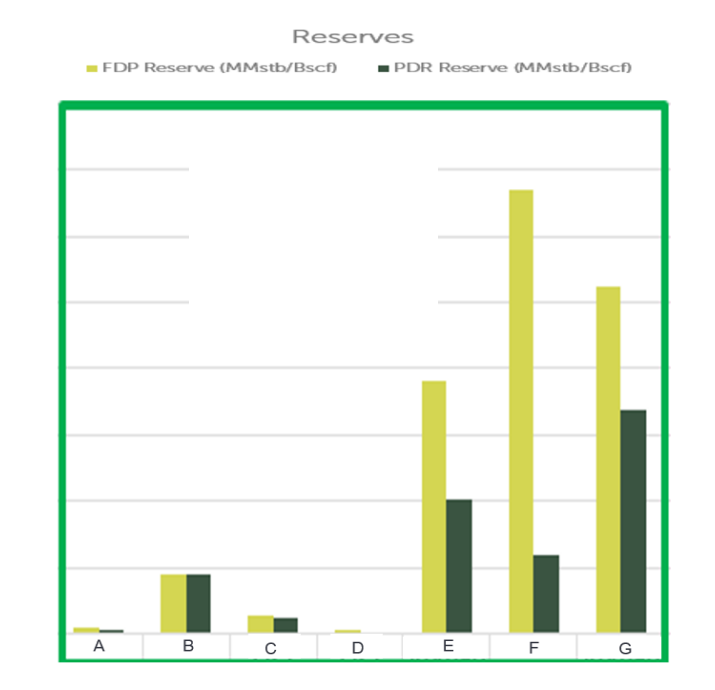
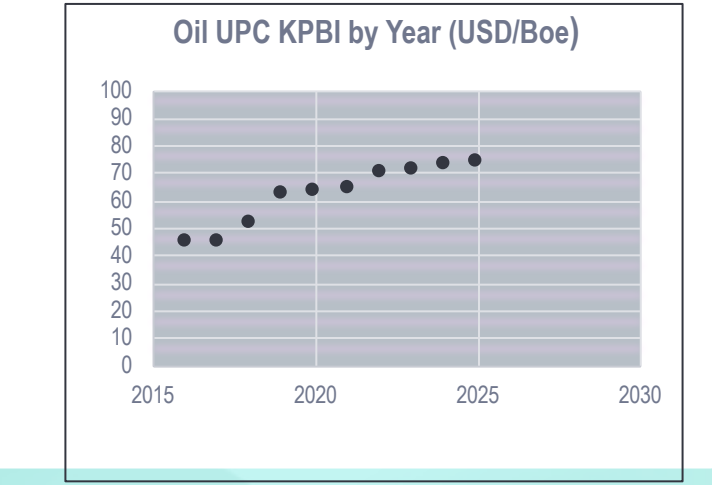
Digital Field Development Planning – A collaboration between technology & process to enable fast & efficient field development planning

Problem Statement: Developing fields today is getting more difficult in current O&G business environment





Case for Change

Business Portfolio

- Malaysia Assets
- International Assets
- LNG Assets
- Ventures

Business Survival & Growth (FDP context)

- **Inefficiency** in managing data quality and timeliness.
- **Longer time** for Resource Maturation.
- **Slow** decision making in important milestones event – eg FDP,
- UFC, UDC & UPC kept on **increasing.**
- RRR **reducing**
- **Gap** in resource / reserve matching.

Open

Digital FDP (Live FDP) will pave the way for Upstream Digital Transformation by transforming from passive to intuitive working model.

Live FDP will be the foundation in stewarding Upstream into the digital age,
Inline with current transformation efforts

Brilliant@Basic

World Class Operator 2018

Distinctive PETRONAS Centre of Economics and Portfolio Evaluation

World Class Wells Delivery 2020

6 Signature Fields

D S B K E R

IO Solution

Live FDP

Artificial Intelligence

3D

E&P Life-Cycle

Fields of The Future

Beyond 2020

2020 *"Digital Upstream"*

2019 *"Enterprise IO Excellence"*

2018 *"Enterprise IO Foundation"*

2017 *"Collaborative Working Environment"*

Passive

Generative

Intuitive

"Live FDP under DoF full deployment

We are here

Destination

Live FDP will integrate full cycle of fields – Exploration to Abandonment

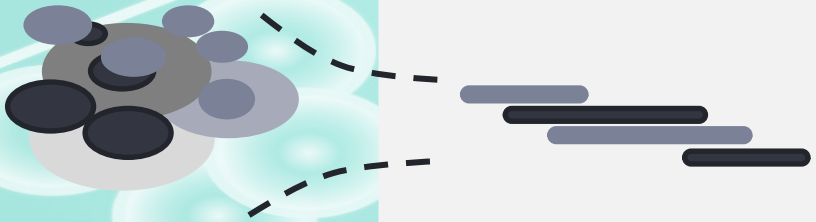
Exploration | **Development** | **Production** | **Abandonment**

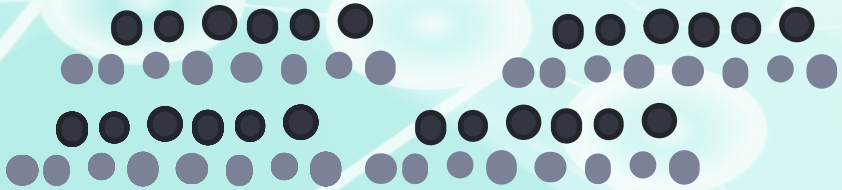
Fast Track Resource Maturation

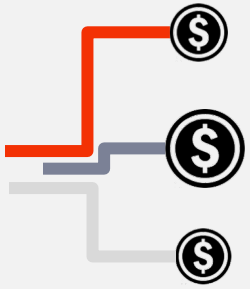
Fit For Purpose Field Development

Optimize, Maximize & Sustain via Best In Class Unit Production Cost

Facilities Rejuvenation & Optimization







STAKEHOLDERS

- MPM
- Partners
- Asset
- G&G
- Petroleum Engineering
- Resource Maturation
- Wells
- Petroleum Economics
- PMT & PD&T integration
- Front end & ORSA

Enterprise IO (Now)

- Reservoir
- Well
- Surface Facilities
- Pipeline
- Terminal
- Customer
- Logistics

Value optimization

Major Business Value obtained from Live FDP supports Business Targets

Category	Benefit	Measurement	Unit	Estimated Value
Reserve Replacement Ratio (RRR)	• Processes more FDPs. • Knowing FDP economics earlier for better issue and risk management. • Positive RRR.	RRR	No.	RRR >= 1
Cost Saving	• Refined FDP accuracy, impacting development cost	Unit Development Cost (UDC)	$/bbl	40% reduction
Time Saving	• Shorten time taken per FDP. • Replicate-able project and design templates. • Increases data integrity and less re-work due to errors. • Full-text search capability • Distinct access of the same information by all members.	Man-hours	Duration	50% reduction

Open

Data Architecture that governs data pathways all the way towards smart visualization allow Top Management to make informed decisions fast with less risk

6 Informed Decisions

Acquisition & Maturation	Monitoring & Surveillance	Analysis & Predictive	Maximization & Rejuvenation

5 Smart Visualization

4 Workflows & Integration

Business Process Automation Engine → Business Process Automation Engine → Analysis & Predictive Engines → Optimization Engines

3 Applications

RTO	PI	ODMS	PGPS	Prosper	Gap	Winglue	ICON	IGBO	FPC	PTEM	
RTD	VTS	Wellview	Pipesim	CPIMS*	SICS*	LIMS*	ARIS*	OFM*	Petrel*	SAP*	

