WEBINAR

Risk Insights in Integrated Energy Development

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KAASE GBAKON PH.D

Senior Forestry Economist at
Ministry of Energy and Resources

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11 A.M EDT

Moderator

Senior Director of Marketing Partnerships & Strategy

Lumivero

spenna@lumivero.com

DR. STACY PENNA

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- Oil, Gas, & Mineral Reserves

Presenter

Dr. Kaase Gbakon, completed his PhD in Petroleum Economics, Management, and Policy with a focus on Energy Systems Modeling, and boasts an extensive background as a Senior Economist at the Ministry of Energy and Resources in Saskatchewan, Canada. With a wealth of experience, he held pivotal roles within the Nigerian National Oil Company including leading the Asset Evaluation and Economics group in Corporate Planning & Strategy, acting as the Lead Commercial in the ANOH Gas Processing Company (AGPC), and serving as a Senior Technical Assistant to the Chief Strategy Officer.

Kaase Gbakon Ph.D., Senior Forestry Economist at Ministry of Energy and Resources

AGENDA

1. Introduction
2. Aim and Objectives
3. Methodology
4. Result
5. Conclusion

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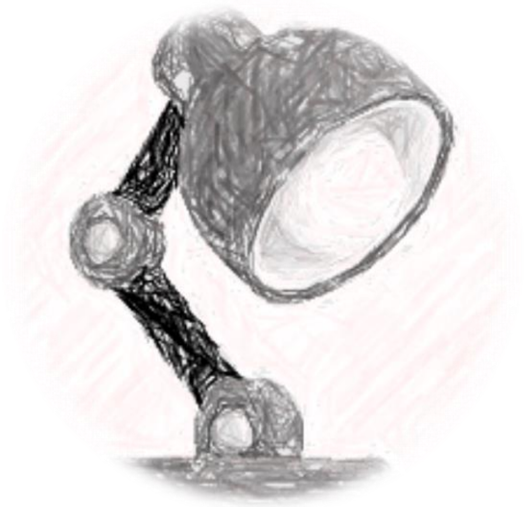
Introduction



- Energy development projects tend to be:
  - Large
  - Capital-intensive and
  - Exposed to significant risk.
- Source of risk include:
  - Commodity/energy price volatility
  - Cost creep, cost of capital
  - Project schedule slip … etc
- Fiscal rules govern how value and risk is shared between governments and investors in energy projects. The combination of fiscal rules and above risks impact cash flow expectations.
- Investors and government reps often build deterministic discounted cash flow models to simulate their respective cash receipts. However, these models leave significant uncertainties unquantified.
- Here, I use two set of fiscal rules to demonstrate the importance of probabilistic cash flow assessment.

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Aim & Objectives

AIM

To conduct a risk assessment comparison of a capital-intensive integrated energy project under two different fiscal rules

OBJECTIVES

- Showcase a built discounted cash flow valuation model
- Demonstrate the use of Monte Carlo simulation in @RISK to perform risk analysis
- Compare the deterministic and probabilistic results
- Make the case for use of probabilistic modelling

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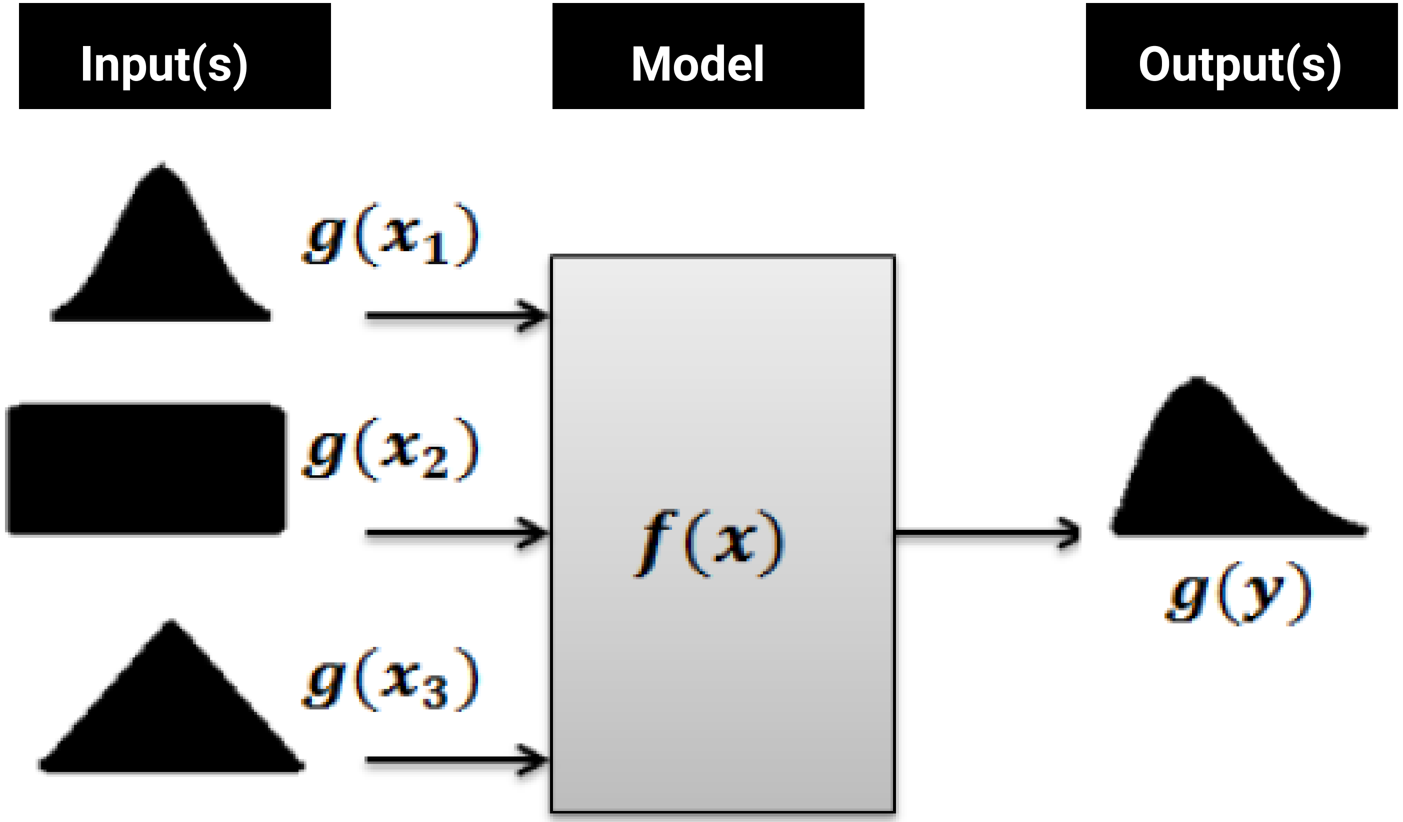
Methodology



