



THE UNIVERSITY OF THE WEST INDIES  
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50 years of Managing for Development in an Ever Changing Economic Environment

# **T&T's Petroleum Upstream Sector A view of the Next 50 years**

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# Aim and Statement of Purpose

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- The object of this paper is to :
  - Present a view of the future role of energy projects in Trinidad and Tobago's (T&T's) revenue base over a 50-year forecast period.
  - Determine at a high level the feasibility of these projects and their requirements.

## Situational Analysis

- T&T has exported crude oil for over 100 years and began exportation of natural gas as LNG in 1998. There is also a large petrochemical industrial base for natural gas that has developed over the past 30 years.
- The starting point for these industries locally is the abundant supply of oil and gas relative to the country demand profiles.
- Oil and gas are finite resources and present production levels are forecasted to decline; natural gas has a proved lifetime of 12 years at the current rates of consumption (Ref: Ryder Scott Reserves Report 2011).
- In 2011, crude oil production has declined to 91,919 b/d (Source MEEA in 2011) and unless new sources are put on to production, this decline will continue.

**T&T is currently largely dependent on the sales derived from oil and gas for government revenues.**

# Country Imperatives

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Main requirements for energy can be simplified

as:

- ❑ **Security of Supply**

( for Power Generation, Transportation and Local consumption)

- ❑ **Revenue Generation**

(Sales of crude oil or refined products, natural gas as LNG, Petrochemicals, etc)

- ❑ **Energy Efficiency**

(emissions, alternate energy sources)

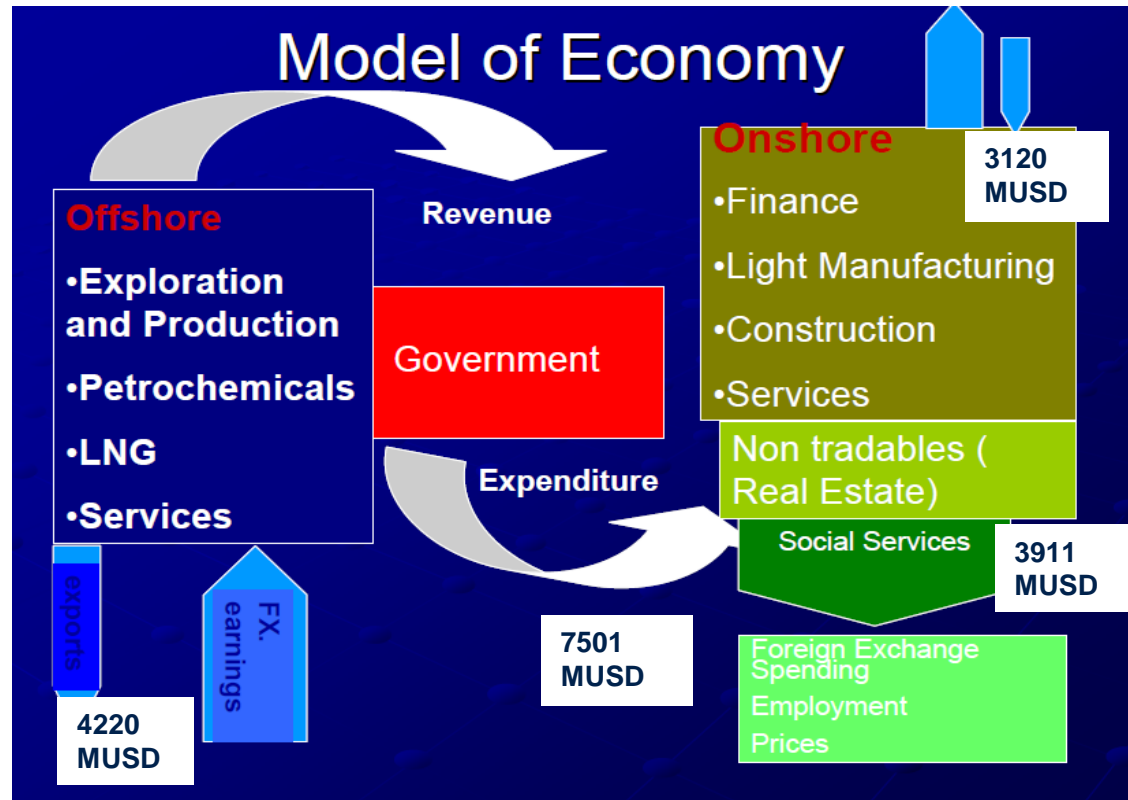
- ❑ **Participation in International Ventures to help replace declining domestic supply**

(use of technical skills to find / produce new resources internationally)

# Current Model of the Economy – Heavily dependent on Natural resource economic rents

US \$ Millions	
	2011
<b>Income</b>	<b>7,339.4</b>
Energy Based	4220
Corporation	2,488.9
Withholding Tax	140.3
Royalties	378.5
Oil impost	15.5
Unemployment levy	185.1
Excise duties	15.1
Petrochemicals	996.1
	0.0
	0.0
Non Energy Based	3120
Non Energy Corporation T	410.0
Personal Income Taxes	780.5
VAT	746.1
Other	1,183.3
<b>Expenditure</b>	<b>7,501.8</b>
Current	6,471.4
Wages	1,125.8
Goods and Services	1,015.1
Interest Payments	419.6
Transfers and Subsidies	3,911.0
Other	1,030.4

Central Bank Data



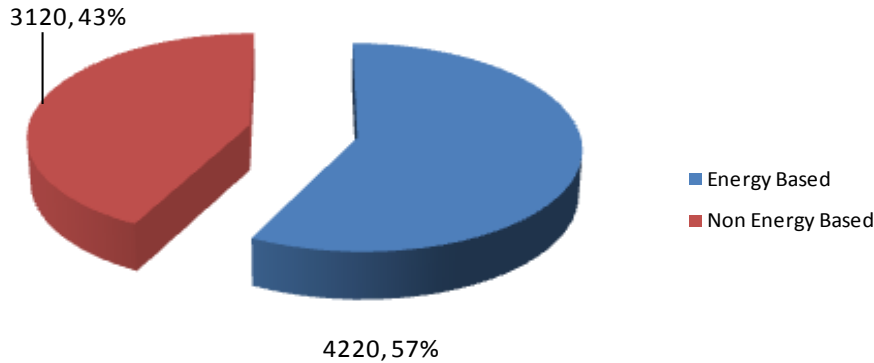
Ref: – Gregory Mc Guire Nov 2005 – Accounting for the Petro Dollar

Transforming Economy requires implementation of the MMCID rules:

- (M)aximise Value Added - For an exporter (producer) like T&T we need to get highest value for resource.
  - (M)easure and (C)apture Economic Rents Efficiently
  - (I)nvest Economic Rents
  - (D)iversify Economy over time
- Ref: – Dr. Dennis Pantin - Accounting for the Petro Dollar 2005

