The Making of Three Energy Complexes
- Integration at Work

March 2007
Value-added Energy Complex Models

In 2006, Alberta Government visited 3 integrated refining and petrochemical sites in Asia:

**Taiwan:**
Formosa Petrochemical Corporation’s No. 6 Naphtha Cracking Plant

**India:**
Reliance Industries’ Jamnagar Refinery

**Singapore:**
Jurong Island Petrochemical Complex
## Integrated Energy Complexes

<table>
<thead>
<tr>
<th></th>
<th>Formosa #6 Naphtha Cracking Plant</th>
<th>Reliance Jamnagar Refinery</th>
<th>Singapore Jurong Island</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Investment</strong></td>
<td>USD$17.5 bil</td>
<td>USD$14 billion</td>
<td>USD$16 billion</td>
</tr>
<tr>
<td><strong>Area</strong></td>
<td>6430 acres</td>
<td>7500 acres</td>
<td>7880 acres</td>
</tr>
<tr>
<td><strong>Crude Oil supply</strong></td>
<td>Imported</td>
<td>Majority Imported</td>
<td>Imported</td>
</tr>
<tr>
<td><strong>Output</strong></td>
<td>Refined petroleum products, petrochemicals and power</td>
<td>Refined petroleum products and petrochemicals</td>
<td>Refined petroleum products and petrochemicals</td>
</tr>
</tbody>
</table>
Formosa No. 6 Naphtha Cracking Project
Formosa Project Overview

- Land reclamation: 2603 ha of new land
- Port Construction
- Environmental protection: 16.7% of total cost
- Refining 540,000 barrels per day (bpd).
- Ethylene (Naphtha crackers) 2,935 kilotonnes per annum (kta).
- Co-generation 2.82 gigawatts
- 2005 profitability: Operating Income Ratio to Capital: 68.44%

Formosa Fundamental Belief:
Diligence and Simplicity
Petrochemicals and Utilities have higher profitability

**Formosa No. 6 Naphtha Cracking Plant**

2005 results (millions of US dollars)

<table>
<thead>
<tr>
<th>Division</th>
<th>Revenue</th>
<th>Operating Profit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Refinery</td>
<td>$9,351</td>
<td>$1,114 (60.3 %)</td>
</tr>
<tr>
<td>Petrochemicals</td>
<td>$3,403</td>
<td>$518 (28.0 %)</td>
</tr>
<tr>
<td>Utilities</td>
<td>$751</td>
<td>$216 (11.7%)</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>$13,495</td>
<td>$1,848 (100%)</td>
</tr>
</tbody>
</table>
Challenges

Government:
1973
Denied permission due to Government monopoly policy
1986 - Permission granted by Government

Site Selection:
Taiwan Yilan County
Taiwan Taoyuan County
Mainland China Fujian Province
1992
Secured offshore site near Mailiao – Land Reclamation!

Dreadful Climate:
Half a year Monsoon season; Earthquakes; Typhoon

Skilled Labour:
Established work camps and temporary dormitory
Peak Foreign workers: 18,500

Feedstock Supply
Formosa – Government’s Support

- Favorable land tax
- Approved exclusive case for acquirement of foreign workers
- Modified rules to approve the application of Mailiao port
- Built external road to connect the facilities
- Approved application of using water and electric power
Reliance Jamnagar – World’s Largest Refinery
Reliance Jamnagar Project Overview

- Combined 2 phases will be the largest refinery in the world. Crude oil processing capacity 1.2 million b/d
- A complex refinery with Petrochemicals, Power, Port and Pipelines, which has vertical and horizontal integration within Reliance Industry
- Ability to process low cost feedstock
- Phase II same design and contractors as Phase I.
- Achieved International refinery operating and safety benchmarks
- Greenbelt for environmental protection
- Export oriented
  - Phase I exports 70-80% to Middle East and Africa
  - Phase II 100% high value added products to US and Europe

Reliance Fundamental Belief:

Growth is Life

Alberta Advantage
Employment, Immigration and Industry
Jamnagar – Challenges

• Markets
  – Limited domestic market opportunities: Government maintains control over gasoline/diesel retail pricing, even though the prices were officially de-controlled in April, 2003.
  – Distance from major world energy consumer markets

• Site Selection
  – Barren desert
  – Lack of infrastructure

• Weather
  – Cyclone in 1998 killed 550 people in the province

• Crude Oil Supply
  – Heavy crude from Middle East and Africa
Jurong Island Project Overview