Source: Paulo R., Jailton C., and Sérgio P., 2013, Monte Carlo Simulations Applied to Uncertainty in Measurement, Theory and Applications of Monte Carlo Simulations Wai Kin (Victor) Chan, *IntechOpen*, DOI: 10.5772/53014.

<u>STEPS</u>

1. Build a discounted cash flow valuation model
2. Define probabilistic inputs into the DCF model
3. Run simulation using @RISK to generate probabilistic outputs
4. Compare the deterministic and probabilistic results

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Case Study: Integrated Energy Project

12 Mbpd Refinery

Gasoline
Kerosene
Diesel
Gasoil
Fuel Oil

150 MMSCFD Gas Plant

Methane
Propane + Butane
Pentanes +

- Oil Production Profile
- Gas Production Profile
- 12 Mbpd refinery
  - 28%gasoline
  - 12%Jet,
  - 30%Diesel,20%VGO,8%FuelOil
- 150 MMSCFD gas plant

- Government was proposing new petroleum fiscal terms to replace the existing one
- An oil and gas company had plans to develop a project which will incorporate upstream production, refining and gas processing
- Company wanted to understand impact of proposed terms on the integrated package
- Some questions of interest included:
  - The value distribution of integrated project
  - The government receipts under existing and proposed terms
  - Most impactful variables to project value
  - What the breakeven values were
  - **The likelihood of value loss under each regime**

A "fiscal regime" is a package of mechanisms for extracting government share through the life of a project…

The last question is the theme of this webinar!

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Assumptions: Deterministic

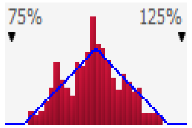
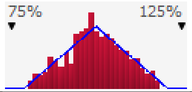
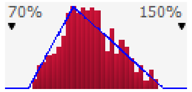
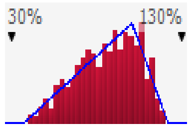
RESERVE AND CRUDE CHARACTERISTICS		Units
Oil Reserve Size	54.26	MMBBLS
Crude API	38	°API
Sulphur content	0.53	%wt S
Gas Reserve Size	1,032	BCF
REFINERY PLANT ASSUMPTIONS		
Construction Start Year	2018	
Duration of Ref. Construction	2	Years
Stream Throughput	345	days/year
% Field Production for Refining	100%	%
Length of days of Product Storage	10	Days
Plant Capacity	11,655	Bpsd
GAS PLANT ASSUMPTIONS		
Shrinkage Factor	10%	%
LPG as % of Liquids from wet gas	53%	%
K - Factors (Net back factors for gas price to U/S)		
K1 (of Revenue from Gas Sales)	40%	%
K2 (of Revenue from LPG Sales)	50%	%
Fixed OpEx (% of CapEx per Annum)	2.50%	%
Variable OpEx	0.50	$/mscf

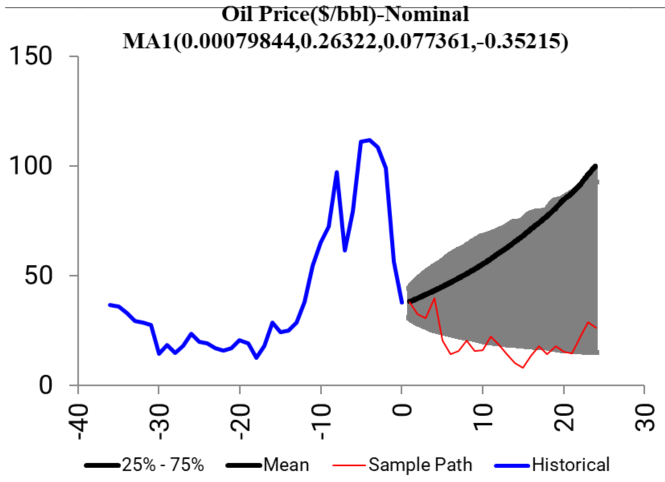
PROJECT ATTRIBUTES	Units	Marg. Field	Mod. Ref.	Gas Plant	Integrated Project
CapEx	$MM	1,227	244	385	1,857
OpEx	$MM	1,155	3,370	3,297	7,823
Reserve Size (Oil)	MMBBLS	54	NA	NA	54
Refinery Capacity	KBPD	NA	12	NA	12
Reserve Size (Gas)	BCF	1,031	NA	NA	1,031
Gas Plant Capacity	MMSCFD	NA	NA	150	150

REFINERY PRODUCT PRICING	$/bbl
Gasoline	65
Kerosene	62
Diesel	64
Light VGO	54
Heavy VGO	62
Fuel oil	40
GAS PLANT PRODUCT PRICING	
LPG	38
Natural Gas Liquids	43

