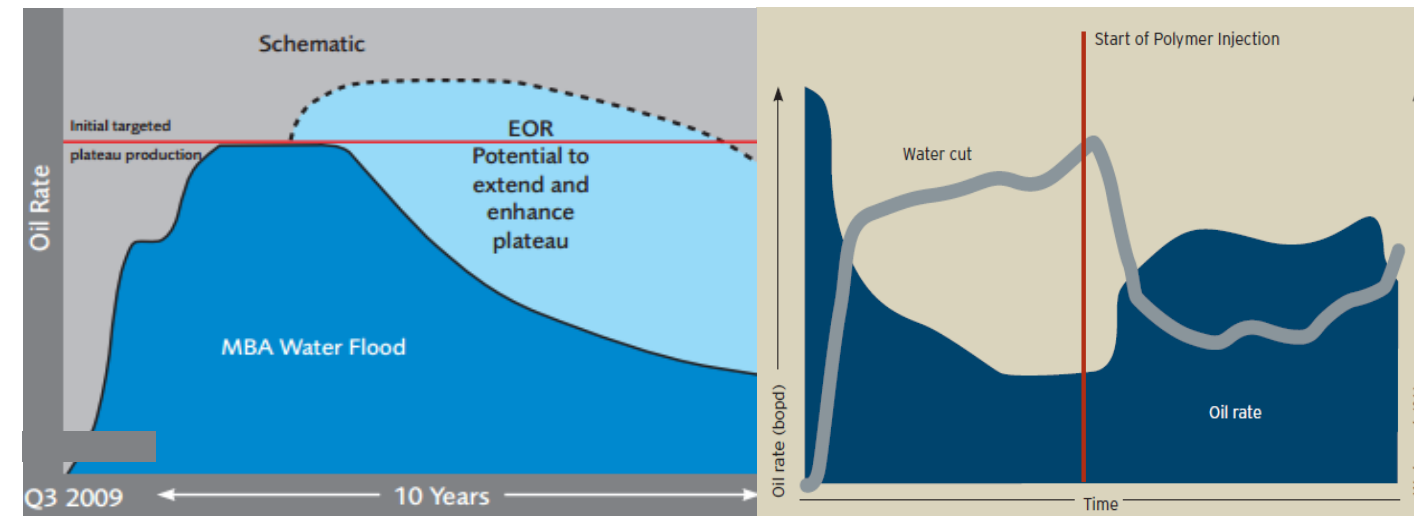


Polymer Enhanced Oil Recovery



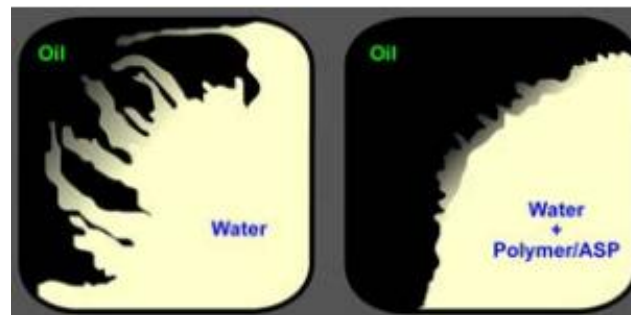
- An exemplar of our commitment towards cutting edge technology and innovation

- **Polymer flood improves the displacement of oil. The addition of small amounts of polymer to injection water increases the viscosity of the water significantly and brings it closer to oil viscosity. As a result it sweeps the oil much more efficiently leading to an increase in oil recovery**
- **Addition of alkali and surfactant along with polymer helps to further increase the recovery due to detergent like effect of these chemicals – termed Alkaline-Surfactant-Polymer or ASP flooding**



Schematic illustrating the appreciable decline in water-cut following polymer injection with a simultaneous increase in oil rate due to better sweep

Left: Water “fingers” through the oil as it moves from injection (I) to production (P) well due to adverse viscosity effects



Right: With polymer or ASP, little or no “fingering” is evident as viscosities are similar, improving sweep efficiency and oil recovery

Polymer Enhanced Oil Recovery



- An exemplar of our commitment towards cutting edge technology and innovation

Mangala EOR - One of the world's largest polymer flood projects

Mangala EOR performance reaffirms potential of the Rajasthan block.

Successful execution of polymer flood has yielded positive results with an increase in oil production and stabilization of the water cut

Bhagyam and Aishwariya EOR – On track for execution

Early polymer flood injection programme started at Bhagyam and Aishwariya

Significant alignment has been reached with our JV partner and execution of the full field programme to commence in FY2017

Learnings from Mangala Polymer Execution to be addresses for even better execution and results from Bhagyam and Aishwariya

Mangala EOR - Highlights

World's largest Centralised Polymer Mixing Facility with a capacity of 80,000 blpd mother solution