2 Data Management

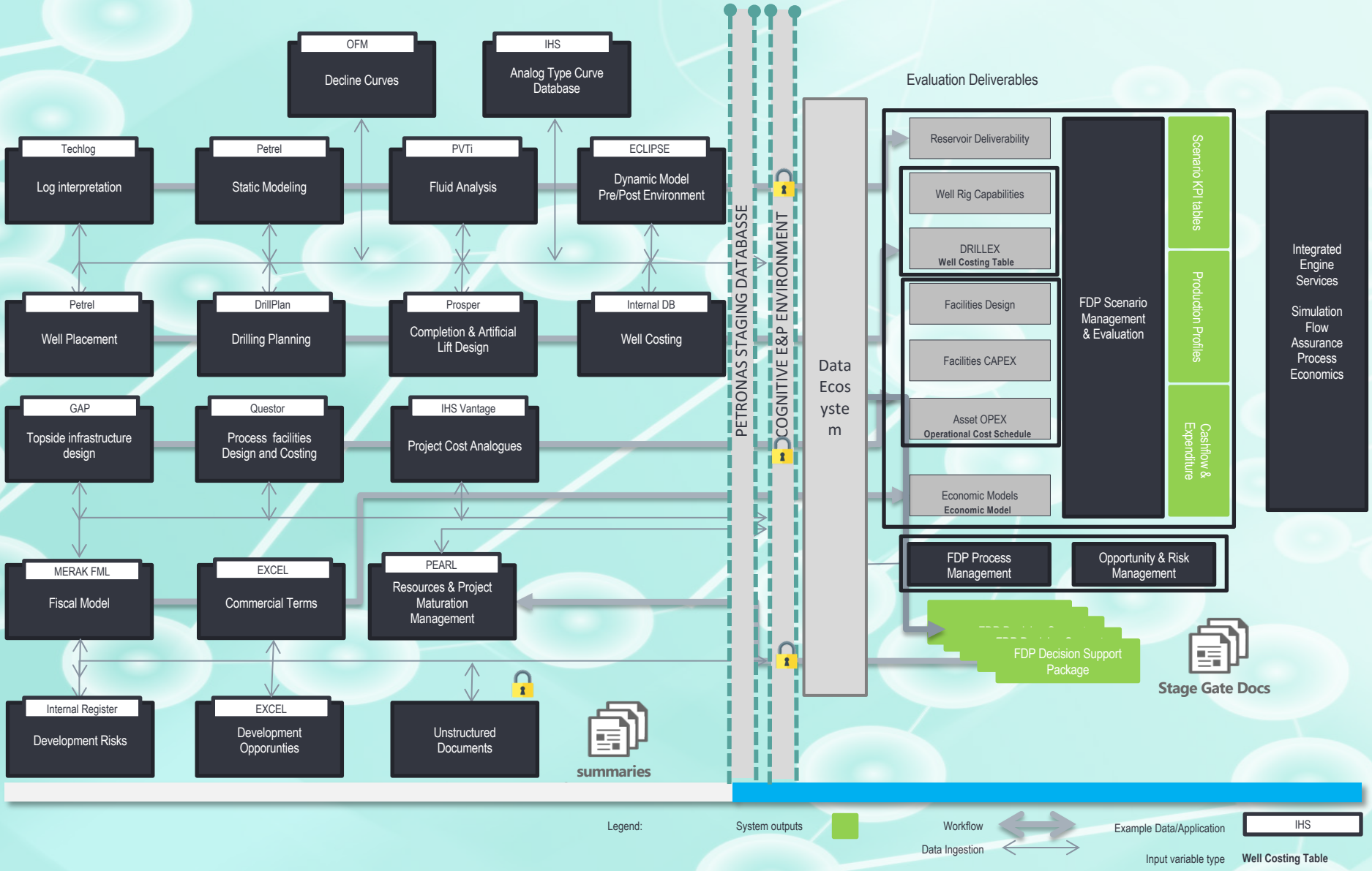
Subsurface | Drilling/Wells | Drilling/Wells | Subsurface | Subsurface | Production | Subsurface | Energy Technology | Production

1 Data Sources

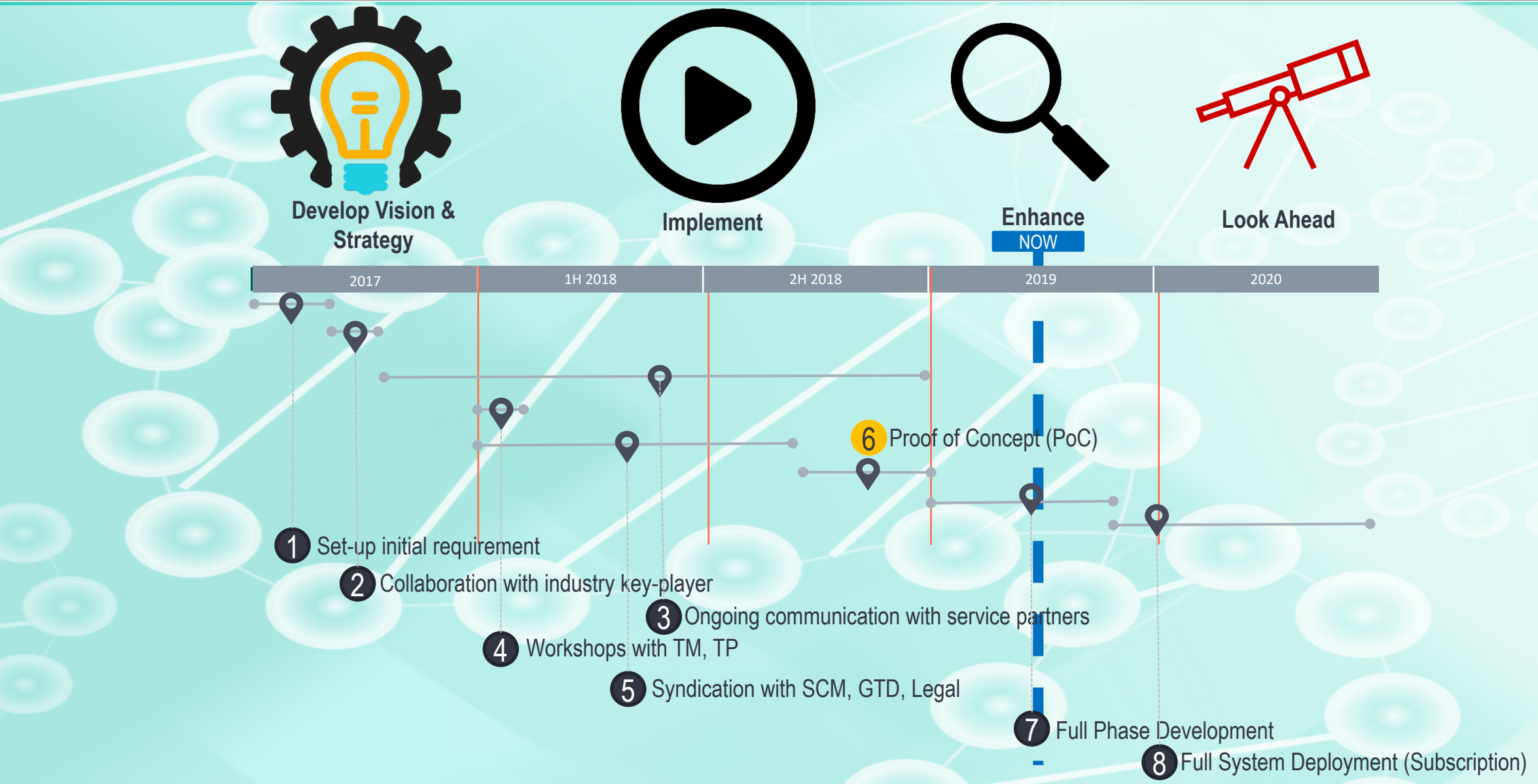
Real Time — 2016 Data Coverage: PI = 24 / 48 Sites (51%) IO = 13 / 24 Sites (54%)

Recorded Time — 2016 Data Coverage: PI = 24 / 48 Sites (51%) IO = 13 / 24 Sites (54%)

Data Flow Diagram shows how Live FDP system assimilate current softwares and integrate them within one ecosystem seemlessly



Live FDP timeline and implementation plan until year 2020



Ultimate Aspiration of Live FDP

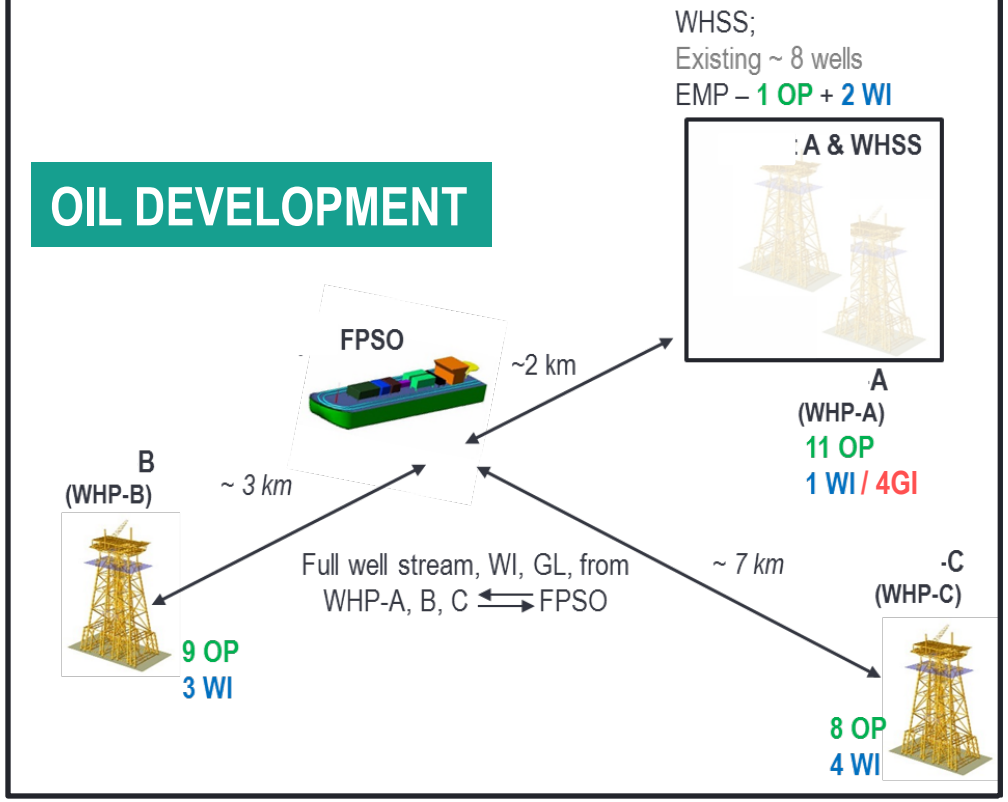
	Definition	Live FDP Roles
Online	A state of connectivity	Online 24/7
Autonomous	Making an informed, un-coerced decision	Run simulation autonomously
Iterative	Generating an unbounded sequence of outcomes towards the desired result	Multiple iterations with significantly less amount of time
Predictive	Predicting technical risk in order to plan ahead and make necessary measures	Able to predict the UDC, UPC, NPV, PIR based on historical data
Prescriptive	Prescriptive countering measures to prediction to make an informed business evaluation and decision	Able to provide best concept based on range of value drivers

