ENERGY SEMINAR: EFFICIENCY IN OIL INDUSTRY
"Improved Oil Recovery through Smart and Efficient Drilling, Completion, and Well Intervention"

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Outline

- Introduction
- Goal
- Case Study
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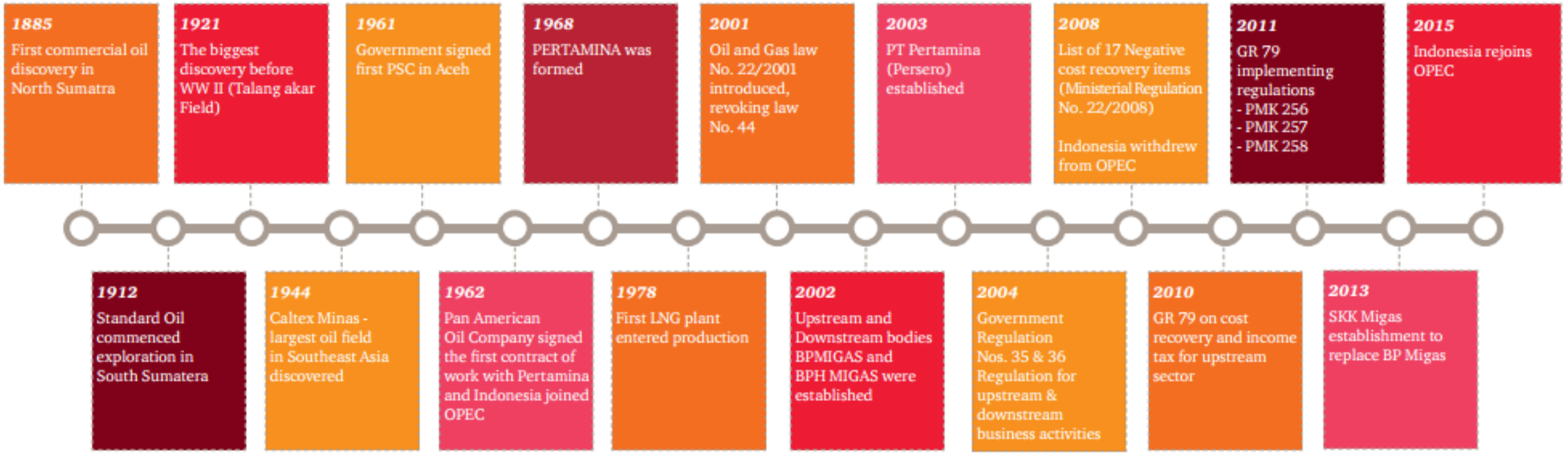
Significant events in the history of Indonesia's Oil and Gas Sector



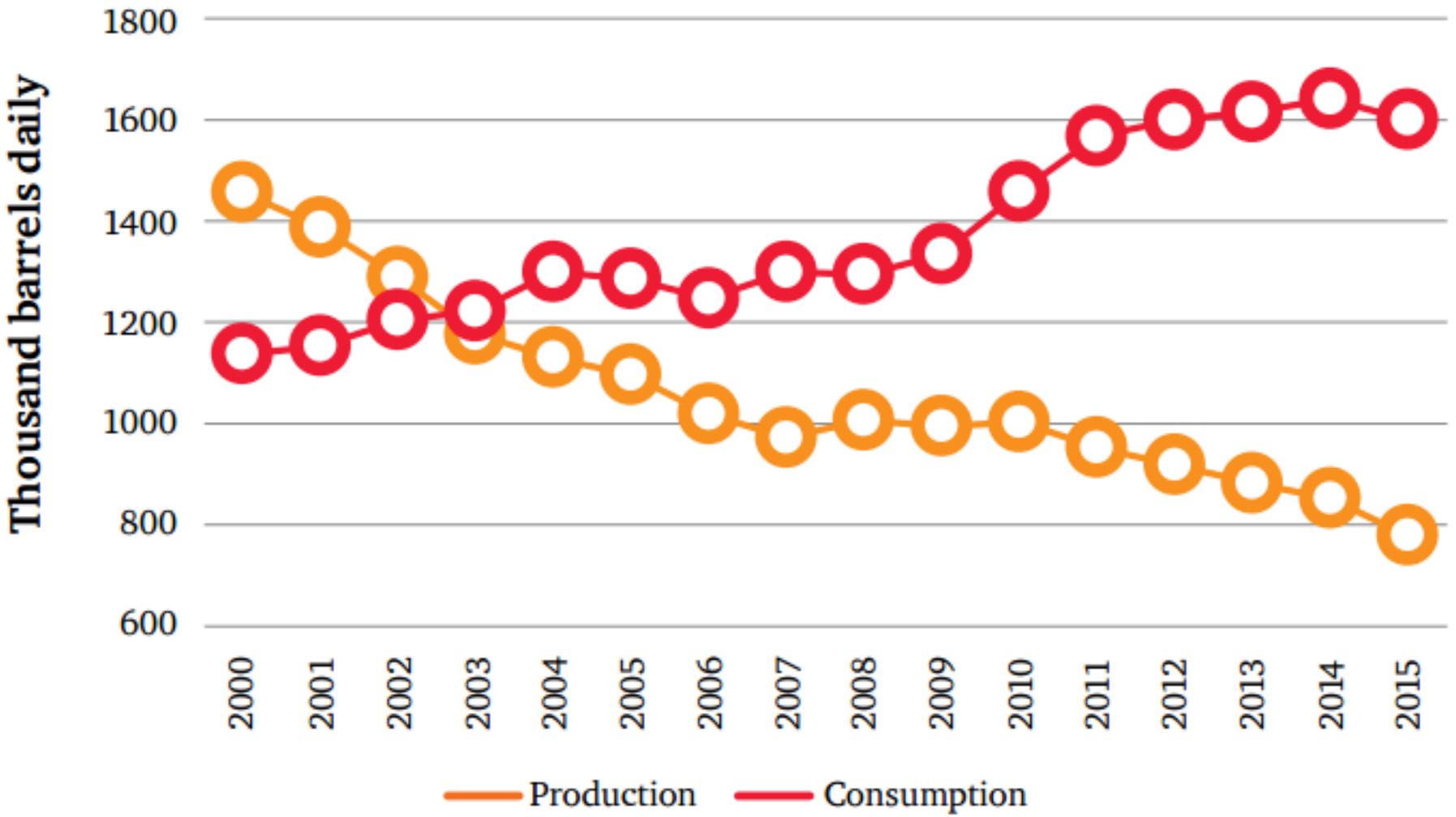
Key Indicators - Indonesia's oil and gas industry