Polymer Injection around 100 wells

Mangala EOR contributes to 56,000 boepd production

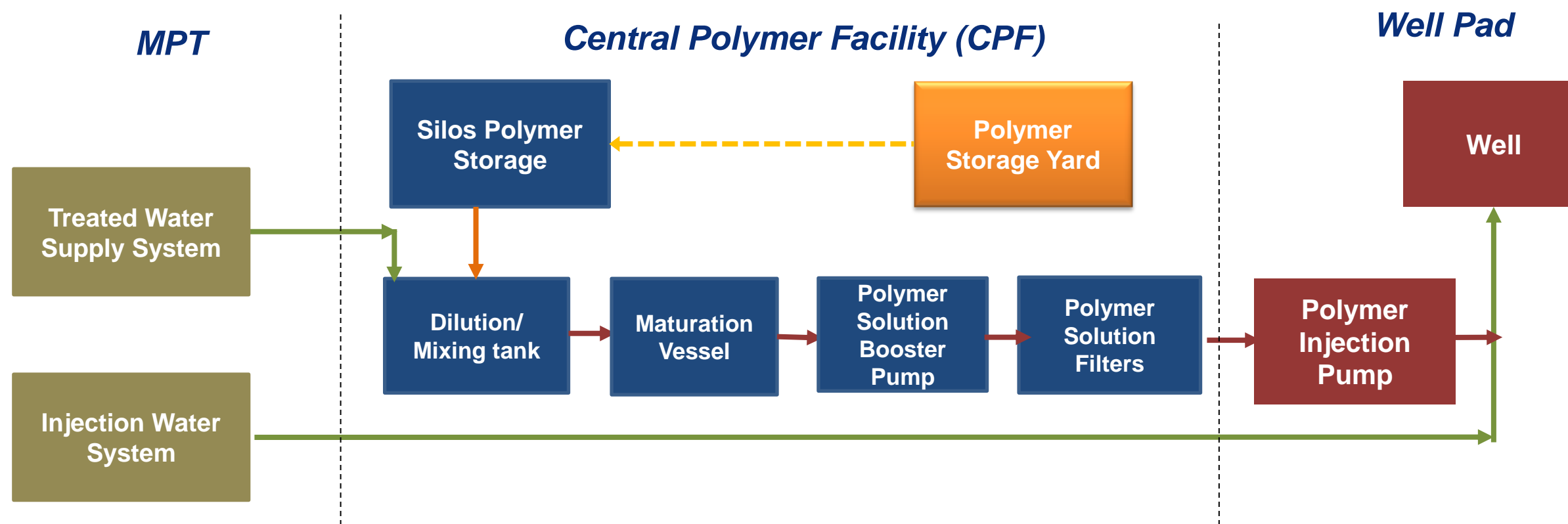




Central Polymer Facility



Process Flow of Polymer to Well Pads

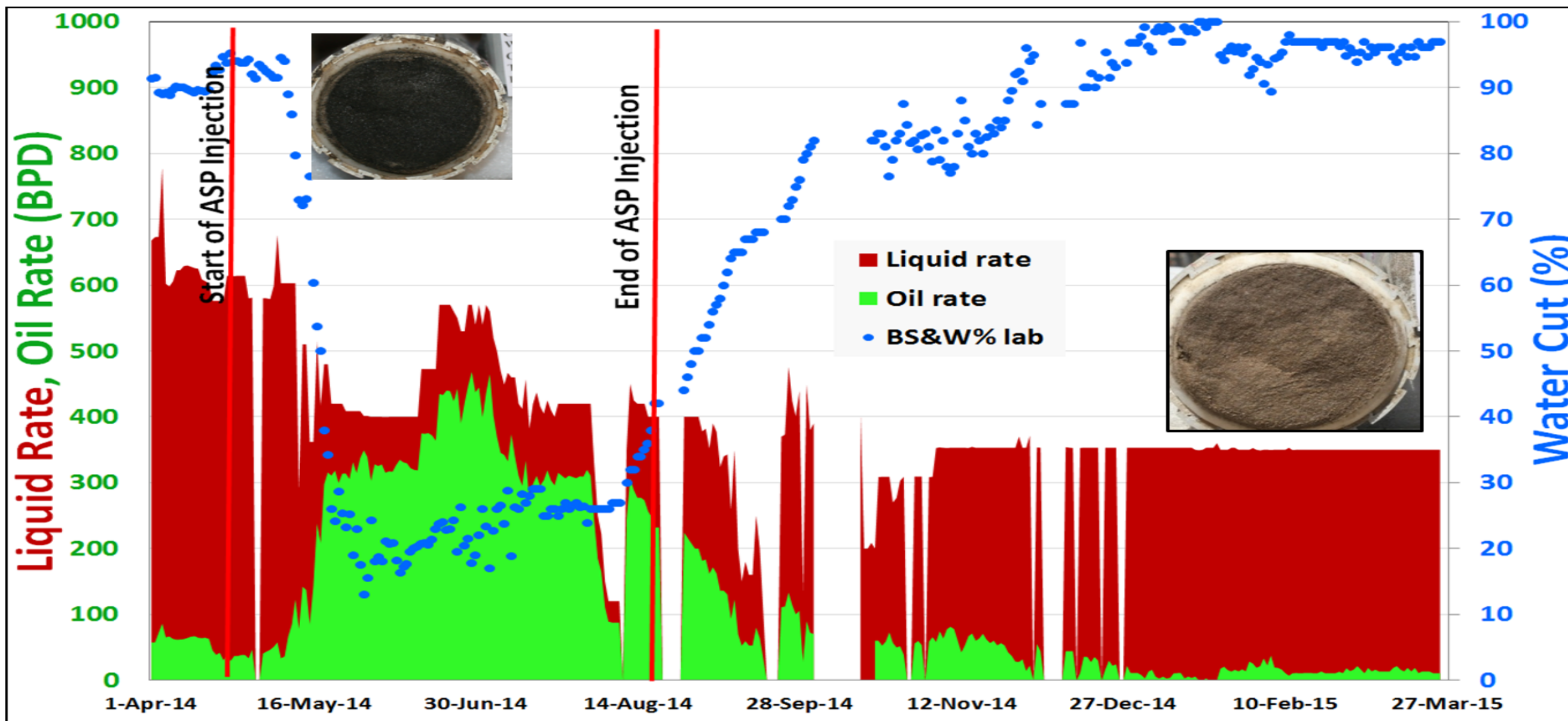




Mangala's Fast-track ASP EOR Program



Pilot ASP Flood Performance



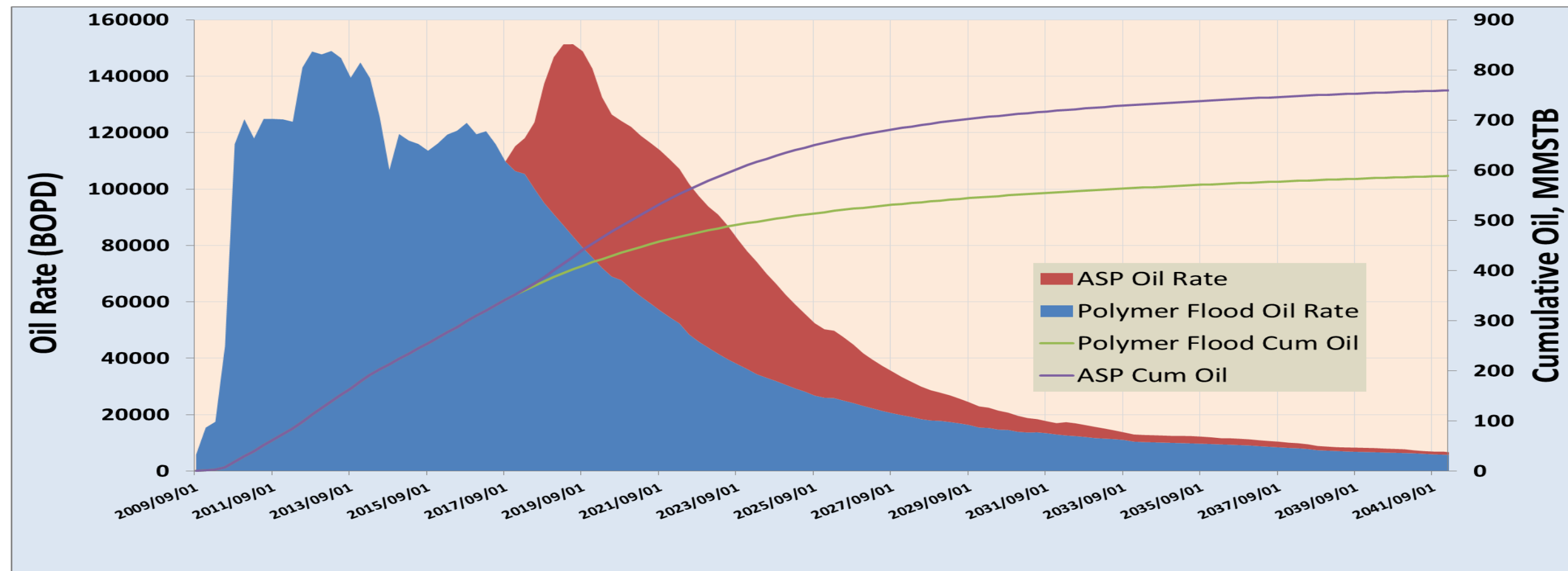
Eight Folds increase in Oil Rate in ASP Pilot; Incremental recovery >20%; One of the best published ASP Pilot performance results in the world



Mangala's Fast-track EOR Program



ASP Flood Performance



- Rare Large Scale ASP Flood Projects across globe
- High End Pioneering project, Full Field Expansion Planned for Mangala. To be followed in Bhagyam and Aishwariya
- High Capex; Opex, lower oil price challenge; Innovations in Field Development planning to make project economical

Mangala ASP Flood Expected to add ~150 MMBBLS by 2030; Together in MBA Cumulative Production expected to surpass 200 MMBBLS