Open

Project S Development Concepts

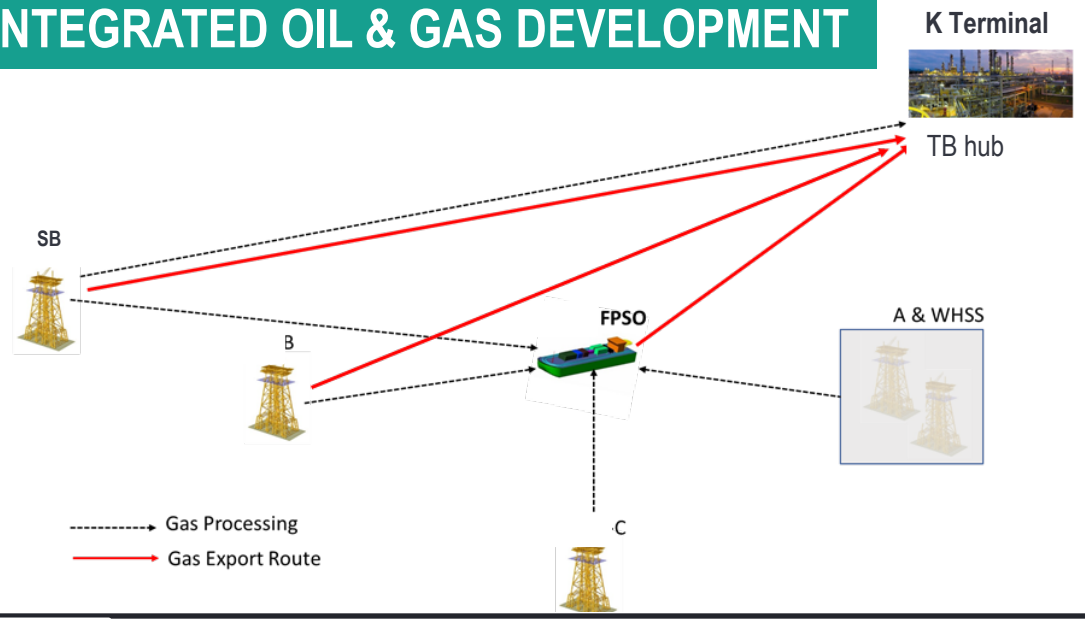
- Focus at S Main ; **D5,5.5,6.0 & E6.0,7.0,8.0** reservoirs
- 3 open-sea appraisal wells (**derisking**)
- **Infill + Water/Gas Injection** for improving oil recovery
- Installation of **WHP-B** & **WHP-C**
- Oil processing & Injection modules on the **FPSO** (lease)

OIL DEVELOPMENT

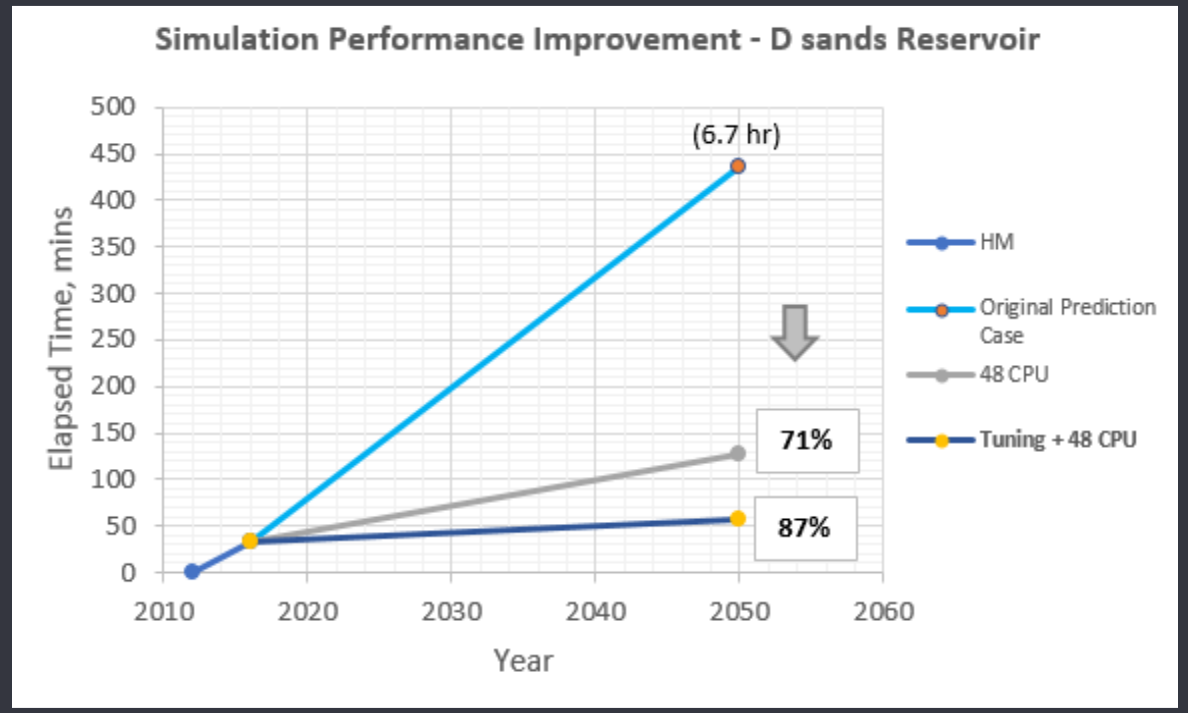


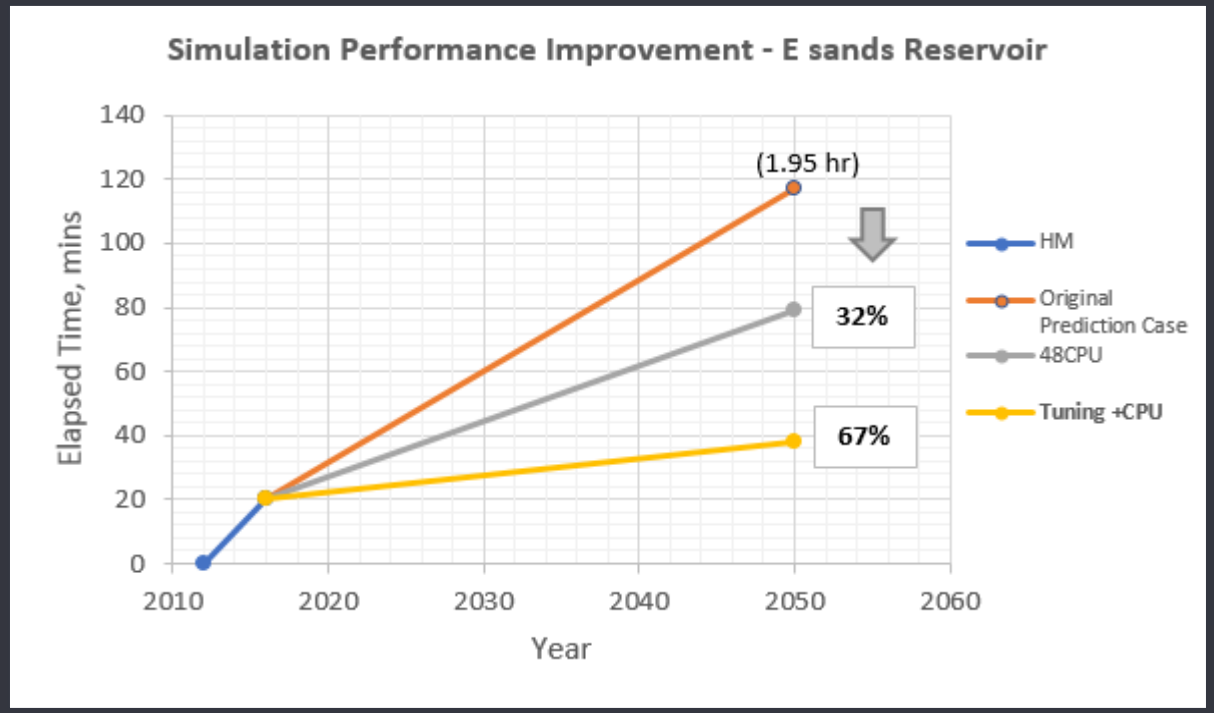
- Oil from SMain only, **Gas (NAG)** to be developed;
  - a) S Main Shallow; B100 + D35/36
  - b) S Barat; B100 down to F10/25
- Installation of **WHP-B, WHP-C & WHP-SB**
- Oil processing & Inj. modules on **FPSO** (lease)
- **Gas processing & CO2 removal;**
  - **a)** **@ TB** - (gas rate: 150 MMscf/d)
  - **b)** **@ S FPSO** - (gas rate: 250 MMscf/d)
- **Gas export route;**
  - **a)** **To TB Cluster** - (rate: 150 MMscf/d)
  - **b)** **Directly to K**Terminal via **new** or **J** pipeline - (rate: 250 MMscf/d)