Indicator	2007	2008	2009	2010	2011	2012	2013	2014	2015
Reserves									
*Oil (Million Barrels)	8,400	8,220	8,000	7,760	7,730	7,410	7,550	7,370	7,370#
Proven	3,990	3,750	4,300	4,230	4,040	3,740	3,690	3,620	3,692
Potential	4,410	4,470	3,700	3,530	3,690	3,670	3,860	3,750	3,750#
**Gas (TCF)	165.00	170.10	159.63	157.14	152.89	150.70	150.39	149.30	149.30#
Proven	106.00	112.50	107.34	108.40	104.71	103.35	101.54	100.26	103.35
Potential	59.00	57.60	52.29	48.74	48.18	47.35	48.85	49.04	49.04#
Production									
***Crude oil (MBOPD)	972	1,006	994	1,003	952	918	825	789	779
***Natural gas (MMSCFD)	7,283	7,460	7,962	8,857	8,415	7,110	6,826	8,218	8,102
New contract signed	28	34	34	21	31	39	14	7	12

Source:

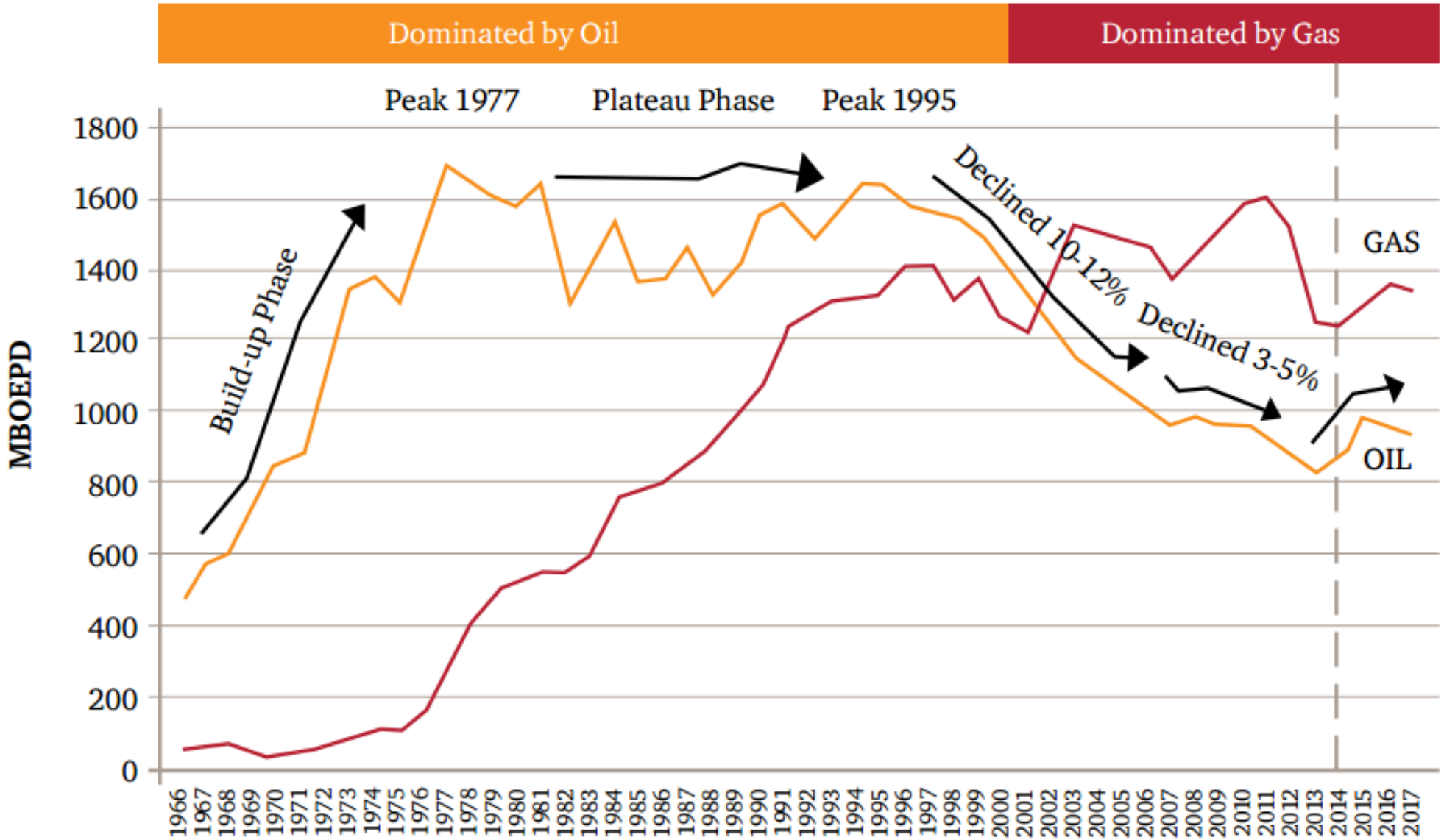
* 2007-2014 Oil Proven and Potential Reserves: ESDM
* 2015 Oil proven: EIA
** 2007-2014 Gas Proven and Potential Reserves: ESDM
** 2015 Gas proven: EIA
New contract signed: ESDM
Using 2014 as an estimate as 2015 data not yet available
*** 2007-2012 Crude Oil and Natural Gas Production: BP Statistical Review of World Energy
*** 2013-2014 Crude Oil and Natural Gas production: SKK Migas Annual Report 2013 and 2014
*** 2015 Crude oil production: Ministry of Finance (State Budget Realization)
*** 2015 Natural gas production: SKK Migas