# T&T Country- Income + Expenditure (2011)

2011 Income MUSD

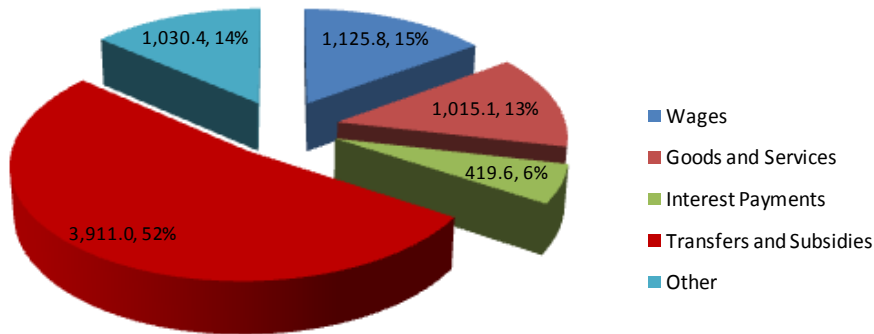


## Income Comments:

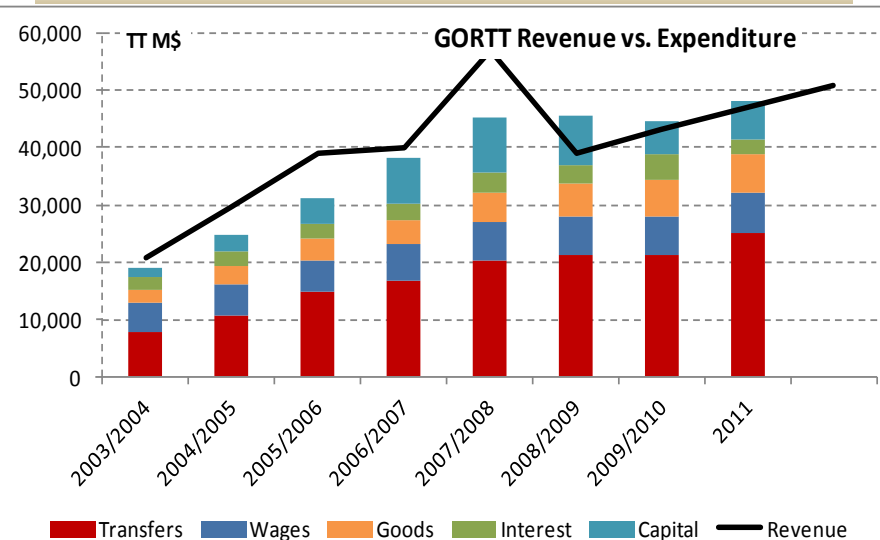
- 57% of T&T's income is derived from Oil and Gas
- Non Energy Based Income comprises
  - Non Energy Corporation Taxes : 5%
  - Personal Income Taxes : 11%
  - VAT : 11%
  - Other : 16%

Source : Central Bank Data

2011 Expenditure MUSD



GORTT Revenue vs. Expenditure 2003 - 2011



## Expenditure Comments:

- 52% of GORTT income goes to transfers and subsidies which almost equates to current income from the Oil and Gas sector

# T&T Oil and Gas Reserves Position

## Commercial Reserves at 01/01/2012 (p+p)

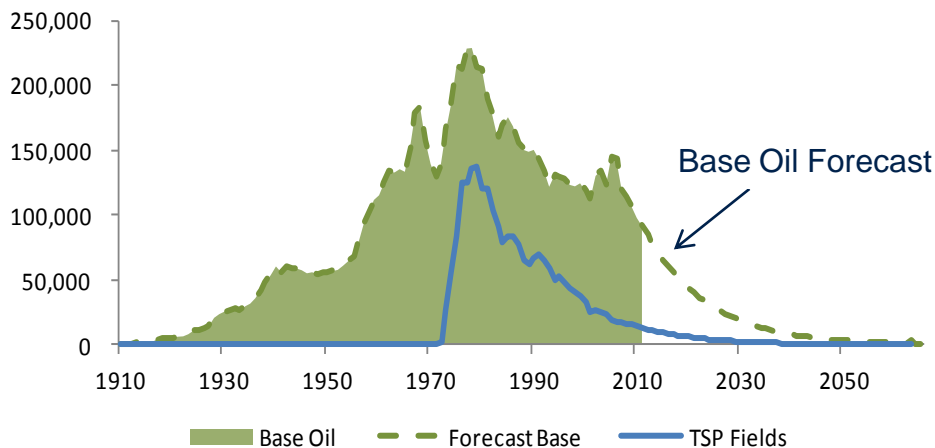
Location	Init Liquids (mmbbl)	Init Gas (bcf)	Rem Liquids (mmbbl)	Rem Gas (bcf)
Angostura	70	974	13	934
Blocks 1(a) & 1(b)	0	7	-	-
BP East & West Blocks	267	22737	88	10531
Central Block	25	884	9	247
East Coast Marine Area	20	4340	13	2483
Galeota Block	37	-	14	-
Minor Fields	127	3	19	0
North Coast Marine Area	-	2589	-	1284
Osprey	13	997	6	513
Pelican	13	154	3	42
Petrotrin Offshore Area	549	80	93	4
Petrotrin Onshore Area	1408	-	47	-
Primera Operated Onshore Fields	32	-	2	-
SECC Block	34	1610	11	872
Toucan	-	451	-	442
TSP Area	946	1325	70	126
<b>Total</b>	<b>3541</b>	<b>36151</b>	<b>388</b>	<b>17478</b>

Source: Wood Mackenzie

11% of liquids reserves remaining  
Excludes Heavy Oil and Tar Sands

# T&T Oil and Gas Production – Historical ( 1910 – 2011) Base Forecast

Trinidad and Tobago Crude Oil Production  
1910-2012 bopd

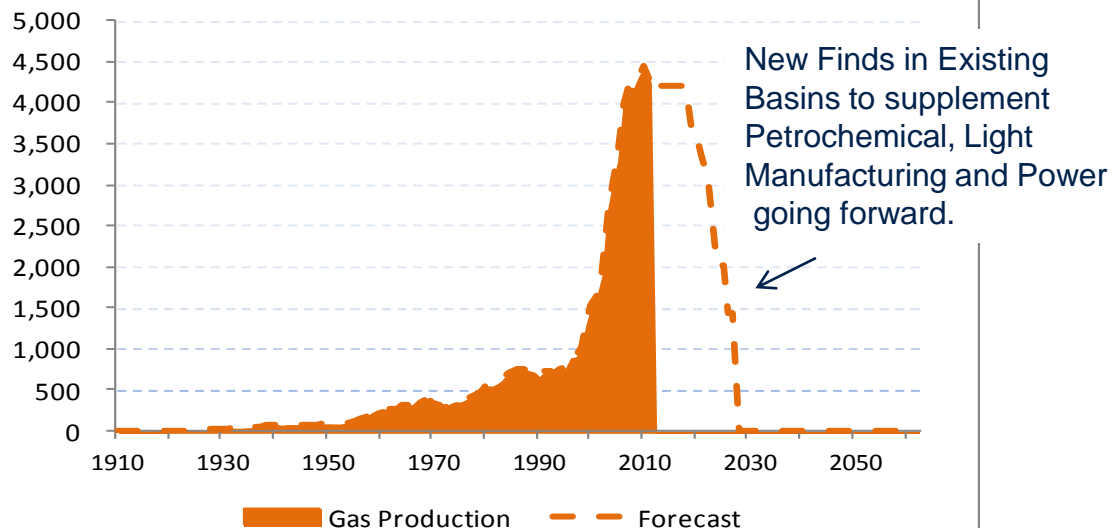


## Major Oil Milestones:

- Land production began in late 1800's
- Marine production started in 1950's
- Peak production in 1978 230 k b/d
- **Decline of 8% post 2011 (author's estimate)**
- Condensate production of circa 35 Kbpd drops off as gas fields decline
- Projections of future production rates were done using this decline assumption