Tight Oil



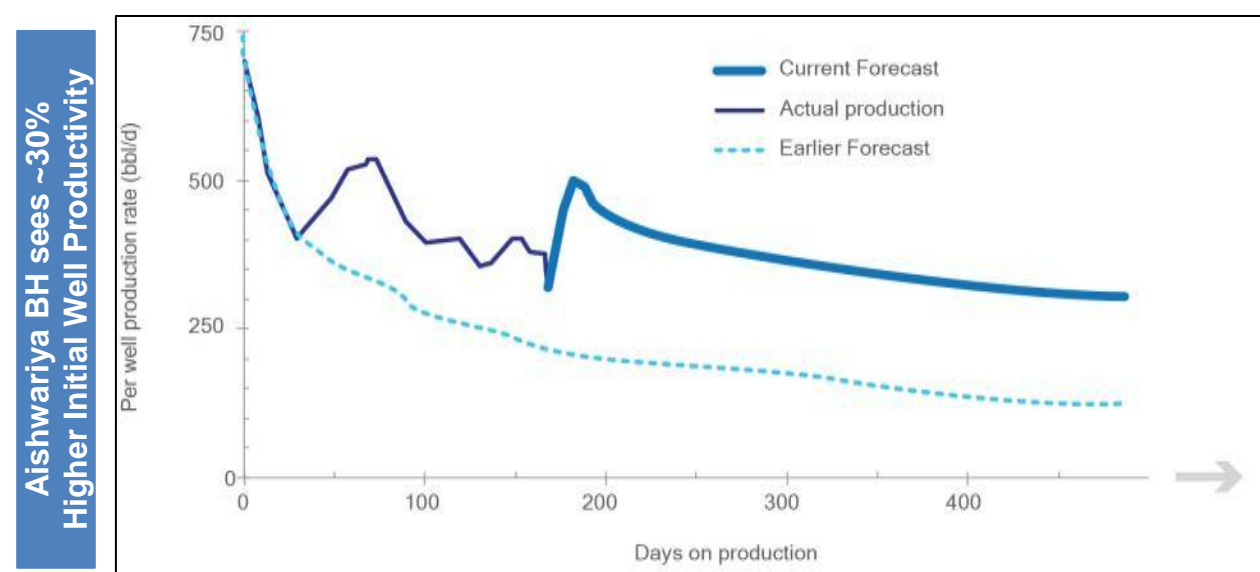
Fueling the Growth Engine

Technology Implementation: Setting new industry benchmarks

- Adoption of cutting edge technologies helping maximize recovery; EUR expected to be double of initial prognosis
- ‘Microseismic’ to better understand frac propagation direction
- Chemical Tracer Technology’ to study zonal contribution
- Improvement in execution of fracs from 1 to 3 per day; Well completion cost reduced by over 40% from planned \$ 8mn
- 30% reduction in initial capex of US\$ 300 million in ABH Project
- Cost Efficiencies to reflect in costing of all Tight Oil & Satellite Field Projects

Barmer Hill vs. US Shale

Parameter	Unit	US Shale	Barmer Hill
Porosity	%	4-16	15-30
Permeability	md	0.001-0.3	0.1-5
Viscosity	cP	0.1-0.3	5
HIIP	Bn Bbls	Large	>2
Depth	Metres	1,500-3,000	600-1,100
Pay Thickness	Metres	15-600	150-300
IP Rate- Horizontal well	Bbl/day	900-2,000	700-1,000*
Drilling & Completion Cost/well	\$ Mn	5-9	5-7*



*IP rates and D&C cost/well in Appraisal Phase at Mangala & Aishwariya Barmer Hill fields



Tight Gas

Sivakumar Pothepalli
Director - Rajasthan



RDG Gas

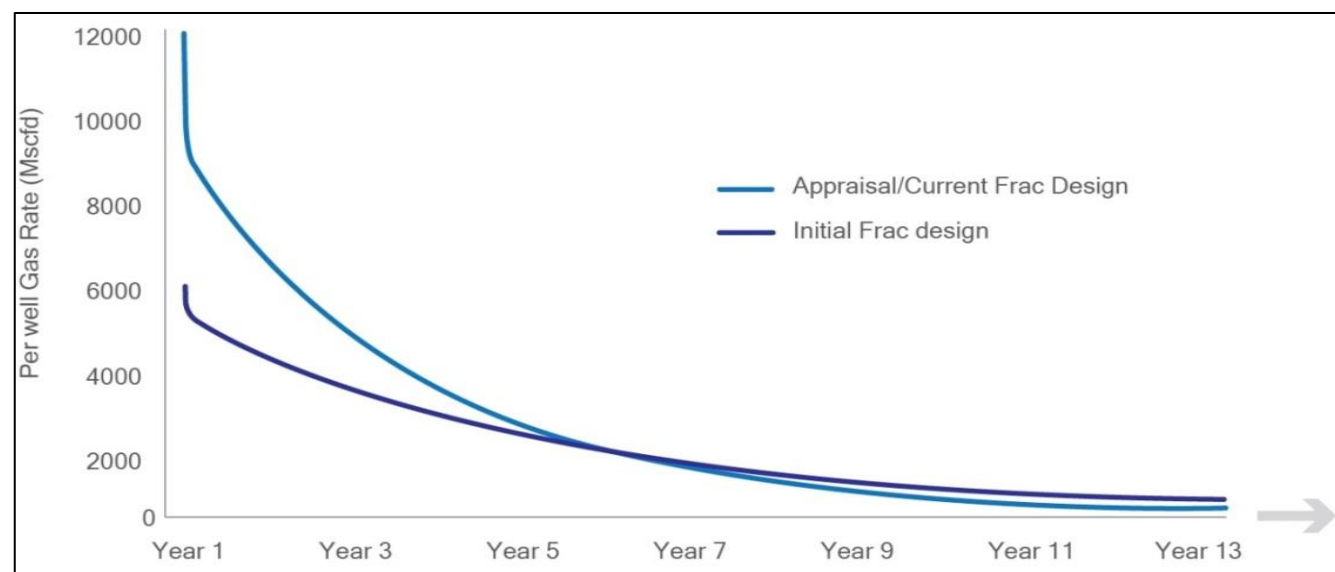
Enhanced Recovery through Cutting Edge Technology



Limited Entry Frac - multiple perforation in single stage

- ~26% increase in gas EUR till 2030 as compared to FDP estimate
- Gross recovery (gas plus condensate) up from 74 to 86 mmmboe
- ~30% increase in reservoir coverage with less number of stages
- ~100% increase in initial well productivity to 8-10 mmscfd compared to wells fraced during 2009-10 campaign
- Design improvement – proppant density, tighter spacing, multiple fracs
- Self sufficient using non potable ground water for frac operations

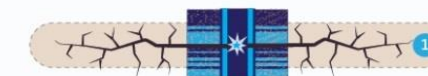
Enhanced Well Productivity through Frac Design



Improvement in Frac Design

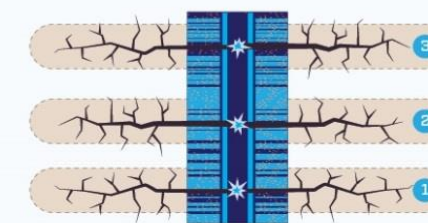
Initial Frac design (2009-2010)

- 10 Wells
- One Perforation per Stage Fracturing
- 5 Frac per Well
- Single Clusters Perforation
- 450 ft Stage Spacing
- 1.2MM lbs Proppant Per Well
- 3000 bbls per stage Fluid