Indonesia Oil Production and Consumption



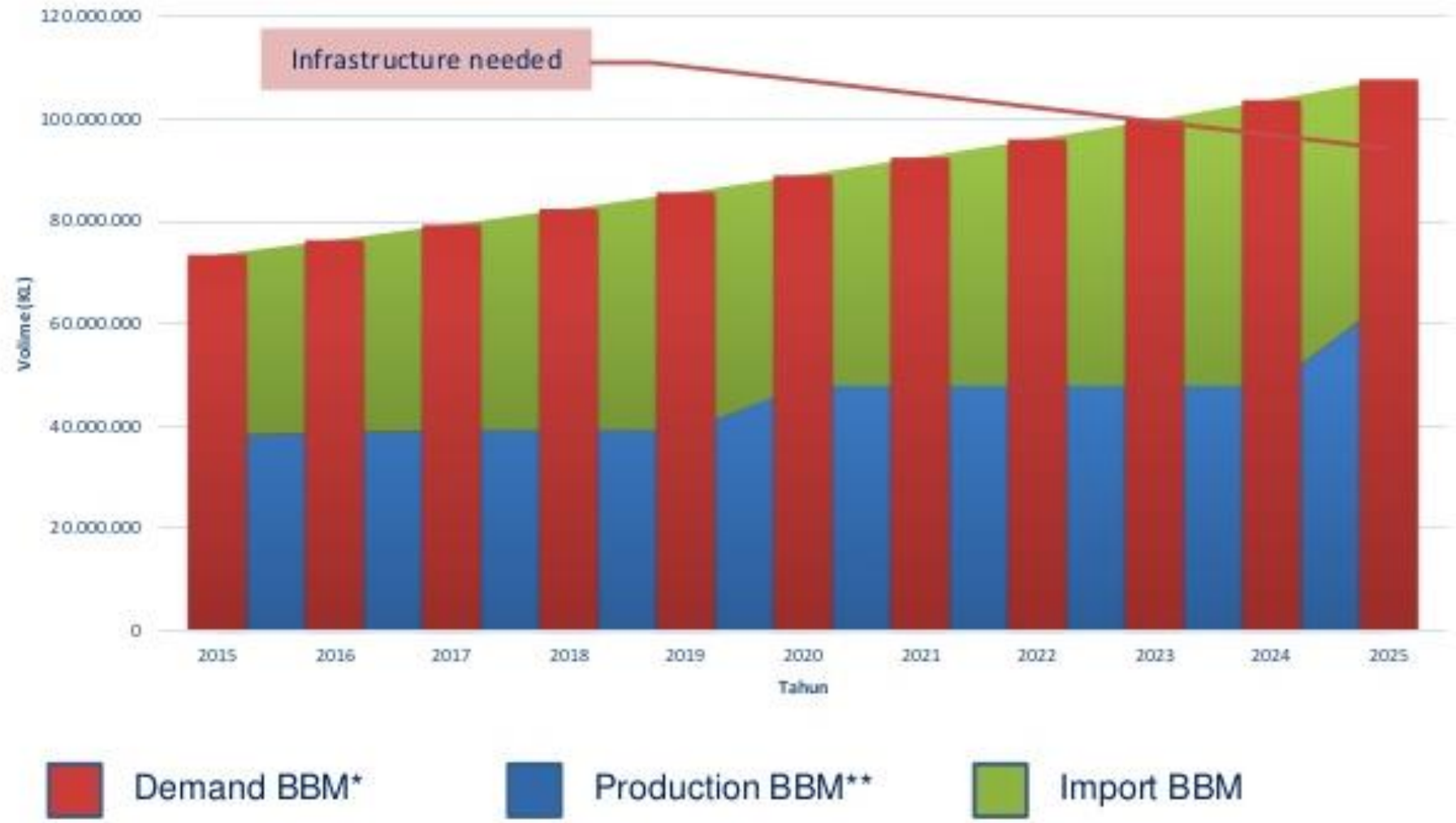
Source:
2000 - 2014: BP Statistical Review of Energy 2015
2015: SKK Migas & MoEMR

Indonesia Oil and Gas Production Profile (MBOEPD)



