Enhance Decision-Making in the Development of Shale Resources*

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Abstract

The unique geological characteristics of shale resources result in development plans that require the exploitation of large resource areas, a manufacturing approach to drilling operations that allows for the efficient execution of many similar type wells, and a very long drilling time horizon to fully extract the resources. Understanding the difference between conventional and unconventional resources and sub-surface and surface factors is critical to driving capital efficiency, maximizing revenues and generating positive cash flows for unconventional resources. Capital efficiency starts with strategy and requires agility and foresight to pursue, abandon or defer capital projects. This is important to companies who are chasing margin over revenue in the current market. Furthermore, capital efficiency is needed throughout the asset lifecycle from strategy to execution. Benchmarking developments against an expected standard framework can help determine blind spots where value could be captured and achieve the most benefit.

The presentation shows impacts of different competing factors on capital efficiency in development of a shale resources. The presentation will cover:

• Shale play resources maturation due to its unique geological characteristics.
• Impact of key sub-surface and surface factors on project economics required to be considered in development decisions.

This article will also show how the above are modeled in an Excel spreadsheet tool to aid decision making for a hypothetical shale play development. Our experience shows that this tool enhances decision making for shale development and also capital allocation. From a capital allocation perspective, capital efficiency requires a clear investment strategy; optimizing a portfolio and projects to align with that strategy; developing internal processes, procedures, and, most important, the skills and capabilities to execute; establishing how value is measured and enabling technology enhancements within the organization’s capabilities and risk appetite.

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Gaffney, Cline & Associates (GCA)

May 22, 2019

Presentation Outline & GCA Introduction

- **Development Decision-Making Framework**
  - Decision Process
  - Deepwater vs. Unconventional
  - 2019 status quo

- **Dynamic Modeling Case Study**
  - Type Well Assumptions
  - Development Scenarios
  - Costs and Pricing Sensitivities

Gaffney, Cline & Associates Oil and Gas Expertise

Upstream

Geology
Geophysics
Petrophysics
Reservoir Engineering
Drilling and Completion
Facilities
Production

Midstream

Pipeline
Process
Operations

Downstream

Refining
Chemicals
Power
Marketing

Functions

Economics
Commercial and Financial
Legal, Regulatory, and Fiscal
Strategy and Planning
Organization
Business Process
Performance Management

Oil & Gas Companies

Shell, Marathon Oil Corporation, ExxonMobil, bp, bhpbilliton, Phillips 66, Repsol, noble energy, Chevron, Chesapeake Energy, devon, Canacol Energy Ltd., Drummond Ltd. Colombia, wintershall Shaping the future., OXY, Cairn, Total, SDX Energy, Crescent Petroleum, PICO International Petroleum, Cheiron Petroleum Corporation, Medcoenergi, Sapetro, equinor, Rose Petroleum, Petrofac, Marubeni

NOCs and Governments

BR Petrobras, Perú petro, Energy Department, ONGC, Pertamina, KUFPEC Kuwait Foreign Petroleum Exploration Company, Qatar Petroleum, The State of Alaska, ecopetrol, PDVSA, Staatsolie, Petronas, YPF, ADNOC, Petrotrin Energy Based, People Powered, anp, Japex, Saudi Aramco, CNPC, Pemex, KOGAS, Republic of Iraq Ministry of Oil

Financials & Law Firms

IFC International Finance Corporation World Bank Group, UBS, Vinson&Elkins, Bank of America, Orion Energy Partners, KKR, European Bank for Reconstruction and Development, JPMorganChase, Merrill Lynch Bank of America Corporation, The World Bank IBRD · IDA, Credit Suisse, Mubadala, Winston & Strawn LLP, citigroup, Deutsche Bank, RPM, Blackstone, SG Hambros, Covington, SMBC, SG Private Banking, Flowstream Onstreaming Commodities, ADB Asian Development Bank, Elliott

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Development Decision-Making Framework

Resource Type → **Sub-Surface Features** → **Cash Flow Timeline** → **Development Decisions**

Development Decision-Making Example			
Conventional Deepwater	Higher geological risk to find the "trap"	Capex first, production later	Largely fixed after project sanction
Unconventional (Shale / LTO)	Lower geological risk associated with continuous accumulations	Concurrent capex and production flows	Iterative decision-making

LTO: Light Tight Oil

Development decisions are driven by sub-surface resource characteristics, and are thus inherently different for shale

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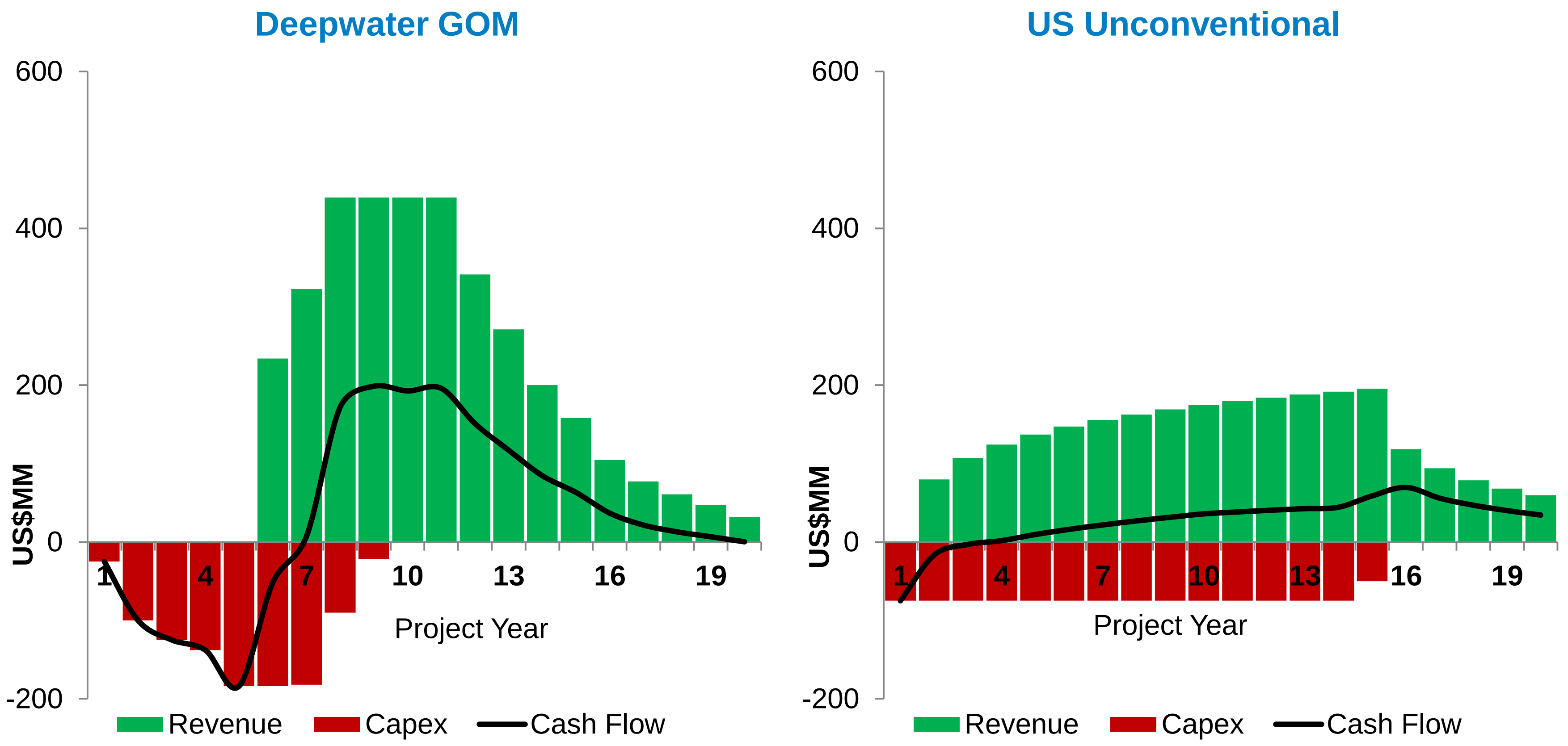
Development Schedule Comparison