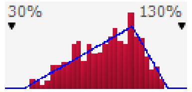
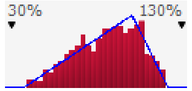
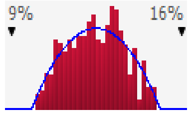
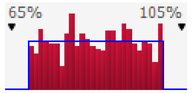
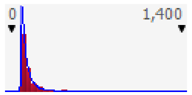
Oil Price assumption of $40/bbl drives product prices

Assumptions: Probabilistic

S/N	Variable	Probability Distribution	Graphs	Justification
1	Upstream field CapEx	Triangular (0.8, 1.0, 1.2)		Based on the observed distribution for lifecycle CapEx less than or equal to $2,000Million
2	Refinery CapEx	Triangular (0.8, 1.0, 1.2)		Basis derived from Upstream CapEx
3	Gas plant CapEx	Triangular (0.8, 1.0, 1.4)		Basis derived from Upstream CapEx
4	Upstream field OpEx	Triangular (0.4, 1.0, 1.2)		Based on the observed distribution for lifecycle OpEx less than or equal to $2,000Million



Oil price is modelled as a Moving Average 1 process

S/N	Variable	Probability Distribution	Graphs	Justification
5	Refinery OpEx	Triangular (0.4, 1.0, 1.2)		Basis derived from Upstream OpEx
6	Gas plant OpEx	Triangular (0.4, 1.0, 1.2)		Basis derived from Upstream OpEx
7	Discount rate	General Beta (2, 2, 0.10, 0.15)		Based on price distributions of securities according to McDonald (1996)
8	Volume of field production refined	Uniform (0.7, 1)		Based on the distribution of maximum ignorance
9	Exchange rate	Log-Normal (164, 56)		Based on constructed distribution of historical exchange rates from 2001

Assumptions: Fiscal Terms

FISCAL INSTRUMENTS	PPT/MFR ("Existing")	PIFB 2018 ("Proposed")
Fees		
Fees and Levies	YES	YES
Signature Bonus	YES	YES
Production Bonus	YES	YES
Royalty		
Royalty by Water Depth	YES (0% - 20%)	NO
Royalty by Terrain	YES	YES
Royalty by Daily Production	YES (for Marginal)	YES
Cost Treatment		
Cost Recovery Limit	NO	YES (80%)
Cost Consolidation (Gas and Oil)	YES	NO
Cost Efficiency Factor	NO	YES
Allowances		
Petroleum Investment Allowance	YES (5%)	NO
Production Allowance	NO	YES
Tax		
PPT	YES (65.75% - 85%)	NO
PIT	NO	YES
APIT	NO	YES

Table of applicable terms under the "Existing" and "Proposed" fiscals

Results: Deterministic

INTEGRATED PROJECT

INDICATORS	Units	PPT/MFR "Existing"	PIFB 2018 "Proposed"
Revenue	$MM	15,016.69	15,016.69
CapEx	$MM	1,857.06	1,857.06
OpEx	$MM	7,823.18	7,823.18
Gov't Take	$MM	2,403.93	1,512.85
NCF	$MM	2,932.53	3,823.60
NPV 10%	$MM	469.08	764.74
IRR	%	15.66%	18.77%
MCR	$MM	(976.39)	(880.22)
Payout	Yrs	8.00	8.00
Gov't Take (%)	%	45%	28%

Government receipts in PIFB 2018 ("Proposed") at $1.5B is less than under the PPT ("Existing") at $2.4B

The investor NPV under the PIFB 2018 ("Proposed") at $765MM outperforms that under the PPT/MFR ("Existing") at $469MM.
This outcome is also reflected in the investor IRR