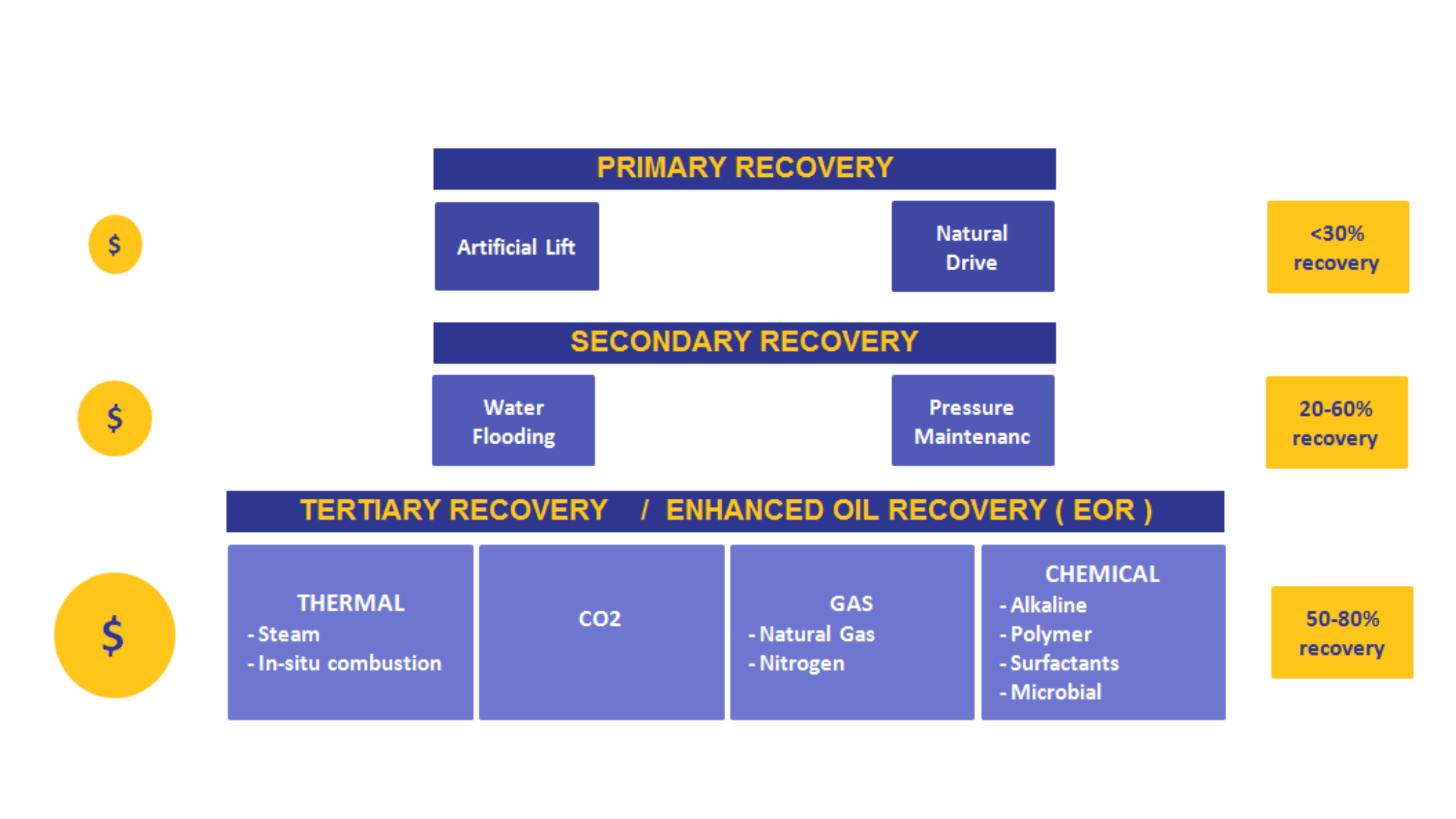
Source: SKK Migas Annual Report 2014

INDONESIA OIL SUPPLY & DEMAND 2015 – 2025



*) Demand Growth Assumption: 3.95%/yr.

**) Assumption: Addition 1 refinery (Pertamina)


PRIMARY RECOVERY
$
Artificial Lift
Natural Drive
<30% recovery
SECONDARY RECOVERY
$
Water Flooding
Pressure Maintenanc
20-60% recovery
TERTIARY RECOVERY / ENHANCED OIL RECOVERY (EOR)
$
THERMAL
- Steam
- In-situ combustion
CO2
GAS
- Natural Gas
- Nitrogen
CHEMICAL
- Alkaline
- Polymer
- Surfactants
- Microbial
50-80% recovery

Old Paradigm

- Cost overruns can easily manifest during well construction due to unexpected drilling problem issues including lost circulation and stuck pipe.
- Too often the best drilling practices used to address trouble zones are limited to a few conventional methods with a narrow range of effectiveness.
- In that purpose, the asset management drilling tools and techniques introduced in our model can be effectively deployed in the analysis of drilling performance.

- They help to detect new opportunities, quantify and address removable lost time and analyze the major problems in a comprehensively and structured manner.
- The aim of this study was to evaluate the Non Productive Time occurred during drilling operation in oil and gas wells in Indonesia