INTEGRATED OIL & GAS DEVELOPMENT



Simulation Performance Improvement for Project S

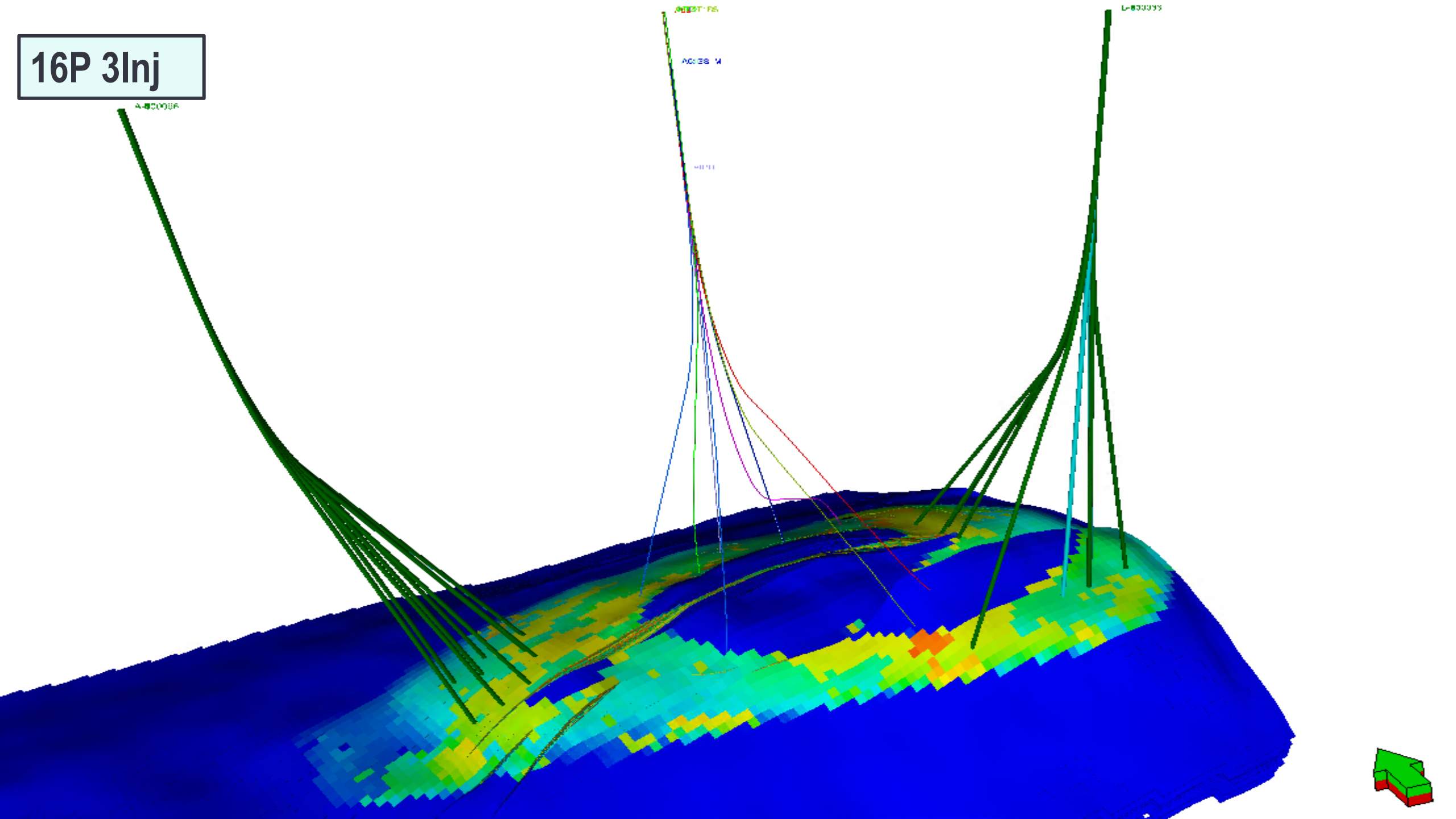




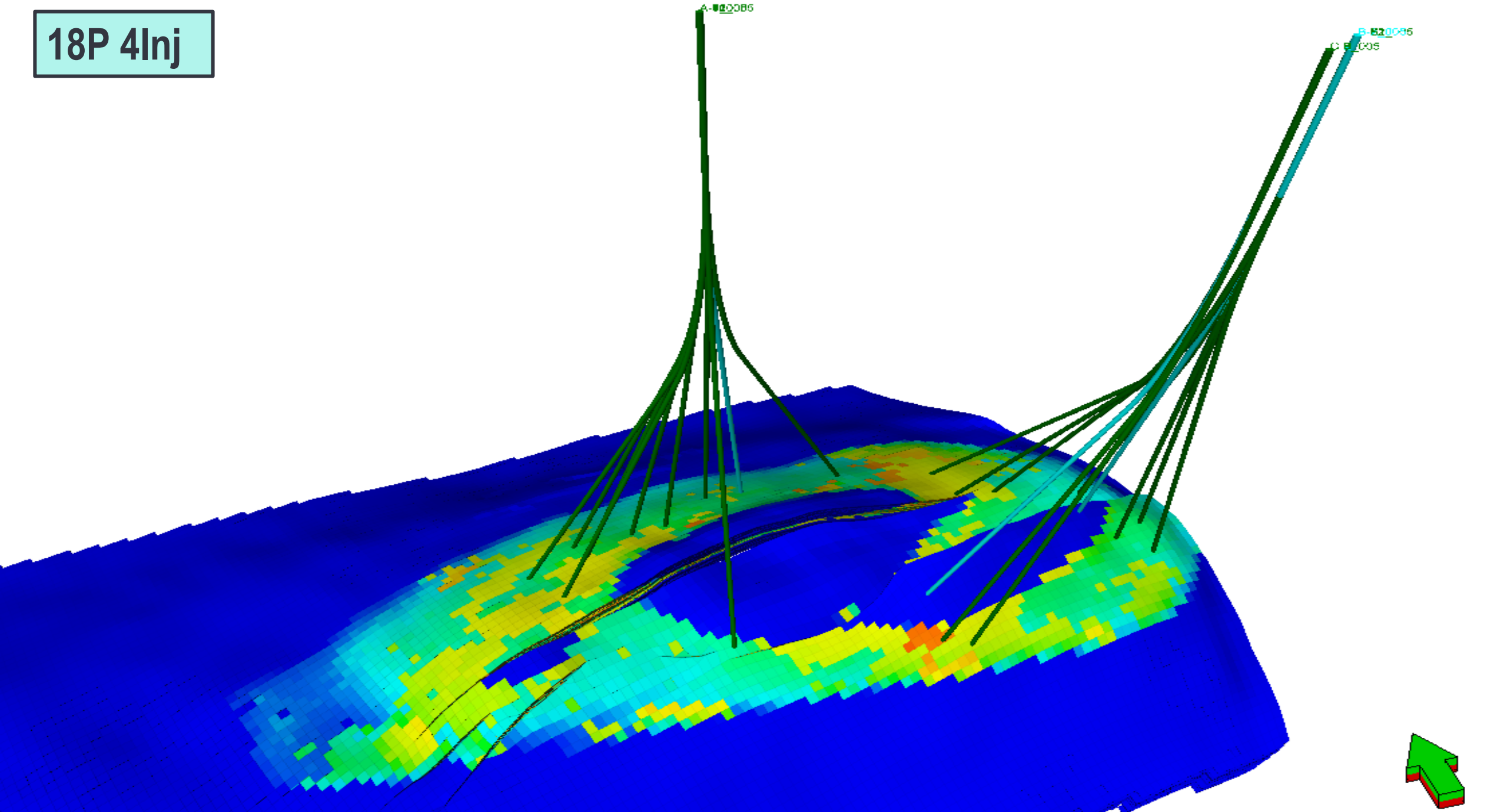
Performance Improvement Due to :

