Sustainable Development and Resource Use

T&T’s Petroleum Industry Sector- Resource Driven Diversification

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Aim and Statement of Purpose

The Trinidad and Tobago (T&T) economy is heavily dependent on the petroleum sector for government revenues and more so for foreign exchange earnings.

The aim of this paper is to review Trinidad and Tobago’s oil and gas sector expected revenue contribution going forward, and highlight key near term events that would impact our income. Options to stabilize and replace the forecasted oil & gas natural income decline is recommended.

Situational Analysis

• T&T has produced crude oil for over 100 years and 16 years ago also began the exportation of natural gas as LNG. There is also a large petrochemical industrial base associated with natural gas as a feedstock. The starting point for these industries locally is the abundant supply of low priced natural gas.

• Competition with US for investments in production of methanol and ammonia as US gas prices are now attractive; hence there can be a slow-down of these investments in T&T

• Oil has declined from 229,000 bbls/d in 1978 to circa 80,000 bbls/d in July 2014; Natural gas has a proved lifetime of only 8 more years at current rates of consumption (Ryder Scott 2014 report estimates 12.2 trillion cubic feet (tcf) proven reserves)

• T&T society is largely dependent on this sector’s income contribution and steps must be taken to secure maximization from the remaining resource
T&T Energy Needs

Security of Supply for T&T for 20 years

• Power Generation ~ 320 million standard cubic feet per day of natural gas
• Transportation requirements of ~ 23,000 barrels per day of refined fuels
• For a 20 year forecast this will require a proven base dedicated for Security of Supply of 2.3 trillion cubic feet (tcf) of gas for power and 167 million barrels of refined transport fuels assuming consumption remains the same

Revenue Generation (Recurrent Expenditure, Capital projects & Savings)

• Sector contribution estimated at 3.3 B US$ (Budget 2014/2015 )
• Sales of crude oil or refined products, natural gas as LNG, Methanol, Ammonia and other Petrochemicals will decline if additional gas reserves are not replaced

Energy Efficiency & Environmental concerns

• Reduce Green House Gas (GHG) emissions
• Implement comprehensive measures to make alternate energy sources more competitive to local fuels
Comments

- Natural Gas Reserves ex Ryder Scott 2014 report is 12.2 tcf proven reserves; (consumption of 4200 Mmscfd or 1.5 tcf/yr; 12.2 / 1.5 = 8 yrs)
- ALNG Trains Gas Sales Agreements come to an end (2018, 2022, 2023, 2027); Cross border gas may come to Trinidad to be processed
- Domestic Power requirements are 2.3 tcf for a 20-year supply
- Alternate Energy Sources may become important by probably 2030

T&T Crude Oil Production Outlook

Note: Forecast is for Crude Oil only NOT condensate

Authors Predicted Natural base decline

Actual Production 2014 (~80K)

Projects required to maintain Base oil production

Comments
- Natural Decline of 6% - 8% post 2013
- Onshore – 22,278 bpd; Offshore 58,242 bpd; Total 80,520 (July 2014)

Source: MEEI, Wood Mackenzie, MEEA, Trinidad Association of Petroleum Scouts (TAPS)
T&T Projected GORTT Revenue from Energy Sector

- Large Deficits can begin to happen in as little as 5 years time
- A lot of planning and mobilization has to take place if we want to execute projects and stabilize our revenue stream over the mid term.