Illustrative project cashflows based on GCA Focus Paper

Spreading shale investments over a long development period provides more opportunities for improvements in decision-making and operations

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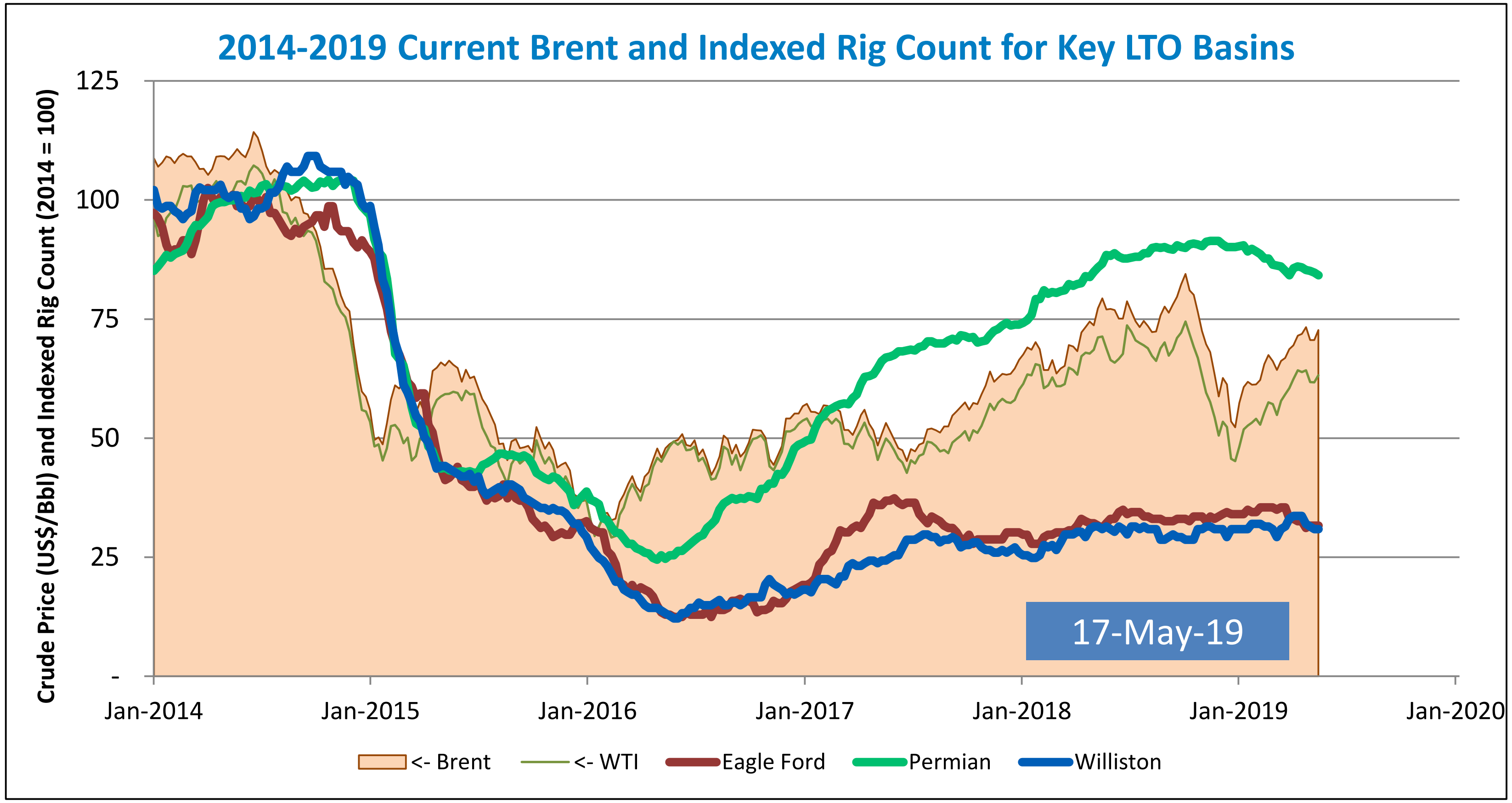
2019: US unconventional resources stays in spotlight and continues to evolve



Source: GCA weekly blog

Operators gradually shift focus from production growth to profit generation through cost reduction and capital discipline