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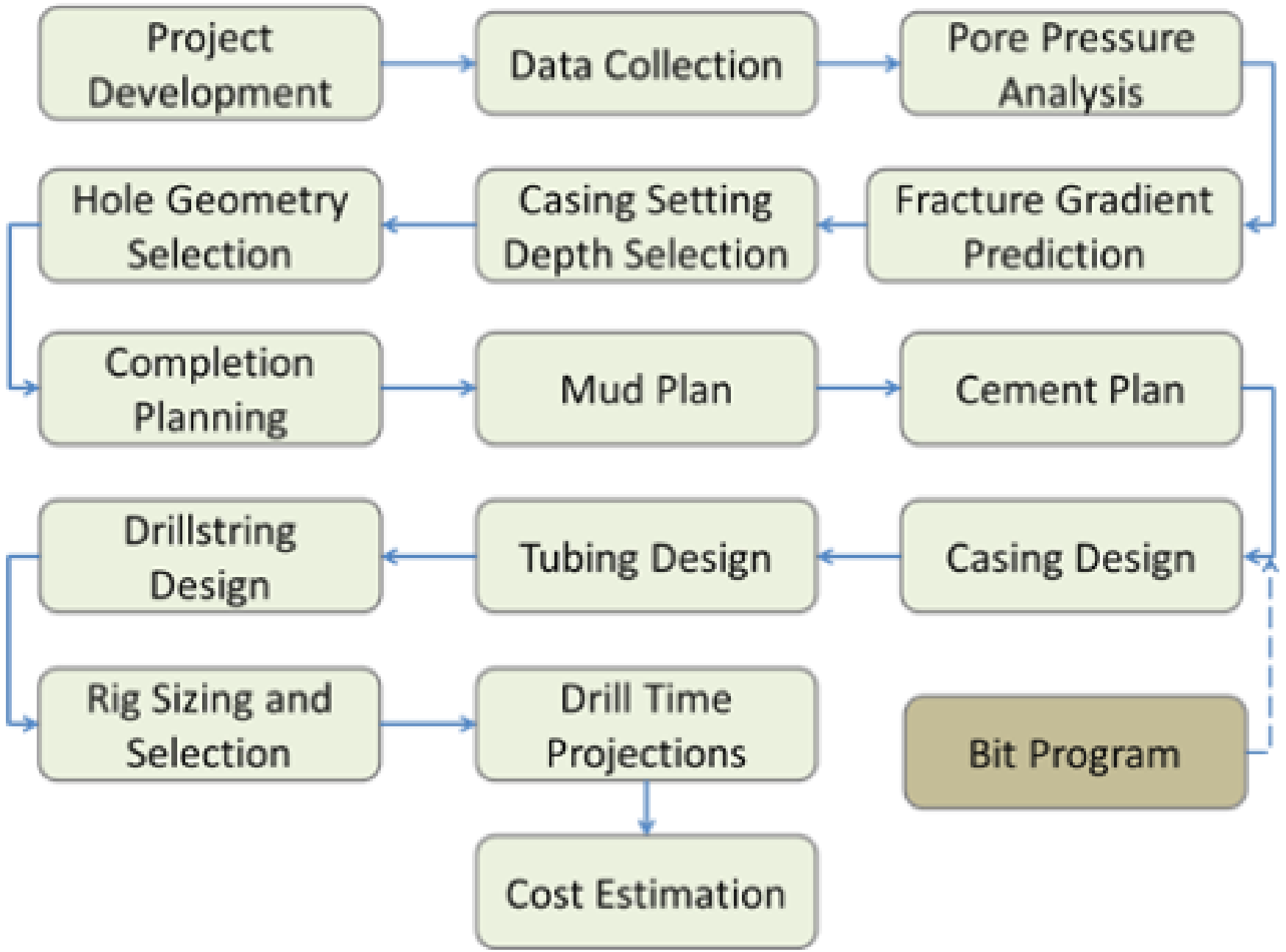
Goal

- Originally, the aim of this system is to provide a platform for regulators to compare the drilling performance of a large number of fields in a transparent and efficient way.
- Advanced analytics workflows around asset evaluation, infill drilling and workover candidate selection.

- We recently accomplished a project which enabled us to build a complete topdown, asset to well, solution for making the right business decisions to develop and operate clients' assets.
- The focus lays on the screening methods for recovery factor maximization. Efficiency of primary, secondary and tertiary recovery methods is assessed.

- The system is built in a top down approach from field level evaluation down to single well performance assessment. The calculations consist of conventional industrial screening methods combined with data drilling practices.
- A risk and uncertainty concept is also set up where the result reliability grows with the amount and quality of the available data.

Flow path of drilling design and operation



- There are many factors and events that impact the time and cost to drill a well. Factors can be classified as either observable or unobservable.
- Measurable factors include the physical characteristics, geology, and drill parameters of the well, while indirect characteristics, such as operator experience and wellbore quality, will be represented by proxy variables.

- Factors such as well planning and execution, team communication, leadership, and project management skills will also impact drilling performance, but to capture and identify the influence of these variables is often beyond the scope of analysis.
- There is no way to identify all the relevant characteristics of drilling, but many factors can be identified and in practice it is necessary to identify only the set factors that describe the primary elements of the process.

The factors that impact the time and cost to drill a well

- **Well Characteristics**
- **Well complexity**
  Site Characteristics
- **Operator preference**
- **Drilling characteristics**
- **Technology**

How should we act

- **Reservoir Benchmarking**: The focus lays on the screening methods for recovery factor maximization.
- **Reservoir Analytics**: The system is built in a top down approach from field level evaluation down to well potential assessment.
- **Well Candidate Selection:** Workover and Infill Drilling candidate selection help to rank and prioritize investments.