**Remaining 2P Oil reserves ~ 388 mbbls**

Gas Production MMscfd



## Major Gas Milestones:

- Train 1 ends in 2018
- Train 2 ends in 2021
- Train 3 ends in 2023
- Train 4 ends in 2027

**Remaining 2P Gas reserves ~ 17.5 tcf**

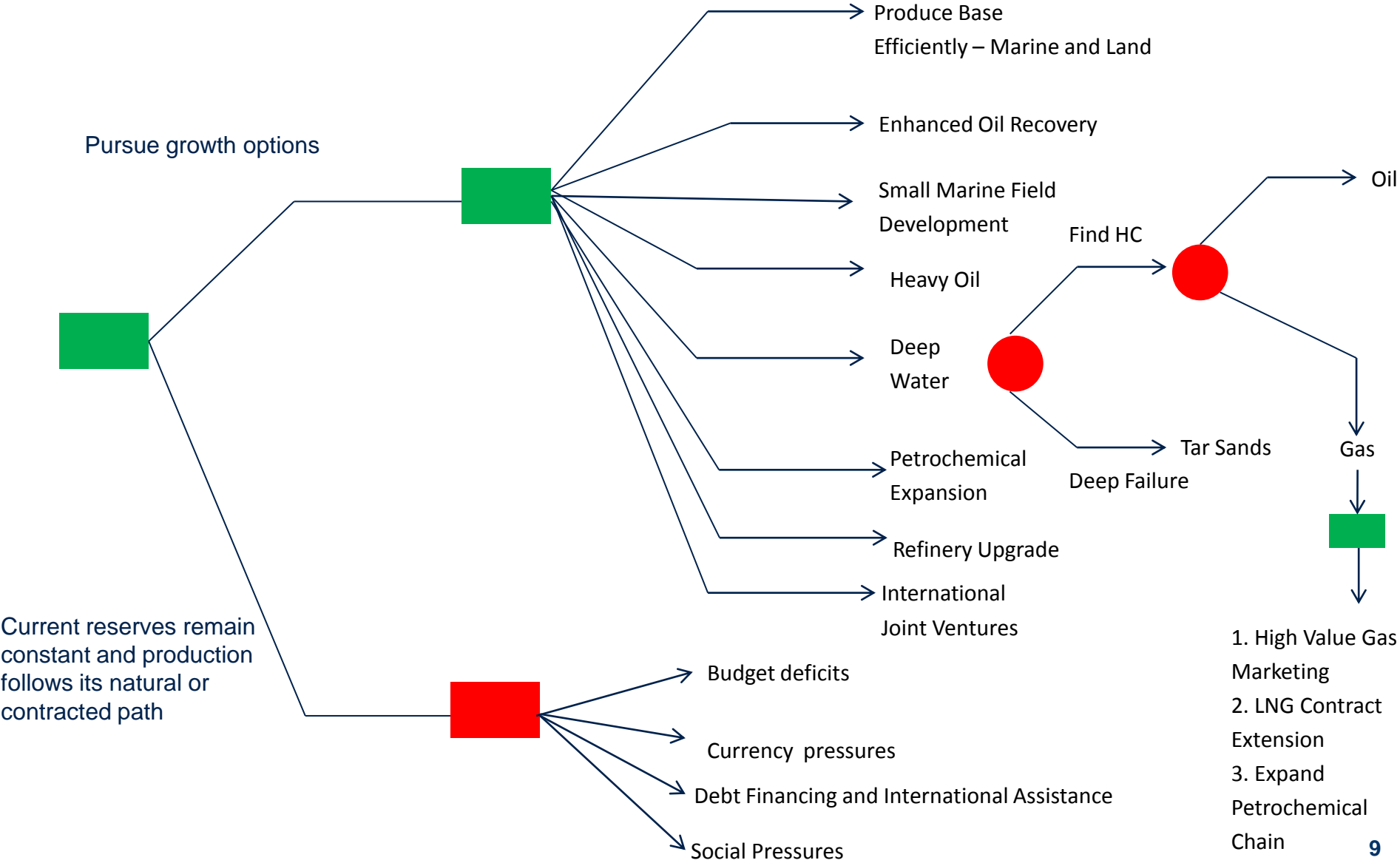
# Future Sources of Reserves and Resource Opportunities in T&T

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- Maintain Efficient levels of Base(existing) oil production
- Enhanced Oil Recovery projects can add 7% - 10% additional recovery from known land reservoirs
- Marine Small fields < 35 mmbbls recoverable resources
- Heavy Oil projects for shallow heavy oil on land and offshore
- Deep Water Oil or Gas field exploration finds
- Tar sands mining on land
- Other – Shale Oil and Gas Hydrates ?