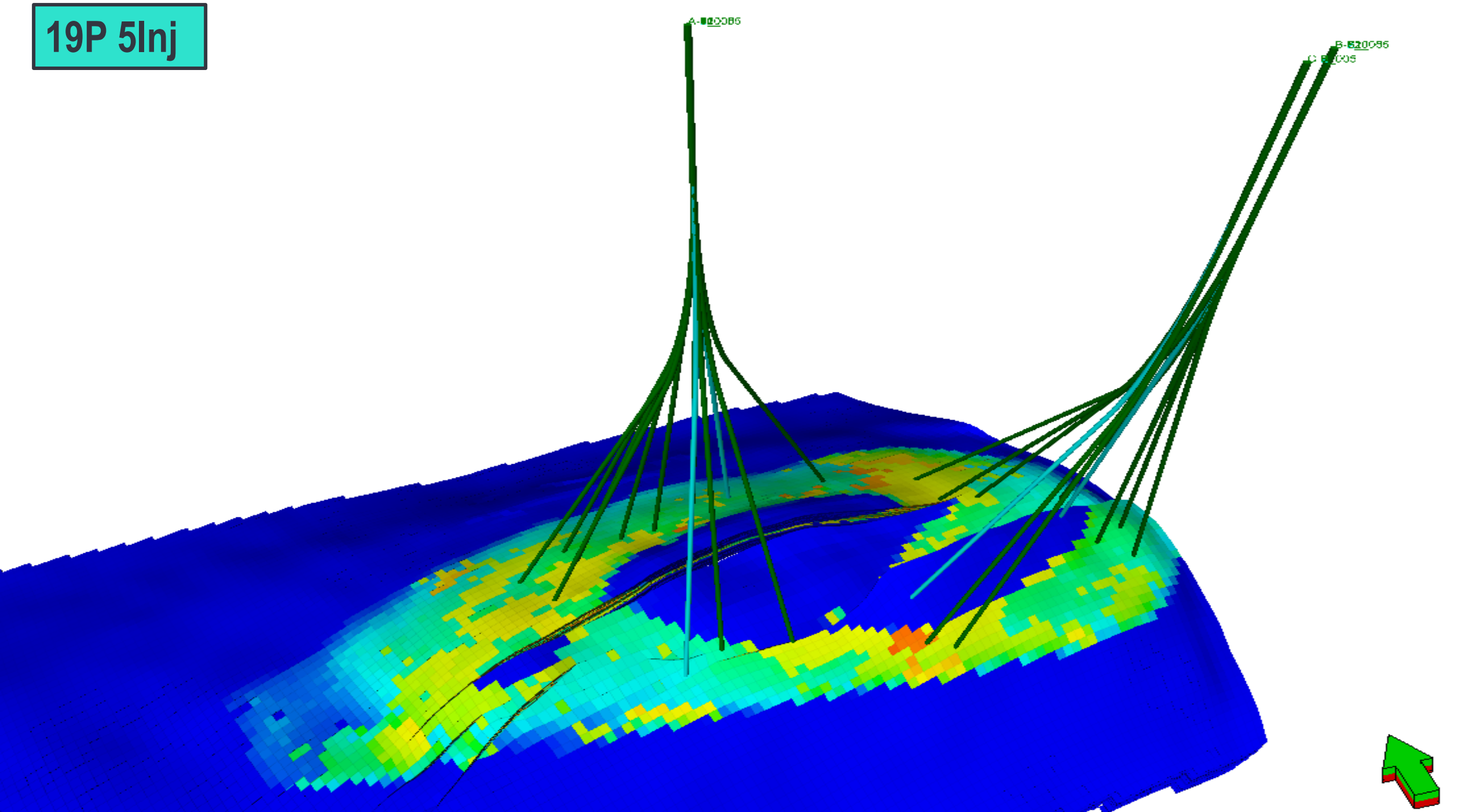
- Model Tuning
- Input Data QA
- HM Performance in Ecosystem Environment
- Elasticity provided by Ecosystem Environment

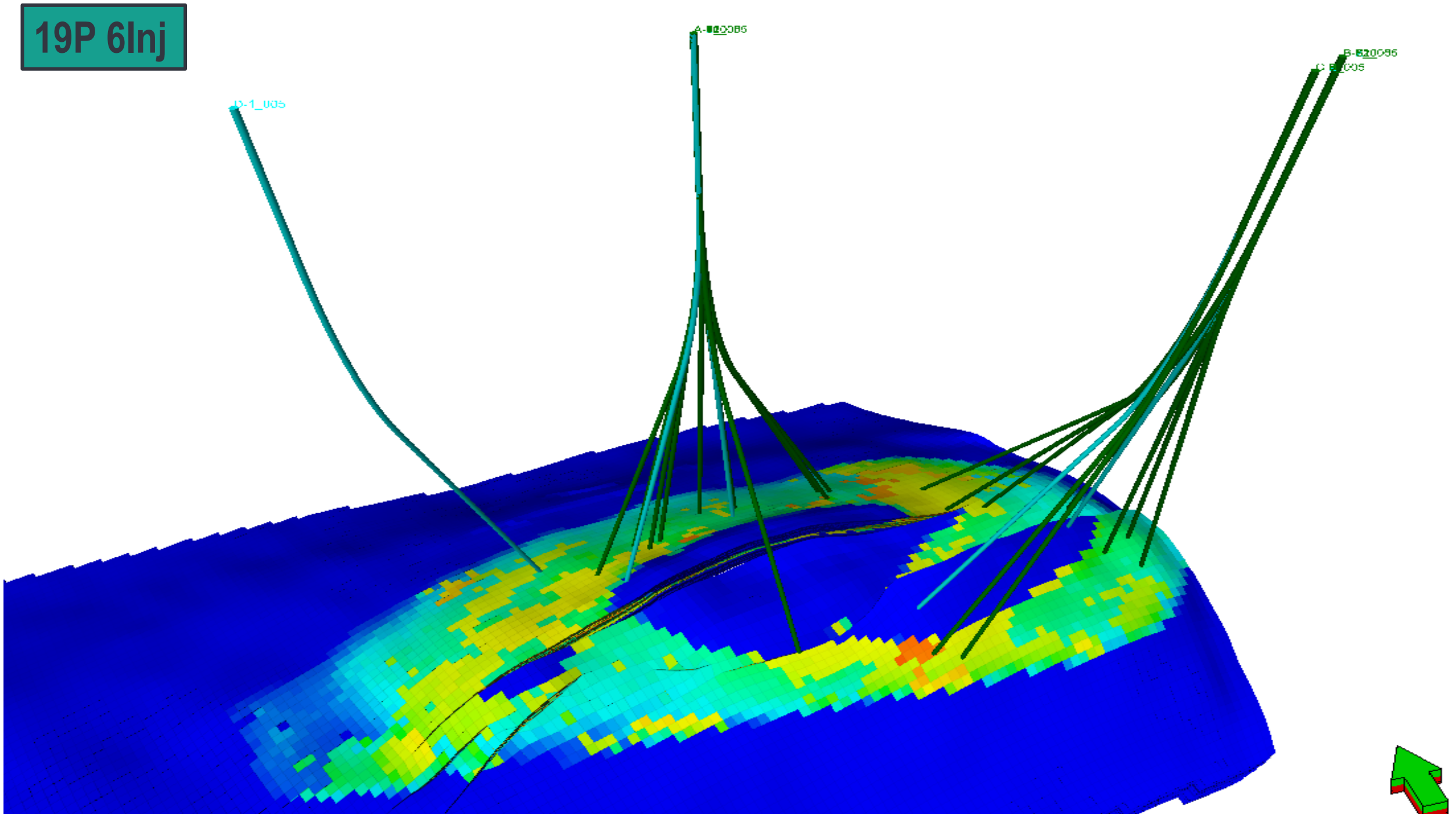
- With less than an hour per case, engineer would be able to run 6 or more cases in a day