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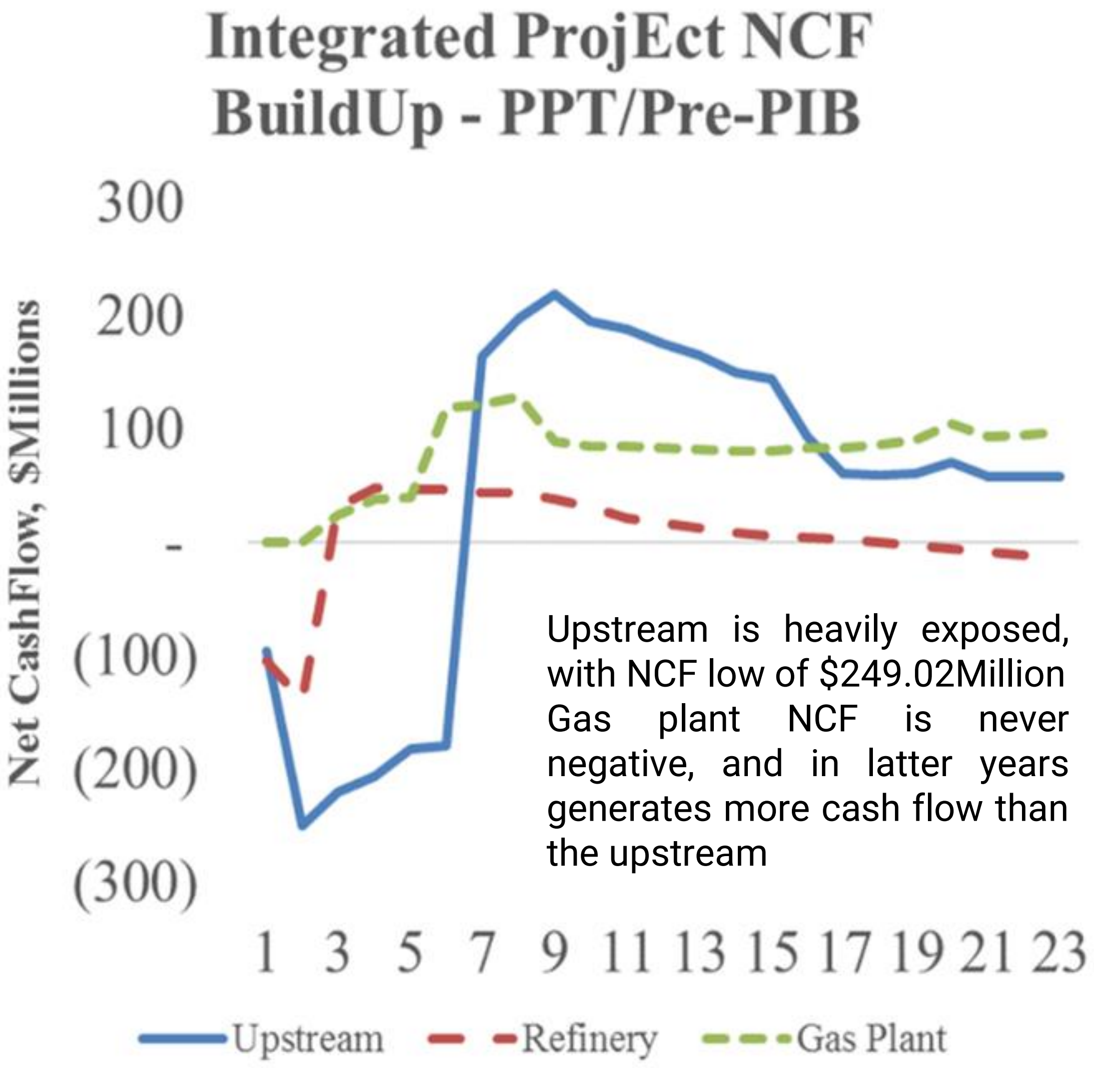
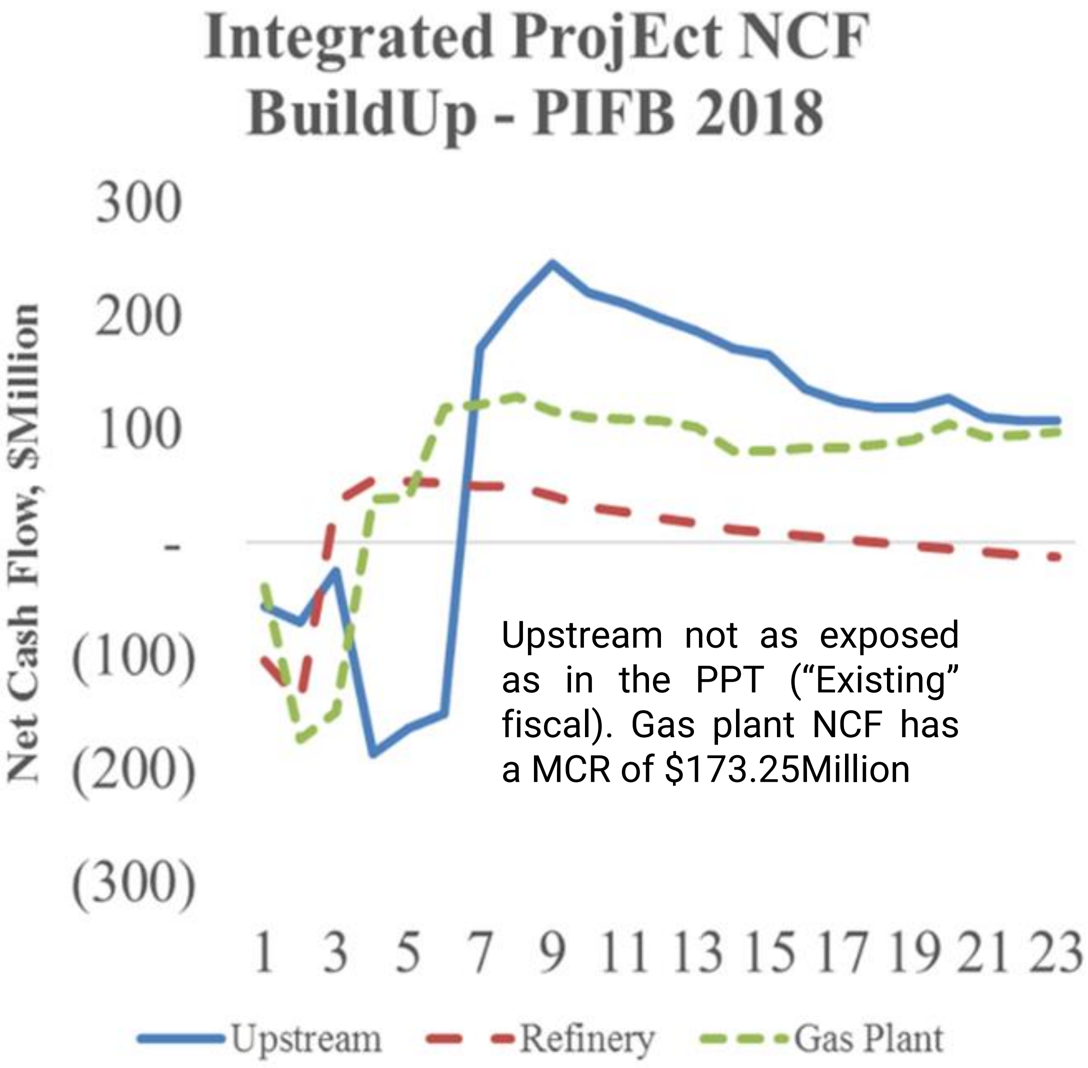
Results: Deterministic