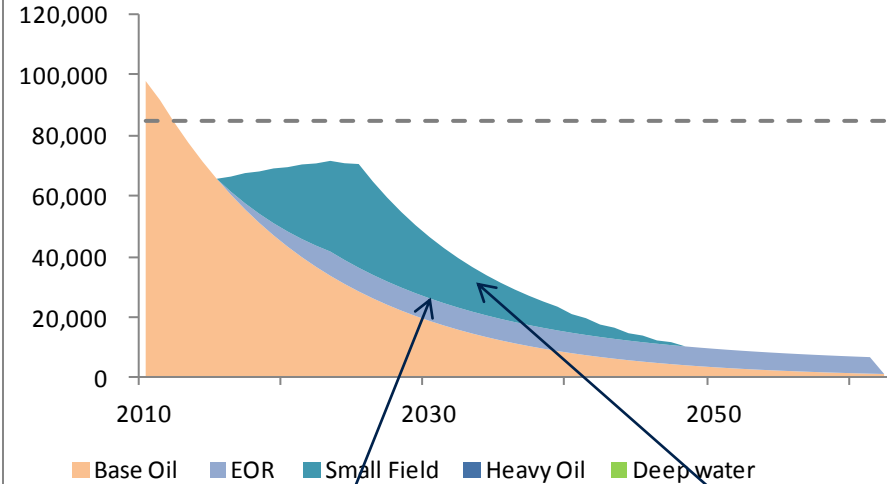


# Development of Possible Options

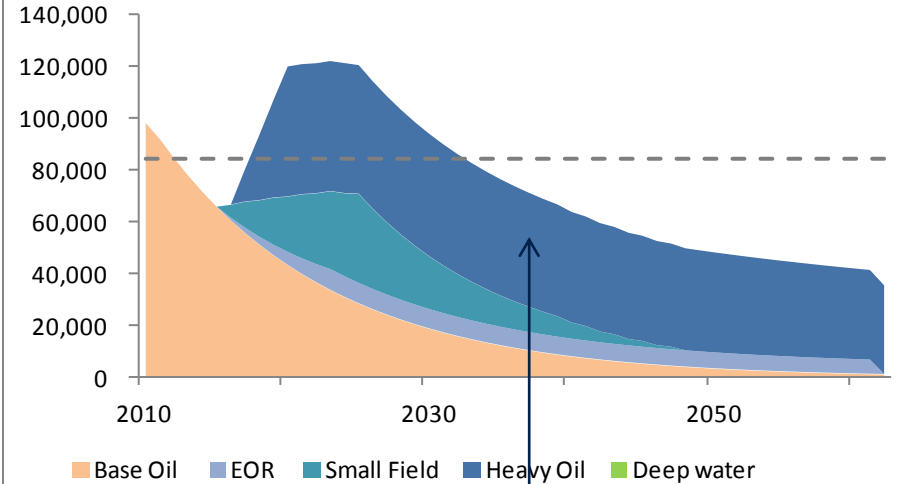


# T&T Next 50 year Estimated Forecast with Projects

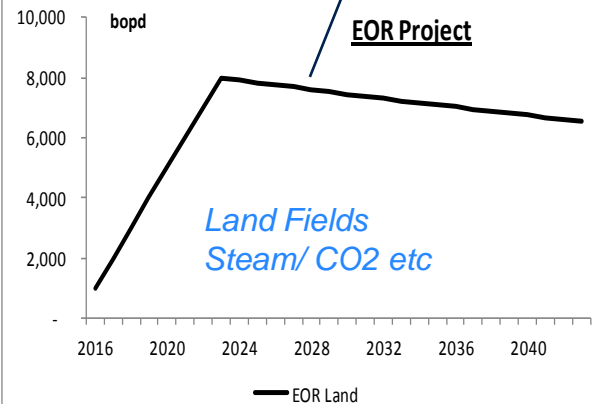
Trinidad Oil Production bopd



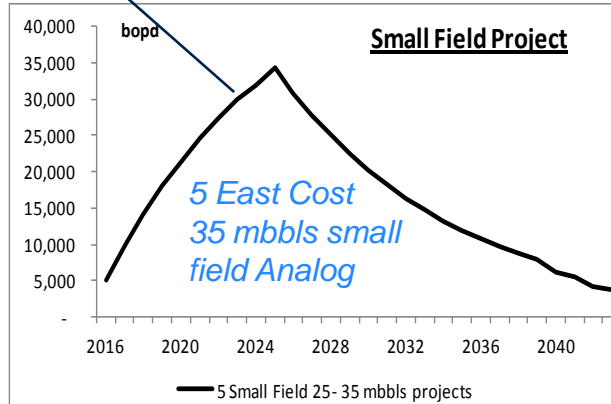
Trinidad Oil Production bopd



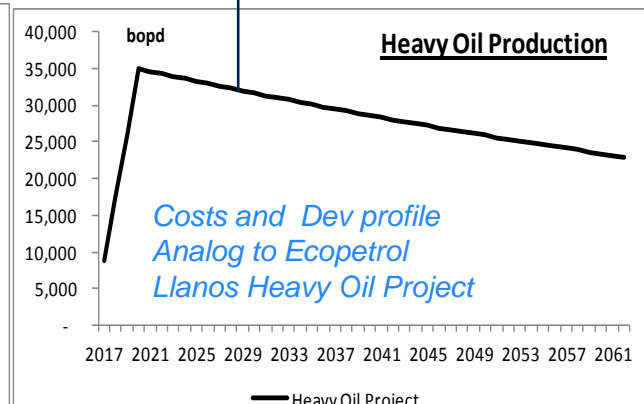
EOR Project



Small Field Project



Heavy Oil Production

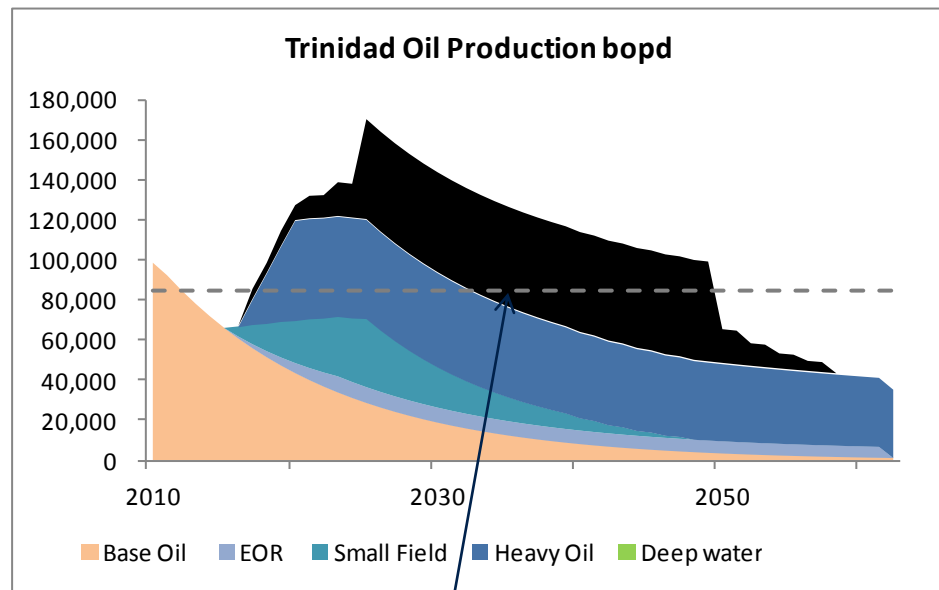
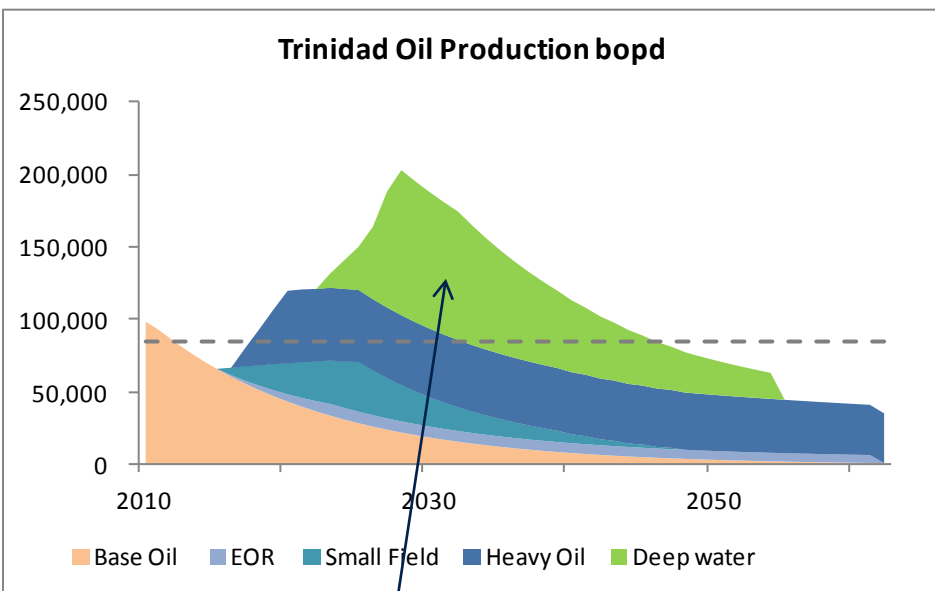


**Land OOIP 1535 mbbls**  
**RF= 7% , 107 mbbls**  
**D cost = 5 \$/bbl, O Cost= 10 \$/bbl**  
**4 years for development**  
**Oil price discount = 15 \$**