16P 3Inj

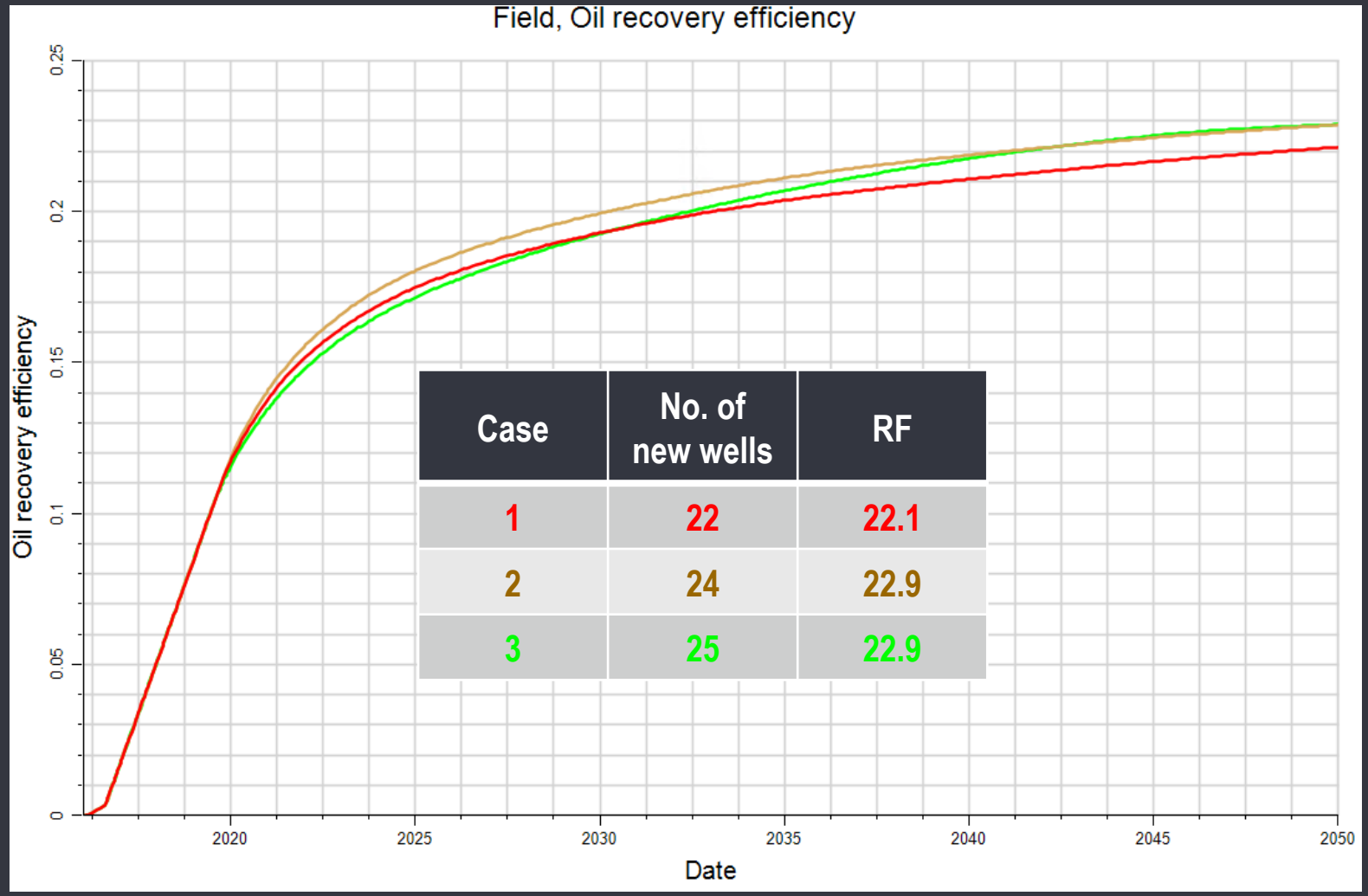
18P 4Inj




19P 5Inj

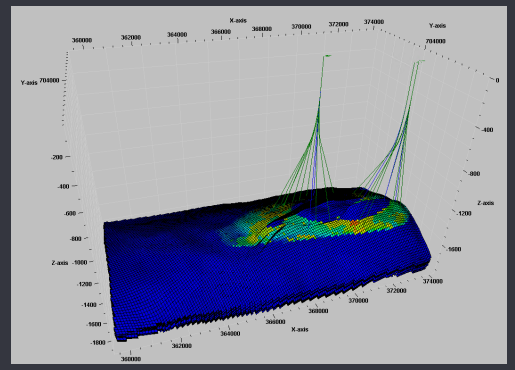

19P 6Inj

Fixed Platform Location with Economic Constraints

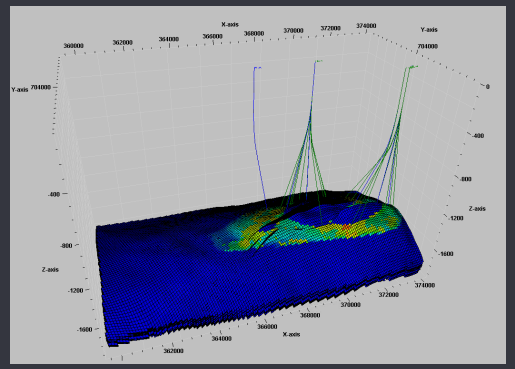


Case	No. of new wells	RF
1	22	22.1
2	24	22.9
3	25	22.9

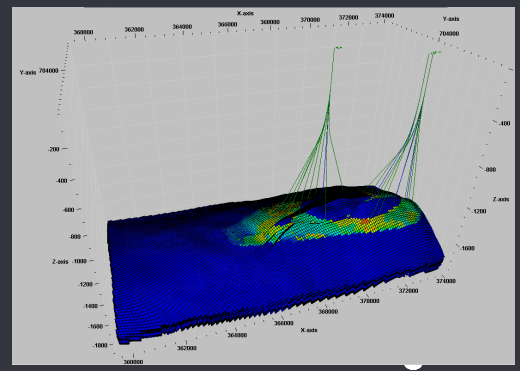
Case 1:18P 4Inj

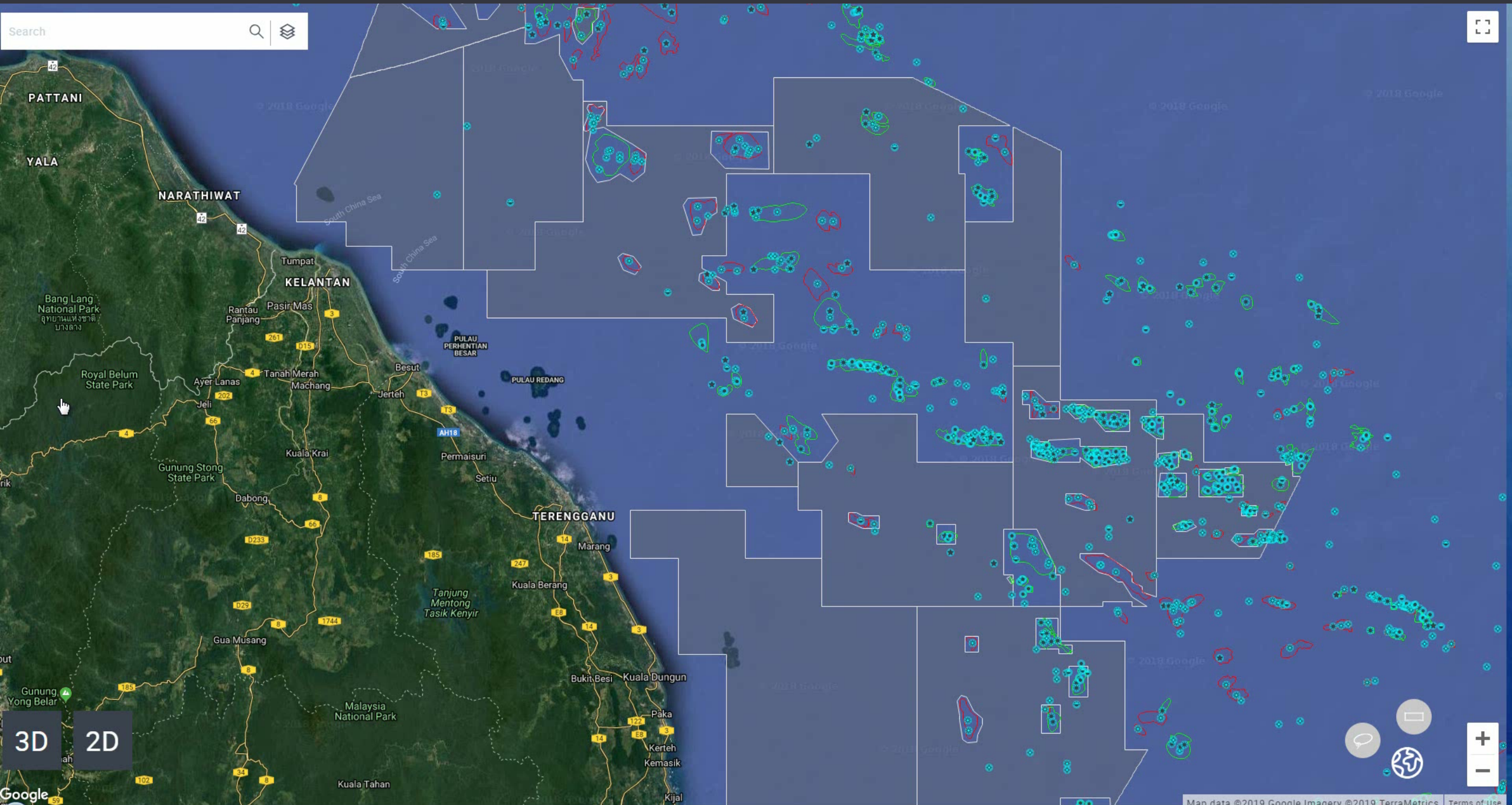


Case 2:19P 5Inj



Case 3:19P 6Inj




Search
PATTANI
YALA
NARATHIWAT
KELANTAN
Tumpat
Pasir Mas
Rantau Panjang
Bang Lang National Park
Royal Belum State Park
Ayer Lanas
Tanah Merah
Machang
Jeli
Besut
Jerteh
PULAU PERHENTIAN BESAR
PULAU REDANG
Permaisuri
Setiu
Kuala Krai
Gunung Stong State Park
Dabong
TERENGGANU
Marang
Kuala Berang
Tanjung Mentong Tasik Kenyir
Gua Musang
Bukit Besi
Kuala Dungun
Paka
Kerteh
Kemasik
Malaysia National Park
Kuala Tahan
Kijal
Gunung Yong Belar
South China Sea
3D
2D
Google
Map data ©2019 Google Imagery ©2019 TerraMetrics