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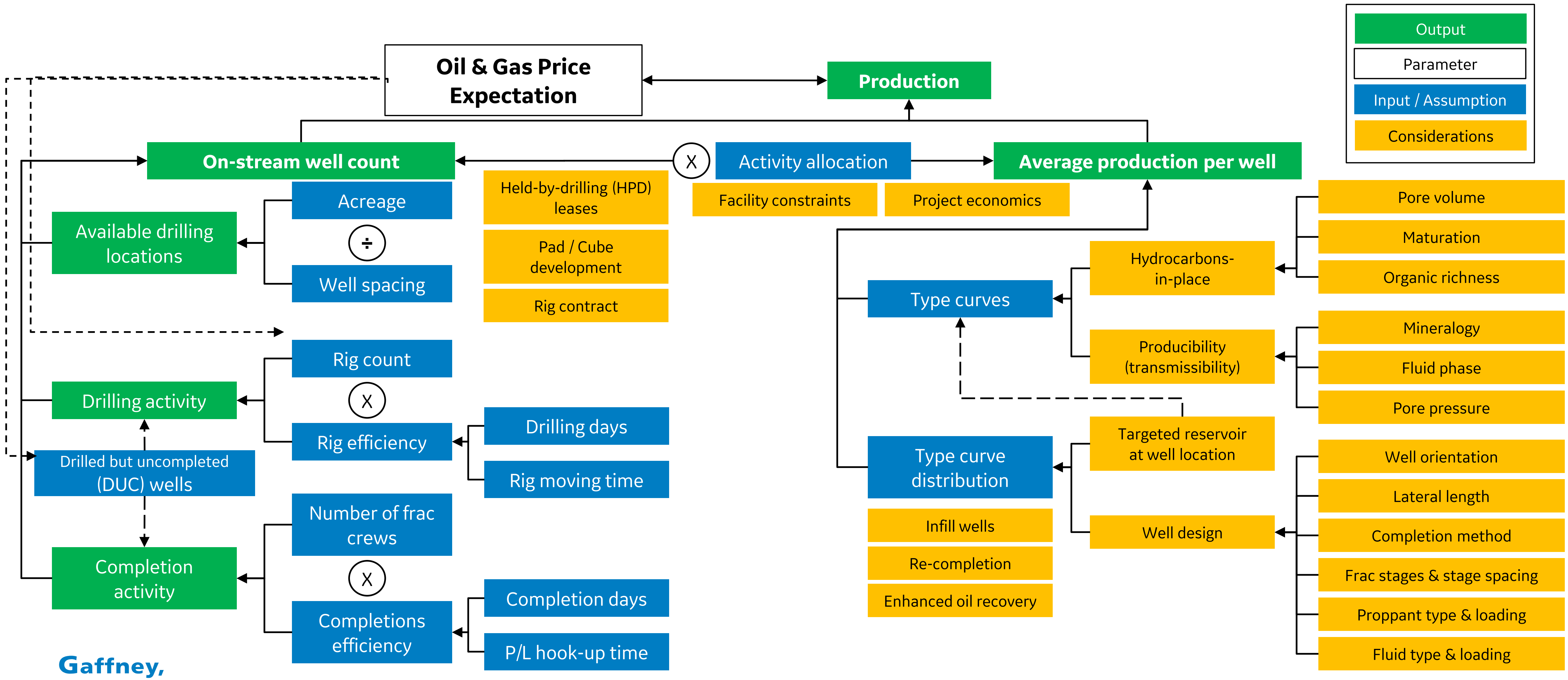
GCA Unconventional Development Model



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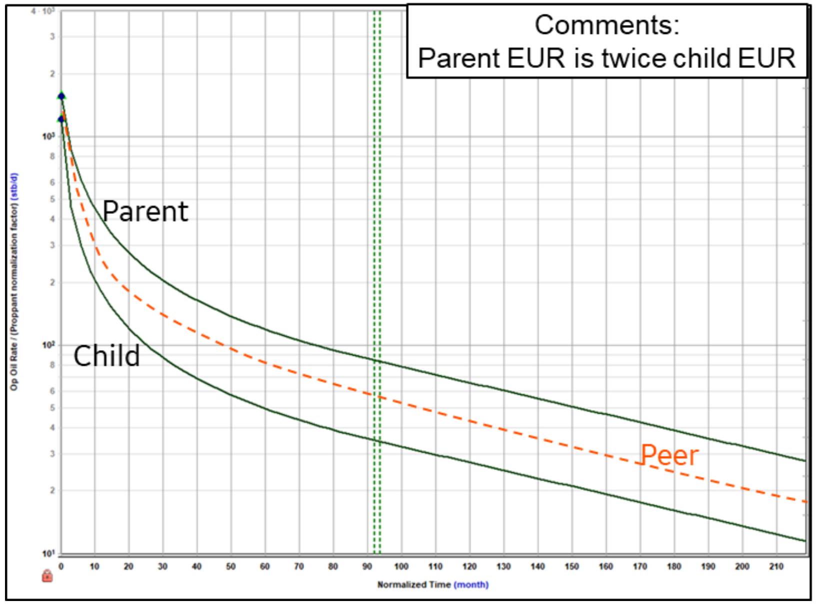
Case Study: Hypothetical Development of A 640-acre Section in a Typical Shale Play

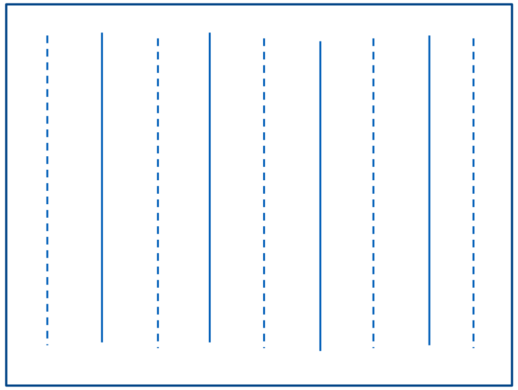
Type Well Assumptions



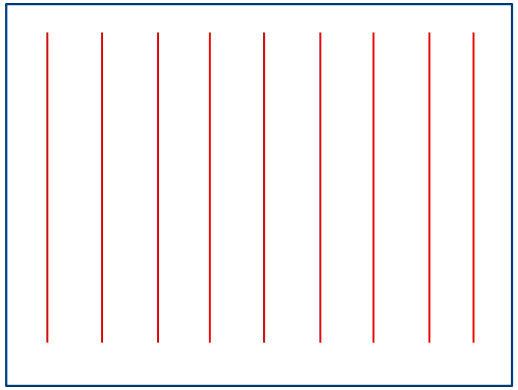
- A selection of Wolfcamp wells
- Peer type wells targeting the same level of ultimate recovery in the section