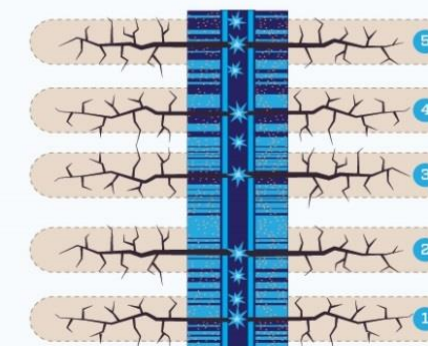
Appraisal Frac design (2014-15)

- 5 Wells
- Limited Entry Technique of Fracturing
- 7 Frac per Well
- 3 Clusters Perforation
- 90 ft Cluster Spacing
- 100 ft Stage Spacing
- 1.4 MM lbs Proppant Per Well
- 2500 bbls per stage Fluid
- Improved Reservoir Coverage
- Improved Productivity



Current Frac design (2015-16)

- 15 Wells
- Limited Entry Technique of Fracturing
- Addressable Switch Firing System (ASFS) perforation Technique
- 7 Frac per Well
- 5 Clusters Perforation
- 60 ft Cluster Spacing
- 100 ft Stage Spacing
- 1.5 MM lbs Proppant Per Well
- 2200 bbls per stage Fluid
- Improved Reservoir Coverage
- Improved Productivity





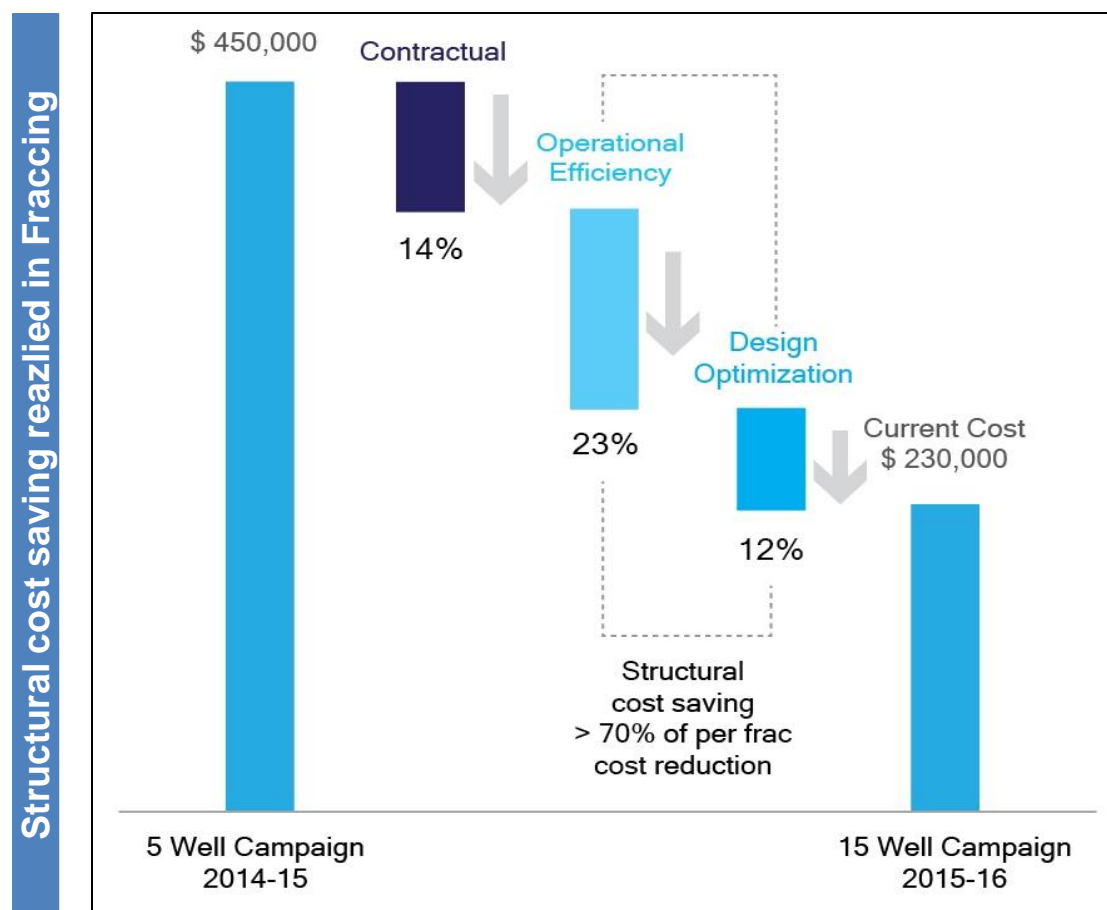
RDG Gas



Realizing Capex Efficiency for Phased Development

Addressable Switch Firing System resulted in

- ~50% reduction in per frac cost to US\$ 230,000
- Over 70% of cost saving is structural from operating efficiency & design optimization
- Days per frac reduced from 4.5 to 2.2



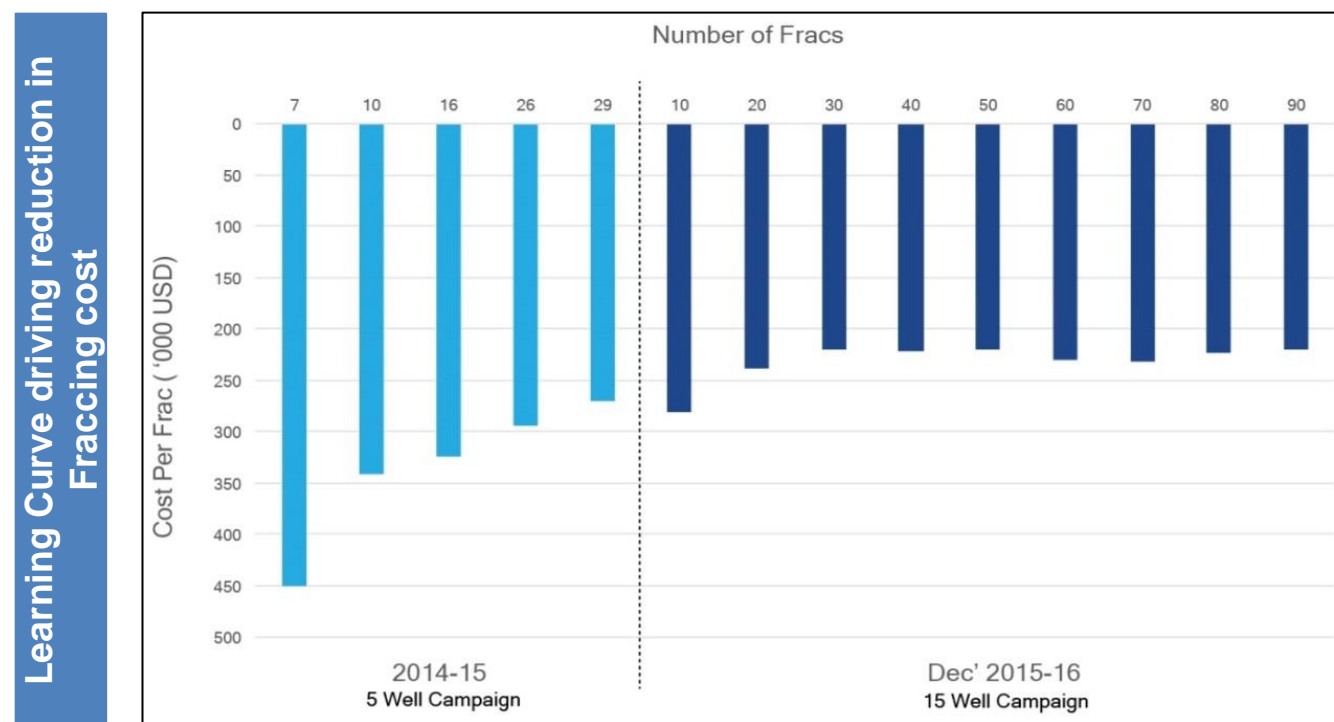
RDG development in phases

Phase 1

- Gas production at 40-45 mmscfd, condensate at 2,500 bopd
- Fraccing completed in 15 wells
- Debottlenecking of existing facility through low cost augmentation

Phase 2

- Gas production of >100 mmscfd, condensate at 5,000 bopd
- Tendering ongoing for terminal, long lead items, rigs etc





Reserves to Cash Flow

Pankaj Kalra
Deputy CFO



Introduction to Fiscal Systems



Royalty/Tax systems

Title to hydrocarbons resides with the contractor who compensates the host government in royalties (% of revenues) and taxes (% of profits)

Eg. USA, Canada, Norway.

