Integration Strategy in Refining and Petrochemical Complex

Dr. LE MANH HUNG
Vice President
PETROVIETNAM
AGENDA

I. PETROVIETNAM’s Downstream in Brief
II. Strategy for Dung Quat Refinery Development
III. Dung Quat Refinery Upgrading & Expansion Project
IV. Refining and Petrochemical Integration
V. Conclusions
I. Petrovietnam Overview

- Founded on September 3, 1975
- Employees: over 55,000
- Assets Value: USD$ 34.4 Billion (for 2014)
- Total Revenue: USD$ 33.9 Billion (for 2014)
- Profit: USD$ 2.1 Billion (for 2014)
- Contribution to the State Budget: USD$ 7.4 Billion (for 2014)
- Core Business:
  - Oil & Gas Exploration and Production
  - Refinery, Petrochemical and Bio-Fuel
  - Gas Industry
  - Power Generation
  - Petroleum Services
I. Petrovietnam Overview

PVN has 2 refineries, 4 petrochemical plants and 2 bio-fuel plants

**In Operation**

- **Dinh Vu Polyester Plant**
  - 175 KTA Polyester PSF and Filament, 2013
- **Dung Quat Refinery**
  - 6.5 MMTA, 2009
- **Polypropylene Plant**
  - 150 KTA, 2009
- **Quang Ngai Bio-Ethanol Plant**
  - 100,000 m³/year, 2013
- **Binh Phuoc Bio-Ethanol Plant**
  - 100,000 m³/year, 2013
- **Phu My Condensate Plant**
  - 270 KTPA, 2004
- **Phu My Fertilizer**
  - 800 KTPA of Urea, 2004
- **Ca Mau Gas - Power - Fertilizer Complex**
  - 800 KTPA of Urea, 2012

**Under Construction and Developing**

- **Nghi Son Refining & Petrochemical Complex**
  - (JV 25.1% by PVN)
- **Dung Quat Refinery Upgrading and Expansion Project**
  - 8.5 MMTPA, (2013-2022)
- **Long Son Petrochemical Complex**
  - (JV 29% by PVN)
Overview of Refining Production in Vietnam

- Stage 2016 - 2017: Vietnam shortages a large volume of fuel products (60-70%).
- Stage 2017-2018: After the Nghi Son Refining and Petrochemical complex put in operation, the total fuel supply meets 50% of domestic demand.
- Stage 2019-2021: Dung Quat refinery expansion project (expected early 2021) in operation, the fuel supplies to the domestic market will increase, but Vietnam also need to import 30-33% fuel.
- Stage 2022-2025: Due to increasing market demand, Vietnam still shortage 33-42% of fuel production.

### Source: Wood Mackenzie (2014)
## Overview of Petrochemical Production in Vietnam

- In years of 2020, Vietnam is expected to remain slightly short of the core thermoplastics (PET, PE & PP) with the deficit increasing over time.