*Analysis does not consider market shocks or LNG arbitrage opportunities
Recommendations going forward for T&T

- Effectively develop remaining resources in sector
- Maximize GORTT value capture from these resources
- Transform this value into sustainable longer-term projects for prosperity

"The design of policy frameworks need to acknowledge that resource horizons are uncertain. As with other aspects of economic policy-making where there is doubt, the uncertainty of reserve horizons suggests a need for planning that consider ranges of alternative scenarios including price shocks”. “Exhaustibility also raises issues of sustainability and intergenerational equity, … as well as the disruptive effects on economic activity and the provision of public services…”

- Macroeconomic policy frameworks for resource-rich developing countries, IMF, August 2012.
Develop the remaining resources efficiently

• Based on the Projected decline in crude oil and associated GORTT revenues there is an urgent and coordinated need to begin work on new projects that will supplement declining reserves and by extension GORTT revenues

• Key E&P projects are:
  • Asset Integrity to maintain existing infrastructure to continue safe production and refining
  • Heavy Oil projects on land and offshore
    • Capital Intensive, newer technologies needed; responsibility for development (state/ partnership)
  • Enhanced Oil Recovery Projects (EOR- water/ steam/ CO2 floods, thermal etc.)
    • A volume of crude oil still remains in underground reservoirs that may be accessed via EOR techniques; development of towns and communities on these areas can impede this recovery
  • Deepwater Exploration – in the best case of a discovery offshore T&T, the time required for its development may be as much as 7 years

These projects are capital intensive and requires competent personnel with good planning and execution
Maximize value from Remaining Resources - What is the best value for the hydrocarbon molecule

Oil
- Crude to Petrochemicals; Aromatics (BTX); Olefins (Ethylene, Propylene, Butadiene) and their derivatives, Vinlys, Styrenics, Polyester options (Crude 100$/bbl; Ethylene ~ 200$/bbl); (technology, capital; 3-4 years to implement)
- Maximize Refinery product stream value - bottom of the barrel upgrade (capital/technology/execution risk)

Gas
- Maximize $/molecule of gas extracted – what is today’s maximum return in $/molecule? (LNG/Petrochemicals/Other)? (Petroleum Pricing Committee input)
- Review expansion options further downstream – increase conversion processes: Methanol to DME, Polypropylene, Plastics; Ammonia to Urea, Fertilizers; (R&D joint ventures, capital/technology/execution risk, 3-4 years to implement)

Price Evolution of Gas Markets: Opportunity for our E&P companies and GORTT

Great opportunity for our E&P companies and GORTT

<table>
<thead>
<tr>
<th>Major World Markets</th>
<th>Trinidad Liquefied Volume (MMscfd)</th>
<th>Liquefaction Tariff ($)</th>
<th>Shipping Tariff ($)</th>
<th>Regassification Tariff ($)</th>
<th>Market Price $/kscfd</th>
<th>LNG Revenue B US$/yr to Upstream E&amp;P operator</th>
<th>GORTT Tax (Billion US$/yr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>US (Henry Hub)</td>
<td>2500</td>
<td>0.5</td>
<td>0.5</td>
<td>0.25</td>
<td>3</td>
<td>1.60</td>
<td>0.88</td>
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<td>Europe (NBP)</td>
<td>2500</td>
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<td>1</td>
<td>0.25</td>
<td>10</td>
<td>7.53</td>
<td>4.14</td>
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<tr>
<td>Far East/Asian (Crude Linked)</td>
<td>2500</td>
<td>0.5</td>
<td>1.5</td>
<td>0.25</td>
<td>15</td>
<td>11.63</td>
<td>6.40</td>
</tr>
</tbody>
</table>
Transforming our value into sustainable long term prosperity

There are several ways to use a resource windfall, and many countries use a combination of all of them:

**SAVE & INVEST**
- Some countries have used a state-owned investment fund to invest a portion of their resource windfall overseas. - Sovereign Wealth Funds
- Invest in global energy assets thru state companies – Norway, Brazil, China, Vietnam, Malaysia, India

**DIVERSIFY**
- Invest the money domestically to build up productive capital stock and fund diversification

**CONSUME**
- Consume the money or resources in the domestic economy, subsidies on energy and other welfare payments. A large majority of countries are forced to dismantle these programs as resources dwindle

Our aim should be to delink our expenditure from domestic resource revenue.