India through OALP is moving to a regime similar to R/T Systems

Contractual Based systems

Service Agreements

Title to hydrocarbons resides with host government
The contractor is paid a fee, typically in cash

Eg. Iran, Iraq

Production Sharing Contracts

Eg. India, Nigeria, Indonesia, etc

Title to hydrocarbons resides with host government & Production in kind is shared between the contractor and the government

Return Based

Production Linked

Rate of Return

Investment Multiple



Production Sharing Contract



Production Sharing Contract

Contract between Contractors and Government for the grant of Licenses and Leases for Exploration and Development and execution of Petroleum Operations

Key Contents of PSC

I. Governance Structure

- Operating Committee
- Management Committee

II. PSC Framework

- Minimum work programme; Relinquishment of Contract areas
- Notification of Discovery & Field Development Plans
- General Rights & HSE Obligations

III. Contracts & Procurement

- Procedures and Obligations
- Purchase of local goods and services
- Tendering procedures & Duty exemptions

IV. Costs & Expenses

- Exploration, Development & Production costs
- Work programme and Budgets
- Expenditure Authorization & Cash calls

V. Production & Sales Process

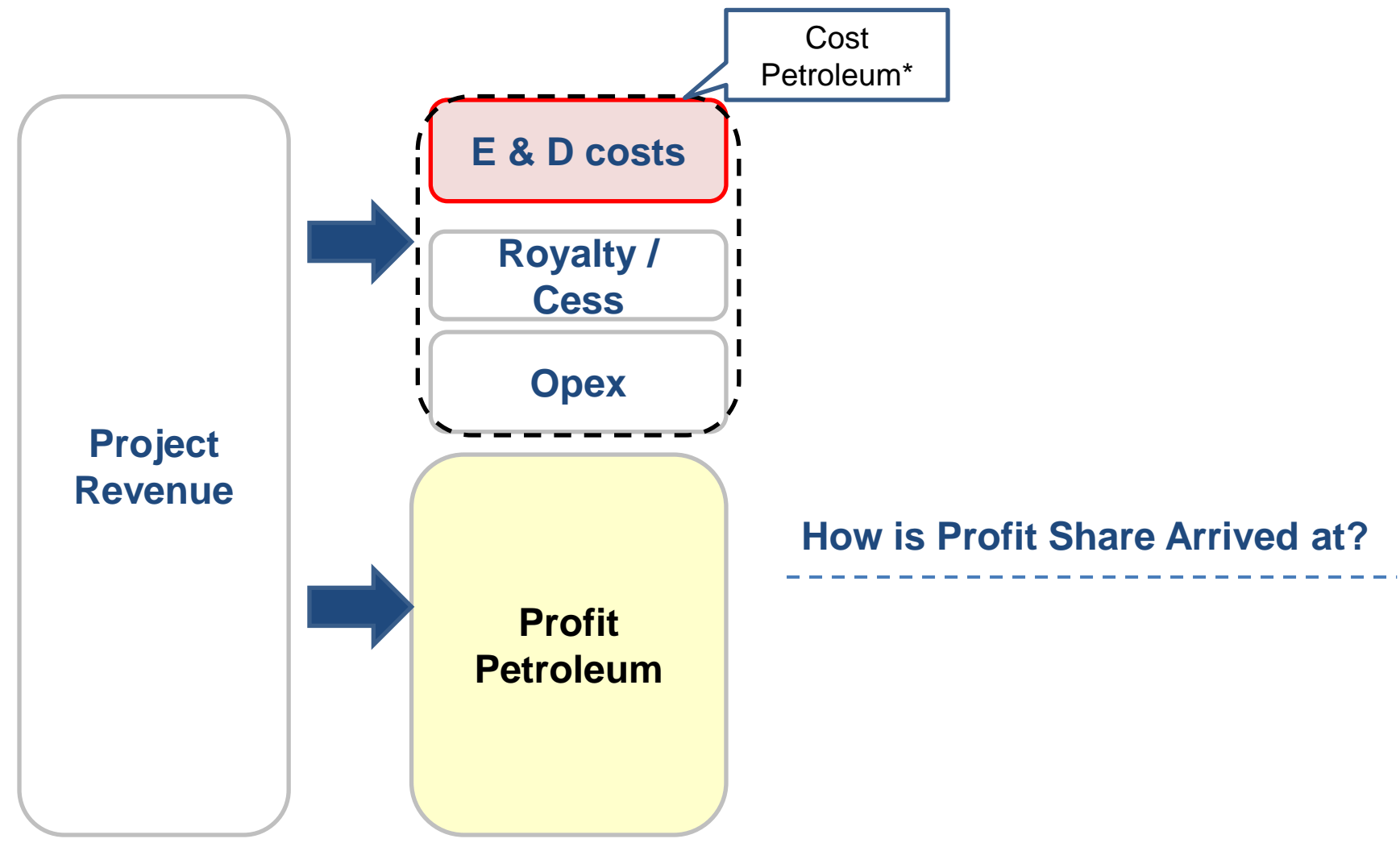
- Crude Oil measurement, Evacuation & Valuation
- Revenue & Profit sharing – EI and PI (Cost oil & Profit oil)
- Profit Sharing; Taxes, Royalties, Rentals etc.

VI. Other Clauses

- Employment, Training & Transfer of technology
- Title of Data & Assets

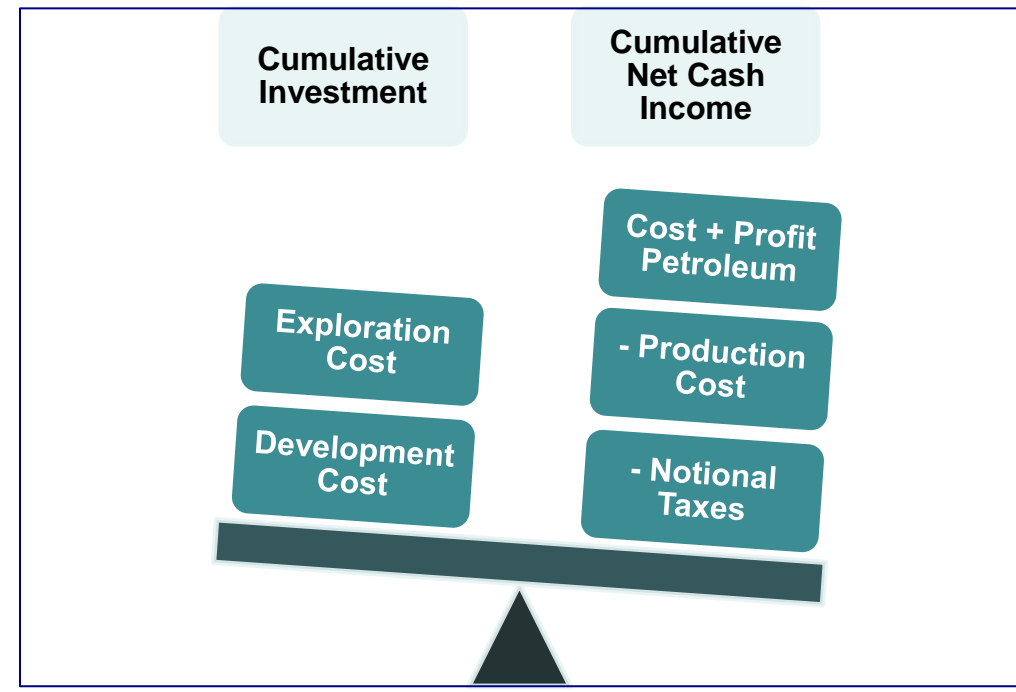


PSC Cash Flow



How is Profit Share Arrived at?