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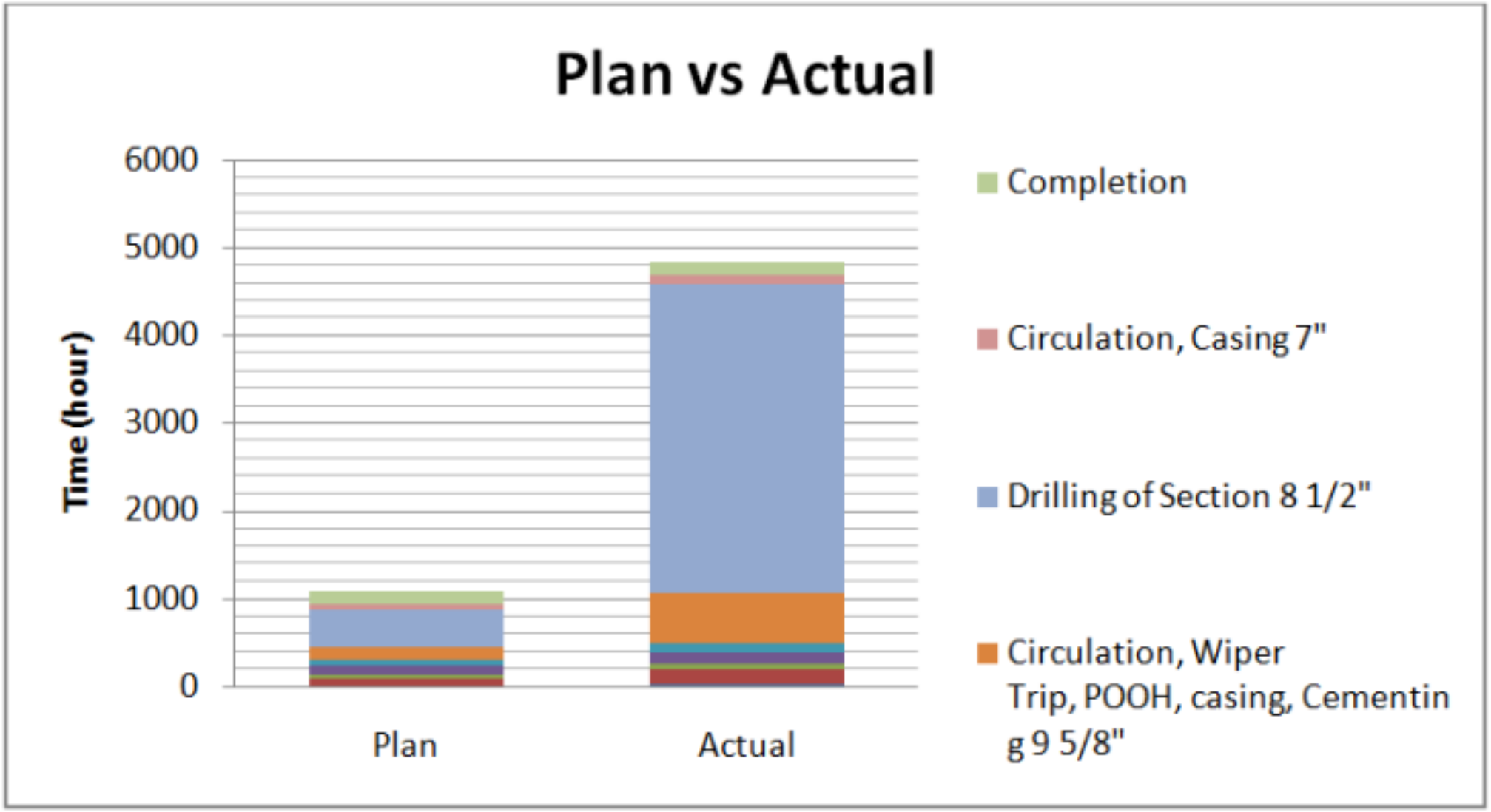
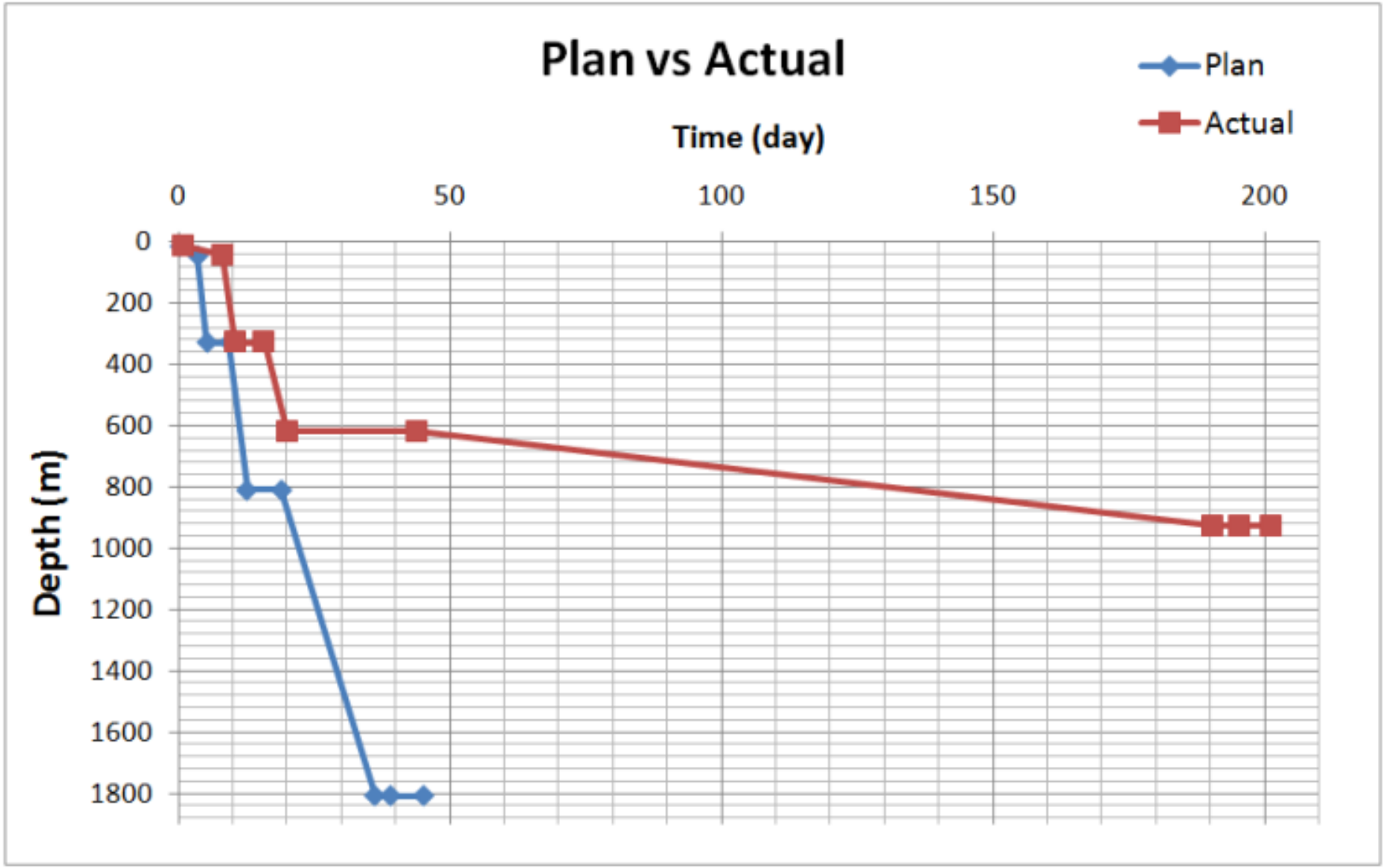
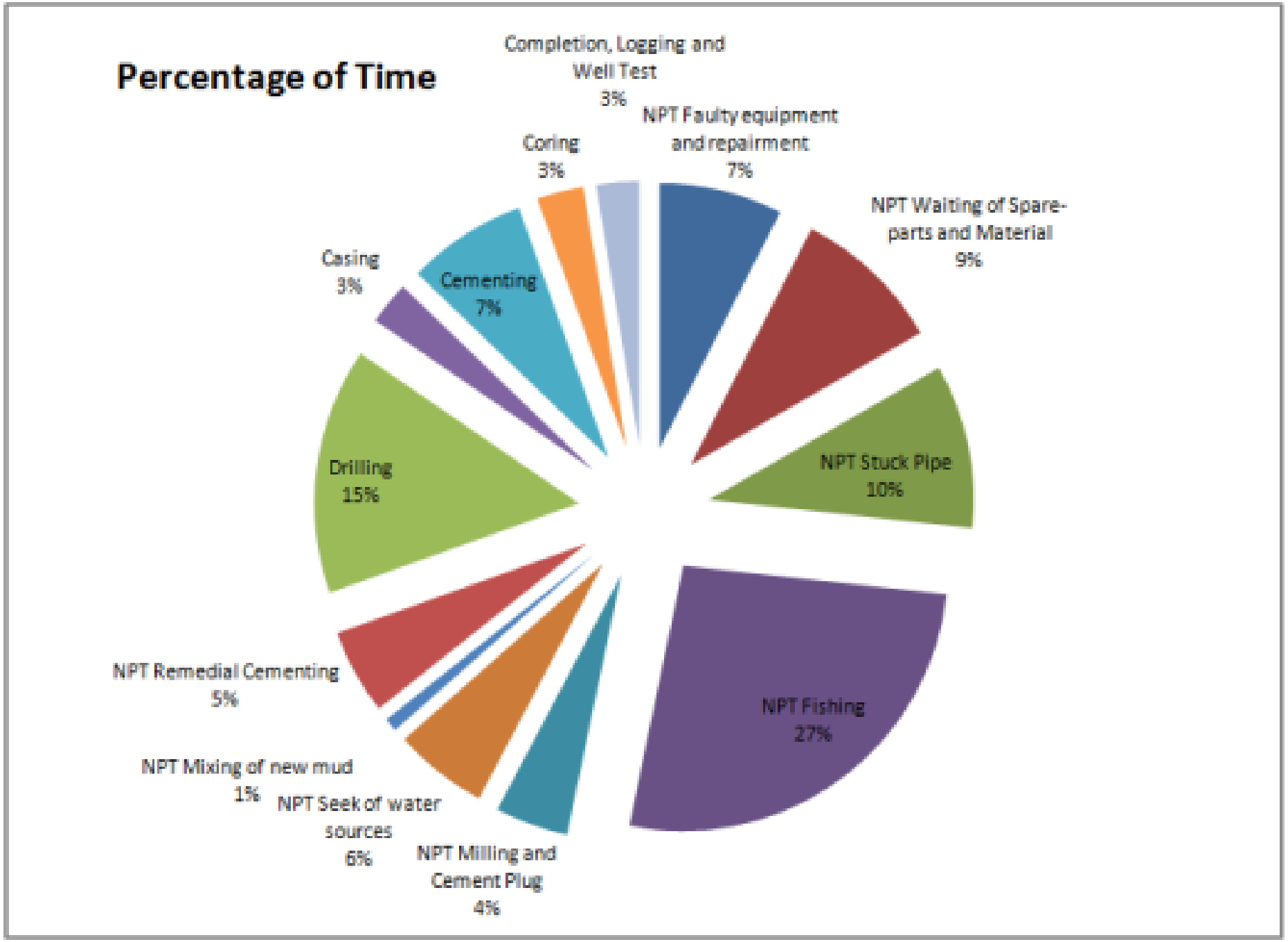
Case Study