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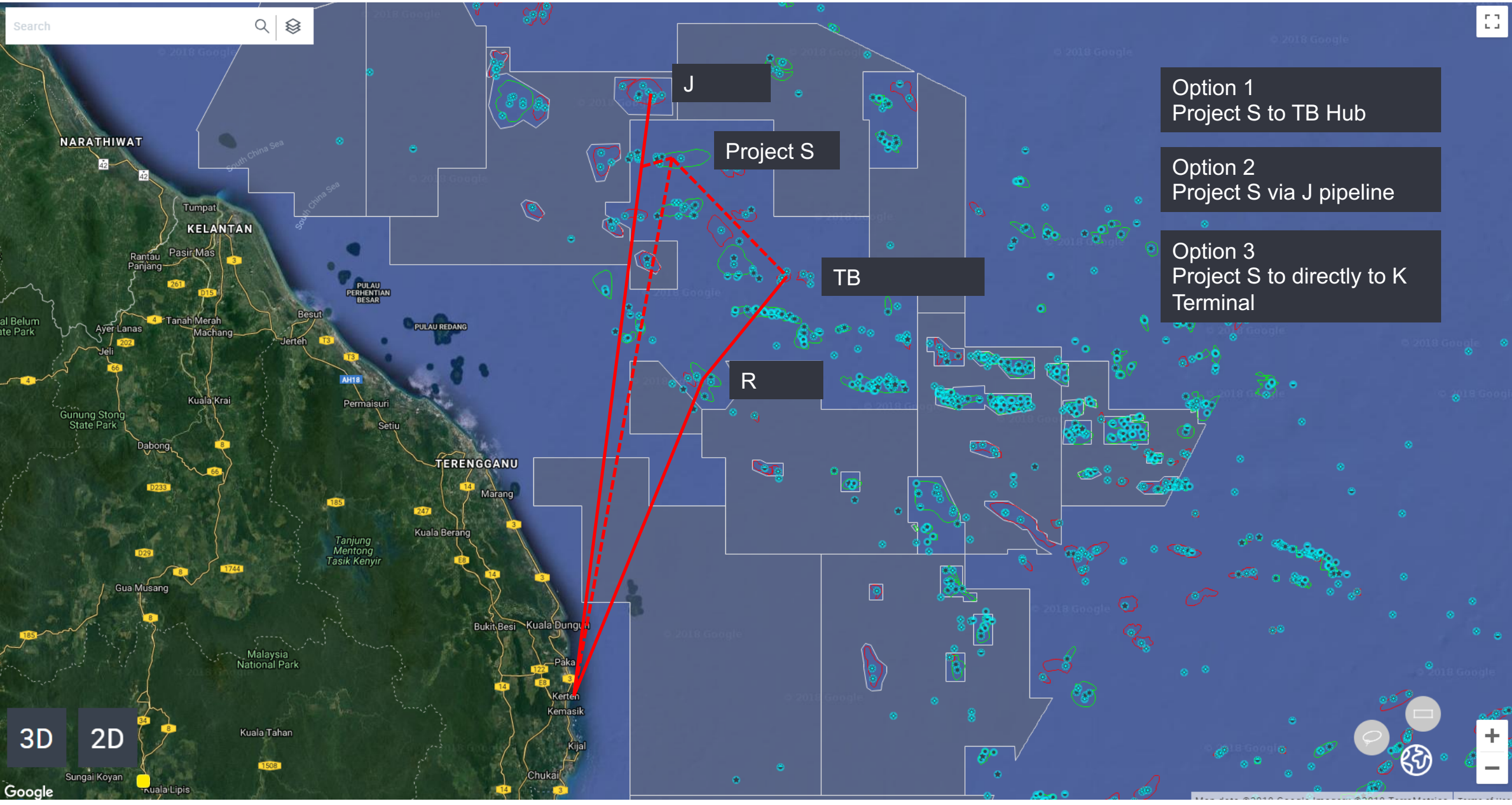
Search
J
Project S
TB
R
Option 1
Project S to TB Hub
Option 2
Project S via J pipeline
Option 3
Project S to directly to K Terminal
NARATHIWAT
KELANTAN
TERENGGANU
Tumpat
Rantau Panjang
Pasir Mas
Tanah Merah
Machang
Ayer Lanas
Jeli
Besut
Jerteh
PULAU PERHENTIAN BESAR
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Setiu
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Kuala Berang
Tanjung Mentong Tasik Kenyir
Gua Musang
Malaysia National Park
Bukit Besi
Kuala Dungun
Paka
Kerteh
Kemasik
Kijal
Chukai
Kuala Tahan
Sungai Koyan
Kuala Lipis
South China Sea
3D
2D
Google

Project S Development Scenarios – Results & Conclusion

Preferred Dev Option

Top Value Tier
Oil Development **Only** (WI/GI)

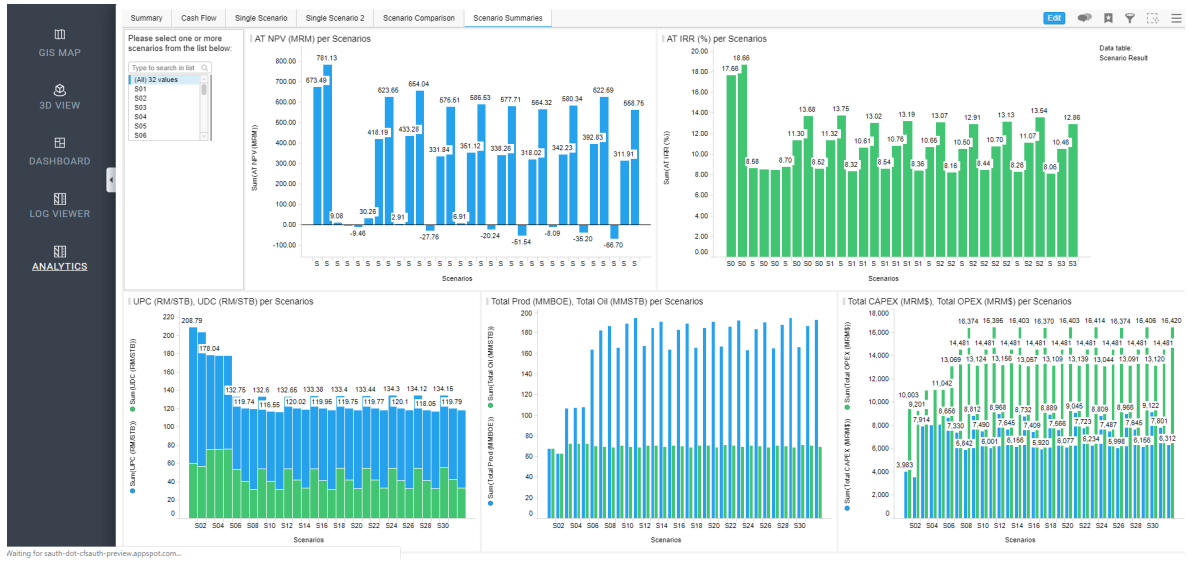
High Value Integrated Development Tier
Oil & Gas (S Main + SB), **Process on FPSO** and Processed Gas Sent to K Terminal **via J Pipeline**, 250MMscf/day