* The permanent income hypothesis holds that a country should sustain a constant consumption flow equal to the (implicit) return on the present value of future natural resources revenue...much of this revenue is to be saved to build up a stock of assets....the return on these assets sustains the spending annuity after extraction has ended.

Macroeconomic policy frameworks for resource-rich developing countries, IMF, August 2012.

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Trinidad HSF ~6 B$
Public Debt ~15 B$
Diversify Internationally - Buy resources overseas as our local resources decline

- Many countries face a decline in production due to their maturing domestic assets particularly legacy oil assets
- These countries have gone internationally in search for assets. - Statoil, Petronas, PTTEP, KNOC, Sinochem, Pertamina, ONGC, CNPC-PetroChina, CNOOC, INPEX, PetroVietnam
- Low risk, non exploration, equity investments are best targets
- Possibility of financing investments by borrowing

International assets currently comprise ~ 25% of National Oil Companies' portfolios by value
Conclusions and Actions

- The Upstream Energy Sector resource base will continue to naturally decline (outside of new discoveries) and can result in a 15% - 20% reduction in GORTT Revenues over the next 5-8 year period (prices constant).
- We must plan for a case based on our current known reserves base.
- Additional Government revenue streams from the sector can be obtained through Asset Integrity, EOR, Heavy Oil and petrochemical projects. These require a great level of capital, competence, coordinated planning and execution to make a sizeable impact.

**Critical Actions – Plan for Base case also:**

- Review the value that can be obtained from the gas and oil molecule, then plan / execute initiatives and projects to maximize this.
- Increase our reserves base globally - T&T state company equity participation in low risk International Ventures to replace declining domestic supply.
- Continuously review and adjust fiscal policy to promote maximization of GORTT revenues.
- Maintain a Strategic Reserves Base for domestic consumption – power and fuels.
- Increase public awareness of sector workings to increase understanding and input.

Create cross functional delivery team to coordinate efforts to stabilize sector revenue
END
Appendix
Trinidad and Tobago Oil & Gas Value Chain Schematic


- Exploration & Production
- Gas Liquefaction for Export
- LNG Shipping
- Regasification and Gas Sales to Markets

Gas Domestic processing
- Power
- Light
- Manufacturing
- Ammonia/ Methanol
- Metals (Iron and Steel)
- Petrochemical

Oil Export

Oil Refining
- LPG
- Gasoline
- Jet Fuel / Diesel
- Fuel Oil / Bitumen

Schematic
GORTT Energy Revenue Model – LNG

In the Net Back model gas market pricing has a large impact on contractor and GORTT revenues due to wide spread between markets.

Revenue to upstream contractor and GORTT can be negative (depending on the contract) in situations where processing, shipping and other tariffs are cumulatively greater than the sale price.

$ Net Back Revenue = Market price – regas tariff – shipping tariff – ALNG tariff

Schematic
GORTT Upstream Energy Revenue Model – License/ PSC

Licence Fiscal System

Upstream Operator revenue receipt

Crude Sales

Gas Sales

Non Income taxes on Oil (Royalties/ SPT/ PPL/PI)

SPT = Supplemental Petroleum Taxes = Fxn{ Price}
PPL = Petroleum Production Levy (4% Crude sales)
PI = Petroleum Impost
Gas Royalties minimal; 10% post 2015

Corporation Taxes

PPT/UL
(Revenue minus Costs- Non income taxes) *~55%

GORTT Revenue

Production sharing Contract (PSC) Fiscal System

Upstream Operator revenue receipt

Crude Sales/ Gas Sales

Deduct Costs (up to a %)

Shareable Between contractor and GORTT

Contractor profit share %

GORTT profit share %

Contractor Revenue

~50%*

GORTT Revenue

~ 50%*

Fiscal systems are designed to share “project profits” between state and contractor.

Different types, e.g. License / PSC / Risk Service etc. essentially do the same sharing function.