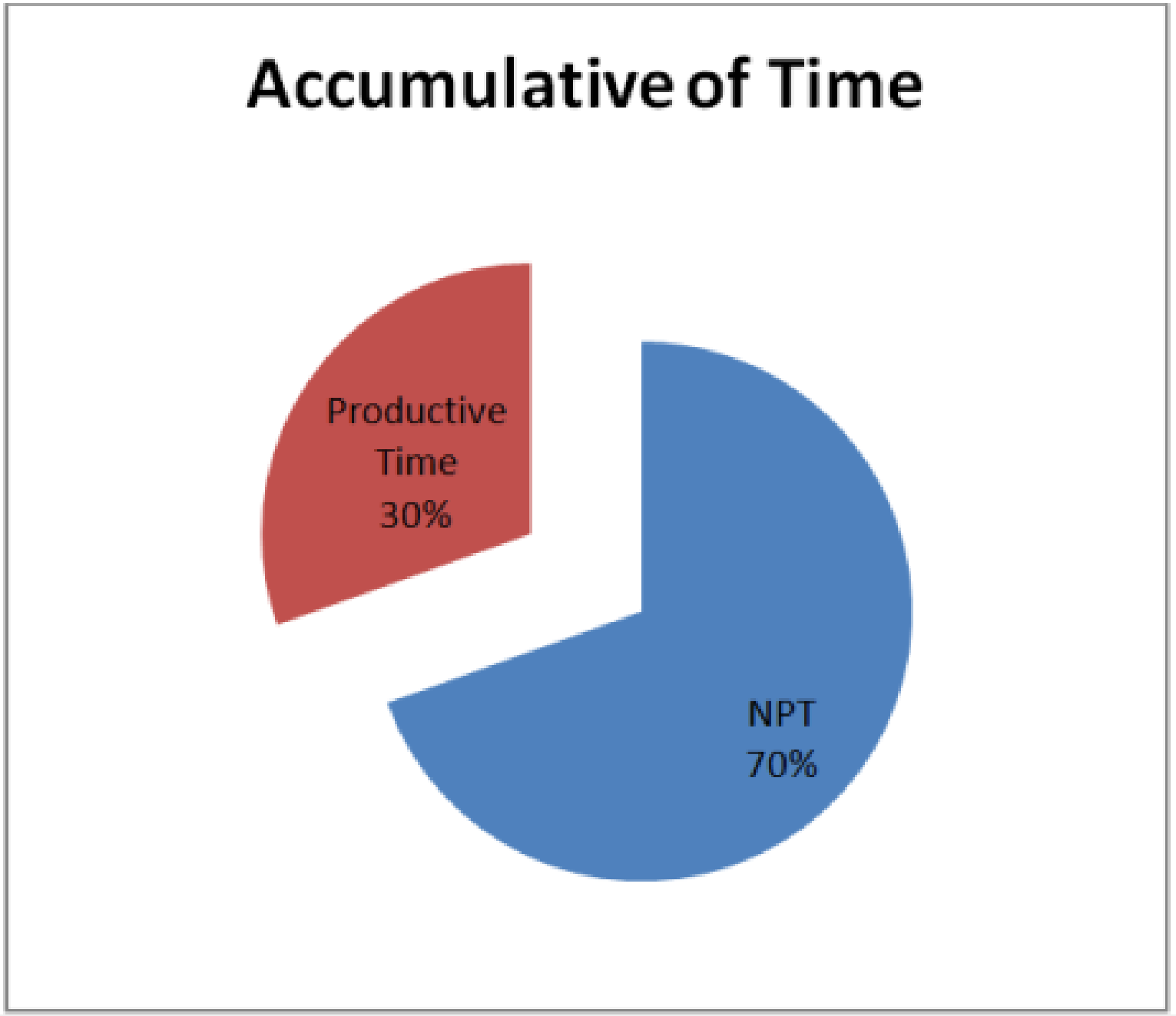
Plan and Actual Drilling Time of Field X