- Man-made island based on 7 small islands, reclaimed land more than 60%
- Almost 90 petroleum, petrochemical, specialty chemical companies.
  - Inc. top 50 global companies like Air Liquide, Air Products and Shell.
- 3rd party service providers of utilities, tankage, terminal facilities, warehouses, maintenance and repair centres.
- 2 logisparks provide full spectrum of integrated logistics, supply chain support.
- Institute of Chemical Engineering Sciences – ICES
  - On site R&D
- Chemical Process Technology Center – CPTC
  - Dedicated training facility to contain a real life chemical process plant

Spirit of Jurong Island: Synergy and Integration
Jurong Island Highlight

- Plug and Play Infrastructure
- Well Connected
- Highly Integrated
- Strong Capabilities
- Safe and Secure Environment

Singapore Economic Development Board:
Integration is the only way to stay competitive
Jurong Island – Challenges

Land Availability
Skilled Labour
Feedstock Supply
Utility Cost
Attract Downstream Companies
Jurong Island - Government Support

• Leadership, vision and clear plan.
  – Infrastructure: land reclamation, road and causeway, waste water treatment
  – detailed development plan
  – Targeted Promotion - specific companies that fit value chain.
    • Help prospective clients to remove challenges
    • Attract as a cluster, rather than individually
  – Low tax: 20% overall (2nd only to Hong Kong).
  – Seed funding with clear exit mechanism (20-30% max).

• Government owns the island and plays the developer’s role, companies are renters.

• Government now looks at new areas for development – such as biotech and digital media
What Did We Learn ...

• World-scale integrated refining and petrochemical operations can deliver superior financial results:
  – Even if paying world price for crude oil and other feedstocks then selling products into wholesale markets.
• Higher value products deliver higher margins.
• Importance of integration and synergies
• Alberta faces some of the similar challenges that need to be addressed
  – Skilled Labour, Attract downstream companies, etc
# Best Practices

## Internal Factors

<table>
<thead>
<tr>
<th>Factor</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Land Availability</td>
<td>✔</td>
</tr>
<tr>
<td>Logistics</td>
<td>✔</td>
</tr>
<tr>
<td>- Electricity</td>
<td>✔️</td>
</tr>
<tr>
<td>- Water</td>
<td>✔️</td>
</tr>
<tr>
<td>- Rail &amp; Pipe</td>
<td>✔️</td>
</tr>
<tr>
<td>Competing Suppliers</td>
<td></td>
</tr>
<tr>
<td>Labour Availability</td>
<td>☒</td>
</tr>
<tr>
<td>Project Cost Competition</td>
<td>☒</td>
</tr>
<tr>
<td>- Feedstock</td>
<td>✔️</td>
</tr>
<tr>
<td>- availability</td>
<td>✔️</td>
</tr>
<tr>
<td>- relative cost</td>
<td>✔️</td>
</tr>
<tr>
<td>Access to Markets</td>
<td>✔️</td>
</tr>
</tbody>
</table>

## External Factors

<table>
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<tbody>
<tr>
<td>Site Management Structure</td>
<td>✔️</td>
</tr>
<tr>
<td>Regulatory Certainty</td>
<td>✔️</td>
</tr>
<tr>
<td>Government Assistance</td>
<td>✔️</td>
</tr>
<tr>
<td>- Infrastructure</td>
<td>☒</td>
</tr>
<tr>
<td>- Subsidies</td>
<td>☒</td>
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<tr>
<td>- Permitting</td>
<td>✔️</td>
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<tr>
<td>Public Support</td>
<td></td>
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<tr>
<td>Industry Organization</td>
<td>✔️</td>
</tr>
<tr>
<td>Environmental Requirements</td>
<td>✔️</td>
</tr>
<tr>
<td>- Strategic Public Policy</td>
<td>✔️</td>
</tr>
<tr>
<td>International Trade Agreements</td>
<td>✔️</td>
</tr>
<tr>
<td>Integration with Education and R&amp;D</td>
<td>✔️</td>
</tr>
</tbody>
</table>

Source: Implementation & Advisory Group Ltd
What Did We Learn …

Making of an Energy Complex – Key Factors

- Vision and Leadership
- Clear, Detailed Planning
- Determination and Perseverance
- Government Can Have a Significant Role
Vision
Leadership

Mr. Wang Yung-Ching
Formosa

Mr. Dhirubhai Ambani
Reliance

Mr. Lee Kuan-Yew
Singapore