$$\text{Investment Multiple} = \frac{\text{Cumulative Net Cash Income}}{\text{Cumulative Investment}}$$



* Cost Petroleum definition depends on contractual terms



Sample Financials Working



Inputs	S. No.	Particulars	UoM	Value	Reference
	1	Gross Production	mmbbls	2.0	
	2	Oil Price Realisation	USD /bbl	50.0	
	3	Opex	USD /bbl	6.0	
	4	Capex	USD Mn	20.0	
	5	Cess	%	17%	
	6	Royalty	%	15%	
	7	Profit Petroleum	%	40%	
	8	Cairn Participating Interest	%	70%	
	9	Partner's Participating Interest	%	30%	

Computations as per PSC	10	Gross Revenue	USD Mn	100.0	(1) * (2)
		Cost Oil			
	11	Cess	USD Mn	17.0	(10) * (5)
	12	Royalty	USD Mn	15.0	(10) * (6)
	13	Opex	USD Mn	12.0	(1) * (3)
	14	Capex	USD Mn	20.0	(4)
	15	sub-total Cost Oil	USD Mn	64.0	(11) + (12) + (13) + (14)
	16	Profit Oil	USD Mn	36.0	(10) - (15)
	17	Gol Share	USD Mn	14.4	(16) * (7)
	18	Cairn Share	USD Mn	15.1	(16-17) * (8)
19	Partner Share	USD Mn	6.5	(16-17) * (9)	

Sample Cairn Oil & Gas Financial	S. No.	Particulars	UoM	Value	Reference
	A	Cairn Revenue			
	B	- Cost Oil	USD Mn	44.8	(15) * (8)
	C	- Profit Oil	USD Mn	15.1	(18)
		Less:			
	D	Royalty	USD Mn	10.5	(12) * (8)
	E	Cairn Net Revenue	USD Mn	49.4	(B) + (C) - (D)
		Less:			
	F	Cess	USD Mn	11.9	(11) * (8)
	G	Opex	USD Mn	8.4	(13) * (8)
H	EBITDA	USD Mn	29.1	(E) - (F) - (G)	
I	Capex	USD Mn	14.0	(14) * (8)	
J	Free Cash Flow	USD Mn	15.1	(H) - (I)	



Sample Financials Working - Sensitivity



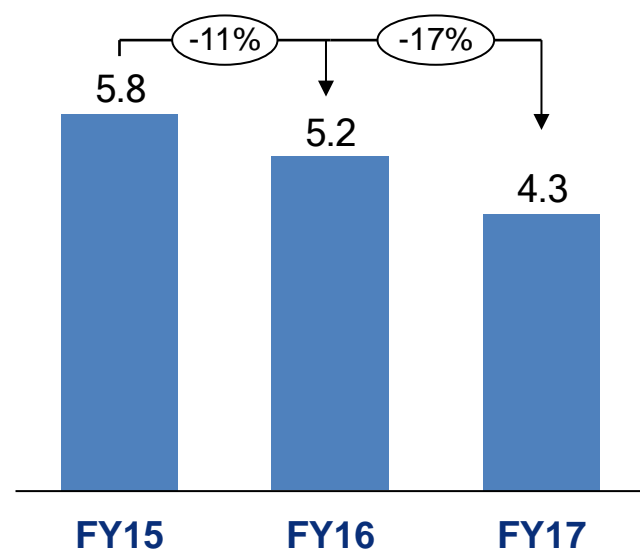
	Net Revenues	EBITDA
Every additional 1 mmbbls of production at Oil price of 50\$/bbl	21.9 MM	11.8 MM
Additional 10\$ higher price realization for every 1 mmbbls produced	4.0 MM	2.9 MM
Every USD 100 MM of Capex increase	28.0 MM	28.0 MM



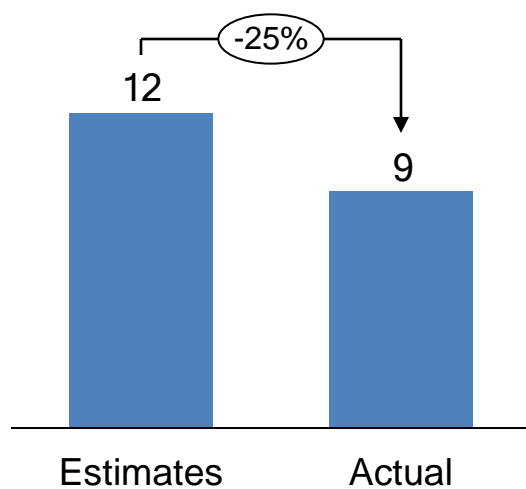
Continuous Optimization of Operating Costs



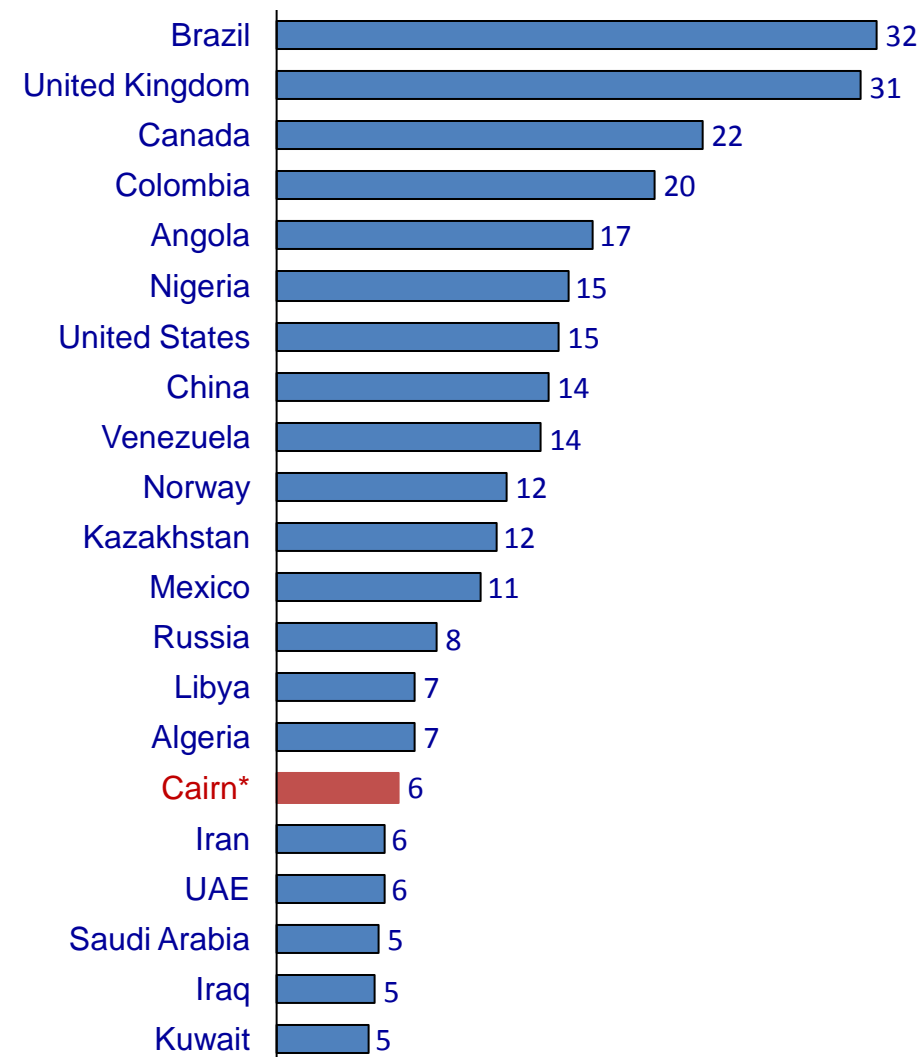
RJ Waterflood Operating Costs (US \$/bbl)