**New Small Field OOIP 430 mbbls**  
**RF= 40% ,175 mbbls ; 35 mbbls/ field**  
**D cost = 10 \$/bbl, O Cost= 15 \$/bbl**  
**4 years for 1<sup>st</sup> field**  
**Every 2 years another , EC= 1000 bopd**

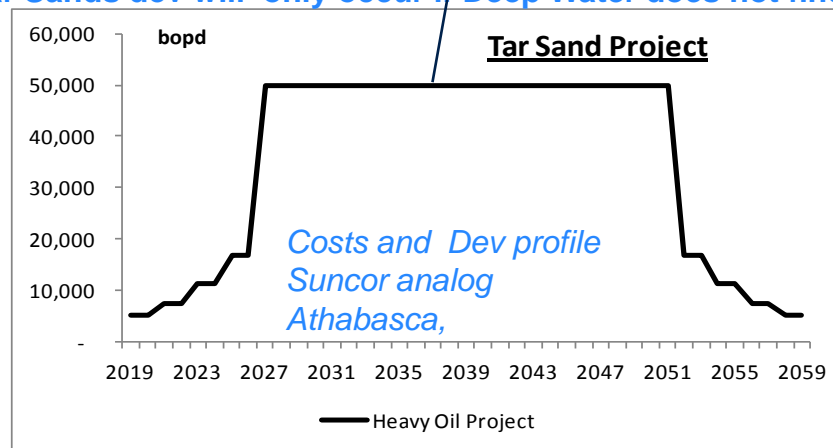
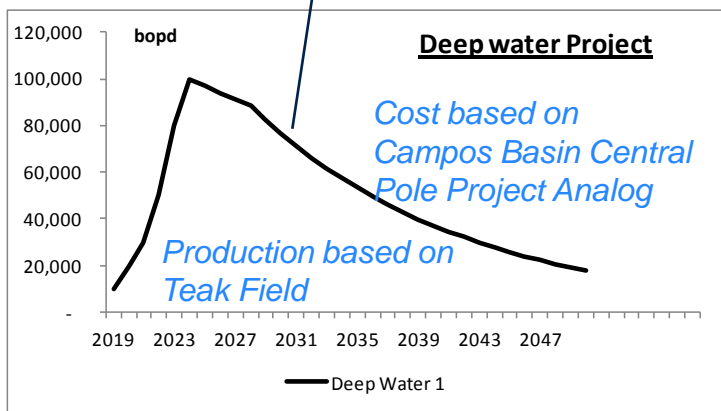
**OOIP 2 billion bbls**  
**RF= 25% , 500 mbbls**  
**D cost = 6 \$/bbl, O Cost= 10 \$/bbl**  
**5 years for development**  
**Refinery Upgrade = 1000 M\$**  
**Oil Price Discount = 10\$/bbl**

# T&T Next 50 year Forecast Estimated Forecast with Projects



Assumes Deep Water finds Oil

Tar Sands dev will only occur if Deep Water does not find HC



**OOIP 1 billion bbls**  
**RF= 50% , 500 mbbls**  
**D cost = 5 \$/bbl, O Cost= 10 \$/bbl**  
**7-10 years for development**

**OOIP 2 billion bbls**  
**RF= 15% , 300 mbbls**  
**D cost = 8 \$/bbl, O Cost= 18 \$/bbl**  
**7-10 years for development**  
**Oil Price Discount = 10\$/bbl**

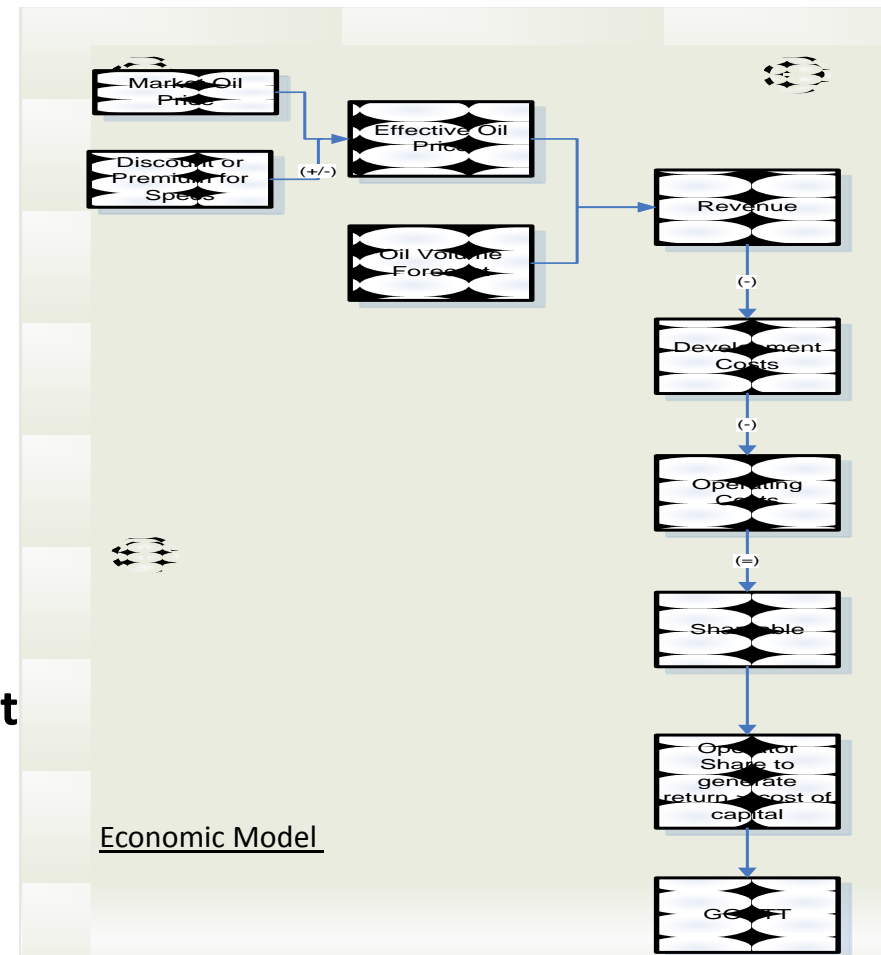
# Methodology and Assumptions of Analysis

- Estimated Cash flows were developed for each resource
- Investment and operating expenditures taken from analogue fields for each resource
- Crude Oil Price is forecasted at 100 \$US/bbl not escalated for simplicity, Discount Factor = 10%

## Economic Model : For each year

- Oil Price \* Volume = Revenue
- Project Costs = Development Cost + Operating Expenditures
- Annual Revenue – Annual Project Costs = Shareable Revenue
- **Shareable is distributed between GORTT and Operator by allowing the operator to generate a reasonable return and the rest the government.**