(Source: customs, PVPro (VPI), 2015)  
Unit: Thousand Tan

<table>
<thead>
<tr>
<th>Products</th>
<th>Dem. 2015</th>
<th>2020</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
</tr>
</thead>
<tbody>
<tr>
<td>PE</td>
<td>1.122</td>
<td>1.557</td>
<td>-607</td>
<td>1.812</td>
<td>-862</td>
</tr>
<tr>
<td>PP</td>
<td>915</td>
<td>1.286</td>
<td>-306</td>
<td>1.532</td>
<td>-536</td>
</tr>
<tr>
<td>PS</td>
<td>196</td>
<td>302</td>
<td>-248</td>
<td>424</td>
<td>-370</td>
</tr>
<tr>
<td>PVC</td>
<td>563</td>
<td>855</td>
<td>-455</td>
<td>1.183</td>
<td>-783</td>
</tr>
<tr>
<td>EVA</td>
<td>115</td>
<td>195</td>
<td>-195</td>
<td>293</td>
<td>-293</td>
</tr>
<tr>
<td>MMA</td>
<td>20</td>
<td>31</td>
<td>-31</td>
<td>46</td>
<td>-46</td>
</tr>
<tr>
<td>PET</td>
<td>513</td>
<td>627</td>
<td>-216</td>
<td>750</td>
<td>-339</td>
</tr>
<tr>
<td>ABS</td>
<td>118</td>
<td>179</td>
<td>-179</td>
<td>247</td>
<td>-247</td>
</tr>
<tr>
<td>SBR</td>
<td>60</td>
<td>91</td>
<td>-91</td>
<td>126</td>
<td>-126</td>
</tr>
<tr>
<td>MEG</td>
<td>85</td>
<td>116</td>
<td>-116</td>
<td>117</td>
<td>-117</td>
</tr>
<tr>
<td>DOP</td>
<td>53</td>
<td>65</td>
<td>-35</td>
<td>76</td>
<td>-46</td>
</tr>
<tr>
<td>LAB</td>
<td>117</td>
<td>175</td>
<td>-175</td>
<td>228</td>
<td>-228</td>
</tr>
<tr>
<td>SM</td>
<td>69</td>
<td>79</td>
<td>-79</td>
<td>93</td>
<td>-93</td>
</tr>
<tr>
<td>PTA</td>
<td>251</td>
<td>296</td>
<td>-296</td>
<td>296</td>
<td>-296</td>
</tr>
<tr>
<td>MeOH</td>
<td>171</td>
<td>293</td>
<td>-293</td>
<td>322</td>
<td>-322</td>
</tr>
<tr>
<td>NPK</td>
<td>4.011</td>
<td>4.342</td>
<td>2.830</td>
<td>4.564</td>
<td>2.608</td>
</tr>
<tr>
<td>Urea</td>
<td>2.278</td>
<td>2.394</td>
<td>246</td>
<td>2.516</td>
<td>124</td>
</tr>
</tbody>
</table>

(Source: customs, PVPro (VPI), 2015)
II. Strategy for Dung Quat Refinery Development

CONFIGURATION OF DUNG QUAT REFINERY

- **Crude oil**: 148,000 BPSD (100% Bach Ho)
- **Owner**: 100% by Petrovietnam
- **Status**: First production 2/2009; Handover 05/2010
- **Operating at 100% -105% designed capacity**
- **Satisfy 30% of the domestic demand for gasoline**

**Dung Quat Refinery**

- LPG: 316 Thousand Ton / Year
- Kerosene/Jet A1: 221 Thousand Ton / Year
- Mogas 92/95: 2,588 Thousand Ton / Year
- DO: 2,353 Thousand Ton / Year
- FO: 359 Thousand Ton / Year
- Polypropylene: 150 Thousand Ton / Year

Map showing the location of Dung Quat Refinery in Vietnam.
II. Strategy for Dung Quat Refinery Development

Products Flow Scheme

- Gas Plant
- LTU 21KBD
- NHT 23.5KBD
- ISOM 6.5KBD
- CCR 21.1KBD
- KTU 10 KBD
- RFCC 69.7KBD
- LCO HDT 28.8KBD
- NTU 45 KBD
- CDU 148 KBD
- SPM
- STABILISER
- Propylene
- PP 150KTY
- LPG
- M92/95
- M90
- JETA1
- DO
- FO
- C3
- C4
- FG
- H2
II. Strategy for Dung Quat Refinery Development

**Challenges**

- Meeting increasing local demand
- Increasing Refining Value
- Diversifying Feedstock
- Meet more stringent product specifications
- Low margin of refining

**Initiatives**

- Increasing Refining capacity from 148,000 BPSD to 192,000 BPSD
- Heavy and sour crudes; Bottom up-gradation
- Natural gas for power generation, Fuel gas and H₂ generation;
- Meeting EURO-V Gasoline/Gas Oil specifications
- Refining / Petrochemical integration: Value added products
Competitive Solutions to Answer Challenges:

- **Solution 1 - In the short term:**
  - To blend Bach Ho crude with other crude oil sources (domestic and import) with higher mixing ratio;
  - To install additional SRU (Sulfur Recovery Unit) \((finished)\).