Cost Optimization in Polymer Opex (\$/bbl)



World Cost Operating Cost (US\$/bbl)



Source for peer company Opex - Rystad Energy, Nov 2015;
 * Cairn opex is blended Operating Costs of Waterflood and Polymer



Way Forward

Sudhir Mathur
Acting CEO

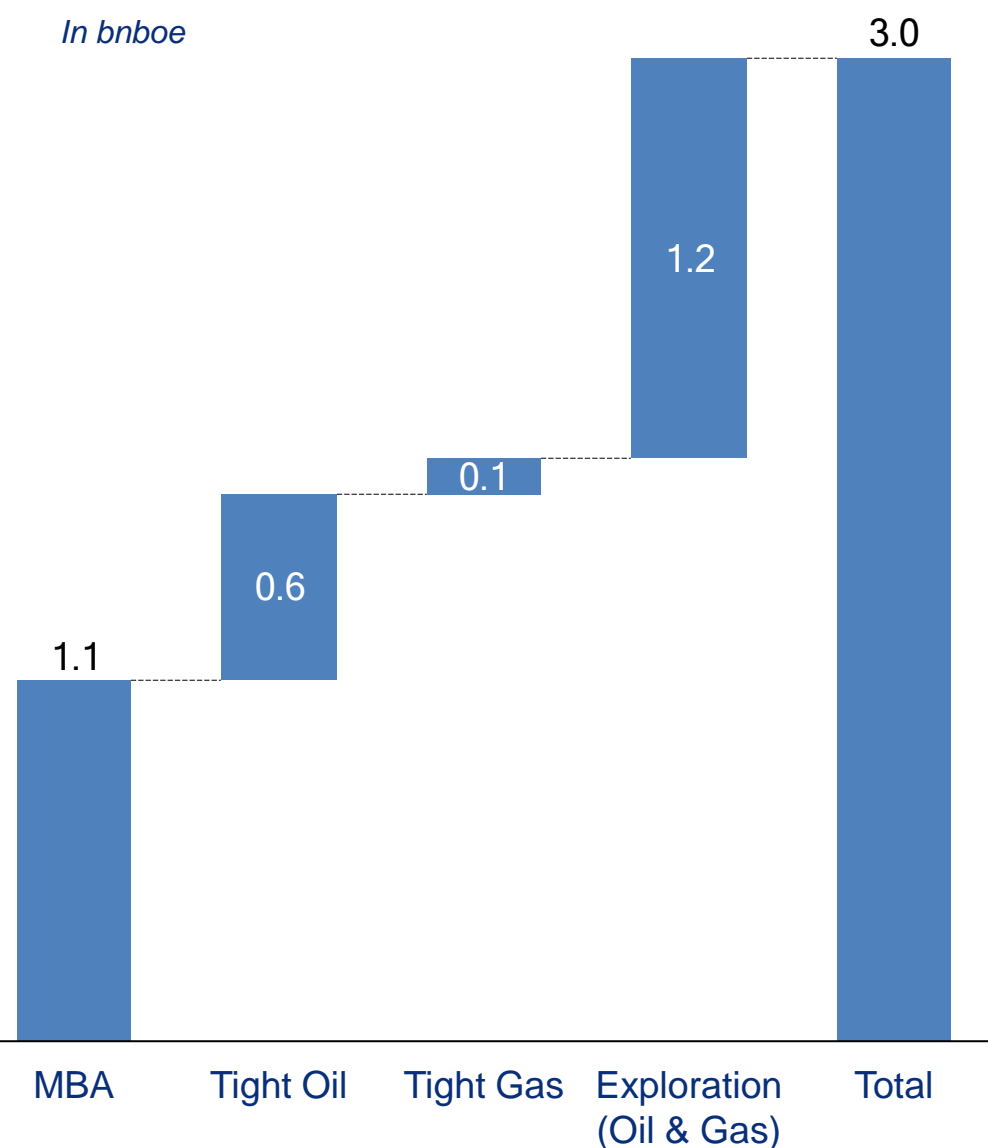


Estimated Ultimate Recovery Potential



Realizing the true potential of our blocks and contributing 50% of India's domestic production

In bnboe



- MBA fields with Enhanced Oil Recovery techniques has potential to achieve Recovery Rates of 50% of HIIP
- Application of cutting edge fracking technologies to unlock value from Tight Oil & Satellite Fields with recovery rates of 15%
- With successfully proven technology in multi stage fracking, RDG Gas recovery rates to reach 60% of inplace volumes
- Exploration in Barmer Basin to further add to the HIIP volumes,
 - Successful track record of Exploration
 - Recent Seismic shows encouraging prospects
- With Integrated Project Development plan for KG offshore in place, there lies a huge opportunity to add value
- Incremental opportunities from OALP round