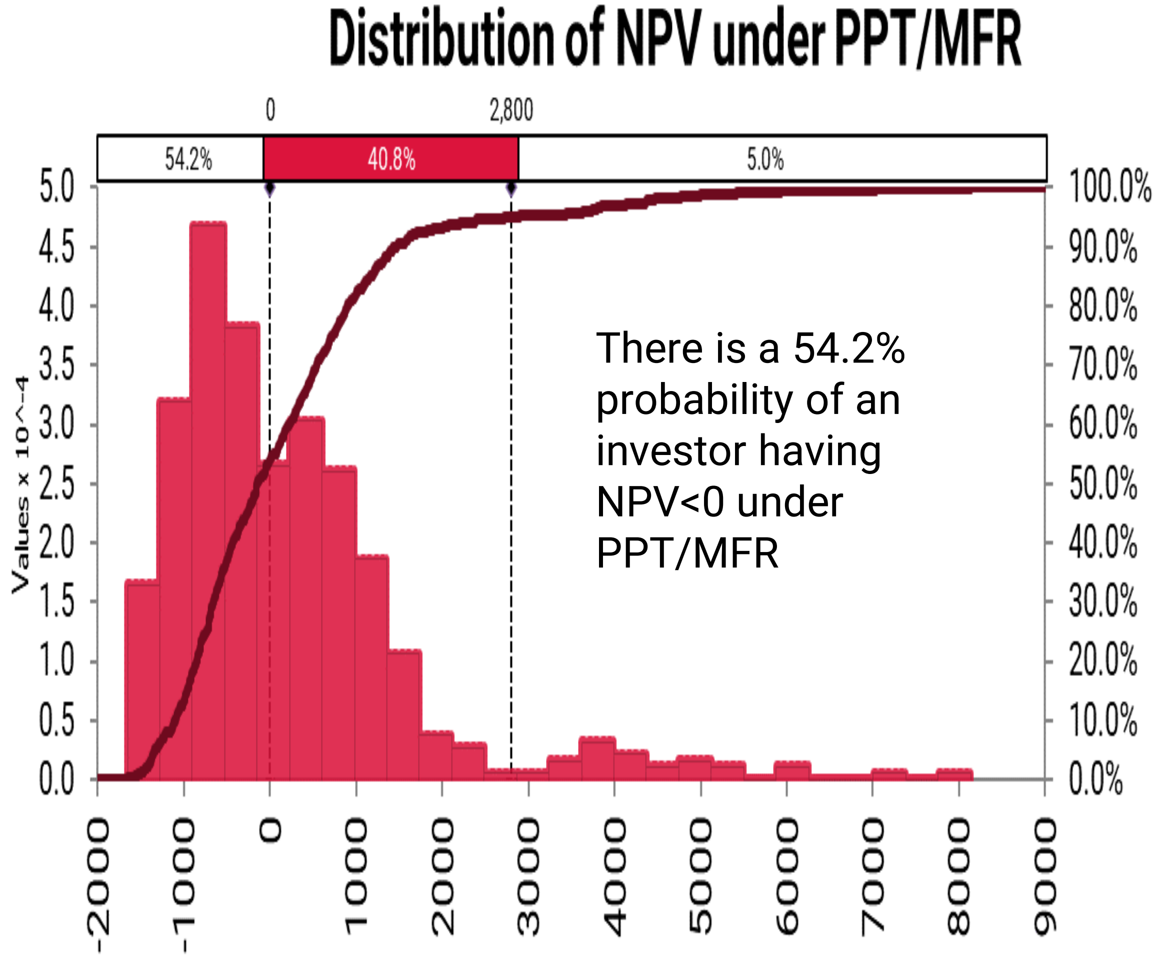


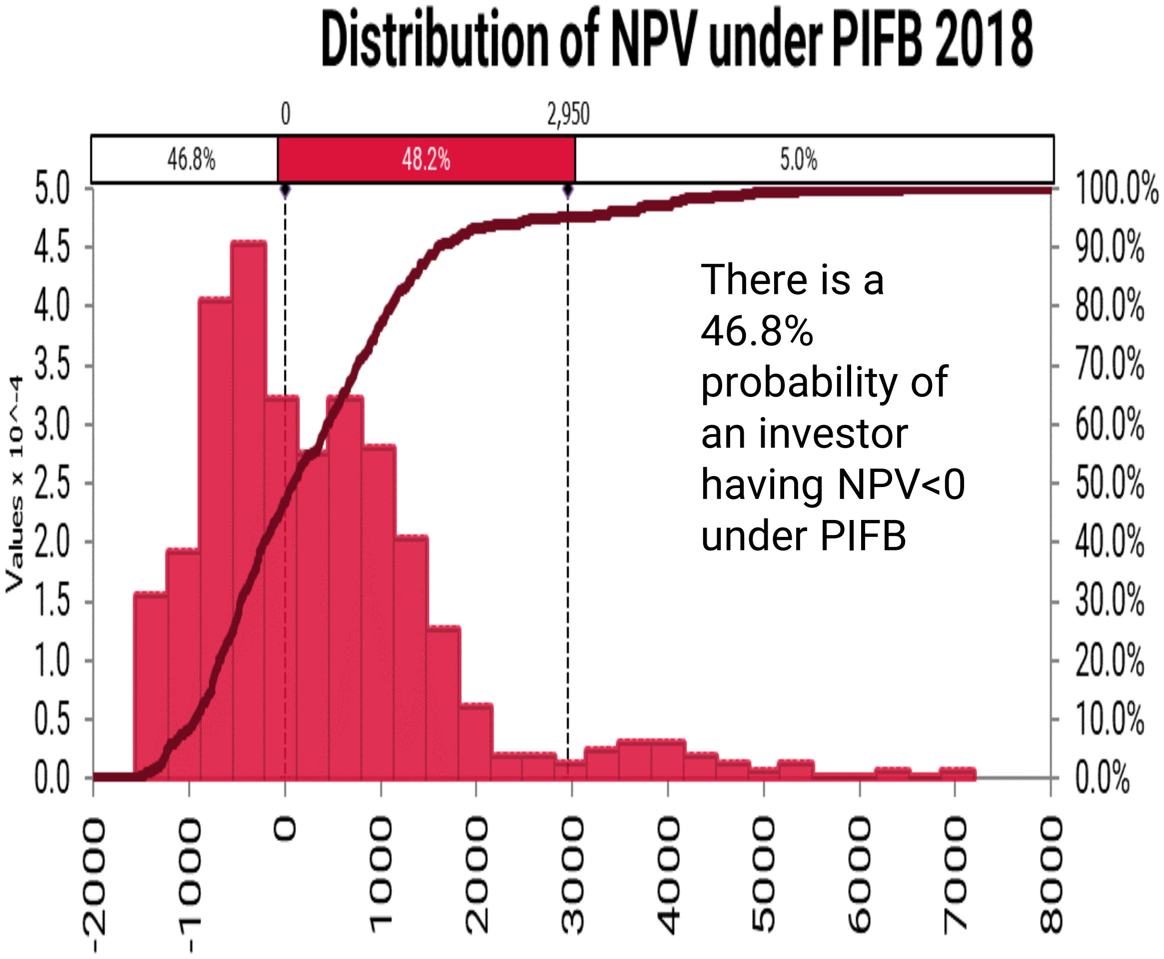
Upstream is heavily exposed, with NCF low of $249.02Million Gas plant NCF is never negative, and in latter years generates more cash flow than the upstream