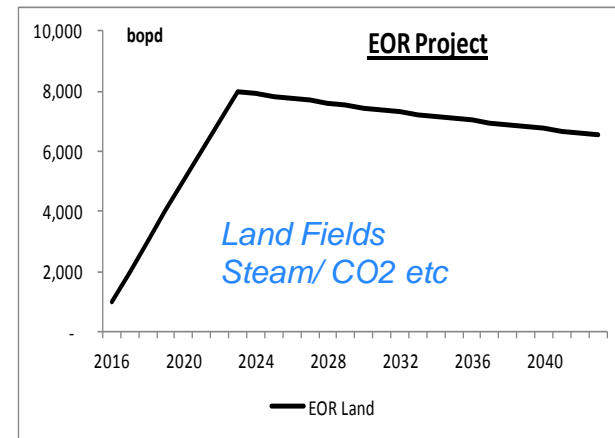
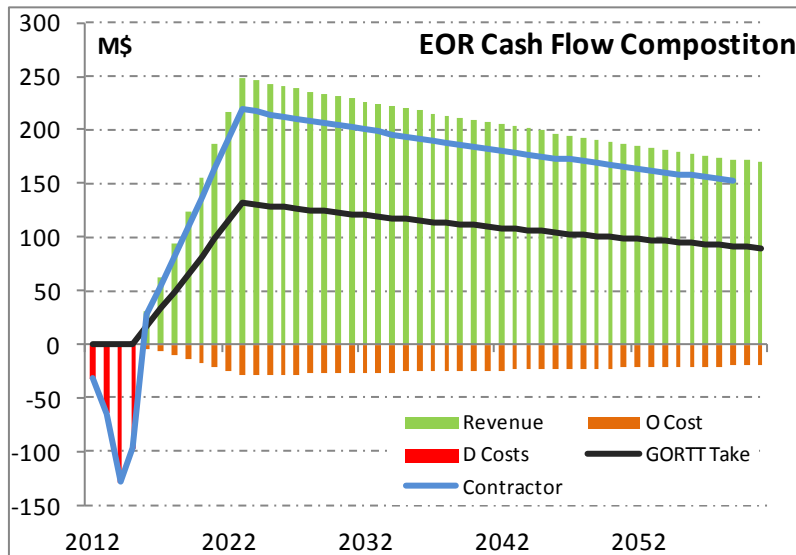
Analysis does not consider market shocks. Operator can be state.



# Results and Findings – Enhanced Oil Recovery (EOR)

Revenue	Development Costs	Operating Costs	Shareable Revenues	GORTT Share, million \$	GORTT Take,	Contractor IRR, %
8,917	322	1,049	7,868	4,721	60%	15%

- Fiscal System Required with ~ 60% GORTT take
- Technology for development required through University/ Foreign Operator partnership with State entities

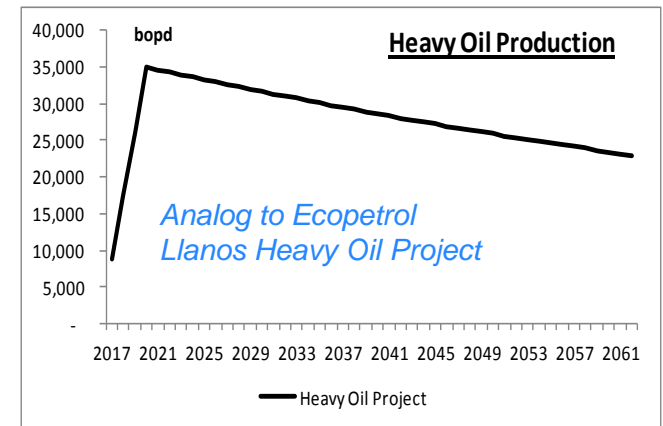
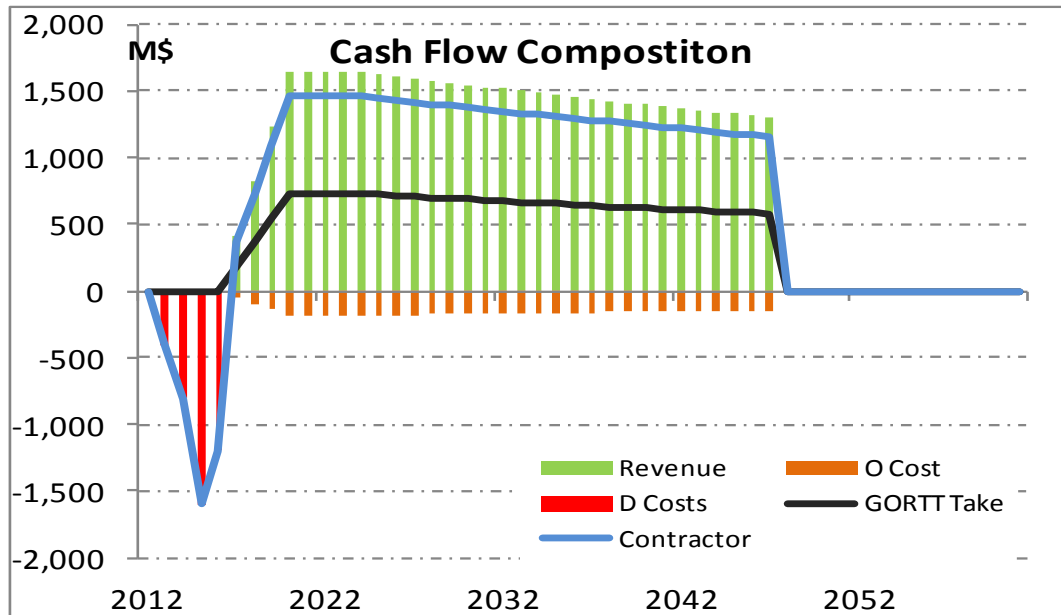


**Land OOIP 1535 mbbls**  
**RF= 7% , 107 mbbls**  
**D cost = 5 \$/bbl, O Cost= 10 \$/bbl**  
**4 years for development**  
**Oil discount = 15 \$**

# Results and Findings – Heavy Oil

Revenue	Development Costs	Operating Costs	Shareable Revenues	GORTT Share, million \$	GORTT Take,	Contractor IRR, %
44,236	4,000	4,915	35,321	17,604	45%	15%

- Fiscal System Required with ~ 45% - 50% GORTT take
- Heavy Oil Value Chain to be developed – Refinery upgrade required
- Technology for development required through University/ Foreign technology provider.

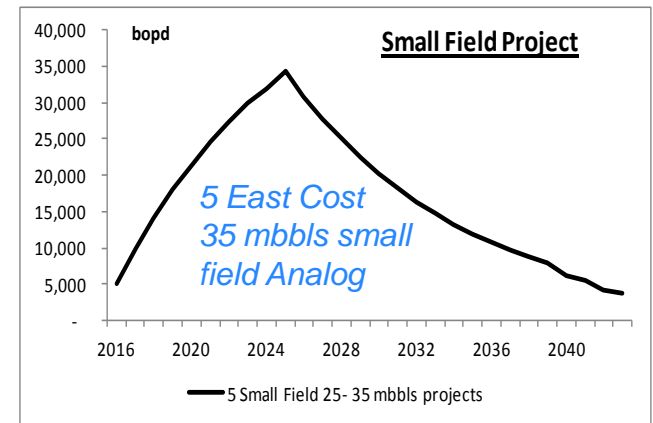
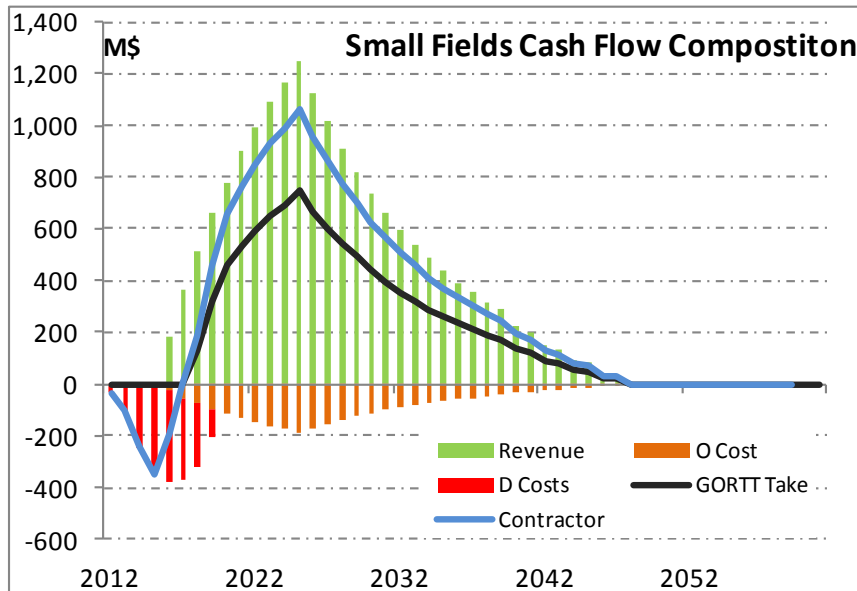