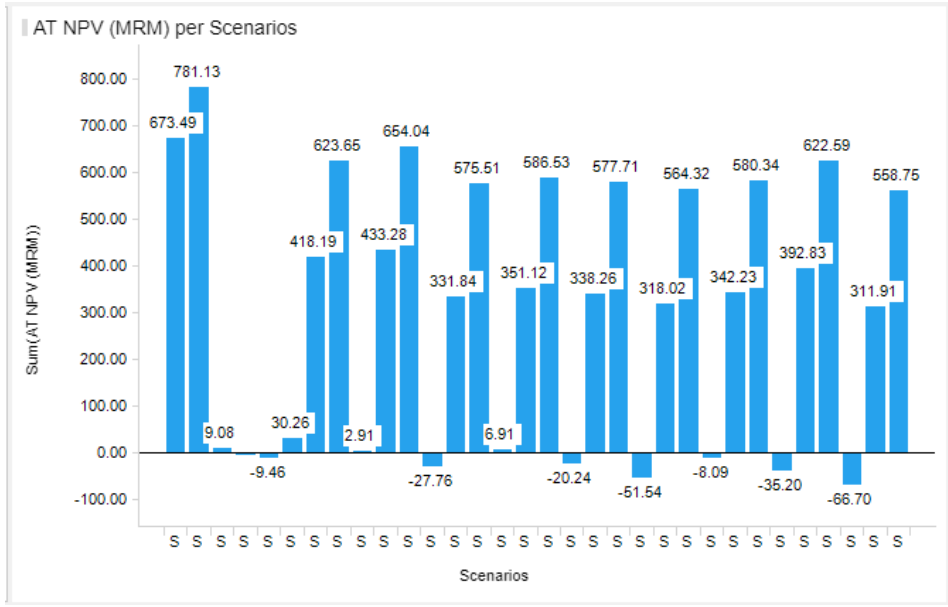
Mid Value Integrated Development Tier
Oil & Gas (S Main + SB, **Process on FPSO** and Processed Gas Sent to K Terminal **via New Pipeline**, 250MMscf/day

Marginal Dev Option

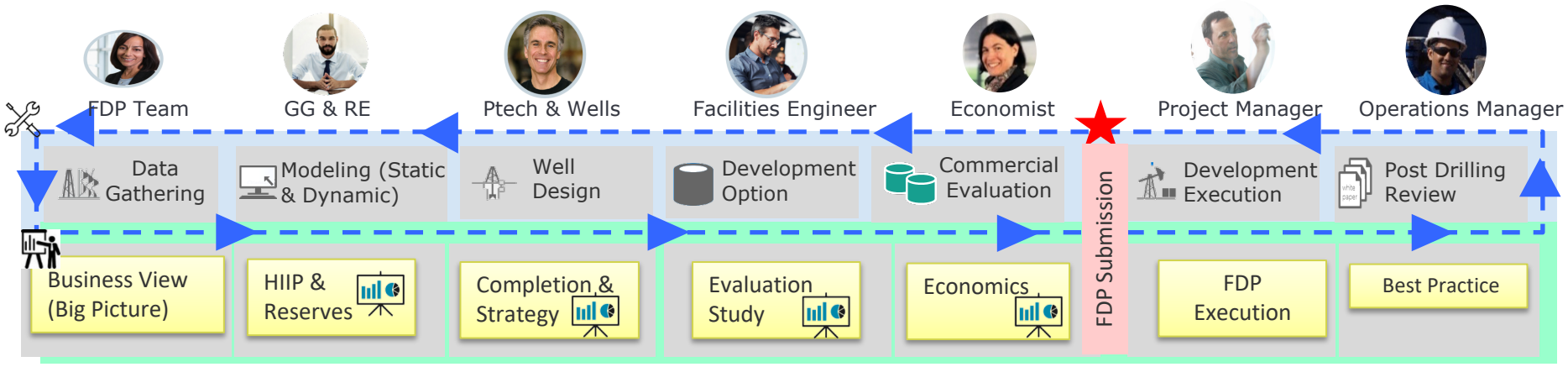
Marginal Value Tier
Oil & Gas (**S Main + SB**), Oil process at FPSO and **Wet Gas Sent to TB Hub** for processing via CRA Pipeline, 150MMscf

Negative Value Tier
Oil & Gas (**S Main only**), Oil process at FPSO and **Wet Gas Sent to TB** for processing via CRA Pipeline, 150MMscf





Live FDP improves Efficiency, Analytics and Imposing New Way of FDP



•DELFI Ecosystem allows ~60-80% time reduction through data syncing across multiple disciplines & geographies	•~50-70% improvement on simulation performance through DELFI Cloud Resources	•~ 30-50% time reduction during the iterations between Subsurface & Wells	•~ 30-50% time reduction during the iterations between Subsurface/Wells & Facilities	•~ 20-30% time reduction during engagements with various parties for data gathering & cost benchmarking for economic analysis	•~40-50% time efficiencies expected utilizing the DELFI Cloud Resources & Applications	•~40-50% time efficiencies expected utilizing the DELFI Cloud Resources & Applications
•Increased opportunity to generate multiple development scenarios & optimizations during framing	•Reduced time required to produce probabilistic forecasts and multiple subsurface realizations	•Increased opportunity for joint Subsurface/Wells technical collaboration for maximing recovey & cost optimization	•Increased opportunity for joint Subsurface/Wells & Facilities Design during technical collaboration for minimizing risk	•Benchmarking to drive business decision and prescriptive analytics to shorten time reaching 1st oil	•(Need to pilot a few FDPs using the new LiveFDP solutions & workflows)	•(Need to pilot a few FDPs using the new LiveFDP solutions & workflows)
•Autonomous advisory and insights enabled by benchmarking to drive development concept identification	•Auto screening of geological realizations with dynamic data allowing users to select "right" models for HM and making robust designs of recovery concepts	•Autonomous sweet spot area identification linked to smart algorithms for automatically creating basic trajectory & well design with or without surface & economic constraints	•Iterative designs and broader asset review allowing FDP teams to formulate right-sized facility designs, enabling robust subsurface uncertainties and cost optimizations	•Automated KPOs calculations & benchmarking to enable enhanced business viability	•Smart algorithms to accurately predict performance at specific depths and improve drilling times and cost	•Comparison of actual drilling results vs. plan (reserves/costs/time)
•Auto-search on technical/solution keywords from past FDP documents or external sources	•Automated data-driven uncertainty & evaluation of reservoir models (coupled multi 3D property modeling to dynamic simulations)			•Automatically integrating subsurface data from Petrotechnical suites to economic evaluations	•Self learning from offset wells to refine critical technical limits & operating parameters pre-during-post drilling	•Recycle end-to-end process instantly based on new findings
•Cognitive search for opportunities to increase value through a selection of Development Analogues from multiple sources				•Auto-rank development scenarios with multiple economic KPOs		
•Explore OPF for area instead of field development (ADP vs FDP)	•Remove infrastructure constraints to allow borderless collaboration across multiple disciplines	•Explore wide range of potential scenarios collaborating Subsurface, Well and Facility options in search of the optimal development strategy	•Create multiple facility concepts in an informed & collaborative environment	•Multi-discipline teams can review and perform permutations to optimize FDP scenarios	•Learn from offset wells contionously to refine critical technical limits & operating parameters pre-during-post drilling	•Shorten approval time of PDRs
•Manage, ingest and enrich data lifeclycle through DELFI Data Ecosystem	•Allow more geological realizations to be dynamically assessed in capturing full range of reservoir uncertainties		•Simulate concepts and run economic comparisons concurrently with Subsurface & Wells technical scope	•Update multiple economic scenario outcomes instantaneously		•Broaden knowledge sharing (LL & best practices) to other projects
•Unite multi domain data through data ecosystem	•Perform technical reviews, comments & endorsement (TP) through digital platforms		•Manage project maturation and risks throughout the digital thread	•Perform digital endorsement of the development scenarios and economic results		•Fasten static/dynamic model updates based on the new findings
•DELFI Data Ecosystem	•DELFI Cloud Computing	•RapidPlan	•DELFI Data Ecosystem	•FDPlan	•PEARL	•DELFI Data Ecosystem
•DELFI Analytics	•Geomodelling and Simulation with unlimited resources	•DrillPlan	•DELFI Analytics	•CorporatePlan	•WPB	•DELFI Analytics
•FDPlan	•Geoscreening and RapidPlan	•ProdOps	•FDPlan	•DELFI Analytics	•Primavera	•FDPlan
•PEARL	•Multiple Property Realization*		•Integration to Questor		•DrillOps/Drillplan/Drilling Interpretation, RigHour	

TECHNICAL
BUSINESS
EFFICIENCY
ANALYTICS
NEW WAY OF DOING THINGS
TECHNOLOGY

Thank You