Illustrative Well Placement

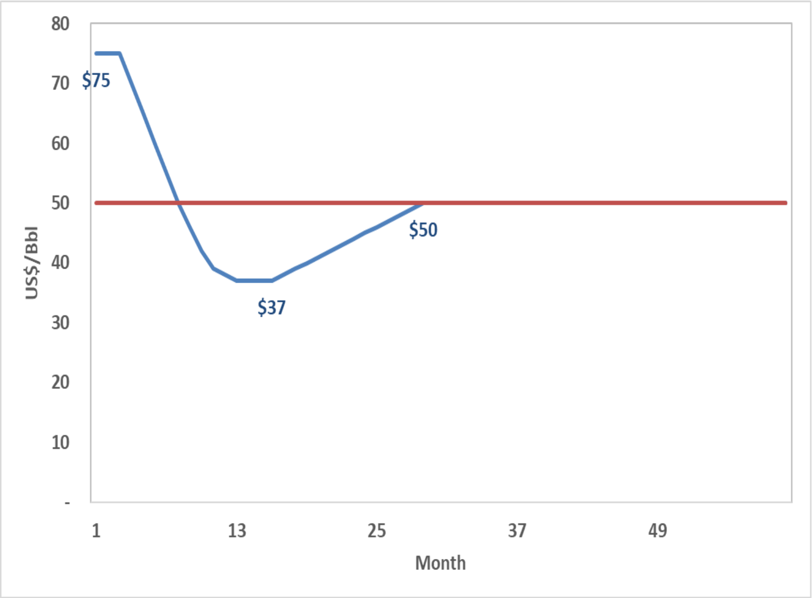
Parent-Child



Peers



Crude Price Cases



- Gas price is assumed to be flat at $3/MMBtu in all scenarios
- Capital and operating cost parameters are modelled after public-domain information about the Permian basin

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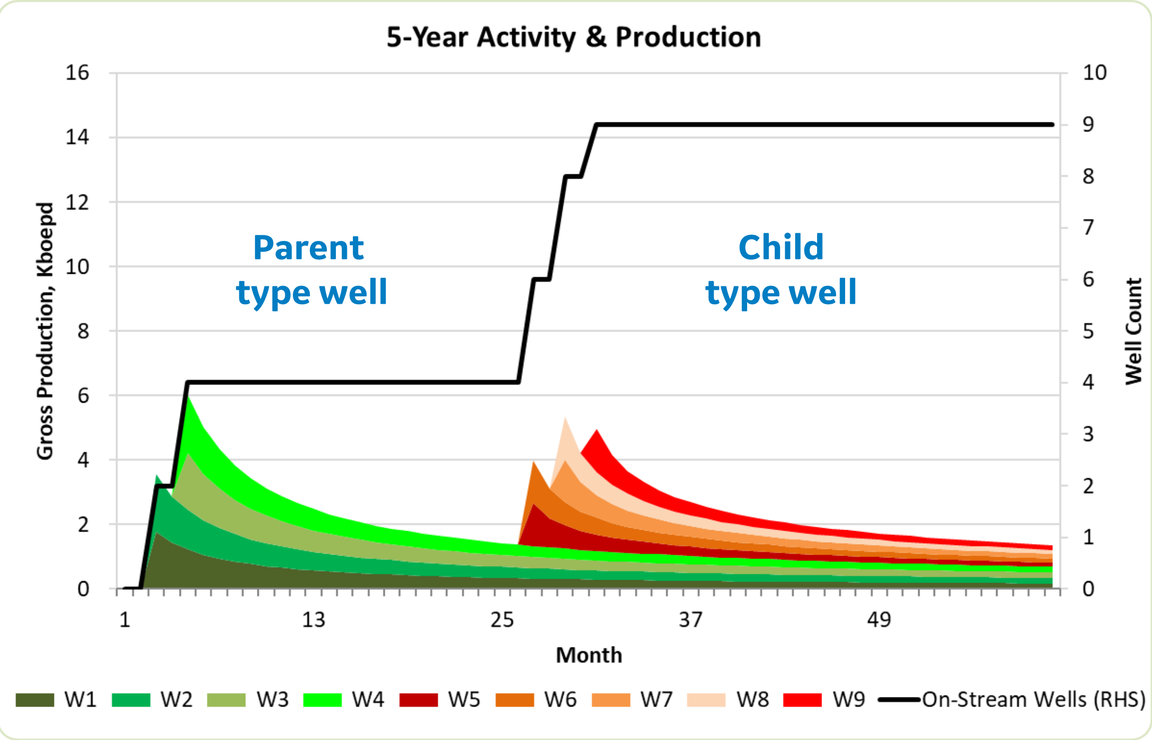
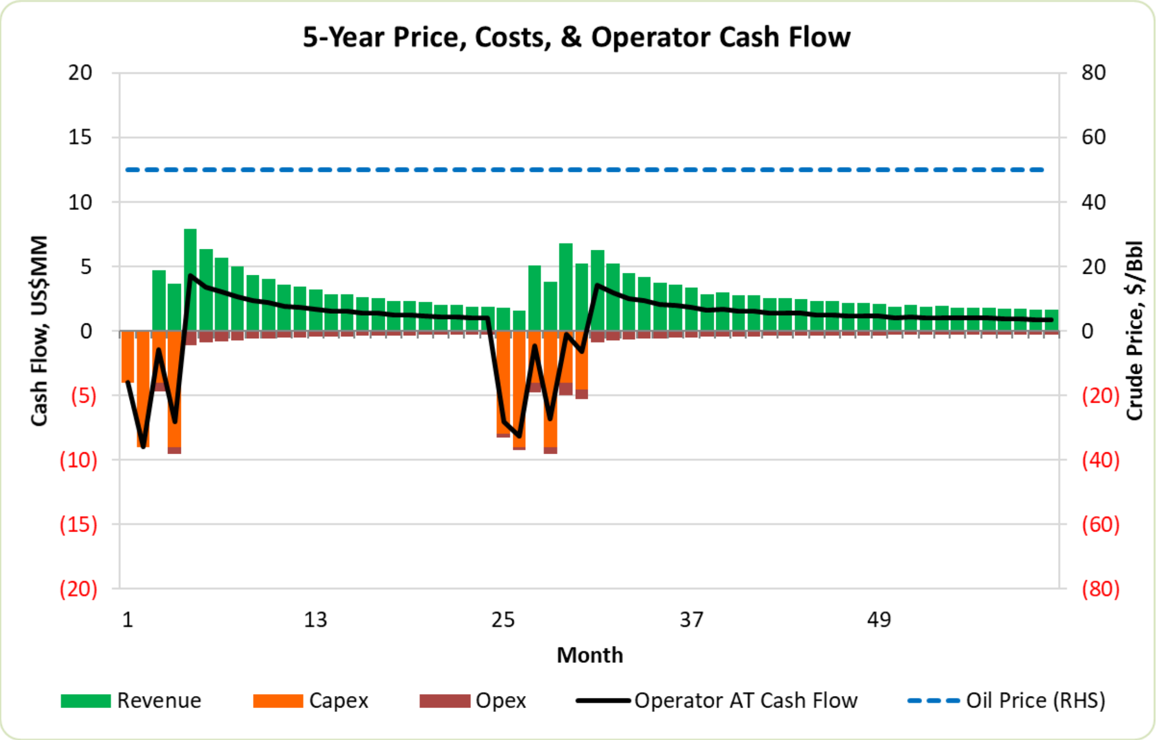
Flexible Development: Parent-Child Wells