**OOIP 2 billion bbls**  
**RF= 25% , 500 mbbbls**  
**D cost = 6 \$/bbl, O Cost= 10 \$/bbl**  
**5 years for development**  
**Refinery Upgrade = 1000 M\$**  
**Oil Discount = 10\$/bbl**

# Results and Findings – Marine Small Fields

Revenue	Development Costs	Operating Costs	Shareable Revenues	GORTT Share, million \$	GORTT Take,	Contractor IRR, %
17,545	1,750 or 350 per field	2,632	13,898	9,869	71%	15%

- Low Cost Minimum Facility Structures required for development
- Since most of the existing fields are operated by MNC's it is expected that these projects may be conducted through FDI's

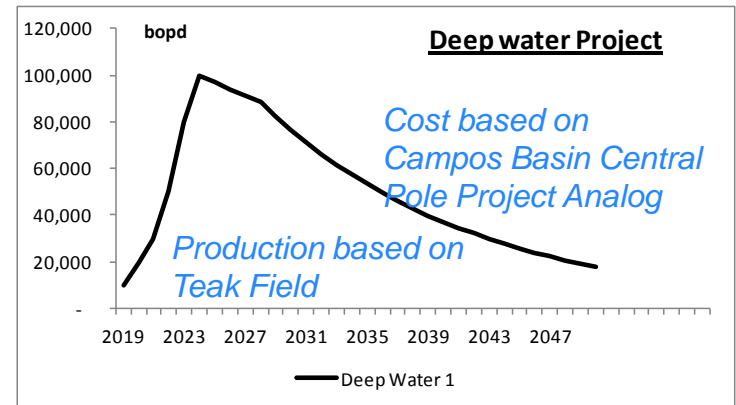
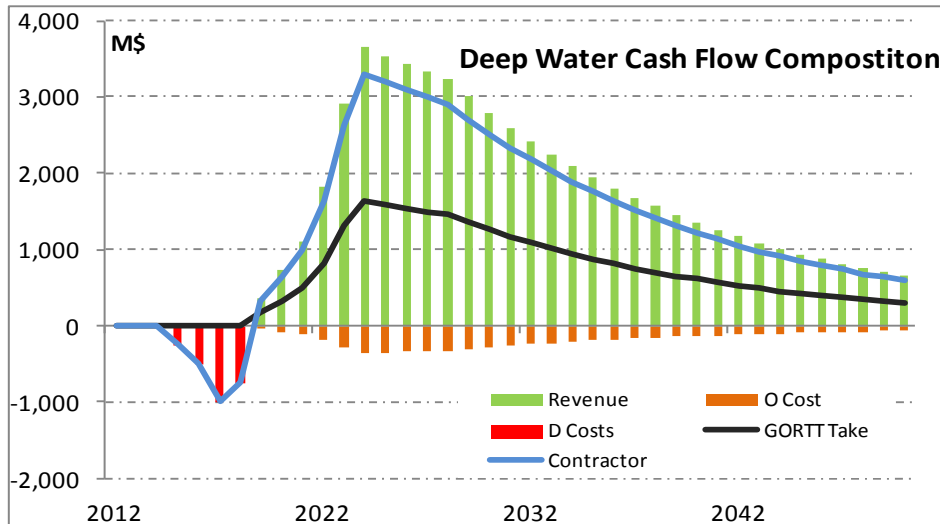


**OOIP 430 mbbls**  
**RF= 40% ,175 mbbls ; 35 mbbls/ field**  
**D cost = 10 \$/bbl, O Cost= 15 \$/bbl**  
**4 years for 1<sup>st</sup> field**  
**Every 2 years another , EC= 1000 bopd**

# Results and Findings – Deep Water

Revenue	Development Costs	Operating Costs	Shareable Revenues	GORTT Share, million \$	GORTT Take,	Contractor IRR, %
58,355	2,500 per field	5,836	50,020	26,260	50%	26%

- New Basins – High Exploration risk
- If HC is found unsure if fluid will be oil or gas
- Currently FDI Driven.
- Mid to long term 7 - 10 years for exploration then development
- If gas is found LNG expansion for sales to high price markets and Petrochemical value chain expansion



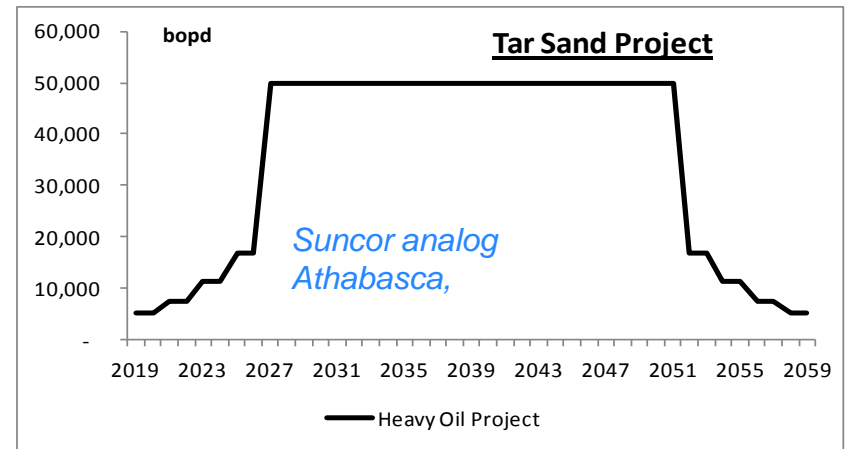
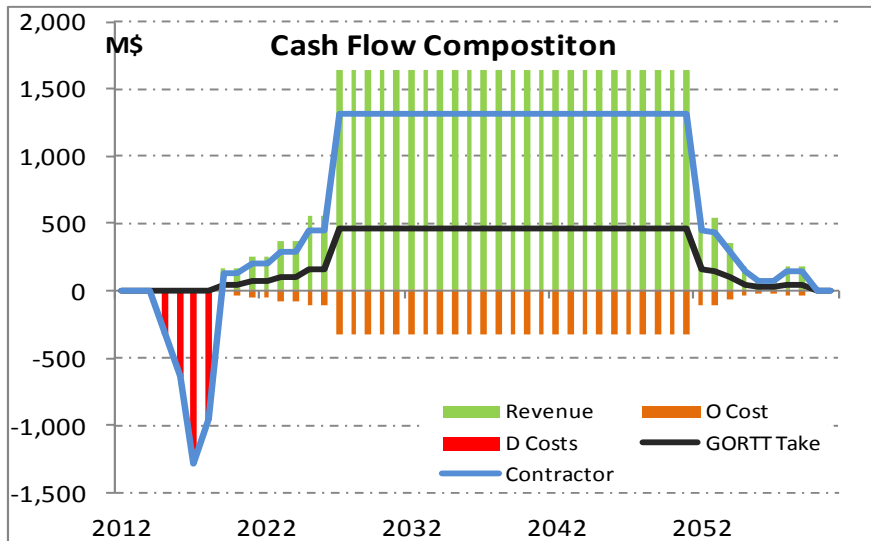
**OOIP 1 billion bbls per field  
RF= 50% , 500 mbbls  
D cost = 5 \$/bbl, O Cost= 10 \$/bbl  
7-10 years for development**