Time vs Depth Graph of Field X




Percentage of Time
Completion, Logging and Well Test 3%
NPT Faulty equipment and repairment 7%
Coring 3%
NPT Waiting of Spare-parts and Material 9%
Casing 3%
Cementing 7%
Drilling 15%
NPT Stuck Pipe 10%
NPT Remedial Cementing 5%
NPT Fishing 27%
NPT Mixing of new mud 1%
NPT Seek of water sources 6%
NPT Milling and Cement Plug 4%


Accumulative of Time
Productive Time 30%
NPT 70%

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Conclusion

- A model of integrative drilling design to support the reservoir benchmark is developing.
- The aim of this system is to provide a platform for regulators and industry to compare the drilling performance of a large number of fields in a transparent and efficient way.
- Advanced analytics workflows around asset evaluation, infill drilling and workover candidate selection can be carried out. The planning of drilling operation is critical phase to push down the technical limit in achieving the perfect well drilling time.
- The drilling problems must be accounted in planning process to reduce the risk of lost time occurrence.

- Based on drilling experience and performance in several field, couple to research study of oil and gas drilling, the planning program of drilling procedures could be derived.
- The detail procedures planning explain each of process and activity, therefore the risk of lost time could be pressed down since the beginning of drilling.
- The system is built in a top down approach from field level evaluation down to single well performance assessment. The calculations consist of conventional industrial screening methods combined with data drilling practices.

Thank you