Upstream not as exposed as in the PPT (“Existing” fiscal). Gas plant NCF has a MCR of $173.25Million

Probabilistic Results: 54.2% probability of an investor having NPV<0 under PPT/MFR





- Lower Risk of making NPV<0 under PIFB than the PPT
- In addition to higher expected NPV under PIFB, the risk of loss is also lower

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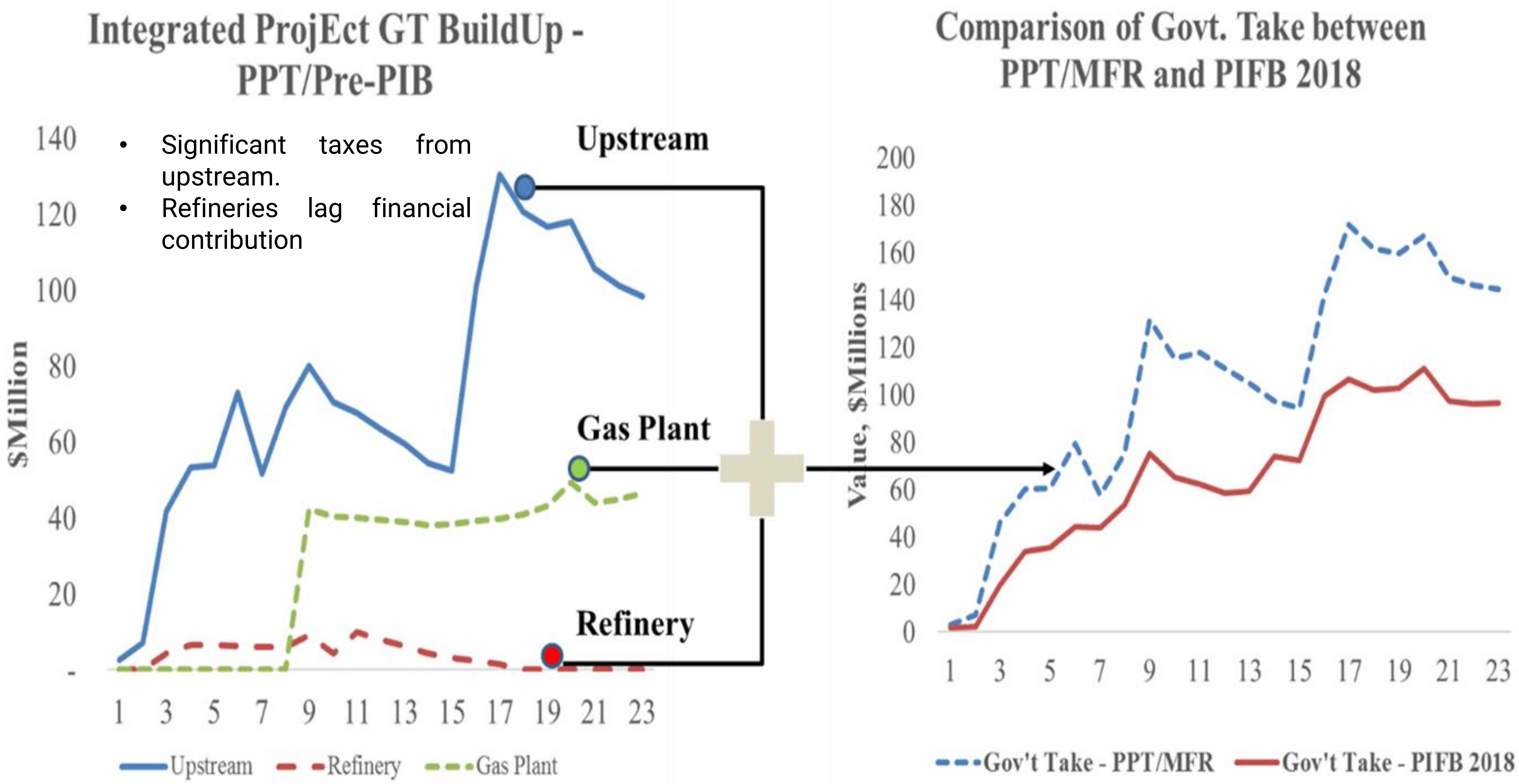
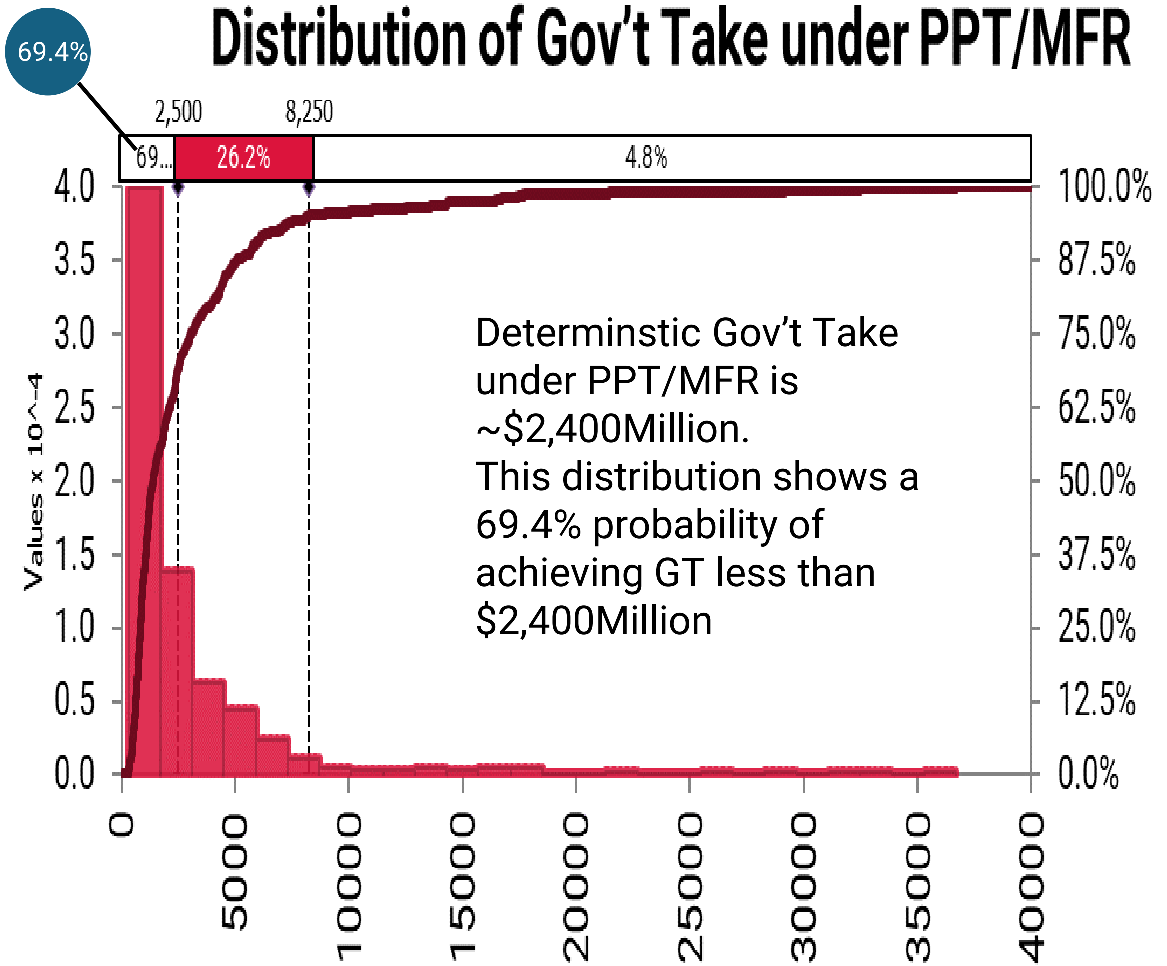
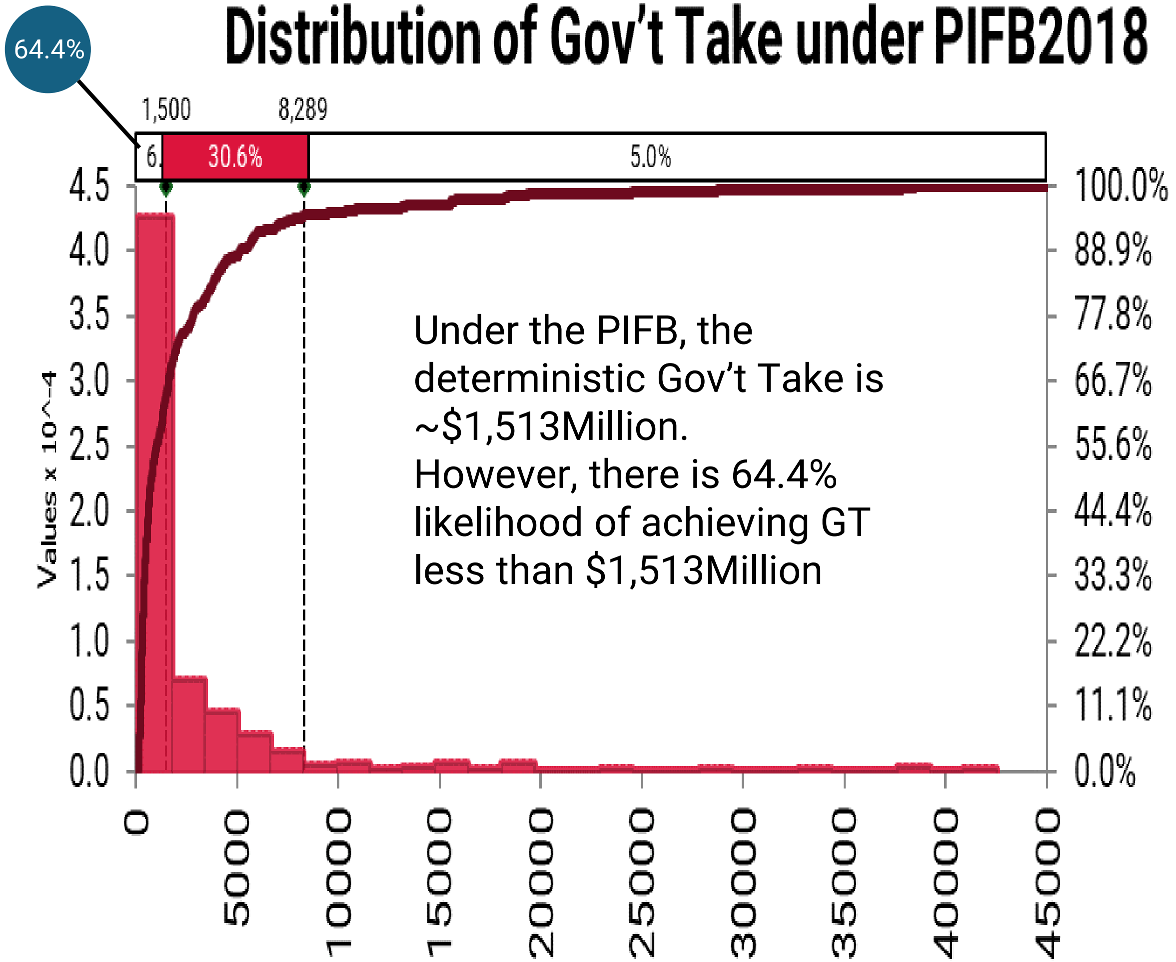
Results: Deterministic Government Receipts