Project Economics

Per Well Production in 5 Years	494 MBoe
Operator After-CIT IRR	104%
NPV10 US$/Boe	$6.7/Boe
Profitability Index	1.8

Parent Campaign

723 MBoe
148%
$9.6
2.7

Child Campaign

390 MBoe
26%
$3.7
1.3

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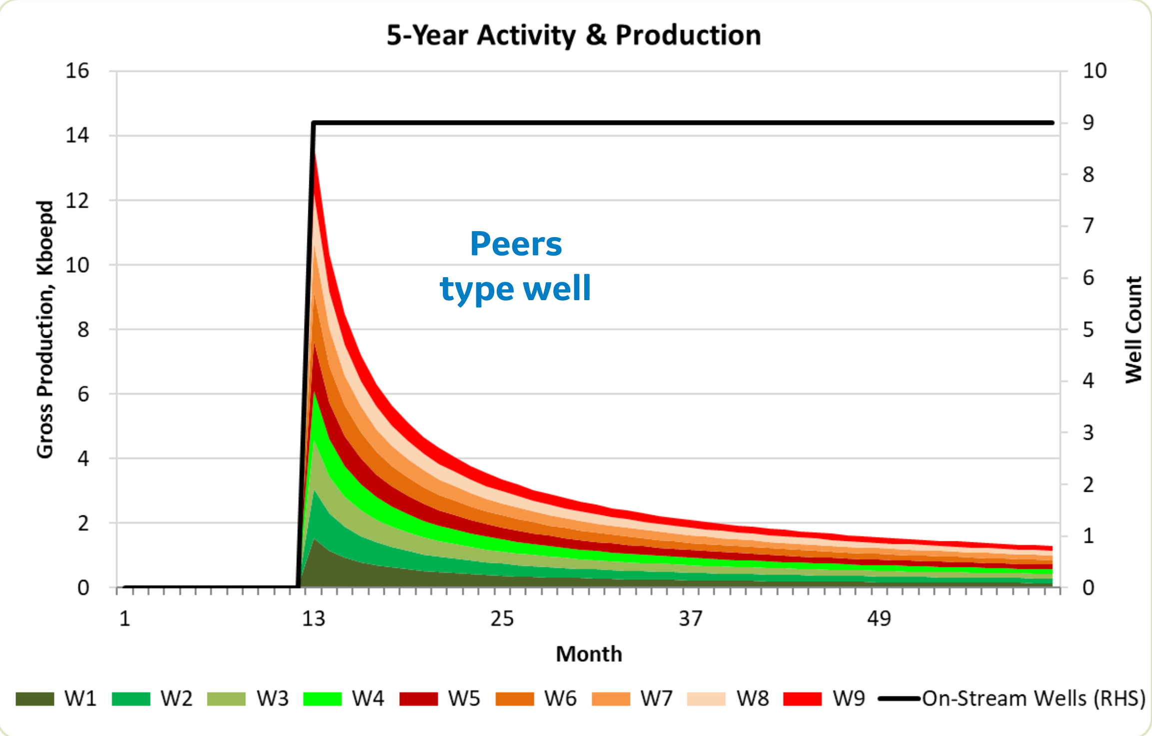
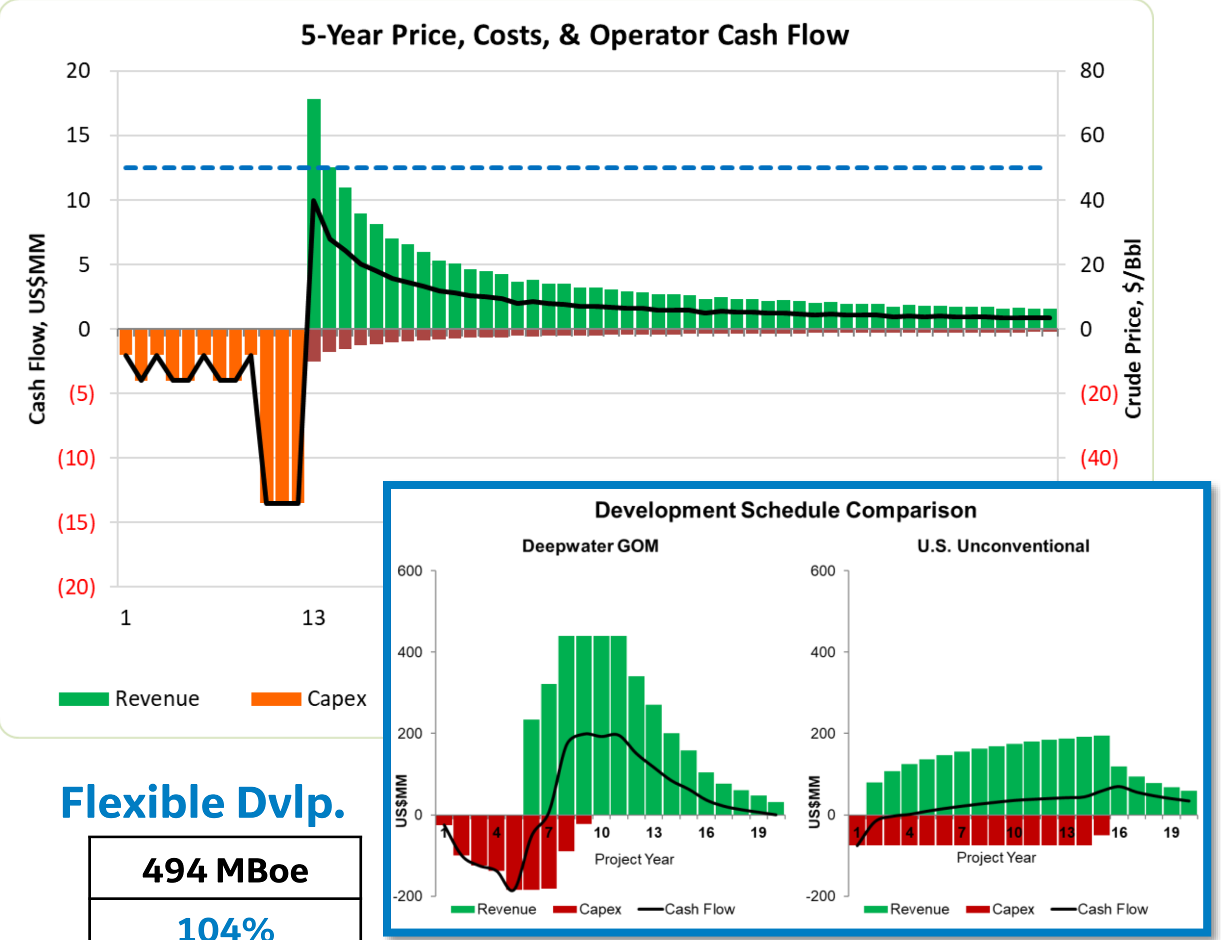
Profitability Index: Present value of future cash flows divided by initial investments