- **Solution 2 - In the long term:**
  - To replace completely Bach Ho crude with imported crude sources \((will be applied for Dung Quat Refinery Upgrading and Expansion Project, 2015 – 2021)\);
  - Using natural gas as a supplement feedstock for Dung Quat refinery;
  - Integration with Petrochemical complex using Natural gas as feedstock;
III. Dung Quat Refinery Upgrading & Expansion Project

Project Key Milestones

- JGC
- Amec Foster Wheeler Energy Limited (28/8/2015)

- FEED: 2015-2016
- FS: 2010-2014
- Pre-FS: 2009
- Q4 2017 – Q1/2021
- Q2/3 2021
- EPC: Q4 2017 – Q1/2021
- Commissioning /Start-up: Q2/3 2021
- OPERATION: Q4/2021
- Approve FID: 2016
III. Dung Quat Refinery Upgrading & Expansion Project

Land Layout

- Additional Land: 110 ha
- New SPM for VLCC
Expected Production after Upgrading & Expansion

Crude oil (ESPO+Murban)

- **Dung Quat Refinery**
  - 192,000 BPSD
  - 148,000 BPSD

- **LPG**
  - After: 273 Thousand Ton / Year
  - Existing: 316 Thousand Ton / Year
  - % Change: 13.6%

- **Kerosene/Jet A1**
  - After: 668 Thousand Ton / Year (EURO V)
  - Existing: 221 Thousand Ton / Year (EURO III)
  - % Change: 202%

- **Mogas 92/95**
  - After: 2,978 Thousand Ton / Year (EURO V)
  - Existing: 2,588 Thousand Ton / Year (EURO III)
  - % Change: 15.0%

- **DO**
  - After: 2,746 Thousand Ton / Year
  - Existing: 2,353 Thousand Ton / Year
  - % Change: 16.7%

- **FO**
  - After: 298 Thousand Ton / Year
  - Existing: 359 Thousand Ton / Year
  - % Change: 16.9%

- **Asphalt**
  - After: 651 Thousand Ton / Year
  - Existing: 0 Thousand Ton / Year
  - % Change: 15%

- **Polypropylene**
  - After: 168 Thousand Ton / Year
  - Existing: 150 Thousand Ton / Year
  - % Change: 12.0%
Integration – A classical Approach

Integration potentially meeting all of petrochemicals feed requirements for various polymer
IV. Refining and Petrochemical Integration

Integration - Alternative Approach

Methanol

MTO

OCP

FCC

Reformer

Aromatics

HDPE
LDPE
LLDPE
PP
PVC
MEG
PO
PET
Polyester Fibers
Styrene
PS
ABS
Epoxies
Polyurethane

MTO: Methanol To Olefins
OCP: Olefins Conversion Process
**Ca Voi Xanh Natural Gas Field**

**Prospect:**
- **Location:** offshore of Da Nang
- **Distance:** ~ 80 km to central Vietnam shore
- **Operator:** ExxonMobil
- **Estimated reserves:** 19 Tcf (Gross) (538 bcm)

**Operator:** Exxon Mobile  
**Start:** 2021  
**Participants:** EM 85% / PVN 15%

**Volume:** 19 Tcf

---

**IV. Refining and Petrochemical Integration**
IV. Refining and Petrochemical Integration

Master Plan for Exploitation and Development of CVX Gas Field

Upstream

- CVX field

Midstream

- Pipeline/GPP
- Power Plant
- LNG/CNG
- Condensate

Downstream

- Further Processing for Petroleum Products
- Further DS
- Methanol Derivatives
- Olefin Derivatives
- MTG
- DME
- Transport Fuels

Integrated with Dung Quat Refinery

Natural Gas to Petrochemicals Complex Projects

Ca Voi Xanh (Blue Whale) Field
Volume: 19 Tcf
IV. Refining and Petrochemical Integration

Central Refinery - Petrochemical Complex using CVX Gas
(proposal 2023 - 2035)

- Location: Quang Ngai/Quang Nam
- Investor: Refining and Petrochemical Corporation/Binh Son Refinery
- Capacity: 1.7 billion m³/year of CVX Natural gas
- Expected Products: High value added products: Methanol, polyethylene, Propylene, PS, SBR, and Derivatives.
- Form of Investment: Joint venture or Self-Investment.
4. Conclusions

1. For the Vietnamese market of refining and petrochemical products, the gap between supply and demand has been still high and tends to increase in the future. It has potential opportunities for developing new petroleum projects in Vietnam.

2. Feedstock for petrochemicals is almost from crude oil. Therefore, products are simple and limited. It is necessary to diversify both feedstock and products.

3. Optimized integration between the Dung Quat refinery and the petrochemical plants based on Natural Gas will improve economic efficiency for new projects as well as available infrastructure and the refinery in terms of scale, deep processing level and world-class competitiveness.
Thank you for your attention!