* Exact Profit Sharing split depends on the PSC
GORRT Energy Revenue Model – Gas Domestic Processing

- Upstream supplier
- X$/ unit
- National Gas Company
- Y$/ unit
- Domestic Buyer
- Revenue (Y-X) $/unit – Capital & Operational Expenditure
- GORTT Revenue thru energy corporation tax

Product flow
Revenue

Schematic
Gas revenue calculation example:

**Gas Revenue calculation:**

1 MMscfd = 1 million standard cubic feet per day = 1000 kscfd

Now 1 scf ~ 1000 british thermal units (btu) ....dependent on calorific value of gas ..can fluctuate around 1000 – 1100 btu generally

1 kscf = 1000 scf = ~ 1000*1000 btu = 1 million btu = 1 Mmbtu
1 kscf = 1 MMbtu

Trinidad current total sales is 4200 MMScfd = 4200*1000 kscfd = 4,200,000 Mmbtu

Theoretical Revenue can be:

- if gas is 3 $ / Mmbtu or ~ 3$ / kscf; Trinidad sales would be 4,200,000*3 = 12.6 M$/day or 4.6 B$/yr
- if gas is 10 $ / Mmbtu or ~ 10$ / kscf; Trinidad sales would be 4,200,000*10 = 42 M$/day or 15.3 B$/yr
- if gas is 15 $ / Mmbtu or ~ 15$ / kscf; Trinidad sales would be 4,200,000*15 = 63 M$/day or 23 B$/yr
Revenue Forecast Methodology

**Base Model**

- 2014/2015 budget estimated energy revenue; Oil revenue then calculated: Oil Production * (100$/bbl – 20$ Operating Cost); GORTT average take = 75% for Oil assumed.

- Remainder energy revenue is equal to Gas and Petrochemicals; Gas and Petrochemicals revenue follows gas contract profile going forward using 2014 inferred as base.

- Analysis does not consider market shocks or LNG arbitrage opportunities

**Economic Model for new projects : For each year**

- Oil Prices are estimated at 100 $US/bbl not escalated.

- Revenue = Price * Volume

- Investment and operating expenditures taken from analogue fields for each resource

- Project Costs = Development Cost + Operating Expenditures

- Annual Revenue – Annual Project Costs = Shareable Revenue

- Shareable for new projects is distributed between GORTT and Operator by allowing Operator to achieve a 15%-20% return on investment and the remaining goes to the state.
Project Forecasts

**Trinidad Oil Production bopd**

- **Base Oil**
- **EOR**
- **Small Field**
- **Heavy Oil**

**Base Oil**

- **1910**
- **1930**
- **1950**
- **1970**
- **1990**
- **2010**
- **2030**
- **2050**

**EOR**

- **1910**
- **1930**
- **1950**
- **1970**
- **1990**
- **2010**
- **2030**
- **2050**

**Small Field**

- **1910**
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**Heavy Oil**

- **1910**
- **1930**
- **1950**
- **1970**
- **1990**
- **2010**
- **2030**
- **2050**

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**EUR 1535 mbbls**

- RF= 7% , 107 mbbls
- D cost = 5 $/bbl, O Cost= 10 $/bbl
- 4 years for development
- Oil discount = 15 $

**EUR 430 mbbls**

- RF= 40% , 175 mbbls
- D cost = 10 $/bbl, O Cost= 15 $/bbl
- 4 years for 1st field
- Every 2 years another , EC= 1000 bopd

**EUR 2 billion bbls**

- RF= 25% , 500 mbbls
- D cost = 10 $/bbl, O Cost= 8$/bbl
- 5 years for development
- Refinery Upgrade = 950 M$
- Refinery Premium = 5$/bbl
Project Forecasts

Assumes Deep Water finds Oil

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

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

EUR 2 billion bbls
RF= 15%, 300 mbbls
D cost = 13 $/bbl, O Cost = 35 $/bbl
7-10 years for development
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