Planned Development: Conventional Approach





Project Economics

Per Well Production in 5 Years	501 MBoe
Operator After-CIT IRR	40%
NPV10 US$/Boe	$5.9/Boe
Profitability Index	1.7

Flexible Dvlp.

494 MBoe
104%
$6.7/Boe
1.8

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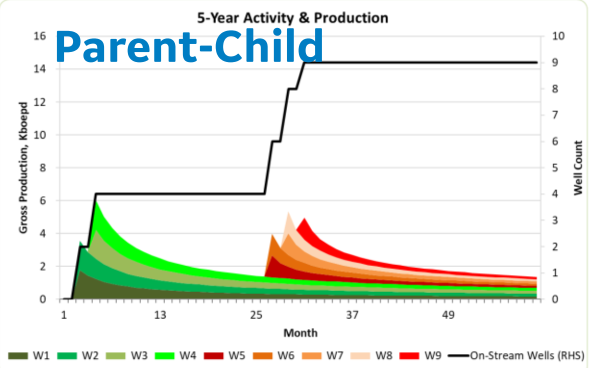
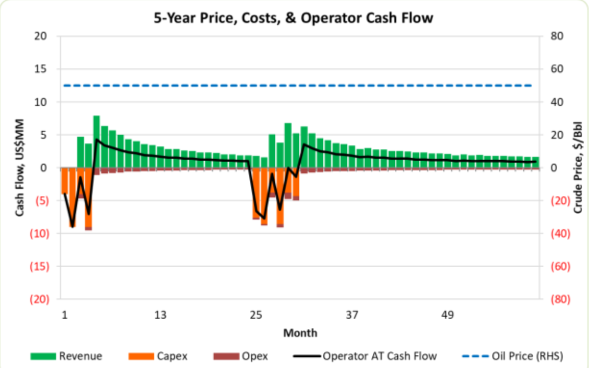
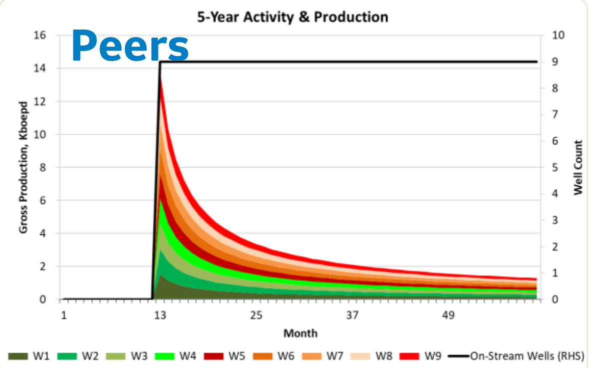
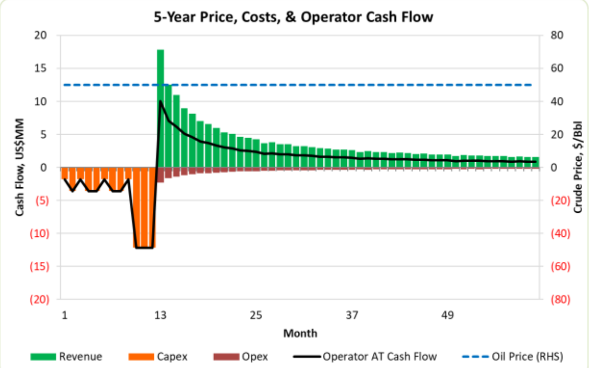
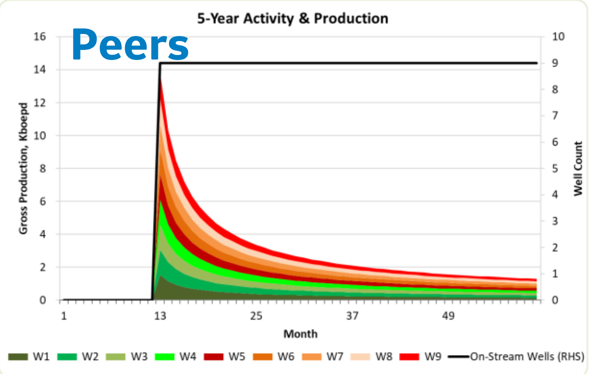
Flexible vs. Planned: Cost Efficiency

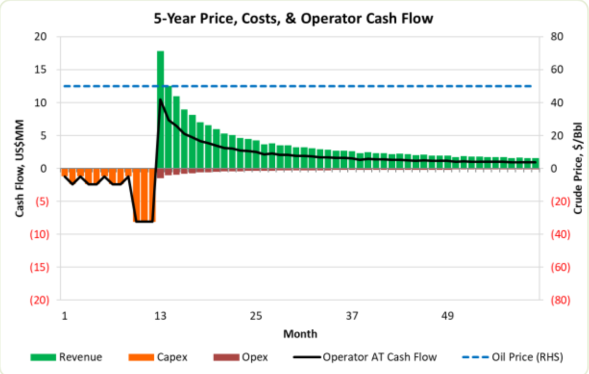












5% cost reduction on Child wells

Per Well Production in 5 Years	494 Mboe
Operator After-CIT IRR	109%
NPV10 US$/Boe	$7.0/Boe
Profitability Index	1.9