- Significant taxes from upstream.
- Refineries lag financial contribution



Probabilistic Results: At least 60% Likelihood of gov't receipts lower than Expected





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While the fiscal rules impact government receipts differently, in terms of the quantum of expected receipts, Monte Carlo simulation shows higher likelihood of attaining lower receipts than expected.

Probabilistic Results: Risk Distribution between Parties

Parties		PPT/MFR "Existing"	PIFB 2018 "Proposed"
Investor	Prob(NPV<0)	54.20%	46.80%
Govt	Prob(GT<E(x))	69.40%	64.40%

- Probability of investor NPV less than zero is higher under "Existing" fiscal than "Proposed"
- Probability that government receipts lower than deterministic value is higher under "Existing" than "Proposed"
- For both parties, "Proposed" fiscal is less risky than the "Existing"
- Risk of government not meeting its expected receipts higher under both proposals than risk faced by investors
- High levels of risk to investor >45% of negative NPV highlights the risk in oil and gas.
- **This table demonstrates the strong case for probabilistic analysis for big, capital spend projects**

Demonstration

Conclusion

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- Investor NPV under the PIFB 2018 ("Proposed") outperforms that under the PPT/MFR ("Existing").
- Investor is less exposed under the PIFB than under PPT/MFR- Maximum Cash in Red under PIFB less than under the current system.
- Refinery economics contributes at most 5% to the consolidated cash flow position of the investor
- Taking both fiscal systems, there is at least a 45% that the integrated project will deliver value loss to an investor
- Likelihood, exceeding 65% that the expected tax receipts to government from the deterministic model will not be achieved.
- The risk of government not meeting its expectations is higher than the risk of the investor not meeting theirs
- This difference in risk outcome is due to the design of the fiscal system; However, the "Proposed" fiscal is less risky to both parties (see "risk matrix")

Appendix: Detailed Fiscal Terms

Key Rates for PPT/MFR (Existing)

Production Based Royalty: Onshore OIL(MFR)		Kbd	Rate
	Tranch 1	5	2.50%
	Tranch 2	10	7.50%
	Tranch 3	15	12.50%
	Tranch 4	25	18.50%
Fixed Royalty: Onshore GAS (PPT/MFR)			
			7.00%

Taxes and Levies		
	NDDC	3.00%
	Education Tax	2.00%
	PPT Onshore/Shallow New Entrant (Yr 1 – 5)	65.75%
	PPT>Yr 5	85.00%

Key Rates for PIFB 2018 (Proposed)

Oil Royalty Rates Based on Daily Production

Oil Royalty Rate/PML	2.5%	5%	7.5%	10%	15%	20%
Onshore (kb/d)	0 – 2.5		>2.5 <=10		>10<=20	>20

Gas Royalty Rates Based on Daily Production

Gas Royalty Rate/PML	2%	4%	6%
Onshore (mmscfd)	0-400	>400<=800	>800

Tax Rates (Applicable for Oil & Gas)

	PIT	
	OIL	GAS
Onshore	65%	30%

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Key Rates for PIFB 2018 (Proposed) – Cont'd

Additional Petroleum Income Tax Rates Based on Price (Gas)

Gas Price Tranch ($/mscf)	0-6	>6<=16	>16
Additional PIT Rate/PML (gas)	0%	0.5%/$1	0.0%/$1

Additional Petroleum Income Tax Rates Based on Price (Oil)

Oil Price Tranch ($/bbl)	0-60	>60<=180	>180
Additional PIT rate/PML (oil)	0%	0.5%/$1	0.0%/$1

	Production Allowance for Oil	Production Allowance for Condensate
Onshore	q > 0MMBBLS	
The Lower of:	30% of value of Oil Production AND $3/bbl* Oil production	30% of value of Oil Production AND $3/bbl* Oil production

	Production Allowance for Dry Gas	Production Allowance for Nat. Gas
Onshore	q > 0BCF	
The Lower of:	100% of value of Gas Production AND $1.50/mmbtu* Gas production	50% of value of Gas Production AND $1.50/mmbtu* Gas production

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