# Results and Findings – Tar Sands

Revenue	Development Costs	Operating Costs	Shareable Revenues	GORTT Share, million \$	GORTT Take,	Contractor IRR, %
45,906	3,200	9,181	33,525	20,671	35%	12%

- High Operating costs
- Environmentally unfriendly with current technology. Needs to be mitigated with technology and planning. Land use policy to be considered.
- Technology for development required through University/ Foreign Operator partnership with State entities



**OOIP 2 billion bbls**  
**RF= 15% , 300 mbbls**  
**D cost = 8 \$/bbl, O Cost= 18 \$/bbl**  
**7-10 years for development**  
**Oil Discount = 10\$/bbl**

## Summary Results from Cash flows (ranked in accordance with execution time)

	D Cost M\$	GORTT Share M\$	GOTTT Take %	Contractor Share M\$	Contractor NPV M\$	Contractor IRR %
EOR	322	4,721	60%	3,147	161	15%
Marine Small Field	1,750	9,869	71%	4,030	316	14%
Heavy Oil	4,000	19,660	56%	15,660	802	13%
Deep Water (per field)	2,500	26,260	52%	23,760	3,096	25%
Totals	8,572	60,510	56%	46,597	4,374	

- All projects are feasible if developments are efficient, and government take is adjusted depending on the specific project type and economic requirements.
- Estimated 8.5 Billion USD investment is required to execute these projects.

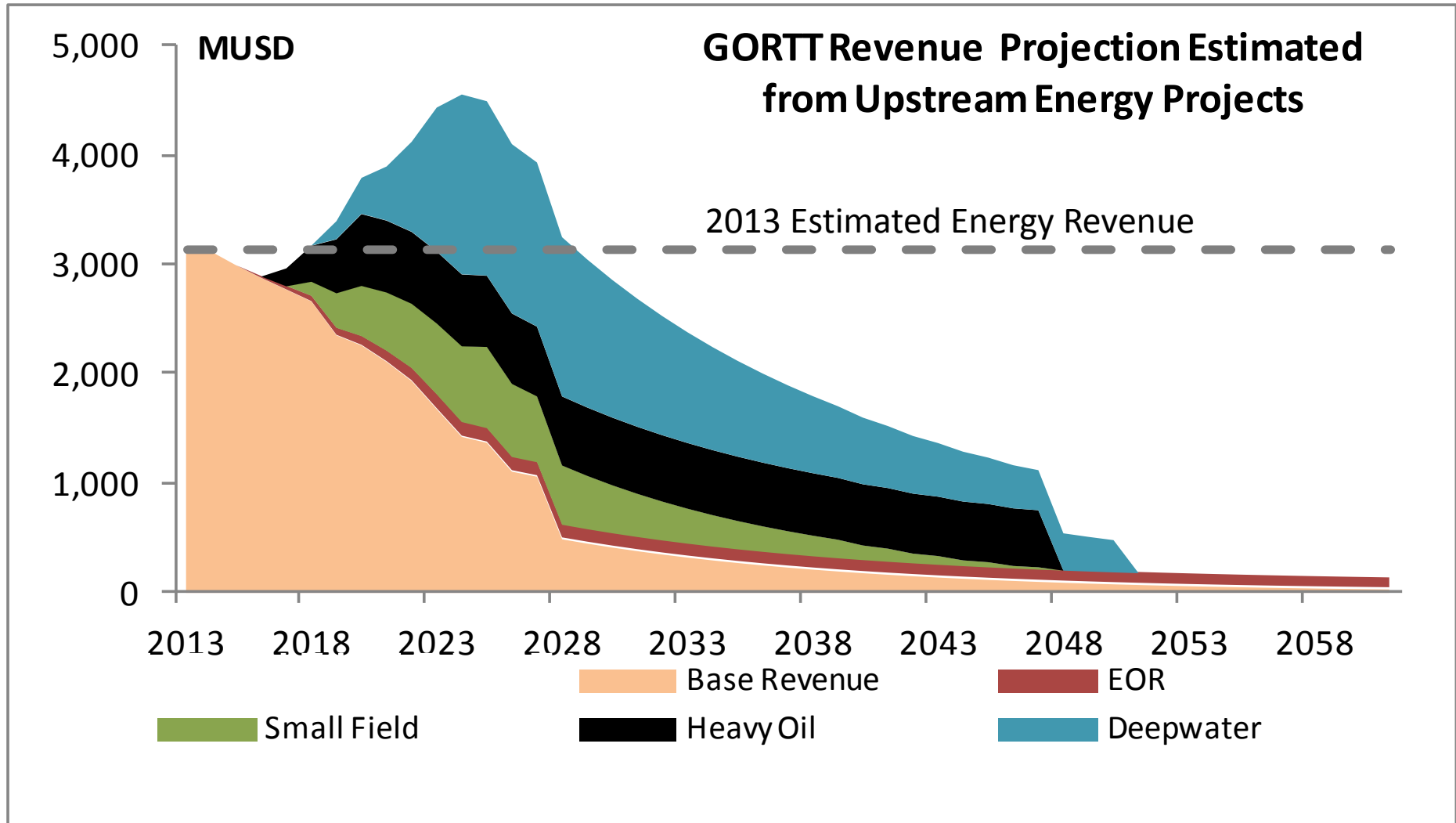
# Results and Findings

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1. Deepwater success in oil will have the greatest impact 100,000 bopd on government revenues of 1.5 billion USD/yr in the shortest time possible (7-10 yrs)
2. Small Marine Fields < 35 million barrels of oil can achieve 35,000 bopd and generate government revenues of 700 Million USD/yr (3-5 yrs). Recent Fiscal adjustment provided.
3. Enhanced Oil Recovery projects can generate 8,000 bopd and generate 200 Million USD/yr assuming an adjustment of the Government Take.
4. Heavy Oil project will require steps of resource definition and appropriate technology. If achieved, this project can generate 35,000 bopd and generate 600 Million USD/yr assuming an adjustment of the Government Take.

# Forecast GORTT Energy Revenue ( 2013-2060)

These measures could stabilize GORTT revenues over the mid term (5- 10 yrs)





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