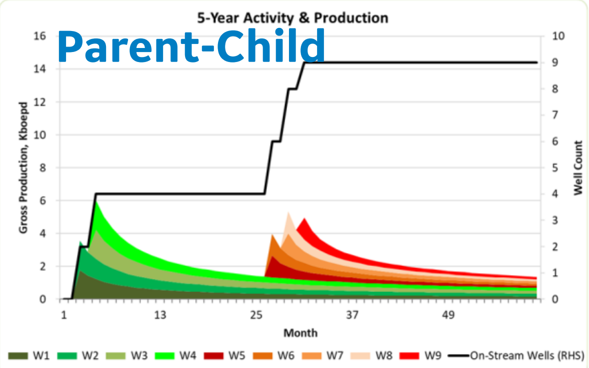
10% cost reduction on all wells

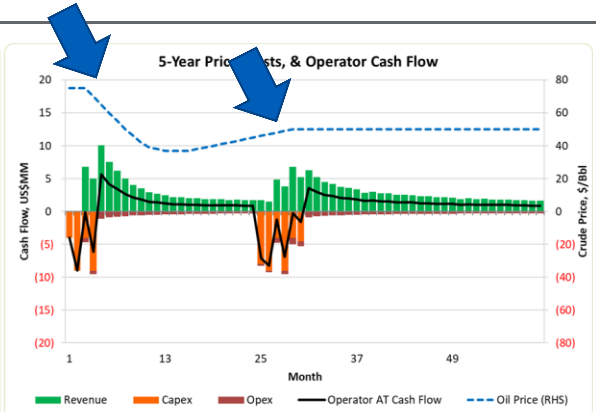
Per Well Production in 5 Years	501 Mboe
Operator After-CIT IRR	52%
NPV10 US$/Boe	$7.0/Boe
Profitability Index	1.9

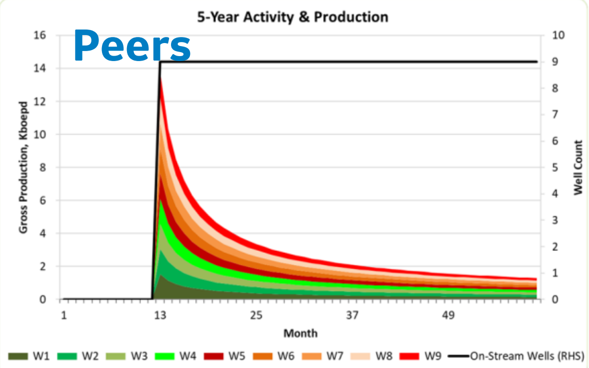
40% cost reduction on all wells

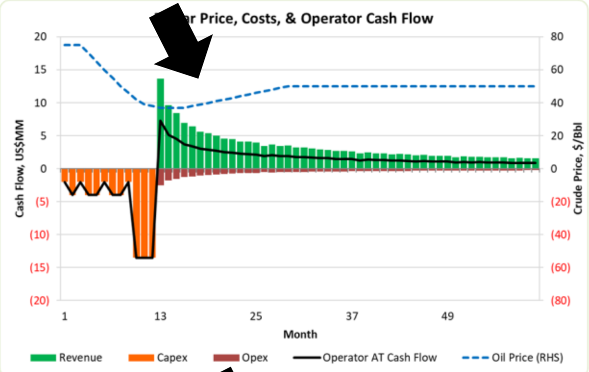
Per Well Production in 5 Years	501 Mboe
Operator After-CIT IRR	112%
NPV10 US$/Boe	$10/Boe
Profitability Index	2.9

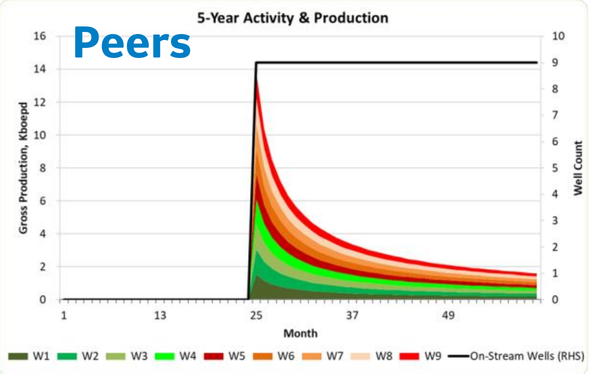
Flexible vs. Planned: Price Sensitivity

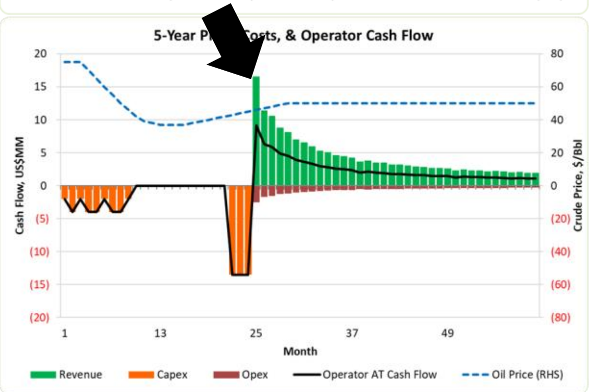












Child wells completed on price recovery trend

		$50 Flat
Per Well Production in 5 Years	494 Mboe	
Operator After-CIT IRR	128%	104%
NPV10 US$/Boe	$6.7/Boe	$6.7
Profitability Index	1.8	1.8