Realizing our Vision of 500 kbopd and Reserves >3bn boe



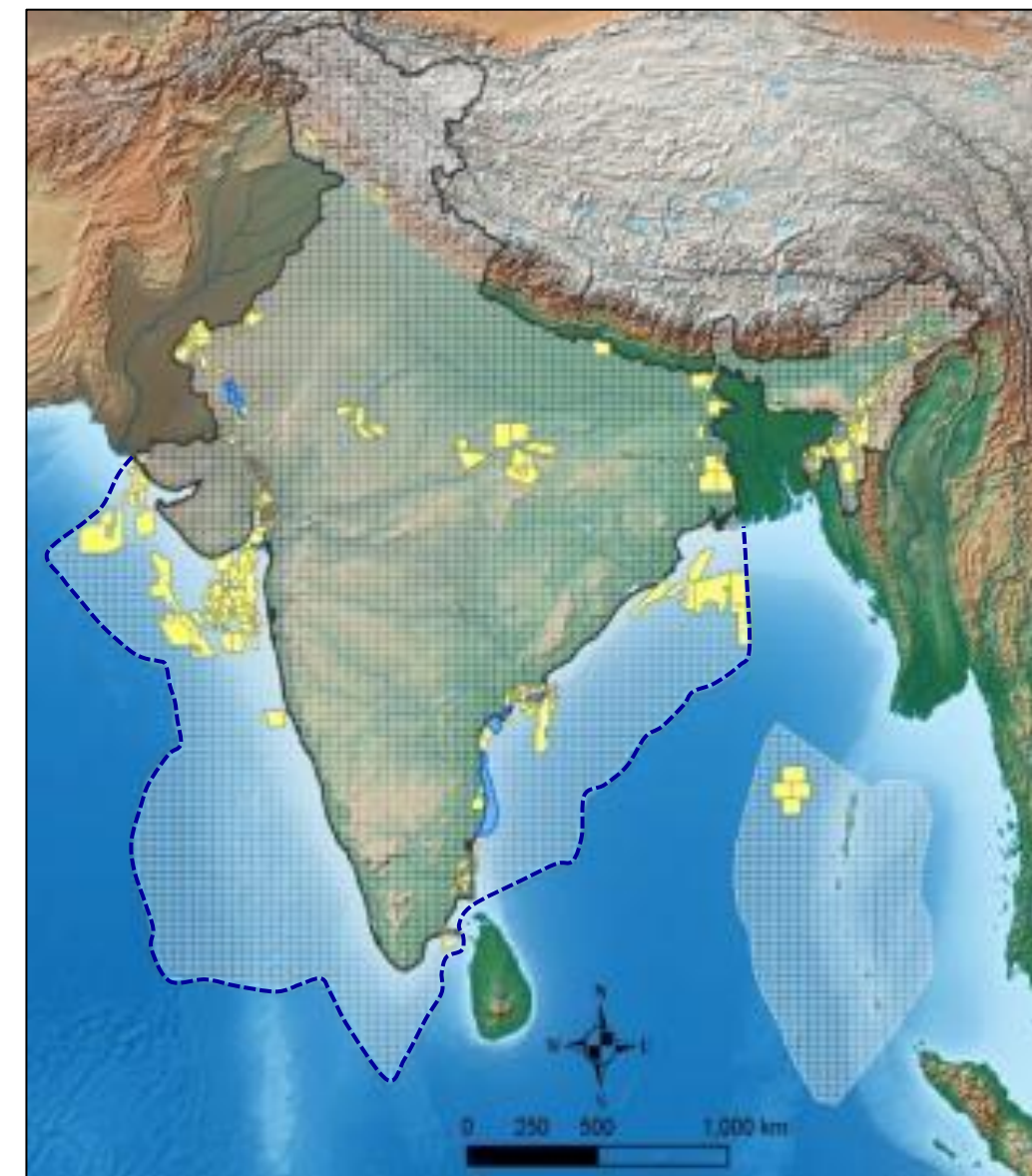
Open Acreage Licensing Program (OALP)



- 65% of the Indian sedimentary area on offer for exploration to Production
- Indian sedimentary basins are gridded into sectors (10' x 10' equals to 331 sq. km): Flexibility to carve out blocks
- Investors to bid without waiting for the announcement of bidding as under current model of offering

Key Provisions under OALP

- Investors can study the NDR data & submit an EOI
- Originator incentive for EOI is 5%
- Exploration allowed during entire contract period
- Single, uniform license for extraction & exploration for all types of hydrocarbon
- Equal weightage to work program & Revenue share
- Simple & easy to administer Revenue Sharing Model,
- No Cess On Oil
- Custom duty exemption
- Full marketing freedom & free pricing for crude oil & natural gas,





Valuation Comparison



	EV (USD Billions)	EV / 1P (\$/bbl)	EV / EBITDA
Peer 1	56	26	22
Peer 2	39	6	6
Peer 3	37	21	11
Peer 4	28	14	11
Peer 5	27	37	17
Peer 6	26	19	9
Peer 7	25	23	9
Peer 8	20	28	13
Peer 9	20	14	9
Peer 10	19	17	19
Peer 11	18	14	12
Peer 12	15	7	10
Peer 13	14	12	10
Peer 14	11	26	13
Peer 15	8	16	7
Peer 16	8	25	8
Peer 17	7	12	4
Peer 18	6	9	8
Peer 19	5	8	8
Peer 20	4	13	9
Peer 21	4	10	8
Peer 22	3	9	3
Peer 23	2	8	7
Peer 24	1	24	5
Median		14	9

Source : Bloomberg



Appendix

Speaker Profiles



Sudhir Mathur, Acting *CEO, Cairn Oil & Gas*



Mr. Mathur has been the Chief Financial Officer at Cairn Oil & Gas since September 2012 & currently is the Acting Chief Executive Officer

He has over 31 years experience working in various industries such as telecommunications, manufacturing, infrastructure and consulting. In his previous assignments he has served as the Chief Financial Officer of Aircel Cellular Limited and Idea Cellular Limited & Director Finance at Ballarpur Industries Limited

He has substantial expertise, knowledge and experience in several key areas of Finance and Strategic Planning, with a proven track record of value creation

Mr. Mathur graduated in Economics from SRCC, Delhi University and completed a Masters of Business Administration from Cornell University.

Suniti Bhat, *Director Oil and Gas, Cairn Oil & Gas*

Mr. Bhat currently serves as Director Oil & Gas, and is responsible for exploration, production & development activities for all Cairn assets

He has been working with Cairn for more than 8 years and has more than 20 years' experience in global Oil and Gas industry with stints in Reservoir Management and Production Optimization with leading operators like BG, Centrica in UK and Central Asia

Mr. Bhat has completed a General Management Program from Harvard Business School, a Masters in Petroleum Engineering from Stanford University and a degree in BE (Hons.) in Chemical Engineering from Punjab University Chandigarh.



Speaker Profiles



Pankaj Kalra, *Deputy CFO, Cairn Oil & Gas*



Mr. Kalra currently serves as Deputy CFO of Cairn Oil and Gas and has been associated with Cairn since 2014

He leads all areas of Finance & Accounts including Corporate and Management Reporting, Joint Venture Finance, Treasury, Taxation & Economic Analysis

He has over 19 years of experience in Corporate Finance including M&A, Project Finance, Treasury, Management Reporting, Investor Relations, Planning & Accounting

Mr. Kalra graduated in Commerce from SRCC, Delhi University and is a Chartered Accountant as well as Company Secretary

Matthew Stanley, *Senior Technical Fellow, Cairn Oil & Gas*

Matthew Stanley currently serves as Senior Technical Fellow and has been associated with Cairn since 2012

During his tenure at Cairn he has led the Subsurface team and contributed immensely in reserve accretion and production optimization. Currently he provides technical expertise in the Development and Appraisal efforts

He has a rich experience of more than 34 years. He spent 27 years of continually progressing positions at Conoco/ConocoPhillips in basins across the USA, including deepwater, and in the Middle East and SE Asia

Mr. Stanley holds a Bachelor of Science degree (Highest Hons.) in Petroleum Engineering from New Mexico Institute of Mining and Technology





Speaker Profiles



Sivakumar Pothepalli, *Director Rajasthan, Cairn Oil & Gas*



Mr. Sivakumar Pothepalli currently serves as Director – Rajasthan Asset & ExCo Member, He leads Operations & Development of all Onshore Oil fields in Rajasthan. He has been working with Cairn since the last 15 years

He has more than 25 years of experience in both Upstream and downstream industry and has worked in various roles in Offshore Assets of Ravva & Cambay and Onshore Assets of Rajasthan.

Apart from independently running the business unit, he is experienced in Operations, Development, New Ventures, Asset Management, HSE, Process Safety, Asset Integrity, and Joint Venture & Regulatory Management

Sivakumar is a Chemical Engineer from NIT Warangal and has done his Post Graduate degree in Management from AIM, Philippines.



Q&A