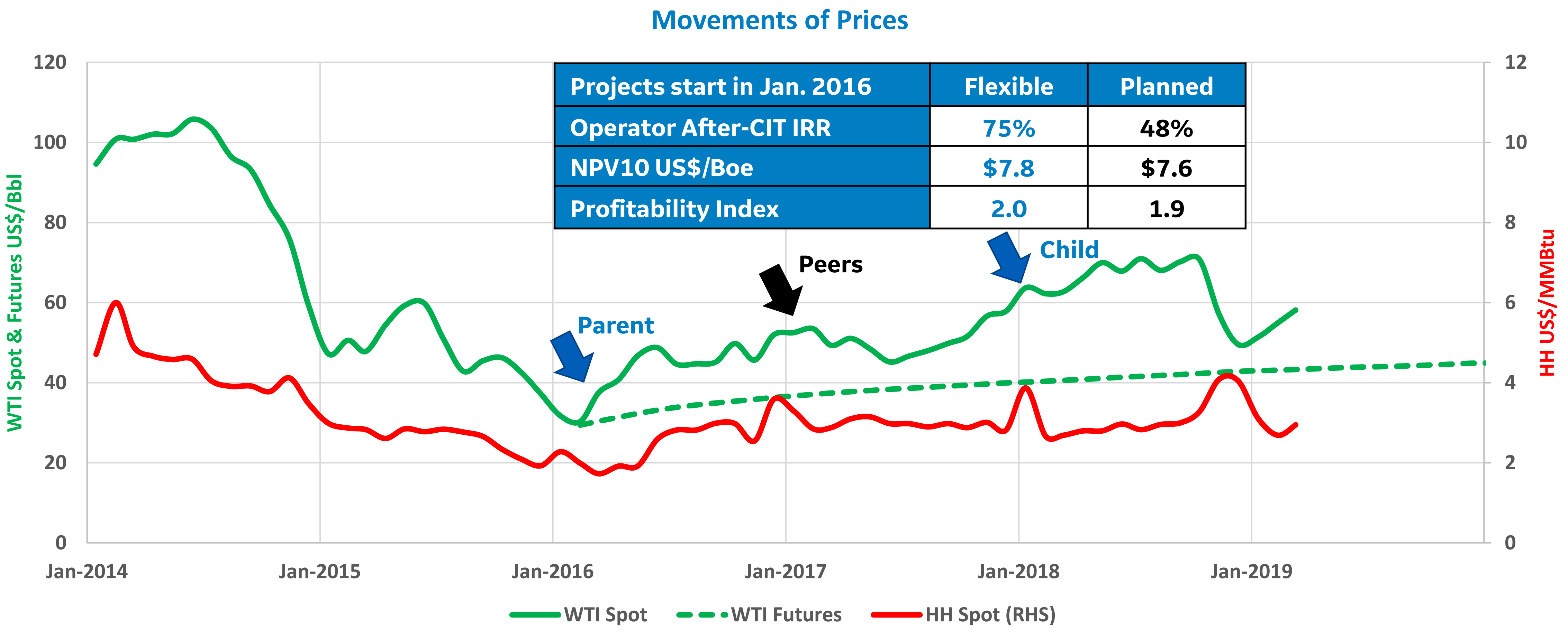
Wells planned at high prices, produced at low

		$50 Flat
Per Well Production in 5 Years	501 Mboe	
Operator After-CIT IRR	29%	50%
NPV10 US$/Boe	$4.5/Boe	$5.9
Profitability Index	1.5	1.7

Delayed completion

Per Well Production in 5 Years	442 Mboe
Operator After-CIT IRR	29%
NPV10 US$/Boe	$4.9/Boe
Profitability Index	1.5

It is not easy to predict commodity prices…



Projects start in Jan. 2016	Flexible	Planned
Operator After-CIT IRR	75%	48%
NPV10 US$/Boe	$7.8	$7.6
Profitability Index	2.0	1.9

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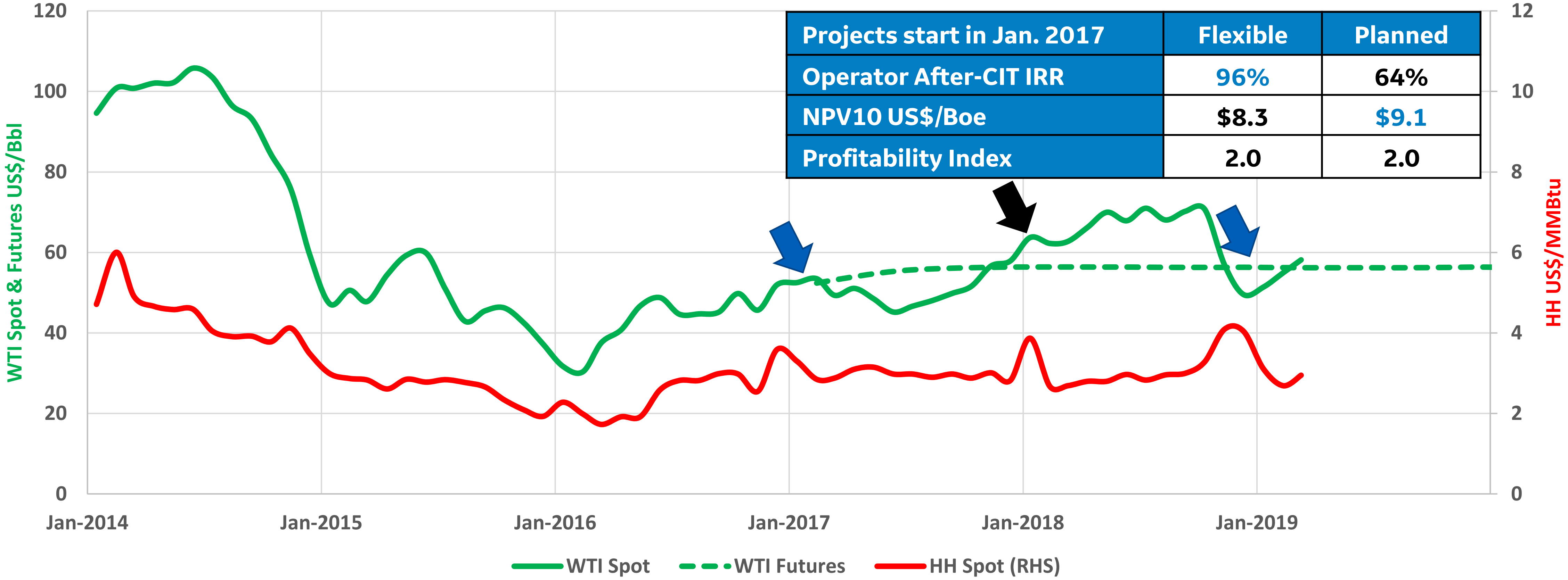
It is not easy to predict commodity prices…

Movements of Prices



Projects start in Jan. 2017	Flexible	Planned
Operator After-CIT IRR	96%	64%
NPV10 US$/Boe	$8.3	$9.1
Profitability Index	2.0	2.0

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Conclusions

- Dynamic modeling of economics, in addition to modelling production, is necessary in developing unconventional resources such as shale
  - Because it is a complex system with multiple factors interacting with each other at small scales

- The tool used to make strategic development decisions has to be comprehensive, flexible, and quick to run
  - Thus, it should not be only a financial cash flow model, a decline analysis software, or a field planning software

- It is important to understand what drives development decisions
  - Maximizing recovery, investment returns, or operational efficiency may lead to different strategies